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Gap analysis report – conclusions of strengths and weaknesses of current specifications and standards

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

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Contents

1 EXECUTIVE SUMMARY 4

1.1 STARTING POINT, D8.5: BUILDING THE FORESIGHT CAPACITY 4
1.2 THE ICOPER GAP ANALYSIS APPROACH 5
1.3 MAIN CONCLUSIONS DERIVED FROM THE GAP ANALYSIS OF THE FUTURE SCENARIOS 6
1.4 MAIN CONCLUSIONS OF THE EXPERT SUMMIT IN LEUVEN 31ST MAY 2010 8

2 INTRODUCTION 9

3 STRATEGY FOR FORESIGHT BUILDING AND GAP ANALYSIS: RELATION TO THE ROADMAPPING PROCESS AND THE ROLE OF THE CONTEXT AND FUTURE SCENARIOS. 10

3.1 ROADMAPPING PROCESS: BUILDING THE FORESIGHT CAPACITY AND DEFINING THE FUTURE STATE 10
3.2 ROADMAPPING PROCESS: SCENARIO ANALYSIS AND GAP ANALYSIS 12

4 CONTEXT SCENARIOS 15

4.1 CONTEXT SCENARIOS STORIES (REVISED) 16
4.2 CONTEXT SCENARIOS ANALYSIS 21

5 DESIRED FUTURE: FUTURE SCENARIOS GAP ANALYSIS 33

5.1 DETAILED GAP ANALYSIS METHODOLOGY FOR FUTURE SCENARIOS 33
5.2 GAP ANALYSIS RESULTS 37
5.2.1 Scenario structure 37
5.2.2 Analysis of future scenarios using the processes and services defined in the IRM – identified research themes and potential gaps 40
5.2.3 Gap analysis: regrouping gaps 52

6 REVISION OF THE DESIRED STATE AND FINAL VISIONS IDENTIFICATION 59

6.1 THE FIVE VISIONS FOR OUTCOME BASED EDUCATION 60

7 THE EXPERT'S POINT OF VIEW – LEUVEN EXPERTS SUMMIT 61

7.1 OBJECTIVE AND METHODOLOGY 61
7.2 RESULTS 61
7.2.1 Critique of the ICOPER Reference Model 61
7.2.2 Methodology Critique 62
7.2.3 Vision 1: Sharing Learning Outcomes: From the Study Programme into the Lecture into the Learner's Achievement Profile 62
7.2.4 Vision 2: Sharing Learning Designs: Collaborating around the Design of Courses 65
7.2.5 Vision 3: Sharing Learning Content - An Authoring Round Trip 69
7.2.6 Vision 4: The Life Cycle of an Assessment Resource: From the Authoring to the Learner's Personal Achievement Profile 70
7.2.7 Vision 5 (future vision): Adaptive Study Programme Design and Delivery 72

8 RELEVANT LET STANDARDS 76

8.1 ICOPER STANDARDS 77
8.2 STANDARDS MENTIONED IN ICOPER DELIVERABLES 79
8.3 OTHER IDENTIFIED STANDARDS 80

9 FURTHER WORK: LESSONS LEARNED, HOW TO EVALUATE STANDARDS AND DATA MODELS, INPUT FOR THE ICOPER IRM EVALUATION 80

9.1 SOME TYPICAL PAST AND RECENT PRACTICE 80
9.2 CONCERNING "EVALUATION" 82
9.3 SOME CARICATURES OF EVALUATION APPROACHES 85
9.4 THE ICOPER GAP ANALYSIS APPROACH 87
9.5 REQUIREMENT FOR FURTHER WORK 88

10 ANNEXES 89

10.1 ANNEX 1: FUTURE SCENARIOS LIST 89
10.2 ANNEX 2: DOCUMENTATION OF EXPERTS SUMMIT 90
10.3 ANNEX 3: ANALYSIS OF USE CASES DEVELOPED IN ICOPER (SERVICES, AND ACTORS INVOLVED) 98

1 Executive Summary

1.1 Starting point, D8.5: Building the foresight capacity

As indicated in the title of this deliverable, this report presents the findings of two main Roadmapping activities that took place during the ICOPER project period from January 2010 to July 2010, namely describing:

a) the gap analysis work performed during this period which resulted in the identification of gaps between the future state (as it was described in the previous Roadmapping deliverable D8.5) and the current state of the art (captured by the contemporary ICOPER Reference Model – the IRM) and;
b) the SWOT analysis of current standards and specifications which are related to the ICOPER visions for Outcome-based education.

The starting point for this work was the D8.5 "Envisaged Future State report – user requirements and future scenarios", which presented the analysis and results of the foresight activities taken by the ICOPER partners to define outcome based education. The goal of these foresight activities was to provide information on the 'current', 'desired' and 'emerging' situation of outcome-based (sometimes referred also as competence- development) education in Europe.

These foresight capacity building activities produced the following outcomes (for further details see D8.5):

a) information on the Big Picture of outcome based education as this was captured, modeled and described by the ICOPER partners, the European Competency SIG and other experts;
b) several ***"desired future scenarios"*** developed by specialised TEL projects (e.g. the current EU RTD projects) and other experts in the field. The goal of this activity was to externalize and express the projects' visions according to their awareness of the results of their research;
c) a set of four plausible ***"context scenarios",*** based on a scenario matrix that provided an overview of the outcome based education in different contexts, against which the identified visions and topics of interest of the 'desired future scenarios' and the IRM ongoing development would be assessed and played out;
d) information on weak signals and trends that track the changing Educational and Technology fields with reference to the larger political, social, economic, and technical forces that drive them.

The ***future scenarios*** presented in D8.5 are essentially describing the desired futures. The analysis of these scenarios was organized and led by a core team (the future scenario analysis team) in collaboration with the context scenarios authors, the ICOPER work package leaders (WPL), the WP7 team responsible for the IRM documentation and the ICOPER prototypes implementation force. This analysis was achieved mainly by comparing the characteristics of the future scenarios to the current developments of the IRM, using the D7.1 IRM document for the first analysis and subsequently the more updated versions of the IRM as they were made available later on. The main results and methodology for this analysis is summarized in Section 5 of D8.6.

The ***context scenarios*** were first analyzed against the D7.1 deliverable, the use cases previously developed by the ICOPER partners and the prototype implementation work. Later they were analyzed against an updated D7.3a along with the latest version of the ICOPER

concept model. As a result of this analysis, the four stories of the context scenarios were updated accordingly. In the beginning, the context scenarios were formulated to summarize the current requirements of the different stakeholders groups in different contexts that synthesized the outcome-based learning domain in Europe. Later they were used to identify gaps between these stakeholders' requirements and the current developments the IRM and ICOPER prototypes. It is envisioned that the final versions of the context scenarios will define the scope and business cases governing the ICOPER IRM. This analysis as well as the updated stories of the context scenarios is presented in Section 4 of D8.6.

The ***second part*** of the D8.6 deliverable presents the conclusions from the European "Experts Summit" - during which a number of experts helped to evaluate strengths and weaknesses of the current standards and specifications (including the ICOPER proposed specification PALO). This work related to competency-based learning from both the 'researchers' and the 'practitioners' point of view. The context and future scenarios conclusions, as well as the current IRM and prototypes development work, formed the input for the identification of four visions for competency-based learning. The SWOT analysis of standards and specifications performed during the Leuven Experts Summit (May 31st 2010) was based on the requirements and challenges derived from these four visions. This work is presented in Section 7 of this deliverable D8.6.

1.2 The ICOPER Gap Analysis Approach

Sensemaking and value-judgment, or indeed **evaluation**, are at the heart of the ICOPER project and all of its work. The ICOPER Suitability Reports (ISUREs) are one manifestation of this work. The work reported in this document, D8.6 "Gap Analysis Report - conclusions of strengths and weaknesses of current specifications and standards" are another manifestation. In both cases, the work has been non-trivial and has exposed limitations in the current "best practice" in the evaluation of standards, some of which are described in the document. ISUREs will not be discussed here; our focus is on the methods that were developed in the direct ICOPER work on Gap Analysis.

The evaluation approach used for the Gap Analysis expresses the level of shared, *circa* 2010 within the ICOPER project, about how this kind of evaluation should occur. It is not the "final word" on how this should be achieved but it is a large step forward and an excellent contribution to the process of creating shared knowledge.

The May 31st 2010 Experts Summit in Leuven, Belgium, set out to gain intelligence about the strengths and weaknesses of the current specifications and standards as an input to the Gap Analysis and this Report. The method revolved around four components, which are listed in Table 8, along with a description of the rationale for each component.

During the design of this method (described in Table 8), a critical trade-off was identified. "Why would experts participate?" was a key question that arose. Meaningful evaluation is time-consuming and sufficient time was required to familiarise experts with the ICOPER context and scenarios. Experts were found to be in short supply and generally not available for extended periods. Our trade-off was one full day of face-to-face activity with a written questionnaire. This was just sufficient but less than our ideal. One conclusion from observing the proceedings of the ICOPER Expert Summit was that conversations often strayed into a SWOT analysis of the real-world represented by the scenarios. Thus, care is needed on the part of the facilitator and in the use of the SWOT conclusions to avoid contamination through evaluation against an implicit preferred future state in the mind of one or more experts. This

observation could be interpreted as strong validation for the use of scenarios; it seems clear that the question of evaluation is only meaningful to the experts in context.

Table 8: *Components and Rationale for the Experts Summit Method*

Component	Rationale
Use Scenarios	Scenarios were created as part of the systematic approach to modelling the current and possible future states taken in ICOPER. ICOPER is focussed on "Interoperable Content for Performance in a Competency-driven Society", so our purpose is "community-specific guidance" and the context is vital. Current state scenarios provide an accessible encapsulation of the context. Future scenarios provide information about the desired future for this domain as expressed by different stakeholders groups.
Indicate Standards	The purpose of the Gap Analysis is to consider standards so hence indicating relevant standards identified by ICOPER partners and inviting additions from the experts provides the necessary focus for the evaluation.
Engage Experts	We believe that meaningful evaluation should address a complex "necessary unity". Mechanical, criterion-based, approaches to evaluation are unlikely to capture this complexity and to miss the value of connections. Experienced humans are much better at dealing with complexity and fuzziness and by engaging experts with different perspectives in dialogue we hope to arrive at more reliable conclusions.
Use SWOT	SWOT (strengths, weaknesses, opportunities and threats) analysis provides a framework to structure both discussion and to capture conclusions that is widely understood by the invited experts yet does not prejudice their evaluation through the criteria imposed by ICOPER. This is primarily philosophically desirable as we recognise evaluating standards in LET are not fully developed and secondly it is practically-desirable as we wish to engage rather than alienate our expert guests.

1.3 Main conclusions derived from the GAP analysis of the future scenarios

The following Gaps, related to ***Processes***, were identified:

a) Planning and Design

"When facing the problem of designing a programme of studies for a learner it is necessary first to identify :

- the learner's pre-existing knowledge, skills and competences
- the learning goals in terms of learning outcomes

Then it necessary to select a coherent sequence of learning activities to reach the learning goal. The ability for a human being (e.g. instructor, expert) to define this sequence of learning activities involves much knowledge in the field considered. This sequence of learning activities also implies the use of learning resources (digital or not) in a given learning environment. As a result, we conclude that: *There is an important gap between the way such design is presently made and what would be ideal in term of supporting such a process to make it more efficient in the important field of knowledge or professional education."*

b) Improving concepts and language to describe and structure learning processes

The process of learning and teaching design was identified as a possible gap. One of the difficulties with this process is that the description of a learning process is closely linked with the content to be learnt. In other words the design of a learning process implies the knowledge

of what has to be learnt. It is usually a sequence of activities that implies the use of cognitive functions (e.g. concentrating one's attention, observing, memorising, replicating, understanding, asking questions to clarify a point, explaining and so on…) in relation to a learning resources and/or another person (e.g. an instructor, coach) who masters the knowledge to be learnt.

Formalisms to describe learning processes exist, IMS Learning Design is an example[1]. The validation and improvement of such a language is recognized as an important goal in these processes. Thus it has been identified that:. *There is presently a gap between the practice of the vast majority of instructors and the minority who know, master and like to use a language like IMS Learning Design* .

Such a language is a useful tool when confronted with the task of developing an on line course. It can help the designer of the on line course to analyse the learning process used by the instructor. Such languages are not, to our knowledge, often used by instructors who are teaching face to face, either to discuss or communicate about their successful implementation of learning design. Again the following has been identified: *What is lacking is a set of good examples demonstrating the benefit of such language to the vast majority of instructors in their field. This can be considered as a gap.*

If this difficulty could be resolved and more evidence could be made available, e.g. by providing a conceptual tool, this could probably help enhance the use of the IMS Learning Design language[2]. In addition, and connected to this premise, the capacity to describe the learning process using pertinent concepts can also be related with another gap, identified as the "possibility to define learning paths". Nonetheless it has also been recognised that there is also a: There is a *gap in our ability to use competency description and qualification profiles for specific qualification, occupation or position made by domain experts and the learning outcome associated with specific programmes of studies*. How and where are learning outcome profiles for certain qualification, occupation or position represented?"

c) Wide dissemination of information about Intellectual Property Rights

Wide dissemination of information about Intellectual Property Rights and their implications for work and learning to help generate constructive solutions for the many conceptual and practical problems of ensuring that IPRs facilitate rather than hinder e-Learning. For example encouragement and support for licensing solutions : suitable standard contracts or licences (including open licences) could be developed to deal with the problem of ownership of works created by employees, especially in educational institutions.

The following Gaps, related to ***services***, were identified:

a) Repository level

A gap exists in terms of more advanced search techniques for LO, which could be partially solved by improved metadata and search engine .
Search techniques based on key words, or on number of accesses to a learning resources, do not appear to provide adequate service for instructors. The user may be drawn to a multitude

[1] IMS Learning Design uses concepts such as: learning activity, support activity, role, properties, unit of learning,, environment (a structured collection of learning objects, services, and sub-environments)

[2] This is normally the goal of a document like IMS LD Best practice and Implementation Guide but such documents could be improved by adapting them to various fields of knowledge

of web-pages that have little, or no, interest[1] to them, leaving them with an unfulfilled need to use a more directed approach. The problem is even more acute when the search process tries to identify learning resources which have a more subtle meaning such as a: study dealing with the "impact of technology on learning". What is obtained, generally, are the texts which contain this sequence of symbols, or where "technology" appears or "learning" appears. These are not necessarily accurate representations of what the user has sought. Ostensibly the instructor is likely to have looked for particular resources with certain characteristics: perhaps in a given language, or for learners who have a given background, maybe s/he seeks a pedagogic presentation based on scholarly research and is not interested in newspaper articles and so on… The instructor is usually willing to discriminate in his search, in other words discriminate using his own experience but this possibility is not reflected in the search facility categories available to him today.

b) Learning Design level

A language to suited to describing learning processes and the environment to support it is proposed in the e-learning literature (IMS LD is an example). The goal of such a language once it is implemented is to support the expression of any pedagogy in the design of units of learning (whatever the level of aggregation) in an on-line learning or blended learning context. The learning scenario is then captured for example as an XML document instance. This will be the basis for developing the content, which is derived from the pedagogic works of authors. We conclude that: *The demonstration of the pertinence of the conceptual framework of such a language and corresponding environment is an important task if such languages are to be adopted by practitioners on a large scale.*

In spite of such an interesting example provided by language such as IMS LD it seems that much work is still needed to validate the concepts of this type of language and it is still necessary to test the acceptance of it amongst practitioners. Again we can conclude that: *This situation can be considered as a gap and further research could be pursued to clarify the benefits of such learning design languages*.

1.4 Main Conclusions of the Expert Summit in Leuven 31st May 2010

During this Summit we have conducted an experts evaluation of the ICOPER visions – five, standards-driven interoperability scenarios related to outcome-based learning. The evaluation revealed that the ICOPER Reference Model constitutes a valuable contribution to the field, but more work needs to be achieved in various areas, for example:

- The underlying **pedagogical assumptions** need to be made clear,
- In the context of learning outcome definitions **vocabularies** play a key role,
- **Teaching methods** and **learning designs** are ready to be shared from a technical point of view, but more guidance on how and why sharing shall take place needs to be given,
- When it comes to content **sharing Web 2.0 technologies** and related standards also need to be looked at in the educational domain,
- A strategy that deals with the heterogeneity of describing **assessment resources** needs to be developed.

[1] It is easy to check that for a research on a topic defined by its name, search engines usually provide hundreds or thousands of links to resources which will be useless since they are not designed for instruction .

2 Introduction

The Overall Objective of this deliverable is to provide information on the comparison between the desired Future State *(future capabilities)* described in D8.5 and the Current State (*present capabilities)* in order to highlight gaps that need to be addressed in order to achieve the desired futures. This work provides direct input to both WP7 activities related to the development of the ICOPER Reference Model (IRM); and to the ICOPER Roadmapping activities related to the identification of Gaps and their assessment. Furthermore, the assessment of these Gaps will identify the future research directions.

The Gap analysis work consists of 5 phases:

1. updating of the 4 **"context scenarios"** (first described in D8.5) and analysis of these scenarios according to the IRM elements: challenges/business rules, processes, and services
2. analysis of the ***'desired future scenarios'*** described in D8.5
3. gaps identification for both, a) context scenarios (closely linked to the current IRM development) and b) future scenarios (mid to long term focus, further development of the IRM)
4. revisiting the Future State and final ***identification of a small number of visions*** for outcome-based education that would reduce the number of Roadmaps for the near and midterm
5. ***SWOT analysis*** of current standards and specifications to achieve these visions (based on experts panel)

This deliverable presents the findings of these activities and it is structured in **9 main sections**:

The **first** section provides an executive summary of this deliverable and of the main conclusions. The **second** section provides an introduction to this deliverable; the **third** section briefly refers to the overall strategy followed for developing the Gap analysis; the **fourth** section refers to the description and analysis of the contextual scenarios for competency-based learning; the **fifth** section refers to the analysis of the future scenarios and description of the identified gaps; and the **sixth** section presents the 5 revisited visions-scenarios (based on the gap analysis work and discussions with the ICOPER WP leaders); the **seventh** section presents the results of the SWOT analysis of current standards and specifications in their ability to achieve these 5 visions (conclusions of the Expert Summit); the **eight** section presents a short overview of the TEL standards and specifications and their relevance for ICOPER; the final **ninth** section provides some views, on how we could assess standards and specifications and the way forward.

It is important to mention that this work was going on in parallel with the development of the IRM and thus cannot be viewed as a linear process. Both WP7, which is responsible for the development and documentation of the IRM and WP8, responsible for the context scenarios and Roadmap creation were interchanging and debating inputs and outputs. In accordance with the SECI framework for knowledge creation [Nonaka 2000,2003], we view these activities as intertwined spirals that provide seed input for starting dialogues among experts inside and outside the ICOPER project. The aim is to identify and externalize the emerging

visions and concerns of the stakeholders in relation to outcome-based education and clearly define both the IRM contexts and the future state. The results of these dialogues are combined through modelling and analysis and then are internalized into new ideas for the IRM development and for the Roadmapping outputs. Figure (1) depicts this approach.

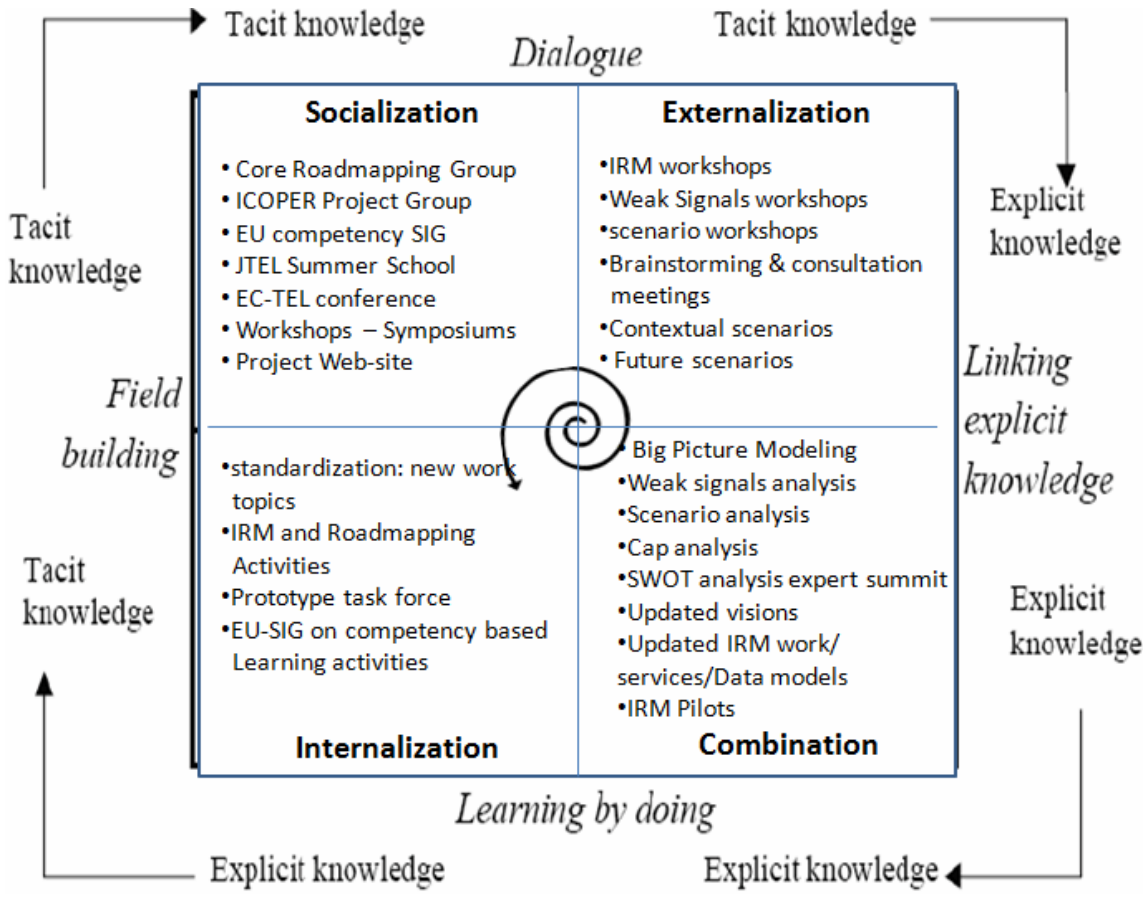

Figure 1: Updated ICOPER Foresight activities framework based on the *Nonaka's SECI Model as explained by Eerola & Joergensen 2002*

3 Strategy for Foresight building and GAP analysis: Relation to the Roadmapping process and the role of the context and future scenarios.

3.1 Roadmapping Process: Building the foresight capacity and defining the future state

As explained in the ICOPER Roadmapping methodology (D8.3 Conceptual Model of the Roadmapping Process), ***our overall strategy*** is to enable the externalization of stakeholders' visions in terms of "desired future scenarios", together with the development of plausible "context scenarios" against which, these visions will have to be developed and played out. Both of these scenario types are going through a process of continuous validation against emerging realities (weak signals) that act as factors of change, which could play an important role in competency-based learning in the future.

Towards the above aims, we have adopted a framework to describe and understand the different Technology Enhanced Learning (TEL) futures and the associated competency-based learning requirements: The future scenarios relates to the stakeholders' visions of the ***desired future***, while the context scenarios relate to a ***set of possible contexts*** within which the future visions will be played out.

The context scenarios can both a) *link* the present needs and concerns of outcome based education stakeholders to the more long term desired future scenarios, and b) *provide* a range of possible contexts within which the IRM can then be assessed. In that way, they define the scope and business rules of the IRM.

The future scenarios describe desirable futures. They are high level scenarios that define the desired future state which is also played out within the identified scenario matrix (4 context scenarios) but also span beyond 10 years from now. The future scenarios can both inform and provide additional insights into a) the context scenarios (validation and revision of context scenarios) and b) the IRM in terms of looking at the identified gaps and decide which of these gaps can be closed today via the proposed IRM and which require further research.

As a first step**,** in D8.5 we have defined a set of 4 draft context scenarios based on a scenario matrix that provides an overview of the future states in four different contexts. They cover the main topics of interest in our analysis, derived from the Big Picture modelling work, our weak signals collection and analysis work as well as from user requirement surveys performed by ICOPER WPs. This scenario matrix was integrated with the IRM work in order to link the WP8 and WP7 approaches related to domain model analysis and definition of the IRM scope.

In parallel with the context scenario work, we have also approached several EU research (RTD) projects and discussed with them the possibility to submit a future scenario that would externalize their project visions. A set of guidelines and templates were prepared for this reason. Additional future scenarios from other experts and stakeholders groups outside the TEL community were collected. We have also created our own ICOPER future scenarios for competency-based learning which we have used as examples for starting discussions with external experts. The horizon for these scenarios is ten years from now, i.e. 2020 and beyond.

The revised set of *context scenarios* presented in this document provide the integration point between the weak signal analysis (what topics are emerging), the topics of interest derived from the future scenarios and the bottom up work of the ICOPER WPs. This approach is used to narrow down the multiple longer term choices for the IRM to few context scenarios for the near term future, which then can be developed in further detail, and extended with more scenarios in the mid and long term.

This approach that links the Roadmapping work with the IRM work is depicted in the following schema (See Figure 2).

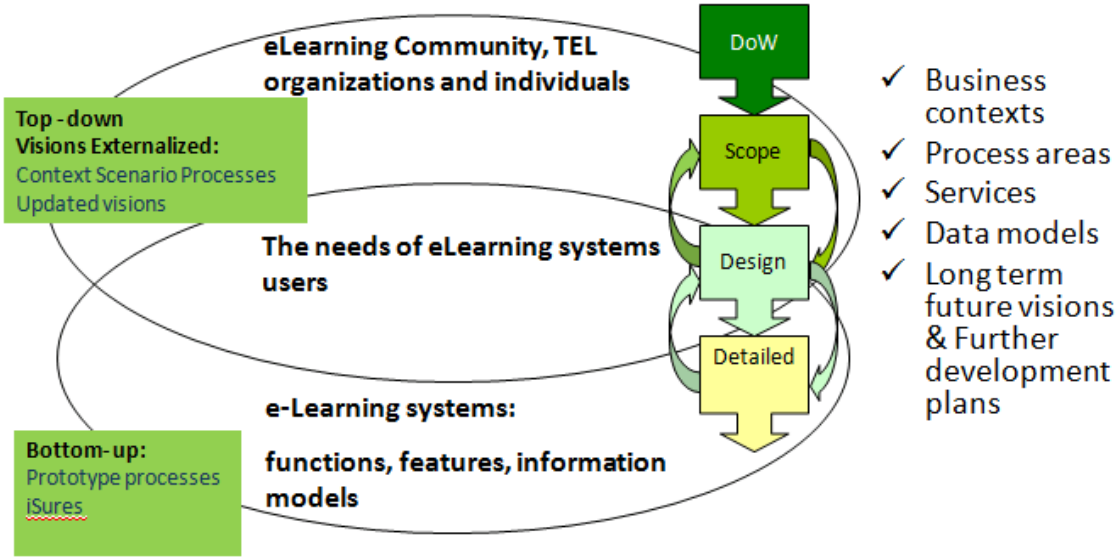

Figure 2: *Context scenarios and desired scenarios in IRM (figure updated: Source WP7)*

During these processes the WP8 teams were closely collaborating with WP7 in order to compare, synthesize, revise and update the key concepts, processes, services and data models of the IRM. As the IRM was progressing, its new versions were served as new input for starting dialogues, revisiting the gaps and updating both the context scenarios and the assessment of the future gaps.

3.2 Roadmapping process: Scenario analysis and gap analysis

During the ***Gap Analysis work*** (reported in D8.6) we compared the future capabilities against present capabilities to highlight gaps that need to be addressed in order to achieve the desired futures states for competency-based learning. The goal of the gap analysis is to try to identify possible improvements to the IRM (or at least relevant research directions) by comparing the characteristics of the future scenarios we have collected with the present state of the art. The Gap analysis methodology was first drafted during a WP8 working meeting in Paris on 25-26 January 2010 between BRUNEL and HEC partners. Later this methodology was presented and validated during the ICOPER General Assembly in Vienna on 3-4 February 2010. Dedicated workshops between WP8 teams on context and future scenarios were also held during this GA in Vienna.

At first, both the *context* and the *future scenarios* were compared to the current version of the IRM (reported in D7.1) This achieved in several face to face and virtual meetings between the context and future scenario teams and during **a 2 days face to face workshop in London (25-26 February 2010)** among the WP8 scenario teams, WP7 IRM leader and the other ICOPER WP leaders. A first validation of the identified gaps, derived from the analysis of both Context and future scenarios, took place in this workshop.

This work was continued with a series of follow up meetings and workshops.
More specifically:

Regarding the Future Scenarios:
After the London meeting, a series of Flash meetings (FM, video conference) workshops with ICOPER WPL were scheduled to continue with the future scenario analysis, on *15th March 2010, 26th March 2010, 13th April 2010, and 26th April 2010*. During these virtual workshops the scenario analysis team presented and discussed the preliminary gaps of each future scenario (derived from the comparison of future scenarios against the IRM version D7.1) with ICOPER WP leaders. During these workshops, the updated elements of the IRM were taken into account.

Input for the flash meetings comprised of:
- preliminary analysis of future scenarios;
- excel spreadsheets per scenario;
- preliminary list of gaps per scenario;
- ongoing IRM development.

Regarding the context Scenarios:
After the first revision of the 4 context scenarios analysis during the **London workshop** (25 - 26 February), the context scenarios were discussed again on several occasions with the ICOPER WP leaders and the WP7 team. In addition, ICOPER WPL and partners had the possibility to add their comments and directly update the four dedicated Google documents presenting the analysis of the four context scenarios.

The updated context scenarios were again discussed in a face to face meeting with the ICOPER prototype development team during a **workshop in Vienna** (29 April 2010). The purpose of this meeting was to align the current work on ICOPER prototypes implementation with the context scenario work and check which processes and services are not described or implemented yet.

The results of the Vienna workshop and the updated context scenarios were discussed again in a dedicated working meeting among WP8, WP7 and other ICOPER WPL during the ICOPER **General Assembly (GA) in Crete (**18 & 19 May 2010). During this meeting, the revised context scenarios were compared against the revised elements of the IRM and more specifically with the IRM key concepts and IRM process elements. A parallel updating and revision of both the context scenarios and the IRM processes and sub-processes took place during that meeting.

Revisiting Future Scenarios: development of five visions for outcome based education

The results from the scenarios analysis (from both context and future scenarios), as well as their identified Gaps (derived from the comparison of the scenario requirements to both the current work of the IRM and the prototypes implementation) were discussed again among the ICOPER WPL via a series of emails and Skype meetings, in order to define a small number of visions (revised scenarios), which would be further analysed and validated by external experts during the **experts summit in Leuven** on May 31st 2010. These revised visions depicted the desired state for outcome-based education with four short-midterm visions and a long term one. Given the timeframe of 10 years it is quite safe to assume that there is a greater uncertainty with regards to the future scenario (long term vision) and less to the other four more immediate futures. This also holds true for the coordinated actions of the relevant stakeholders (near term roadmaps and the development of the ICOPER IRM) and the final recommendations (Long term Roadmaps) which will be developed during the next phase of the Roadmap.

Each vision (scenario) was expressed as follows: a) a short description b) a list of relevant stakeholders groups c) and a list of related standards and specifications that could be utilised to realize the vision.

During the experts summit in Leuven, these visions were assessed and validated using a SWOT methodology to analyse the current standards and specifications with respect to their capabilities to fulfil these 5 visions. More detailed information can be found in Sections 5 and 6 of this document.

The above description of the Scenario Analysis and Gap analysis processes is presented in Figure 3.

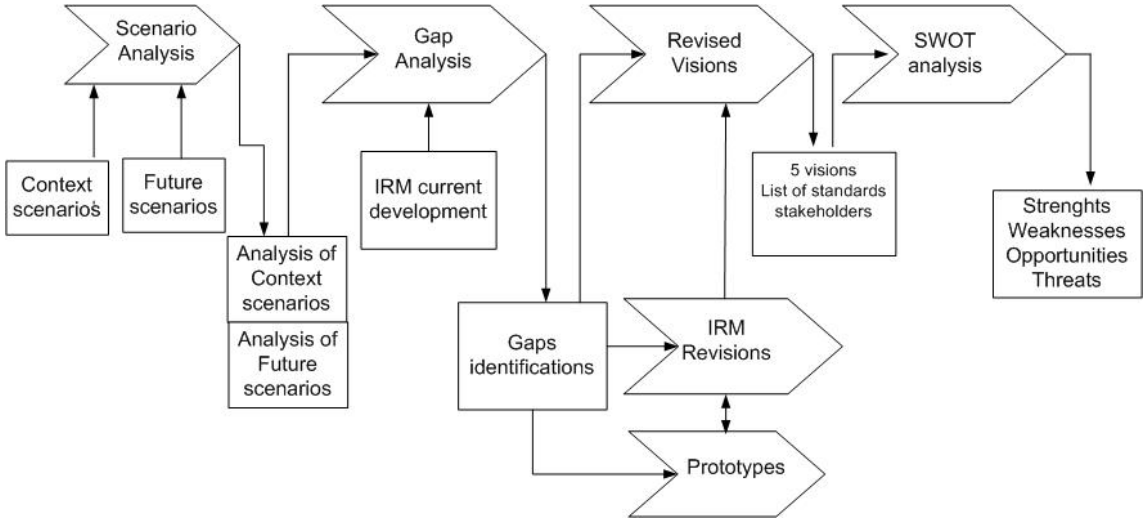

Figure 3: *Scenarios Analysis and Gap analysis process*

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- D8.5 “Envisaged future states report – user requirements and future scenarios”
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4 Context Scenarios

In our effort to develop our context scenarios, we have taken into account several approaches to competency development that depicts the perspectives and views of different stakeholders such as: the **educational** view, the **employer** view and **societal & market dimensions** such as the **employee-employability** view and the labour market processes. (Reported in D8.5 as part of the Big picture of outcome-based education).

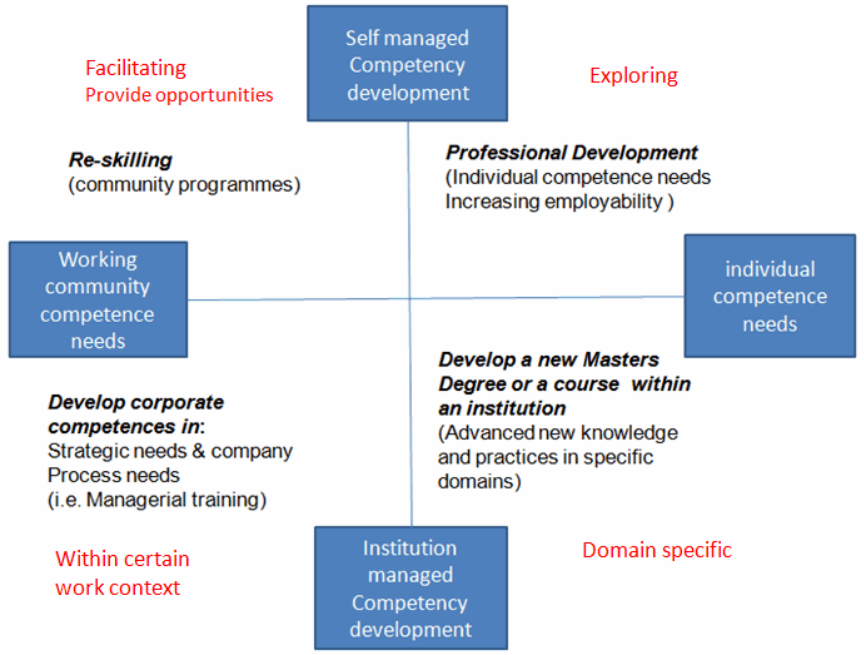

Figure 4: *Scenario matrix (context scenarios)*

Our scenario matrix (see Figure 4) is identified by ***two dimensions which differentiate competency development***. The 'values' dimension reflects the underlying principles driving the choices made by individuals and organizations (e.g. Higher Education Institutions – HEIs - and Life Long Learning - LLL - institutions, or companies) in terms of setting up and organizing the competency-development, while governance is related to the degree of autonomy in managing competency-development. Thus, these dimensions reflect the *level of autonomy of one's learning* and the *needs of the target audience*. The vertical axis shows whether competency development is managed by an individual or by an institution. This differentiation relates to the autonomy and responsibility levels of one's learning. The horizontal axis differentiates competency development as "individual competency needs" versus "working community competency needs". An individual could be a university student, an employee, or job seeker or unemployed person and a working community could be a company, a department, a Small or Medium Enterprise (SME), an association, a community of practice, a specific project within an organization, etc. The main assumption made here is that individuals are usually motivated by different personal needs, learning goals and motives, while working communities are usually motivated by specific common learning goals.

Here we would find scenarios for ***Re-skilling*** (upper left quadrant), ***Professional development*** (upper right quadrant). ***Development of corporate competences*** (lower left quadrant), and

Development of a new Masters degree or a course within an institution (lower right quadrant).

At the individual end of the spectrum competency development is focused on developing new and emerging competences (related to self exploring or domain specific research) while at the end of the community spectrum competency development is focused on maximizing the existing competences of a group usually related to specific business or task processes that are predefined for the community (providing opportunities for re-skilling or competency development within specifics work contexts).

4.1 Context Scenarios stories (Revised)

This section presents the updated context scenarios (14 June 2010) and their analysis. The analysis was started by identifying the related challenges and problems addressed by each scenario. Then, for each challenge/problem we identified the related process areas and the related services needed to meet these challenges in order to realize the scenario. A comparison with the current development of the IRM was performed, looking at the respective IRM process/sub process areas, services (as specified in the IRM prototypes), and IRM data models. The red characters in the following tables denote the current identified gaps with respect to the IRM elements. A new category referring to the data exchange needs for realizing the scenarios (related to the IRM data models) will be added at a later stage in collaboration with the Prototype task force and the WP7 leader. As explained earlier, the final goal of the context scenarios is to serve as the business cases for the IRM therefore, it is very important that at the end of the project all the scenario elements are completely covered by the IRM. Therefore, each context scenario goes into a continuous update, taking into consideration the visions from the future scenarios, the prototypes development work and the IRM development. In parallel, since the context scenarios also specify the scope of the IRM, a continues debate is taken place between the WP8 teams and the IRM development teams, in order to make sure that all elements of the context scenarios are included in the IRM version at the end of the project. Finally, for each scenario we are also listing the main stakeholders that are relevant for this scenario.

Scenario 1: Re-skilling

The Labour market perspective comprises of:

- *Self managed, community based learning*
- *20% unemployment*
- *20% of job offers are not satisfied*
- *Gaps between competences needed and workforce abilities (demand doesn't match the offer)*
- *Increased Government funding programs on personal initiative for re-training and up-skilling of individuals*

The following scenario outlines this type of professional development:
The recent economical crisis affected almost all European regions and economical sectors. In the past two years (Sept 2007 – Sept 2009) the overall unemployment rate in EU-27 rose from 7.1% to 9.2%, with extreme cases of Ireland (from 4.6% to 13%), Latvia (from around 6% to 19.7%) and Spain (from 8.6% to 19.3%). Nonetheless occupations where demand is lower than the offer or where the people taking job positions are not qualified enough for the job, for example in natural sciences and technology teaching, still exist. One of the government's attempts to reduce unemployment rate is a newly established community programme that

motivates people from particular sectors, e.g. financial, to be re-skilled and get another occupation.

Maria worked as a junior financial analyst in a large investment bank that recently went bankrupt. She has not been able to find a new job in the financial sector for the past 6 months, so she decided to take an opportunity that a government programme offers and try to obtain some missing qualifications for a potential mathematics teaching position. The courses are mostly related to pedagogy. The programme helps her by provision of a portal/social community where people interested in the programme can meet and learn together, a list of required learning outcomes(knowledge, skill, competences), overview of various accredited educational providers and learning opportunities, and financial subsidy to cover her education costs.

Maria goes to the portal to choose a set of courses that allow her to identify all her potential missing learning outcomes and at the same time consider how she does not exceed the funds she was granted by the government. Based on the provided learning outcomes she wants to obtain the portal suggests a series of blended courses as well as grouping with other learners according to their respective backgrounds and potential learning outcomes. Maria chooses a few courses from the suggested list, enroles into the courses and learns together with her contemporary peer learners. Assessment of obtained learning outcomes is carried out by the educational providers within the courses.

Assessment records are taken as evidence for Maria's achievements and stored in Maria's personal achieved learning outcomes (PALO) profile. The obtained learning outcomes enable Maria to gain national qualification, at a later date, for the selected occupation.

Actors involved in this scenario are the:

- Learner
- Higher Education Institution (HEI) or similar educational provider
- Government
- Placement system

Scenario 2: Professional development

Employability, employee perspective comprises of:

- *Self managed, individual*
- *Learners' employability and career development. Maximizing your over all competences "Staying employable". Career development services can help learners develop their competency portfolios and suggest certain Learning opportunities from different curricula.*

The following scenario outlines this type of professional development:
Peter is a motivated young computer professional, working as a programmer in a big software company. Already as a teenager he was dreaming about becoming an entrepreneur in the area of computer games development and founding his company before the age of 30.

The computer science programme Peter attended at a his local university lacked many learning outcomes that Peter needs to obtain while pursuing his goal, especially in relation to the area of management and finances. Peter also has to regularly update his computer science knowledge and skills regularly to be able to follow the rapid scientific and technological progress. In an attempt to organize an individual learning path Peter needs first to analyse his

knowledge, skills and competence gaps and clearly define learning goals in terms of his intended learning outcomes. A free on-line service at a career development agency helps him by analysing those gaps by using an automatic semantic matching of his achieved learning outcomes to the competencies data the agency has designated for a variety of different occupations and positions. Missing learning outcomes are represented in Peter's profile as his learning needs.

Based on the identified learning needs, he decides that his first goal is to obtain competences in project management and group leadership. Since Peter's completing his university studies Peter has been maintaining his materials in a Personal Learning Environment (PLE) that supports both self-directed learning and peer collaboration. The PLE's tools and services enable Peter to find learning opportunities that best suit his intended learning outcomes at different educational institutions as well as other users. They also keep notifying Peter about the changes and upgrades of the computer science programme from his alma mater and suggest topics he should learn to as well as allowing him to stay in touch with the latest developments in these fields. His obtained learning outcomes are taken into account during selection of the best suited learning opportunities. As Peter does not speak other languages than English and French, the search engine should list only or ranks higher the potential learning opportunities in for those two languages when presenting search results. From the list of found identified learning opportunities Peter selects a blended course on project management that also enables him to obtain competences in group leadership. The course is given by a local University of Economics University. Peter uses a variety of social software tools from his PLE when interacting with his teachers, their assistants and other learners. For the final assessment in the course he has to prepare a small project and lead a group of peer students who will help him implementing the project.

Thus Peter is obtaining knowledge, skills and competences from found both discovered and recommended learning opportunities, as well as from in informal learning instances and at in his working environment. e.g. by he has taken active participation in an open source games developing community. His learning outcomes obtained from educational institutions are usually formally assessed by those institutions. On the other hand most of the user generated learning opportunities he finds contain self-assessment methods and less formal material is available for assessing those outcomes. In order to obtain formal certificates, however, for some of those (informally obtained) outcomes he could takes assessment tests at a variety of local HEI, lifelong learning centres, and or vocational training institutions.

His achieved learning outcomes are stored in his personal achieved learning outcome profile (PALO). Peter's accumulated learning outcomes can thus be verified by in relation to official evidence records obtained from different educational institutions and also proven on the basis of achievements collected in his ePortfolio.

Actors involved in this scenario are the:

- Learner
- Learning supporter (teacher, assistant)
- Higher Education Institution (HEI)
- Career Development Agency
- Relying party, e.g. company
- Institution that assesses the learner's outcomes

Scenario 3: Development of a new Masters degree or a course within an institution

The Institution (Educational) perspective comprises of:

- *Institution managed, individual*
- *Developing courses or master's degrees that will cover the new developments in the profession, taking into account the emerging trends in society and contributions from experts.*

The following scenario outlines this idea:
Provided information security is becoming an essential requirement for every aspect of modern society. Unfortunately some current university programmes (e.g. computer science, social science, criminal justice) may tackle this interdisciplinary field from their points of view only and as such may not "produce" the complete or holistic experts that companies need.

To meet such needs the University of Adriatic has decided to create a new masters programme relating to information security. The main goals of the study programme are defined in a dialogue between the HEI representatives, assorted professional associations and related specialist companies. The learning outcomes students will obtain are the crucial point when creating curriculum. A dedicated working group has been established comprising of HEI staff and associated learning professionals (e.g. teachers, facilitators) and these people are involved in creating the definition of the general programme learning outcomes that are in line with strategic goals and in the development of the programme. Developed learning outcomes are validated with the companies and professional associations. Budget restrictions imposed by the Ministry of Education are taken into account when defining the time framework of the programme, the number of different courses and the number of learning professionals (e.g. teachers, tutors) involved. New study programme can be offered by the university once it is evaluated and accredited by the national accreditation body on the basis of the full documentation. This includes a detailed description of the learning outcomes of the programme and all courses. Evaluation of the programme implementation is regularly performed in order to assure high quality of all new masters programme.

Simon has been selected as responsible for computer forensics teaching in the new programme. As part of the preparation of his course (sometimes referred to as a unit of learning) he defines, in collaboration with other members of the information security laboratory, a detailed list of general and subject specific learning outcomes for the course. Then he selects appropriate teaching methods, existing learning designs and assessment methods. With the help of a content designer selects, he updates and prepares learning content and tools, and combines everything in a learning design. Expected learning outcomes learners will obtain in the course follow the general programme outcomes defined at the institutional level.

Before the course starts, Simon plans to upload the learning design (the course) he created to institution's Moodle learning management system under Creative Commons licence for re-use. He also creates a learning opportunity that contains more details for the students about the course. Learning outcomes that students obtain after successfully finishing Simon's course on computer forensics are added to his list of "taught" learning outcomes. Exporting this part of the profile enables Simon to get in contact with other learning professionals teaching similar courses.

Actors involved in this scenario:

- Learner
- Learning supporter (Teacher, Content designer)
- Higher education institution
- Accreditation body

Scenario 4: Development of corporate competences:

Industry perspective comprises of the:

- *Institution managed, community based*
- *Corporate training*
- *Content developed jointly by corporations and educational institutions*

The following scenario outlines the development of corporate competences:

In the light of an engineering company's strategy to become the leading manufacturer of electric cars the ABC Company are preparing themselves to start a project on developing a new generation of in-wheel motors. This will require the change of various business processes as well as the updating of new skills and competences to be obtained by certain company employees. Based on the overall project goals, business processes and outcomes will be set by the company management, whereby a human resource developer will analyse the existing and required learning outcomes on individual and department levels thus identifying the knowledge, skill and competence gaps for a Research and development (R&D) group which will be responsible for the development of the new project. The analysis will be achieved within a corporate learning environment that contains the professional learning outcome profiles of every employee.

The Internal training department of the ABC company designs, in cooperation with an external HEI, a learning plan for the R&D group and thus identifies necessary learning opportunities. Here, financial restrictions and time deadlines are an important factor during the planning and design process. The company and the HEI also clearly define their intellectual property rights regarding the created learning, teaching and training material.

During the development of the new project, the R&D group is working close with the HR manager and the training department to develop the necessary training modules for the newly developed processes. A learning design methodology is linked to the business process management in order to be able to measure learner performance in relation to the defined learning outcomes and business needs. Joint face-to-face training activities and predefined learning activities within the corporate learning environment also supplement learning in the workplace. Obtained learning outcomes are verified by means of tests and monitoring of working processes. After the completion of a training measure the obtained learning outcomes are stored in learners' portable personal achieved learning outcome (PALO) profiles.

Actors involved in this scenario are the:

- Learner
- Learning supporter (Teacher)
- Company management
- Higher education institution
- Human resource developer
- Institution placement system

4.2 Context Scenarios analysis

Scenario 1: Re-skilling

Scenario analysis (processes or services marked in **red** are currently missing from the ICOPER use cases or the IRM)

Context scenario story	Related challenges and problems	Related process and sub-process areas	Related Services
Recent economical crisis affected almost all European regions and economical sectors. In the past two years (Sept 2007 – Sept 2009) the overall unemployment rate in EU-27 rose from 7.1% to 9.2%, with extreme cases of Ireland (from 4.6% to 13%), Latvia (from around 6% to 19.7%) and Spain (from 8.6% to 19.3%). However, on the other side there still exist occupations where demand is lower than the offer or where the people taking job positions are not qualified enough for the job, for example in natural sciences and technology teaching.	How and where are learning outcome profiles for certain qualifications represented? Are taxonomies of learning outcomes for certain occupations semantically comparable in a way that allows comparison of required learning outcomes for two different qualifications, e.g. financial analyst and mathematics teacher?	Modelling learning outcomes	Define learning outcome (LO) profile for qualification
One of the government's attempts to reduce unemployment rate is a newly established community programme that motivates people from particular sectors, e.g. financial, to be re-skilled and get another occupation.		Actor analysis, Context analysis and modelling, Gap analysis, Strategy and goal setting	Map/match learning outcomes
Maria worked as a junior financial analyst in a large investment bank that recently got bankrupted. Since she has not been able to find a new job in financial sector for the past 6 months, she decided to take an opportunity the government programme offers and obtain few missing qualifications (mostly pedagogy related) for mathematics teaching position.			
The programme helps her by provision of a portal/social community where people interested in the programme can meet and learn together,		Learning content and tools selection	

a list of required learning outcomes (knowledge, skill, competences), overview of various accredited educational providers and learning opportunities,	How to syndicate content from various education providers via a Gov portal?	Planning learning outcomes	Portal brokerage services
and financial subsidy to cover her education costs.			
Maria goes to the portal to choose a set of courses that allow her to obtain all missing learning outcomes and at the same time not exceed the funds she was granted by the government.			
Based on the provided learning outcomes she wants to obtain the portal suggests blended courses and grouping with other learners according to their background and achieved learning outcomes.	How can learners be (semi-automatically or automatically) grouped together according to their past achievements?	Gap analysis, Learning content and tools selection	Provide a set of learning outcomes, Select context, Recommend learning opportunities, Group learning outcome profiles
Maria chooses a few courses from the suggested list, enrols into the courses and learns together with other peer learners.	Who orchestrates the learners so that they are able to identify one another as peers?	Learning activities	Browse learning opportunities, Book learning opportunity, Learn with learning opportunity, Annotation service
Assessment of obtained learning outcomes is done by the educational providers within the courses.		Learning assessment activities	Visualise assessment, Answer assessment, Submit response, Perform assessment, Create assessment record
Assessment records are taken as evidence for Maria's achievements and stored in Maria's personal achieved learning outcomes profile.		Learning assessment activities, PALO management	Create achievement, Update profiles
The obtained learning outcomes enable Maria to get national qualification for the selected occupation.			Manage profiles, Validate learning outcomes, Map/match obtained learning outcomes to qualification profile

Scenario 2: Professional development

Scenario analysis (processes or services marked in **red** are currently missing from the ICOPER use cases or the IRM)

Context scenario story	Related challenges and problems	Related process and sub-process areas	Related Services
Peter is a motivated young computer professional, working as a programmer in a big software company. Already as a teenager he was dreaming about becoming an entrepreneur in the area of computer games development and founding his company before the age of 30.			
The computer science programme Peter attended at a local university lacked many learning outcomes Peter needs to obtain while pursuing his goal, especially in management and finances. Peter also has to regularly update his computer science knowledge and skills to be able to follow the rapid scientific and technological progress.			
In an attempt to organize an individual learning path Peter needs first to analyse his knowledge, skills and competence gaps and clearly define learning goals in terms of intended learning outcomes.			
A free on-line service at a career development agency helps him analysing those gaps by automatic semantic matching of his achieved learning outcomes to the competences data the agency has for different occupations and positions.	How can miss learning outcomes be (automatically) defined on the basis of learner's personal achieved learning outcomes and qualification profiles for specific qualification, occupation or position? How and where are learning outcome profiles for certain qualification, occupation or position represented? What about multilingualism?	Domain analysis, Gap analysis, PALO management	Select context, Map/match learning outcomes
Missing learning outcomes are represented in Peter's profile as his learning needs.	Where and how are learning goals and learning needs represented and stored? Is there another profile besides personal	Learning goal setting, Profile management	Update profile

	achieved learning outcome profile (PALO)?		
Based on the identified learning needs, he decides that his first goal is to obtain competences in project management and group leadership.		Learning goal setting	Select learning outcome (LO)
Since Peter's university studies he has been maintaining his personal learning environment (PLE) that supports self-directed learning and collaboration.	How Peter's PLE interoperates with university's learning system?		
The PLE's tools and services enable Peter to find learning opportunities that best suit his intended learning outcome at different educational institutions as well as other users.	How to find in OICS that connects numerous heterogeneous learning systems, content repositories, social networks, etc., learning opportunities that best suit learner's intended learning outcomes? Are we searching units of learning or learning opportunities? Social networks?	Learning content and tools selection	Search learning opportunity, Retrieve learning opportunity, Learning outcome based search for learning facilitator, Browse learning opportunity
They also keep notifying Peter about the changes and upgrades of the computer science programme from his alma mater and suggest topics he should learn to stay in touch with the latest developments.	How to optimize recommendations or make it smarter (e.g. only recommend learning opportunities related to missing learning outcomes, new content, etc.)?	Domain analysis	Subscribe, Aggregate, Recommend learning opportunities
His obtained learning outcomes are taken into account during selection of the best suited learning opportunities. As Peter does not speak other languages than English and French, the search engine should list only or rank higher the learning opportunities in those two languages when presenting search results.			Learning outcome based query rewriting, Learning outcome based ranking, Personalisation/filtering
From the list of found learning opportunities Peter selects a blended course on project management that also enables him to obtain competences in group leadership.			Select learning opportunity
The course is given by a local University of Economics. Peter uses a variety of social software tools from his PLE when interacting with a teacher, his assistant and other learners.		Learning content and tools selection, Learning activities	Book learning opportunity, Learn with learning opportunity, Annotate learning opportunity/content

For the final assessment in the course he has to prepare a small project and lead a group of peer students who will help him implementing the project.	What services and methods are used for assessment that is not question and answer related? For example monitoring project management and group leadership by teacher and peers, simulated car driving, typing, performing a surgery, etc.?	Learning assessment activities	Match users to roles, Perform assessment, Organize/aggregate evidences
Peter is obtaining knowledge, skills and competences from found and recommended learning opportunities,		Learning activities	Learn with learning opportunity
as well as in informal learning and at work, e.g. by active participation in an open source games developing community.	How can results achieved at work, e.g. developed open source games, that are part of learner's portfolio of results be represented in his profile? Who can create achievements from the results? How does an assessment record look like in this case? How can this be done automatically or semi-automatically?		
His learning outcomes obtained from educational institutions are usually formally assessed by those institutions.		Learning assessment activities	Visualise assessment, Answer assessment, Submit response, Perform assessment, Create assessment record, Create achievement
On the other hand most of the user generated learning opportunities he finds			Search learning opportunity
contain self-assessment methods and material for assessing the outcomes.	How to transform user generated content into a learning opportunity? (tag, offer, share, assess, and aggregate user generating content and relate to specific learning outcomes)?	Learning assessment activities	Visualise assessment, Answer assessment, Submit response, Perform assessment
In order to obtain formal certificates for some of those (informally obtained) outcomes he takes assessment tests at local HEI, lifelong learning centres, and vocational training institutions.	In order to assess informally obtained learning outcomes, an institution has to directly link learning outcomes with appropriate assessment (no learning opportunities are involved). Where can	Learning assessment activities	Search assessment based on learning outcome/learning opportunity (assessment opportunity), Answer assessment, Submit response,

	Peter find who can assess his achievement/learning outcome? When are achievements created (after the end of each course for that course or at the end of the programme for all courses together)? Should assessment record directly refer to obtained learning outcomes in PALO?		Store assessment, Perform assessment, Create assessment record, Create achievement
Achieved learning outcomes are stored in his personal achieved learning outcome profile.	How to ensure authenticity and integrity of the records in an off-line mode when the information is not stored in HEI but given to a learner? Is there anything to prevent the learners in this case to add additional intended learning outcomes to existing achievement?	PALO management	Update profiles
Peter's learning outcomes can thus be proved by means of official evidence records obtained from different educational institutions	How to ensure that only authorized users can access certain learning outcomes related data in learner's personal achieved learning outcome profile?	PALO management	Manage profiles, Verify/validate achievement
and also verified on the basis of achievements collected in his ePortfolio.	Are all portfolio results represented as achievements connected with context and intended learning outcome? What about the work results, such as created software, written papers, organized events, etc.? Can a learner update an achievement in his personal achieved learning outcome profile, e.g. add description in another language?	PALO management	Get referral, Create achievement, Manage profiles, Aggregate profiles, Deduce achievement, Update profiles

Scenario 3: Development of a new Masters degree or a course within an institution

Scenario analysis (processes or services marked in **red** are currently missing from the ICOPER use cases or the IRM)

Context scenario story	Related challenges and problems	Related process and sub-process areas	Related Services
Provided information security is becoming an essential requirement for every aspect of modern society. Unfortunately current university programmes (computer science, social science, criminal justice) tackle this interdisciplinary field from their points of view only and as such do not "produce" the complete experts that companies need.	How to plan a new programme in a new field?	Gap analysis, Actor analysis	Data mining
To meet those needs University of Adriatic has decided to create new master programme on information security. Main goals of the study programme are defined in a dialogue between representatives of the higher educational institution and relevant companies and professional associations.	How to plan the new program, in particular if there is no experience in developing outcome-based curricula?	Strategy and goal setting, Context analysis and modelling	
The learning outcomes students will obtain are the crucial point when creating curriculum. Special working group at the institutional level and learning professionals (teachers, facilitators) are involved in the definition of general programme learning outcomes that are in line with strategic goals and in the development of the programme.	How to organize the process of the programme development? What is the difference between modelling and planning learning outcomes?	Learning outcomes modelling	Select context, Search learning outcome (LO), Browse LO, Customise LO, Create LO, Upload LO, Share LO
Developed learning outcomes are validated with the companies and professional associations.		Validation of learning outcomes	
Budget restrictions imposed by Ministry of education are taken into account when defining the time framework of the programme, the number of different courses and the number of learning professionals (teachers, tutors) involved.	Are there already existing courses or programmes which can be reused in the programme development?	Time and budget planning	Search learning design/learning opportunity, Statistics services, Financial services
New study programme can be offered by the university once it is evaluated and accredited by national accreditation body on the basis of the full documentation that includes a detailed description of the learning outcomes of the		Evaluation planning	Accreditation services

programme and all courses.			
Evaluation of the programme implementation is regularly performed in order to assure high quality of the new master programme.		Evaluation activities, Optimization and improvement	
Simon has been selected as responsible for computer forensics teaching in the new programme.	How to select learning supporters that are best qualified to support learning towards general programme learning outcomes?	Gap analysis, Recruitment	Select learning supporter/content designer/…
As part of the preparation of his course (learning design) he defines in collaboration with other members of the information security laboratory a detailed list of general and subject specific learning outcomes for the course.	How well does learning outcome description format support learning outcome ontologies or complex learning outcome maps (semantic relations between learning outcomes)?	Planning learning outcomes	Select context, Search LO, Browse LO, Customise LO, Create LO, Relate LOs, Upload LO, Share LO
Then he selects appropriate teaching methods, existing learning designs and		Learning & teaching design	Search teaching method/learning design, Retrieve teaching methods/learning design, Visualize/Show/Display learning design
assessment methods,	How to select assessment methods that can be used to really assess all intended learning outcomes, especially when LOs go beyond simple knowledge (assessing skills and competences)?	Assessment planning	Search assessment, Retrieve assessment, Display assessment, Select assessment method, Edit assessment, Assemble assessment, Store assessment
with help of a content designer selects, updates and prepares learning content and tools, and	How to (re-)use existing, high-quality materials? How to design blended learning scenarios as part of the studies?	Planning content and tools, Reuse and adaptation of content	Search content/tool, Browse content/tool, Retrieve content/tool, Edit content
combines everything in a learning design.		Learning & teaching design	Integrate teaching method with content, Link teaching method with learning design
Expected learning outcomes learners will obtain in the	How to ensure that specific course		Map/match learning outcome

course follow the general programme outcomes defined at the institutional level.	related learning outcomes "cover" all general programme learning outcomes?		
Before the course starts Simon plans to upload the learning design (the course) he created to institution's Moodle learning management system			Upload learning design
under Creative Commons licence for re-use. He also creates a learning opportunity that contains more details for the students about the course.	Are offers represented as learning opportunities? What needs to be checked/done before a teacher can create a learning opportunity (e.g. check availability of rooms, platforms)?	Course administration, Rights management	Clear legal rights of content within the learning design/learning opportunity, Define rights, Create learning opportunity
Learning outcomes that students obtain after successfully finishing Simon's course on computer forensics are added to his list of "taught" learning outcomes. Exporting this part of the profile enables Simon to get in contact with other learning professionals that teach similar courses.	In which learning outcome profile are stored learning outcomes that a learning professional taught about or supported? If this is a PALO profile, how can one differentiate between obtained and taught learning outcomes in the profile?	PALO management	Manage profiles, Update profile of taught learning outcomes

Scenario 4: Development of corporate competencies

Scenario analysis (processes or services marked in red are currently missing from the ICOPER use cases or the IRM)

Context scenario story	Related challenges and problems	Related process and sub-process areas	Related Services
In the light of company's strategy to become leading manufacturer of electric cars they are preparing themselves to start a project on developing new generation of in-wheel motors. This will require change of various business processes and new skills and competences to be obtained by certain company employees.	Organizational learning		
Based on the overall project goals, business processes and outcomes set by the company management,	How to associate required learning outcomes with general business goals and processes? How to define which knowledge, skills and competences employees need to fulfil the goals? Where are those intended learning outcomes stored?	Strategy and goal setting, Learning outcome modelling	Select context, Search LO, Customise LO, Create LO, Upload LO
a human resource developer analyses existing and required learning outcomes on individual and department levels and identifies knowledge, skill and competence gaps for a R&D group which will be responsible for the development of the new project. The analysis is done within a corporate learning environment that contains the professional learning outcome profiles of every employee.	By definition, learning outcomes are associated with a learner. Is it possible to specify (represent) learning outcomes also on other levels, e.g. group, department, company? For example, what is a group of individuals able to achieve together? Is this stored/represented somewhere or does it need to be deduced when needed on the basis of learning outcome profiles of all employees? Are there learning outcome ontologies envisaged (semantic relations between learning outcomes) or is natural language	Actor analysis, Gap analysis, Group management	Map/match learning outcomes, Define LO profile for target profile/job, Define learning outcomes for groups

	processing required to compare learning outcomes and analyse gaps?		
Internal training department designs in cooperation with external higher educational institution a learning plan for the R&D group and identifies necessary learning opportunities.		Planning content and tools, Learning & teaching design	Search teaching method/learning design, Retrieve teaching method/learning design, Search content, Retrieve content, Edit content, Link teaching method with learning design, Integrate teaching method with content, Upload learning design/learning opportunity
Here, financial restrictions and time deadlines are an important factor during the planning and design process.		Time and budget planning	
The company and the higher education institution also clearly define their intellectual property rights regarding the created learning teaching and training material.		Rights management	Define rights
During the development of the new project, the R&D group is working close with the HR manager and the training department to develop the necessary training modules for the new developed processes.		Learning and teaching design, Planning content and tools	Search teaching method/learning design, Retrieve teaching method/learning design, Search content, Retrieve content, Edit content, Link teaching method with learning design, Integrate teaching method with content, Upload learning design/learning opportunity
Learning design methodology is linked to business process management in order to be able to measure learner performance in relation to the defined learning outcomes and business needs.	How to link learning outcomes to business processes? How to assess learning related to competences?	Learning assessment planning	Create assessment
Joint face-to-face training activities and		Learning activities	Teach within learning opportunity, Learn with learning opportunity

predefined learning activities within the corporate learning environment supplement training and learning at workplace.		Learning activities	Select learning opportunity, Book learning opportunity, Learn with learning opportunity
Obtained learning outcomes are verified by means of tests and monitoring of working processes.	How to transform work results into achievements?	Learning assessment activities	Visualise assessment, Submit response, Store assessment, Perform assessment, Create assessment record, Create achievement
After the completion of a training measure the obtained learning outcomes are stored in learners' portable personal achieved learning outcome profiles.		PALO management, Rights management	Update profiles

5 Desired future: future scenarios gap analysis

5.1 Detailed Gap Analysis Methodology for future scenarios

Introduction: general principles

The gap analysis of the future scenarios is one step within the Roadmapping process. The ultimate goal of the Roadmapping process is to provide a list of the relevant future research topics concerned with the use of technology in outcomes-based learning. The topics that are identified should be those that are considered most relevant by the actors involved in the process. Another goal of the gap analysis is to also try to identify possible improvements to the IRM (or at least discover relevant research directions) by comparing the characteristics of future scenarios with those that are seen to be the present state of the art. Since ICOPER primarily deals with standards in e-learning, it is natural that the research themes should be related to standards. These standards concern the ICOPER Reference Model processes (IRM Processes) as well as Reference Model services (IRM services) and their associated data models.[1]

The methodology relies on identifying mismatches between future services used in the scenarios and processes considered desirable, on the one hand, and the present state of affairs or state of the art in the field, on the other hand. These mismatches are often called gaps. To generate future desirable processes and services, scenarios are imagined and presented in texts describing future learning situations and services that are considered to be an improvement by the author. It is important in such scenarios to identify the core features that make it possible to provide the new services that are considered useful.

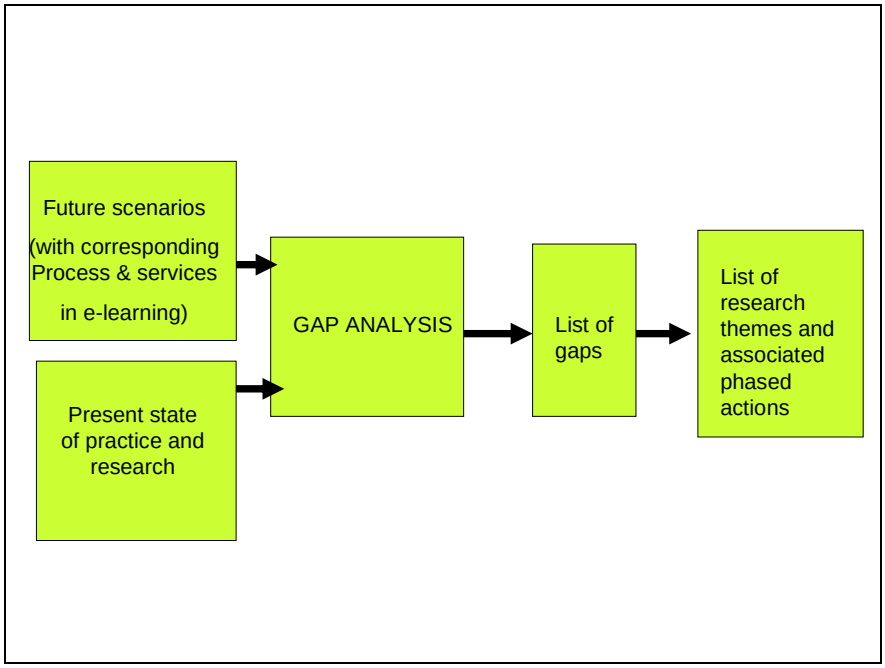

***Figure 5**: Standard steps in gap analysis and identification of research needs*

[1] Usually described in terms of Entity, attributes relation in D7.3a

Description of the process

The **first step** (step 1) is to check whether or not the set of scenarios is sufficiently relevant for the task. This involved:

- generating the scenarios from knowledgeable experts,
- analysing the scenarios in order to eliminate ambiguities and errors due to possible misunderstanding,
- evaluating the scenarios.

In our case the state of the art is defined by the IRM. Hence, it seems appropriate to analyse the scenarios in terms of IRM processes and IRM services. The goal of this phase is to generate a set of scenarios that seems relevant to the stakeholders involved in the process.

A minimum test of relevance requires that the scenarios:

- are not created solely by e-learning specialists: in our case, the scenarios were generated by different types of stakeholders, such as instructors, managers of educational institutions, learners,
- are discussed by other persons to remove problems related to misunderstandings the ideas of the author of the scenarios,
- are evaluated for possible legal or ethical issues.

It is also important to separate the following two elements of each scenario, from each other:

- core features that involve services and processes,
- hypotheses that concern the context within the chosen time horizon.

For example, an hypothesis may be implied by the scenario with respect to Intellectual Property Rights (the author imagines that they have disappeared or have been reinforced), the standard behaviour of certain actors, the level of unemployment, etc…

Hypotheses can then be evaluated for their relevance or likelihood.

The second step (step 2) is performed by analysing the scenarios in order to identify the processes and services that they imply, and by checking whether these processes and services currently exist in the IRM or can be described using the IRM.

The idea is to extract from the scenarios the list of core features of interest (in terms of processes and services).

During the **third step** (step 3) the core features are grouped in terms of processes and services into a set of categories, according to the IRM if possible.

For example, the forthcoming Medicator scenario (concerning medical studies) describes the use of a virtual patient to simulate the diagnosis phase for the learners, as well as access to Digitalised Medical Records (DMR).

Two core features of this scenario are:

- the design and implementation of a virtual patient for learners in medicine,
- a system to generate and manage the DMR of patient within a specific country[1].

[1] To take this example there is a large body of literature on this issue and experimentation is in an advanced stage in France, the UK and Germany on the DMR, but we are not aware of anything dealing specifically with

The **fourth step** (step 4) focuses on the identification of the state of the art for the core features of the scenarios.

The **fifth step** (step 5) focuses on the identification of gaps for the core features
This is achieved by comparing the core features for expected processes and services described in the scenario with the present state of the art concerning these core features.

For example, the state of the art concerning DMR is fairly well known by experts working in this field in each EU member state. Several such systems are being tested in France, the UK, and Germany, among other countries.

The state of the art concerning virtual patients is probably more difficult to assess. It is understood that there are already a number of physical artificial patients that are used for training related to specific medical knowledge. There are virtual simulations of organs, but to our knowledge a digital patient covering all main human biological functions has not yet been developed.

In this respect the state of the art concerning digitised virtual patients, therefore, has to be explored and related to the IRM.

With respect to the case of the virtual patient, we believe that this is a very bold view of the future of medical studies[1]. We suggest, however, that only an expert in this field can provide an educated judgment on such a feature.

In addition to these documented steps, the results of the GAP analysis also provided input for the development of the final five visions that were presented to the panel of experts during the **Experts Summit in Leuven** (31 May 2010). (see related Sections 5 & 6)

Follow up work:
During the **next steps** (step 6) we will present the results of the future scenarios to a panel of experts who will be asked to evaluate the importance of each gap. For this work, we have foreseen a dedicated Experts Summit during the next annual meeting of the competency SIG in Berlin in December 2010.

The criteria of importance for the gaps can be:
- social
- economic
- ethical
- efficiency in learning

This initial list has been formed in order that we may utilize a specific technique, sometimes called story boarding, for each gap.
The idea is to:

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the use of such a system in learning. This would seem to be rather straightforward, notwithstanding problems of data protection and privacy, which are, of course, of prime importance.

[1] In addition to fundamental issues related to the fact that, in medical training, the interaction with real patient is considered by practitioners a key point of the training. As a result, investing in a substitute under the form of a virtual patient may not provide the same quality of results as in other fields, such as training pilots in the airline industry or the air force, where simulation is known to be very effective as a learning tool.

- provide a brief description of each gap to the panel of experts,
- ask these experts to develop a story line describing future potential, risks and research needs, as well as links to the gaps and scenarios embodied in the gap story line.

The **final goal** is to obtain the breakdown of the research issues that need to be solved in order to be able to implement the services described in the future scenarios. Identifying the main research sub-tasks to solve each research question is often helpful.

A summary of the process that was followed for ICOPER is presented on Figure 6. Gap identification was based on a comparative analysis of the state of the art (synthesised in the ICOPER Reference Model) with the characteristics of the services required by the future scenarios[1]. This analysis has led to a list of gaps, which were first regrouped before their evaluation. The gap evaluation process involves the identification of the relevant criteria for various stakeholder groups,

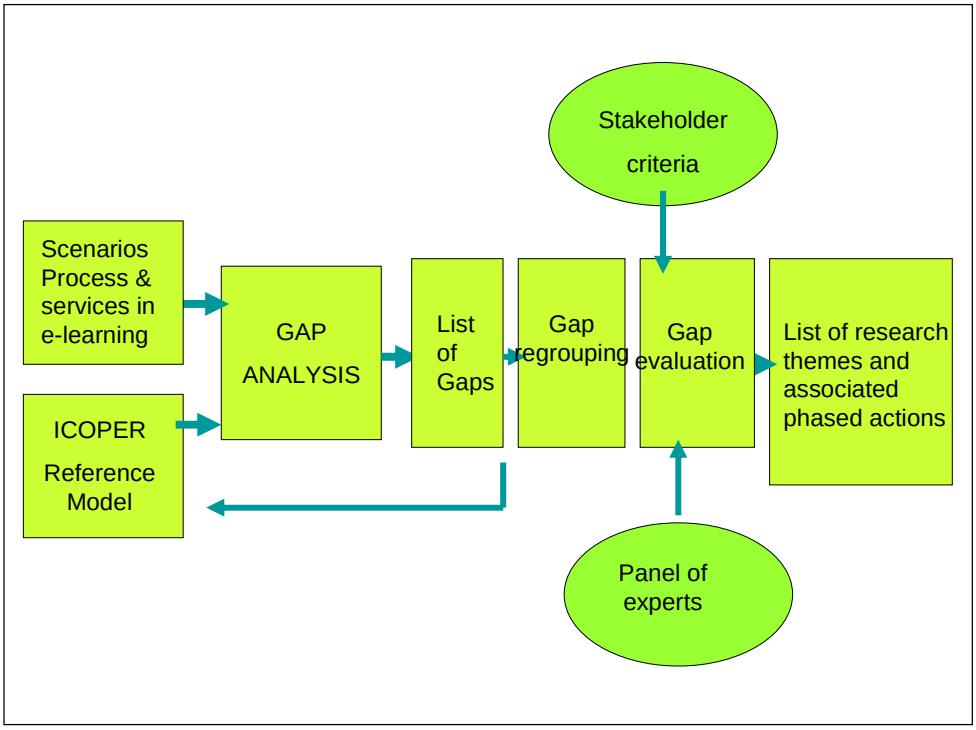

Figure 6: *Road-mapping and gap analysis adapted for ICOPER*

and, subsequently, an evaluation of the gaps by a panel of experts after a critical review of the suggested criteria. Ideally, the panel of expert should be a balanced representation of the stakeholders. A possible use of the identified relevant gaps is to improve the IRM.

References

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[1] And for some services by the context scenarios also.

5.2 Gap Analysis Results

Introduction

This section relates to the account of the validation process that have involved ICOPER experts, starting with the London February 2010 meeting and continued through a series of Flashmeetings (FMs: recorded video conferences). We have asked the authors of scenarios to clarify our understanding of their texts when needed. Replies were received from the authors of the "FESTO" and "Art History scenarios"; as a result, we cannot rule out the possibility that we may have, at some point, misunderstood some of the other authors' ideas.

In the first draft of this analysis we have used the list of processes and services described in the D7.1 document, dated 15.10.2009 for the definition of the IRM, which was current at that time. We have also used the definitions found in the ICOPER Discourse Tool at the date of this section. This first draft was revised after a series of FM with the ICOPER WPL during which the then recent developments of the IRM was taken into account. Nevertheless, we would also like to point out that this analysis is based on future scenarios only and does not take into account the important ongoing work carried out on context scenarios/prototype development and evaluation, nor is it based on a comparative analysis of the implementation of standards by e-learning platforms currently available from commercial providers. This work, however, has provided input to the ICOPER Reference Model (IRM), the context scenarios and the prototypes implementation groups. The key concepts and identified gaps derived by the scenario analysis were taking into account by those groups and when possible several aspects have been incorporated into the groups' current work. The criteria for these discussions and updates were the time horizon of the gap (priority was given to short and midterm gaps), the perceived importance and coverage of the gaps, whether the existing standards could be useful to close those gaps and the ICOPER available resources.

Additionally, this work was also revisited again, during May 2010, when it was discussed with the context scenario developers and the prototype development task force in order to focus on the five visions for outcome based learning that would be presented and discussed during the Experts Summit. The reason for this re-grouping was that we needed to associate specific standards and specifications to the identified gaps (derived from both the context and future scenarios, as well as from the requirements related to the prototype work) in order to proceed with a SWOT analysis of these standards and specifications and assess their ability to bridge such gaps. (see Figure 3 and also Sections 5 & 6 for further details.)

In this section, gap identification is based on a comparative analysis of the state of the art (synthesised in the ICOPER Reference Model) with the characteristics required of the future scenarios. This analysis leads to a list of gaps, which are first regrouped before their evaluation.

5.2.1 Scenario structure

Each scenario is analysed to collect information according to the following information sub-sets:

Information subset 1: general information concerning the scenario

- ***vision:*** captures the vision of the author regarding the use of technology in training and learning;

- ***key learning task:*** expresses the key learning task that the scenario describes;
- ***context:*** expresses the context in which the scenario takes place (university, workplace, locations with access to mobile devices, etc …);
- ***constraint:*** expresses any constraint that is implied by the scenario;
- ***Learning Object used (LO):*** records which types of LO are used in the scenario, important for unusual LOs such as special real time simulations, object created with CAD software[1], or three-dimensional virtual worlds, ...;
- ***special equipment,*** *if any****:*** refers to any physical equipment required by the scenario, such as a video conferencing system, PDA, new type of e-book;
- ***software application or language,*** *if any:* refers to any software application or development tool used in the learning processes described by the scenario, such as multi user competitive games available through the Internet, medical patient simulation (simulation of biological systems), languages for modelling a given domain of knowledge (economic modelling, ecological modelling for example …) , knowledge base (expert) applications, etc …;
- ***use of biometrics:*** whether or not the scenario describes the use of biometric technology;
- ***system learning objective:*** the key learning objective described by the scenario in terms of knowledge;
- ***skills and competency:*** this complements the EQF (European Qualifications Framework) information collected in the next information sub-set;
- ***accreditation:*** whether or not the scenario implies an accreditation of the learning outcomes.

Information sub-set 2: EQF

This second subset is expected to make the link with the EQF classification. It describes whether or not the scenario includes learning and training concerning:

- knowledge,
- skills, or
- competencies.

Information subset 3: topics found in the IRM[2]:

Processes

- learning needs analysis
  - learning outcomes identification and modelling,
  - actor/stakeholder analysis,
  - gap analysis, (using learning opportunities instances)
  - context analysis and modelling;
- planning and design of learning opportunities and learning outcomes
  - planning of learning outcomes,
  - learning and teaching design (including cooperative design) if no existing & usable UoL is available.
  - design and planning of learning opportunities (courses with content and tools)
  - re-use and adaptation of content,

[1] Common in profession such as architecture or engineering.

[2] At the time of our analysis, only the D7.1 deliverable was available (version dated 15.10.2009) . The 7.3a version introduces the following actors: learner, learning facilitator (instructor), Educ. Inst. Administration,, Company HR dept. Content provider(faculty members,…), the analysis was updated using D7.3a.

    - assessment design, production, planning
    - time and budget planning,
    - rights management (especially when using third party works);
  - learning provision
    - search and retrieve UoL,
    - select learning content(UoL) and tool,
    - learning activities,
    - learning assessment activities,
    - evaluation activities., update Learning outcome.

Note that in the table, we do not break down the processes at a lower level, as defined in D7.3a, nor do we analyse it by classes of actor[1].

Services

- repository services (search and retrieval of sharable educational resources by type using metadata, metadata harvesting …),
- publication services (management of collections of learning resources),
- user management services (includes identity management , regrouping and outcome profile management),
- learning outcome services (searching, adding, linking, exporting …),
- recommendation service (list users whose learning outcome profile contain a given learning outcome, advise user of missing LO to obtain a degree),
- learning design services (searching Teaching Method TM/UoL, retrieving TM/UoL, adapting TM, UoL …),
- learning registry services (provide a catalogue of Learning Objects Repository (LOR) with corresponding transfer protocols),
- learning delivery services (searching /retrieving UoL or LO, importing/exporting UoL or LO, and authentication),
- validation services,
- identification service (assign unique persistent identifier managed by the OICS
- assessment services (authoring assessment, grading and visualisation of results, delivery , course evaluation),
- collaboration services (supporting video interaction, e-mail, discussion forums, etc).

Information subset 4: identifying, in the view of the analyst:

- issues of the scenario,
- hypotheses.

Issues are the unsolved problems (gaps in the present state of the art in e-learning) that research is expected to solve, so that the vision of the future becomes reality.

Hypotheses refer to the explicit or implicit hypotheses included in the scenario that are not related to technology. For example, the scenario may imply that the law requires companies to finance professional training for their staff to a certain extent, or that it is always possible to find, on the Internet, UoLs that fulfil one's needs and that are available for free.

We shall try to associate the "gap" with each scenario, and also to include a small « story line » that describes future potential risks and needs for research associated with this "gap".

[1] (learners, learning facilitator, educational institution administration, company HR department, content provider)

5.2.2 Analysis of future scenarios using the processes and services defined in the IRM – identified research themes and potential gaps

The processes and services described in the future scenarios are sorted below according to the categories of processes and services listed in the IRM. The number in parentheses refers to the scenario number. **If a process or service described in the scenario cannot be found in the list of the processes and services described in the IRM and is considered relevant it is considered a gap. However a service can, in our view, be listed in the IRM[1] and still be a gap in the sense that research is needed to implement this service given the present state of the art.**

Some authors have described actions implying processes, or the use of services or persons for their realisation, which they consider themselves as missing, raising research issues or going beyond the present state of the art. These actions and the corresponding research issues are then mentioned. The list of functions of the IRM API includes a **submitMetadata** and **submitEnrichment** procedure, which allow the extension of the metadata record of a LO.As a result, some of the gaps listed below could disappear if these procedure is used to add the information at the origin of the gap. Gaps have been defined with reference to the definition of processes, services and metadata as described in D7.3a.

Processes

a) *Needs analysis*

- Identifying and obtaining a UoL to fulfil a given learning goal (n° 3a Art Gallery). This scenario raises the issue of the method of identification of UoLs, learning opportunities or programme of studies to fulfil a given learning goal. This raises the issues of the identification of the relevant learning goals, methods and concepts to define them. (a link with the EQF and job description is a direction). This raises the question of identifying whether the competency to be acquired is an individual or a collective competency. As a learning outcome is associated with LOM (5.12) it is possible to search using LO if a LO is considered the consequence of the use of a UoL. This assumes that LO are defined in a consistent manner (see API) when this information is captured as an attribute of a UoL. This is not an easy task since the 5.12 attribute is of a type container, but we understand the LO must be described in a natural language (language string).
- Identification of the goals of the learner (n° 4 i-SME): this was a missing process (and hence a gap) in the 2009 description of the IRM; it is probably no longer the case in the 2010 description, since goal setting appears in the processes of the learner. It is impossible to perform a needs analysis without an idea of the goal of the learner. The goals could be a profession the learner is willing to practice (be a doctor) or a learning outcome he wishes to master (speaking a foreign language).
- Initial assessment of learner to identify needs, this is probably a gap since it is difficult to perform a needs analysis for a learner without any verification of his level in term of EQF. The initial assessment and the learning goals enable us to diagnose whether the learner has the capacity to reach his goal (in terms of learning outcomes) and, if yes, to move to another process.
- Learning outcome modelling (n° 3a Art Gallery).

[1] A precise definition of the functions and procedures provided by the IRM is defined by the ICOPER API. This list of procedures help understand whether a service described in a scenario could be developed using them. However, most services in the scenarios are defined in general terms.

- Stakeholder analysis (identifying persons who have an interest in the learning process): this is no longer a gap in the 7.3a version of the IRM, as stakeholder analysis is now a listed process.
- Finding the relevant UoL as a function of work plan and career objectives (scenario from Open University): this process can be related to the identification of a learning opportunity to fulfil a learning goal; however the goal is expressed here in terms of career objectives, which implies acquisition of more than just knowledge (skills , competencies).
- Identifying the goals of the learning process, in order to estimate the value of acquiring new competencies at the level of the individual, company (a collective competence) or group of companies. (n° 4 SMEs). (a higher order collective competence): one of the challenge is to determine the value for the organisation of acquired competencies, which according to the author of this scenario, should not be limited to purely economic aspects of the question; goal identification is mentioned in D7.3a. however no mention is made of the difference between a personal goal and a company goal (collective objective).

b) *Planning & design of learning opportunities (courses, programme of studies)*

- How to match a person's competencies to job offers (n° 9, ISO/IEC Sonja): this scenario describes a sophisticated set of interoperable services to:
  - update an e-portfolio,
  - edit CVs
  - support the selection of job offers matching with the LOP of the person looking for jobs,
  - send the CVs to the selected companies.

  This set of services is a gap in the sense that it addresses an important issue not solved by services described in the IRM; however, one can argue that this is not within the scope of the IRM and is an issue rather than a gap.
- Planning learning outcomes.
- Learning and teaching design (n° 3a Art Gallery): this process is described in the processes associated with the learning facilitator; it is not a gap in the sense we have defined above; it encompasses three sub-processes (content selection, learning method selection, tool selection); however, the process of defining with care the teaching and learning methods and transferring them to another instructor is a difficult exercise, especially if the new instructor does not have the opportunity to participate I, a session managed by an experienced instructor; the formalism and the concepts to make the learning method explicit may be lacking; we could consider this to be an issue in spite of the fact it is not a gap.
- Planning a route in a building given a learning goal (n° 3a Art Gallery): this process is the consequence of the fact that in certain domains the learning design relies on the geo localisation of artefacts to be studied. (a similar case appears in scenario 13 concerning education in architecture). This type of requirement is not mentioned under this heading in the list of IRM processes.
- Selecting UoLs that can be mastered by the learner on his own (n° 5 Sarah, work focus learning): this supposes that it is possible to identify (using the Learning Outcome associated with the UoL) whether the learning outcome of a UoL can be mastered by a learner in isolation without assistance; the process to achieve this result in a reliable way does not seem obvious.
- Selecting UoLs for which assistance is required (n° 5 Sarah, work focus learning).
- Selecting courses with accreditation: this process is straightforward and is not a gap or an issue.
- Modelling the learning process by creating the right mix of net based, face to face and simulation based training (n° 4 SMEs): this process is related to the analysis of the nature

of knowledge and skills to be acquired to decide what type of learning resource is best adapted to the learning process. (for example a simulation can be better suited when dynamic aspect of knowledge have to be observed and understood); although some would consider this to be outside the scope of the IRM, we believe it is related to the IRM process of designing the learning process for the learners; it is difficult to tell if it is a gap, but it is usually an issue which can be overlooked.

- *Learning modelling* (expression used in n° 4 SMEs): defining the optimal mix of different types of training; this mix is defined by specialists.

c) *Learning provision*

- A process is described that identifies learners and stores their data; this process is performed by a "trusted third party"(scenario n° 1, Constance G); this can be considered an issue in the sense that this type of "trusted third party " is not available today to our knowledge. But it is not a gap since it is outside the scope of the IRM.
- In some scenarios learning takes place in a virtual world (simulated reality or mock up): for example, in scenario n° 6, training takes place at a virtual hospital and uses virtual patients[1] and their medical records (n° 6 medical profession); this type of service can be considered a gap in the sense that this type of virtual mock-up of a building or monument should be developed for the domains when needed (in the scenarios, the services of an hospital, a virtual visit of a monument in architectural studies) for learning. This type of software environment (virtual walk through a 3 dimensions space) is presently available mainly on PCs, however this is changing[2] how to facilitate the access and use of such software through the Internet can be considered an issue.
- Competitive quizzes are used (n° 3b first aid worker);(considered gap since this type of assessment is not listed in the IRM, except if one considers it is just a pedagogical form of using a quiz)
- Case study for scene analysis (n° 3b first aid worker): this can, to our knowledge, be generated by a CAD system or a virtual world software; it is currently possible to access some CAD systems through the Internet, however how much of their functionalities is accessible is unknown to us.
- Protocol of treatment once diagnosis has been made (n° 3b first aid worker): this is a form of assessment for medical students, which measures the capacity to diagnose and then to associate the right protocol of treatment. Can be considered a pedagogical form.
- Providing access to a LO as a function of the location of the learner (n° 3a Art Gallery): displaying information depending on the geo-localisation of the learner is not a service provided by the IRM. So it can be considered a gap.
- Learning content and tool selection (n° 3a): the process exists in the IRM, but the methodology of selection is, in many system (LMS,…) far from satisfactory.
- Mixing personal and institutional environment (n° 13 architecture studies, Lille - see below, an issue rather than a gap).

d) *Learning activities*

- Exchanging with other team members on a diagnosis (n° 3 b first aid worker): this is a traditional learning process (in medicine for example, but also in other domains such as

[1] To our knowledge, the trend for the training of medical doctors (especially trauma specialists) is not to design virtual patients, but hybrid systems. These systems combine a reproduction of the human body with its internal organs. the physical mock-up of the human body is connected to a computer that will simulate various potential incidents, which the learners have to diagnose and control through treatment protocols. The physical contact with the human body is considered a requirement.

[2] See the case of Sketch Up a software application for architectural design recently acquired by Google.

management) whereby an instructor asks a learner to express and explain his diagnosis, and then ask the other learners to do the same, in turn; a process of questions/answers initiated by the instructors helps to make explicit the assumptions and facts used by the learners in their reasoning and to develop a critical analysis; a classical bias is to tend to defend one's point of view without being willing to understand other points of view. (obstacle to sharing knowledge) , other behaviour which may prevent learning include avoiding tackling the real problems and refusing to reassess past decisions.

- Applying a protocol of medical treatment (n° 3b first aid worker): this type of process can be considered as an assessment, as long as an evaluation of the protocol is made; the protocol is the equivalent of a procedure applied to the field of medicine, it is a medical procedure that has been validated by a group of medical experts and recommended in a given situation; we do not consider this process to be a gap.
- Learning activities and events should be visible across services and context (n° 13 architecture, from a Future learning EC-Tel workshop): the scenario develops the idea that students are led to move from one context to another (from institutional to personal services for example.);the description in the scenario does not mention specific learning related processes or services; this can be considered an issue, but it was not possible to contact the author for clarification.

Services

a) *Repository*

- Search UoLs by type (course description, concept introduction, audio recording, simulation, exercises etc …) (n° 1 Constance G, n° 3a Art Gallery):the search and retrieval service of the IRM allows the retrieval of "lists of Sharable educational Resources of specific types"; the **getUnitsOfLearning and getLearningResources** procedures of the OICS API can normally be used to perform this function; so it should not be a gap; however, it is well-known that to obtain the learning resource they need, instructors tend to use search criteria such as learning resources produced by authors of good reputation in their field whom they trust; so it is likely there are still issues in the search function if you consider you need to understand the question to provide the right answer and not just link to hundreds of documents that match an algebra of keywords.
- Search UoLs by expected course outcome in terms of EQF (n° 1 Constance G): this should not be a gap since Learning Outcomes are taken into account by the IRM. (attribute 5.12). but as the definition of the LO is a text string, many semantic problems can occur. (see above)
- Search for UoL using UoL description, including fees (n° 5 Sarah); this is a gap in the sense that even if an attribute Rights and Licence (6) is present in the ICOPER LOM specification there is no obvious way to identify whether the UoL requires payment of a fee. In many cases, payment is conditional.(e.g.: no payment if the author of the UoL is paid for teaching , payment of a fee if it is used without the author once the pedagogical know how has been transferred.)
- Search for course description (n° 2 joint course design and teaching): this process corresponds to the needs of a course (learning opportunity) designer to study the structure of other courses on the same topic; this need is systematic for a service course (same course taught by several instructors at the same time).and this is not the same as searching using the Learning Outcomes of the course; the course designer is interested here in the content and the learning design; however he can start by a search using the Title (1.2) (ex introduction to C programming, Introduction to English as a foreign Language …). This is may be an issue more than a gap.
- Search by Syllabus.

- Search for person with given interest or profile (n° 2 Joint teaching); this is considered to be outside the scope of the IRM, since the IRM does not include information on faculty or instructors; it is clearly a social network functionality (but possibly a specialised social network since it is not sure Faculty members wish to use Facebook!); contacts with faculty are usually initiated at professional conferences or when visiting another university, since a personal relation is needed to make the decision to do joint work and only then can electronic support be worthwhile.
- Manage faculty description, search faculty using profile (language spoken, affiliation,…), teaching and research interests etc …; this is considered to be outside the scope of the IRM.
- Finding colleagues with similar interests (n° 2 joint teaching) in a given context; this is considered to be outside the scope of the IRM.
- Learning object can be a software application such as: a simulation (e.g. virtual patient in scenario n° 6), application software, a compiler, a modelling tool, etc …this is not a gap if one considers just the description (metadata) of the software, and if the software can be freely downloaded for use on a PC; it can be a gap if the software must be adapted to be used through the Internet. Many software applications are used in courses or UoLs and their use through the Internet may require significant investments for adaptation; this can be considered an issue.
- Designing a search engine capable of looking for internal as well as external resources (n° 7 Festo AG): the question raised in this scenario is related to the fact that most organisations (and not just consulting companies) are developing their own digital learning resources; a search engine may be designed to differentiate the search on computers used by the company and on computers outside the company; the IRM process does not make this differentiation, but it is more an issue than a gap.
- Providing interoperability between various LMS (n° 3a Art Gallery): this type of issue was explored in several studies; when the scenario requires that a UoL be exported from one LMS to another, clearly compatibility is needed at different levels; with respect to metadata harvesting, this is normally taken care of by the Harvesting Service of the IRM.; with respect to the transfer of the files or UoL this probably an issue.
- Providing export capability to other standards; (see above).
- Providing a unique LO identification to facilitate search and identification of IPR (see Digital Object Identification - DOI - three such identification schemes currently exist). This is not a gap, since according to the IRM, all resources managed by the OICS are assigned a unique, persistent identifier.

b) *Learning outcomes*

Export the learning outcomes acquired with a UoL to a CV stored in a social network application (n° 1 Constance G); since a procedure get **LearningOutcomeProfile** of the API is able to retrieve the LOP for a user, it should not be difficult to develop the extension to export this piece of data to a CV; hence this is not really a gap, but it may require some development work.

c) Learning design

- Create a LO using a modelling tool or language (in a modelling or knowledge based system for example - n°2 course design and delivery): on this issue see Klein (2002); in many domains of knowledge, software tools that are related to the concepts and procedures of the field (specialised simulation languages, business games, decision support systems, ERP etc… are standard examples…). are being developed; in a more general way, expert systems play an important role because their task is to formalise the knowledge of the field; as a result, there are in certain field important learning tools that

can, not only allow inspection of knowledge in various formalisms, but also to provide automatic explanations; the issue raised in the scenario is related to the need to share these pedagogical applications with distant learners when their use is incorporated in a Learning design (course); this is related to the coupling of the use of content (user manual, text of models or application used in exercises …), the use of a learning strategy and the use of software tools to run a pedagogical application[1]; one straightforward solution when the instructor is demonstrating the tool is to share the application through a video-conferencing system having this capability; when it is needed to practice the software tool by the students, the alternatives are to export the software on the PC of the learners with the associated IPR issues or to transform the software for use through the Internet (transform it as a service); since the IRM is more about the description of learning resources, this can be considered as an issue outside the scope of the IRM and not a gap.

- Share a LO defined using a modelling tool or language (n° 2 course design and delivery); See above.
- Use learner data concerning course registration to select appropriate UoL (n° 3a Art Gallery); one of the service of the IRM is the recommendation service; apart from listing users whose LO profile contain a certain LO, the definition being very general, it is not obvious to decide whether this is a gap.
- Simulate an organisation (ex: hospital , university) (n° 6 medical profession); for example generate a virtual walk or tour of physical artefact , which in the scenarios are usually buildings, as the IRM focuses mainly on the description of learning resources, if we take this restrictive understanding of the IRM, this is not a gap.
- Simulate a biological systems (ex: virtual patient) .(n° 6 medical profession); (see above)
- Design a system able to provide recommendations depending on "learner profile" (n° 7 Festo AG).
- Design "open widgets"(n° 7 Festo AG).
- Define the right mix of courses using a learning consultant (n° 8 Julia); This is more a challenge in the sense that such learning consultants are not easily found, especially in SMEs. This can be considered outside the scope of the IRM.
- define the right mix of web-based, face to face and various forms of simulation (n° 12).

d) Management of access rights

- Associate rights to a person and/or to an institution (n° 2 course design and delivery).
- Organisations exist that claim to provide Digital Object Identifier (DOI).

e) *Learning delivery*

- Attend a course in a virtual world (n°1 Constance G); since the IRM deals mainly with the representation of information concerning learning outcomes (LO), Learning Design and Learning opportunities (courses , pedagogical simulations etc…), it is possible to describe a learning opportunity offered through various types of virtual worlds.
- Provide telepresence services (high end video conferencing) to support interaction between several distant classes and sharing applications for distant presentations (n° 2 joint course design and delivery); such equipment exist since 2000, but are still costly; the idea is to have at least one classroom equipped in most universities.
- Transfer LO to the learner's PDA or electronic tablet (iPad ?) (n° 3a Art Gallery).
- Create and store "learning paths" (n° 7 Festo AG).
- Automatic identification by universal log-in (n° 3a): the IRM API offers three procedures related to user management **createUser**, **getUser** and **modifyUser**; the issue raised by the

[1] The three sub-processes are defines as: content selection, teaching/ or learning method selection and tool selection.

scenario is² related to the universality of login (one unique identifying procedure for all systems); this is a gap but also a complex issue and not just for technical reasons.
- Deliver LO according to geographical location.
- Interface various standards for LOs and UoLs (n° 9 architectural studies): this issue is linked to the Harvesting and Registry services of the IRM; apparently the registry service is expected to provide the information concerning the standards and protocols used by outside repositories; the Harvesting service should be able to interface with repositories for importing metadata records to the OICS.

e) Assessment
- Capture data on assessments (n° 3a art Gallery).
- Automatically assess learners using a multi-user competitive simulation (n° 2 joint teaching); this highlights the fact that, if the knowledge can be formalised as a set of quantitative models, it is often possible to formalise the assessment as a procedure and make it automatic; this is not a gap but may be a type of assessment method associated with the use of the model.
- Grade learners using quizzes (n° 3a Art Gallery): this grading can be automatic or not according to the type of quiz used.
- Learners obtain grades if they exchange/share educational resources or answer other persons' questions. (n° 6 medical profession); his is a grading procedure, hence outside the scope of the IRM.
- Learners create case studies that are used for their own assessment (n° 6 medical doctors); this is not a gap.
- Design an "intelligent" (?) rating tool used for both content and recommendations.(n° 7 Festo AG).
- Performing an assessment is different from visualizing results: this process is not listed in the list of IRM processes, but is needed; and it is a gap (also mentioned in the context scenarios).
- Create an assessment: this process is not listed in the list of IRM processes, but it is needed and it is a gap (also mentioned in the context scenarios).
- Calibrate an assessment: this process is performed by a group of instructor who are going to use the same assessment for different learners of the same course or programme of studies, so that the assessment is being used in a consistent manner and does not introduce biases; it is not listed in the list of the IRM processes, but can be considered outside the scope of the IRM.

f) Collaboration
- Computer supported cooperative tools are provided to allow distant teams to cooperate to share digital object (on projects involving software application joint development by distant users) (n° 2 joint teaching):the service description of the IRM in the D7.3a version does not included this kind of service. (it was included in the D7.1), since this type of service is provided by the industry on a regular basis, it is not a gap from the research point of view and can be considered outside the scope of the IRM; however since supporting distant cooperation is a key feature in distance Education, this could be the object of debate.
- Multi-point video conferencing is provided to support teams of learners cooperating from the distance. (n° 2 joint distant teaching): this type of service is provide by specialised companies on a regular basis since the 1990s. (see above).
- Use chat to exchange views on LO and tasks (n° 3a Art Gallery).

- Use instant messaging and social networking to keep other learners aware of each other's activities (n° 10 Architecture).

g) Licensing

- Define or provide licence contracts to faculty members willing to license their UoLs or LO (n° 2 joint distant teaching): the IRM has an attribute to the LOM providing the information concerning the licensing model used with the learning resource (6.3); the user management service of the IRM offers basic authentication, and authorisation to manipulate Learning outcome profiles but not to offer and accept a licence, or obtain access to the resource[1].
- Define or use a unique identifier for LO with IPR metadata: the IRM provides an identifier (1.1) so this is not a gap; several such identifiers exist provided, by other projects or organisations.

Data Model

- An attribute of confidentiality for data elements is needed; in order to be able to restrict access to data to specific audiences (n° 1 Constance G, n° 6 medical record of patient): in certain situations, personal data is very useful for learning purposes, as highlighted by two scenarios; however the owner of the data may wish to restrict the usage of this data[2] and the IRM does not seem to have an attribute to state these restrictions, except under the form of IPR; this requirement may be considered a gap.
- Rights on data in data bases (n° 1 Constance G).
- Identity of avatars in virtual world (n° 1 Constance G).
- Time validity associated with data - right to "forgiveness" (n° 1 Constance G): we have not identified such an attribute and we would consider this type of attribute to be a gap.
- An instructor entity is available (n° 2 joint teaching and design): an instructor or faculty member may be interested in contacting other instructors[3] interested by a topic; since the LOM includes the author of a UoL this should be possible and not constitute a gap; it may, however, be considered as typical of a social network service; this view is fine if the membership is controlled (such as faculty members of a given network of schools or universities.).
- Define condition of use of a LO (rights management) (n° 2 joint teaching): see above.
- Obtain statistics on the use of LOs, especially who is using it, when there is a possibility to book a LO and whether there is a fee to use it. (n° 2 joint teaching).
- Learning theory associated with a learning method: making this link is probably a challenge, since few instructors are knowledgeable about learning theories, in spite of the fact that theories are important to design experiments to test them and to prove the claims. learning is mainly a cognitive process[4], and several theories have been developed , initially behavioural theories, then learning theories originating from cognitive science and constructivist theories to name a few.
- 3 D image files (n° 3b first aid worker): the scenario describes a learning activity during which learners watch and analyse the scene on the occasion of a virtual walk around the

[1] There was an attempt in this direction in a service such as EDUCANEXT.

[2] For example companies may wish to restrict the access to their data to a given educational institution, or wish the data to be used for an agreed educational goal.

[3] Note: the instructor entity (or person entity with relationship teaches with the entity learner) should have attributes such as name, field of research, courses taught, language spoken, etc ..

[4] Something happening in your brain, a change of state, which is closely linked to the cognitive process of concentrating one's attention, observing, remembering and understanding.

injured person lying on the floor; our understanding is that the learners must use some type of software (CAD, artificial life, etc…) that allows them to simulate a walk through a 3 dimensional simulated space; as the goal of the IRM is more to describe such software used in pedagogical activities rather than to run them[1], we consider this service description to be outside the scope of the IRM.

- Data defining geographical location of LO and of the learner himself (3a Art Gallery).
- Data concerning relationship between LOs (3a Art Gallery): this scenario describes a situation where a LO must be used in relation with another one;. this is not a gap since it is possible in the IRM to create a relation between LOs (7 and 7.1) and this operation can be perform using the **submitRelation** procedure of the API.
- Data concerning producer of LOs (3a Art Gallery).
- Information concerning the owner of IPR on learning object (n° 3a Art Gallery): a UoL is the work of his author, in certain cases, according to the country's intellectual property law, the authors own the intellectual property on his work (content) or the legal entity at the origin of the work[2] which own the intellectual property (the employer for example). The present IRM data model does not associate the owners of the IPR to a content (work); as shown on the IRM Concept Model (p 42); the IPR are associated to the entity "Shared Educational Resource"; the attributes 6 (Rights) and 6.3 (Description of Rights) of the ICOPER LOM Profile are expected to make this clear, but the fact that the **learning content** entity has no relationship with the entity **Right Holder** creates a problem; of course, Sharable Educational Resources include Learning Content and an entity can have IPR on the Sharable Educational Resources, but it should be clear that the work of an individual or a legal entity is subject to IPR *before and after* it is included in a Sharable Educational Resource.
- Data concerning avatars (n° 3a Art Gallery).
- Data concerning pedagogy or learning theory used (constructivist approach …): the **getteachingMethods** procedure of the IRM API solves this issue; it is not a gap.
- Standardisation of competencies description in relation with EQF (n° 4).
- How to reduce the difficulty associated with the diversity of languages in Europe. (n° 4).
- Data structure of an Electronic Health Record (HER) (n° 6 medical professionals).
- Who is the rights owner for the UoL? (there may be several rights owners, as in n° 11); we have addressed this question above.
- Entity person (see ISO/IEC JTC1 SC36 Actor entity) in relation with entity Role (n° 4).
- Entity organisation (see ISO/IEC JTC1 CS36 institution Entity) (n° 4).

Other Research Themes

- Designing and testing prototypes of systems using competencies description across all sectors.(n° 4 learning speed for SMEs);
- Universal login procedure across a group of organisations that wish to cooperate. (n° 3a Art Gallery); (see above)
- Software to allow visitors to annotate images of artefacts and transfer them to a mobile device; (n° 3a Art Gallery).
- Browsing in 3 dimensions (n° 3b First aid);
- Real time multi-person voice and mail conferencing system on a mobile device (n° 3b First aid);

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1 Eventually allow the learner to download them.

2 We shall not enter here in this rather complex matter; IPR protection varies according to each country's intellectual property legislation. Software is usually owned by the employer, video follows specific intellectual property rules with several owners of rights, etc.

- Research on ontologies for competencies (n° 4);
- Use of technology or methods to learn a foreign language (n° 5 Sarah), what is good research on this topic , how can technology be used intelligently for this purpose; example of a solution already experimented: using computer supported cooperative tools such as instant mail and video-conferencing between students of European higher education institutions from different countries (n° 5 Sarah);
- What kind of knowledge, skills and competencies are acquired more effectively at the workplace and under which conditions (n° 8 Julia);
- In what sense is "social learning" different from traditional learning methods (n° 7 Festo AG);
- Various member states have created organisations (such as technical centres) to reinforce learning in clusters of SMEs; these organisations take care of standardisation processes and professional training in their industry; how can we reinforce their capacity to achieve their goals (n°4 SMEs);
- What new technical centres should be created, why they were not created already; for certain clusters of SMEs, educational institutions provide the service (n°4 SMEs) in competition or in cooperation with these technical centres;
- How to improve support to specific clusters of SMEs in designing learning resources useful for their members.(n°4 SMEs);
- What knowledge, skills or competencies can be acquired through a competence network (n° 8 Julia);
- What are the key knowledge, skills and competencies needed to ensure the success of specific professional tasks (n° 8 Julia);
- The ideological content of technologies and technological "progress applied to learning technologies"; on this topic see, Noble (1997);
- Resistance to technology , and how changes occur in education (see Huberman);
- How to protect digital material from degrading due to disappearance of old equipment and software (not specific to e-learning material !. It is well known that digital material has a much shorter life span than acid-free paper[1]);
- Aggregation level in LO (granularity).

Some additional remarks

Three agencies in Europe have created a Digital Object Identifier (DOI)[2]. It is useful to have a look at the metadata they use for LOs. This should be all the more interesting as, when using the DOI, the LO is linked to a set of metadata that is claimed to be compatible with the main **standards** for communicating and managing digital educational content (**IEEE LOM v1.0** and **SCORM CAM v1.3**).

The ELEONET Metadata profile uses all the LOM metadata + additional ones.

Criteria for gap evaluation and methodological issues

With respect to criteria, some indication of useful criteria comes from stakeholders. A first tentative list of stakeholders is the following:

- authors of pedagogical works,
- instructors,

[1] Most

[2] To our knowledge m-EDRA, Nielsen Book-Data and TIB.

- educational institutions,
- companies and other organisations that provide training and programmes of studies,
- learners,
- publishers of pedagogical works,
- producers of e-learning software or software that has a strong potential to support learning (LMS, on-line course development tools, modelling languages, knowledge based systems),
- providers of e-learning services.

For authors of pedagogical works, the criteria on which they are likely to focus are:

- improvement in learning generated when the difficulty raised by the gap is reduced,
- protection of their IPR (moral as well as economic rights),
- additional revenue[1] generation,
- increased possibility to see their works known, distributed and generating additional revenue (if for example the works use a standard structure - (metadata…- they can be more easily exported and exchanged to other environments).

Instructors who are not authors focus on:

- improvements in learning for students and learners,
- improvements in search for and access to learning resources,
- simplifying their tasks in designing courses and seminars and evaluating learners, given their context of work,

For educational institutions, solving some of the identified gaps could lead to:

- improved management of the production of learning resources (digital or not) ; learning resources are used in many institutions for the evaluation of faculty members by an evaluation committee,
- improved protection for the institution and the faculty members' IPR,
- improved use of learning resources; this can come from :
  - using the learning resources to attract students to the institution by making them accessible on the Web (see for example MIT's open course initiative, many have followed, etc …)
  - using learning resources in proposals for companies in continuous education,
  - re-using learning resources in other institutions of the same group or community.
  - generating additional revenue from the resources (by using them in a larger set of courses, on line or not, exporting them); this is the activity in which institutions such as case studies clearing houses are involved (e.g.: Harvard Case clearing house, …).

For companies providing professional training that closes the identified gaps:

- protecting their IPR is a constant goal in their strategy,
- easier access to good learning resources is essential for keeping a competitive portfolio of services,

[1] Best seller text books generate more income for their authors than their academic salaries!

- improved learning resources are an important factor in their marketing approach because they are an important facet of their training on the products and services they provide,
- enhanced cooperation with universities and industry technical centres.

Learners are interested in the disappearance of gaps, which will help them to:

- speed up their learning process,
- access knowledge and develop their skills more easily,
- access knowledge and develop skills at a lower cost,
- obtain accreditation from what they have learned by structuring and validating their work experience in order to obtain better positions in their organisation.

Publishers of pedagogical works (text books, digital or printed etc …) are interested in the resolution of issues and gaps that will:

- help them maintain or develop their market share; it is well known that standards are a very efficient marketing tool if you succeed in having a sufficient market share to impose your standard.; doing gives you a competitive advantage,
- improve their revenue by providing digital versions of the works or digital extensions (presentation slides, on line courses etc …) that will reinforce the position of the products they sell.

e-learning software providers (on-line courses, business games, simulations,…) are interested in:

- standards that decrease the cost of producing their software,
- the protection of their IPR,
- technical solutions to make products and services running on PCs accessible through the Internet,
- high quality licence contracts with authors.

e-learning service providers are interested in:

- having stable standards to extend their markets,
- having their economic rights protected,
- innovations that reinforce the credibility and efficiency of e-learning courses.

The following table shows the importance of the criteria according to stakeholders.

Table 1: *Relevance of criteria for stakeholders*

criteria / stakeholder	authors	instructors	higher education institutions	other employers	learners	textbook publishers	e-learning service providers
improved learning of knowledge							
improved IPR protection							
increased revenue generation							
extended distribution of author's works							
improved search for LR							
simplified new course design							
simplified management of LR							
increased re-use of LR							
extended attraction on students							

or customers							
improved image of organisation							
increased number of accessible quality LR							
support for cooperation with other institutions							
faster learning of knowledge or skills							
easier access to LR							
extended market of e- textbooks							
decreased cost of producing and delivering LR							
easier migration of e-learning software to the Internet							
provision of licence & rights for LR							
increased level of adoption of the standard (vendors & users)							

5.2.3 Gap analysis: regrouping gaps

The first step of the gap analysis has led to a fairly detailed list of processes and services described in the future scenarios and extracted from them. The study of these processes, services and data (see § 4.2.2 above) has led to differentiate between:

- processes or services that are missing in the IRM and result in gaps or issues,
- processes or services that can be considered outside the scope of the IRM,
- processes or services that are more issues than gaps.

Since similar gaps were describes in the various future scenarios, we have attempted to regroup the gaps that are similar (analogy). We would like to point out some gaps that we consider interesting.

For processes

Sub-process needs analysis

Stakeholder analysis

This activity is described[1] in the list of processes of the IRM as a sub-process of the strategy analysis[2]. It was therefore not classified as a gap. This process can be important since, as one would expect, the criteria used by various stakeholders involved in the definition of the needs are likely to differ. As a result, the design of a programme of studies (or even a UoL) is likely to be missing some key elements if a stakeholder analysis is not performed.

Let's take the case of a small multi-national company that has requested a proposal for training a group of 25 plant/subsidiary managers, regarding some recent changes in their reporting system. The request is forwarded by the Human Resources department of the

[1] Page 22 of D7.1 (15.10.2009)

[2] Page 33 of D7.3a.

company to a higher education institution (HEI). The head of executive education at the HEI transfers this request to the faculty members who are competent in the field of operations and financial reporting, or to the head of the Finance and/or Operations Management departments. The faculty members or the group of faculty members interested in designing this seminar for the company may propose to design an online course to be used as a prerequisite, since it could be the most efficient way to provide a common background to the participants in topics such as reporting, management accounting, information systems, especially when the participants are scattered all over the world.

In such a case, the stakeholders will be:

- the manager who expresses his needs, and especially the unit or individuals who ask for this training; they focus on the experience and competence of the faculty members involved in the seminar (for the line management) and the price (for the Human Resources department);
- the Executive Education department of the HEI that is eager to satisfy this important prospect, especially since this prospect can, if the seminar is successful, become an important customer;
- the faculty member in charge of the seminar who sees an opportunity to work on an interesting topic and to potentially develop valuable new learning resources that could be used on other occasions, if the first seminar is a success; in addition the seminar can be the source of additional resources for the HEI and the faculty members teaching it;
- the heads of various plants and subsidiaries who will evaluate the impact of the seminar on participants and decide, through their evaluation, whether the seminar should be repeated or not;
- the unit in charge of developing on-line courses in the HEI or an outside company providing the packaging of the content into an OLC, which is likely to include content provided by faculty members as well as documents and data provided by the customer company;
- the head of the Human, resources department of the company in charge of selecting the provider for this training.

As can be seen in this example, at least six stakeholder groups[1] are involved in implementing this seminar; the goals and criteria of these stakeholders must be carefully analysed to produce a successful seminar that provides a good balance between the needs and goals of the various stakeholders.

Improving concepts and language to describe and structure learning processes

When facing the problem of designing a programme of studies for a learner, it is necessary first to identify:

- the learner's pre-existing knowledge, skills and competencies,
- the learning goals in terms of learning outcomes.

It is then necessary to select a coherent sequence of learning activities to reach the learning goals. The ability for a human being (instructor, expert) to define this sequence of learning activities involves much knowledge in the specific field. This sequence of learning activities also relies on the use of learning resources (digital or not) in a given learning environment.

[1] In fact, the number is probably larger because at least four or five faculty members are likely to be involved in a week long seminar, and a similar number of competencies must usually be mastered.

There is an important gap between the way such designs are presently made and an ideal process that would be more efficient."

This process of learning and teaching design was identified as a possible gap[1]. One of the difficulties with this process is that the description of a learning process is closely linked with the content to be learnt. In other words, the design of a learning process implies the knowledge of what has to be learnt. It is usually a sequence of activities that implies the use of cognitive functions: concentrating one's attention, observing, memorising, understanding,… in relation with learning resources and/or another person (instructor, coach) who masters the knowledge to be learnt.

Analysis of gaps related to services

The analysis of the gaps regrouped in this category highlights:

Repository functions

The existence of a gap related to advanced search techniques for LO; this gap could be partially bridged by enhanced metadata and search engines.

Search techniques based on keywords or the number of times a learning resource has been accessed do not provide an adequate service to an instructor. He is directed to a multitude of web pages of little interest[2]. The problem is even more acute when the search tries to identify learning resources that have a more subtle meaning, such as study dealing with the "impact of technology on learning". This search usually results in links to texts that contain this sequence of symbols, or where either "technology" or "learning" appears. In fact, the instructor is likely to look for resources with certain characteristics: in a given language, for learners having a given background, a pedagogical presentation based on scholarly research and not on articles from newspapers, etc … The instructor is usually willing to discriminate in his search, but this possibility is not offered to him today.

Learning design functions

Languages to define learning processes and the environment to support them are proposed in the e-learning literature, IMS LD being a prime example. The goal of such languages, when implemented, is to support the expression of any pedagogical approach in the design of UoLs (whatever the level of aggregation) in on-line learning or a blended learning context. The learning scenario is then captured for example as an XML document instance. This is the basis for developing the content, which is derived from pedagogical works of authors.

The demonstration of the relevance of the conceptual framework of such a language and corresponding environment is needed if such languages are going to be adopted by practitioners on a large scale.

Despite interesting examples provided by languages such as IMS LD, it seems that much work is still needed to validate the concepts of such a language and to test their acceptance

[1] It is not a gap in the sense that this process is listed in this category in deliverable D7.1

[2] It is easy to check that for a research on a topic defined by its name, search engines usually provide hundreds or thousands of links to resources, which will be useless since they are not designed for instruction.

among practitioners. While such a language can be considered useful when an instructor is confronted with the task of developing an on line course, it is far more often considered as a burden by the vast majority of instructors *This situation can be considered as a gap and research could be pursued to clarify the benefits of such learning design languages*. The lack of a set of good examples to demonstrate the benefits of such a language to the vast majority of instructors in a given field.[1]. would seem to be a significant contributing factor.

Learning delivery

- assessment,
- cooperation,
- a need in terms of more advanced search techniques or a social network for identifying instructors to develop cooperation; this cooperation could be supported by a social network, but the social network should put the emphasis on professional aspects rather than personal ones,
- licensing,
- a need for standard licensing contracts was identified.

Analysis of gaps related to the data model

One usual argument for the low level of reuse of e-learning material is the lack of standards. Over the years, several such standards have appeared. Jayal and Shepperd make an analysis of 8 standards they consider the most influential in e-learning. The standards they have studied are essentially:

- IEEE (IEEELTSC), which proposes a description of learning objects based on 9 classes of metadata: general (including identifier itself subdivided into catalogue and identifier), lifecycle, metadata, technical, educational, rights, annotation, classification;
- UK LOM, an attempt by CETIS[2] to optimise the IEEE LOM for Educational communities in the UK;
- IMS (IMSQTI);
- ADL: Sharable Courseware Object Reference Model (SCORM);
- OKI: Open Knowledge Initiative (OKI);
- Open archives Initiative Protocol for metadata Harvesting (OAI-PMH), which defines the exchange of metadata concerning Learning Resources between learning resources providers and service providers.

Dubost, Klein, Dang (2004) compare AICC, IMS, SCORM and the standard of a service provider (EduEuro). They analyse the situation with respect to LMS and point out that the level of aggregation of the learning resources and the description of the learning resources themselves varies from one LMS to another.

With respect to the evaluation of standards, one difficulty is probably that stakeholders think in terms of the impact of the standards on the criteria that are relevant for them and for which a tentative list is given in Table 1. As a result, an analysis of the standards has to be made in relation with such criteria:

[1] This is normally the goal of a document like IMS LD Best practice and Implementation Guide.

[2] Centre for educational Technology Interoperability Standards.

In management education, case studies are frequently used and are costly learning resources to create[1]. As a result, authors will be keen to protect their IPR on such resources, since these are the material for the publication of case books and the evidence of their investments in pedagogy. Instructors who are not authors of a case are interested to find case studies corresponding as closely as possible to their teaching needs. As a result, authors will check whether standards allow them to express their IPR on their works used as learning resources. The instructor will be interested to check whether the standard allows him to search efficiently for the case he needs.(criteria of improved search). Therefore, meta-data such as :language, topic of the case, date of production (lifecycle…) will be his focus of interest. Another major issue for the instructor will be the existence of a pedagogical note for the case study. The pedagogical note may be considered as another learning resource. The instructor will be interested in the quality of the standards with respect to metadata such as language in which the case is written, and the quality of the description of the teaching topics of the learning resources. He will check to see whether a pedagogical note is associated with the case study and, most of the time, he will not consider re-using a case study, of which he is not the author, if such a pedagogical note is not readily available or is of insufficient quality. As a result, a standard that does not provide metadata stating whether a pedagogical note exists is of little value to him. In that respect, IEEE-LOM and ICOPER, which do have a metadata subset called "relation" are better suited for this purpose than IMS, which lacks this metadata subset. We would suggest adding the occurrence of teaching note to the list of possible occurrences.

The instructor is also interested in information related to the nature and purpose of the learning resources:

- Is it designed for a presentation of concepts?
- On which learning method is it based?
- Is it a teaching note?
- Is it an exercise?
- Is it the solution to an exercise?

From this perspective, a standard providing more information related to the pedagogical use of learning resources will better fulfil the criteria of facilitating the search for a learning resource with a specific teaching or learning purpose. From this point of view the ICOPER IRM provides more details.

The management of a University is interested in following up the production and use of learning resources by the faculty and in reducing their production costs. It is also interested in using the learning resources as evidence of the quality of its faculty and to improve its image of contributor of knowledge to society at large.

Conversely, an institution can be an important producer of learning resources. In the first case, a university will be motivated to use an LMS that complies with the most widely used

[1] A good case study can require several interviews of people working in a company or several organisations over a period of a year and several successive drafts. The writing of the pedagogical note on the case may be a larger document than the case itself. (from 20 to 40 pages). A typical cost of producing case studies involves the salary cost of the research assistant, of the faculty member supervising the case development, in addition to travel and hotel costs. A cost in the range of several thousand Euros is not uncommon.

standards to import what instructors need. Criteria such as level of adoption of the standard[1] will be important to facilitate the import of learning resources. If a university produces a large number of digital learning resources, it could be important to employ a widely used standard in order to be able exchange or to export more easily its production. A standard is more likely to be successful if it is the result of a joint effort by a large number of organisations, using many learning resources, and if these organisations have an established reputation for the quality of their teaching. It is therefore unlikely that a standard will survive and thrive if it is not supported by organisations that can cover the costs of developing and maintaining the software for the associated educational services. Since most educational institutions do not have this capacity, software companies are often involved in the supporting institutions.

Cooper highlights the many dimensions of standards evaluation. Acceptability of the change by expected users, usability of the tools, match between innovation and the context, goals of the use of the technology.

We would like to stress that innovation in educational institutions is usually of external origin. Hence, innovation is likely to stay when it is adopted by users, in our case instructors, faculty members, authors, learners; as a result, the feeling that they have about the scope of the changes and efforts they have to put up with in order to adapt to an innovation is a fundamental variable. This feeling relates to:

- the perceived complexity of innovation,
- the cost of adopting innovation,
- the ease of communication,
- the personality and nature of the link between adopters and the source of innovation
- the compatibility between innovation and context[2]. (institutional, historical, cultural, political etc …).

With respect to this last issue, we would here remind that the cultural context of a university is not the same as that of a company. What is possible for the introduction of an ERP in a company may not be possible for the introduction of e-learning in universities and there may be good reasons for that.

We believe two issues must be addressed. One is related to the intrinsic value of a standard and another one is its adoption on a large scale. The first issue is related to the fact that improved educational services are developed and judged as such by professionals; the second issue is entrepreneurial in nature and focuses on long term sustainability of software services and products using standards.

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[1] If a university is a member of a consortium of universities or if it is using many learning resources from another educational institutions, it is appropriate to check that the choice of a LMS complies with the standards that are used by the main producer of learning resources or adopted by the consortium.

[2] For example, instructors may be willing to use an innovation like video-conferencing for joint teaching between educational institutions but due to administrative constraints (different course schedule, difficulty to obtain technical support, cost …) they may be led to stop its use.

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The Nielsen Book database, holds 10 million title records, is available to booksellers and libraries worldwide, the service provides sophisticated search and discovery tools to allow these businesses to make informed buying decisions. Nielsen Registration Agencies allow publishers, booksellers and libraries to trade by providing ISBN prefixes in the UK and Ireland, unique SAN (Standard Address Number) and GLN (Global Location Number) identifiers for businesses, and ISTCs (International Standard Text Code numbers) to identify textual works contained in books. For Nielsen the development of each of these standard identifiers has been and will be essential to the efficient trading and supply chain management for both terrestrial and digital commerce.

http://www.eleonet.org/

The **ELEONET** (European Learning Objects Network) project aims to create a **European catalogue** of **Learning Objects (LOs) metadata** accessible by schools, teachers, and students for immediate retrieval and re-use of educational content. Digital educational resources available through the ELEONET **catalogue** will be persistently identified using the DOI (Digital Object Identifier), the international standard for managing any Intellectual Property in a digital environment.

Table 2: *Comparison of 3 standards with respect to subclasses of metadata for learning objects*

		IMS	IEEE-LOM	ICOPER
general	title			
	catalogueEntry			
	language			
	description			
life cycle				
Meta-Metadata				
technical	format			
	location			
educational	learning outcome			
	LRType			
	LRDescription			
	granularity		learning time ?	learning time ?
	prerequisite	?		
rights	IPR			
	cost			
relation				
annotation	instructor		no distinction	
	student			
	peer			
classification				

6 Revision of the Desired State and final visions identification

During May 2010, we revisited the gaps that were identified, from both the analysis of context and future scenarios as well as from challenges and issues identified from the prototype work, in order to generate and produce a small set of visions that would define the outcome based education. These revised visions depicted the desired state for outcome-based

education and involved four short-midterm visions and one long term. Given the timeframe of 10 years it is quite safe to assume that there is a greater uncertainty with respect to the future scenario (the long term vision) and less with regards to the other four more immediate futures. The same implication holds for the coordinated actions of the relevant stakeholders (i.e. near term roadmaps and the development of the ICOPER IRM) and the final recommendations (the long term Roadmaps) which will be developed during the next phase of the Roadmap.

The reason for this re-grouping was that we needed to associate specific standards and specifications to the identified gaps (derived from both the context and future scenarios, as well as from the prototype work) in order to proceed with a SWOT analysis of these standards and specifications and assess their ability to close those gaps. During our London workshop (25-26 February 2010), and in later discussions among ICOPER partners, it became apparent that it was impossible to perform SWOT analysis on a standard or a specification without having a specific context or challenge against which the standard or specification would be evaluated. Usually it is safe to assume that most standards are without technical flaws or weaknesses. So it was imperative to investigate the standard as to its efficiency and effectiveness to close specific gaps, fit for a specific purpose, within a specific context (outcome-based education) and specific challenges.

In addition, specific gaps identified in future scenarios that were related to further research in the field were not applicable in this exercise as by definition current standards and specifications are based on existing state of the art practices. The recommendations for closing such gaps will be more oriented towards future research directions and will be discussed during the final Roadmapping recommendations document.

Each of the 5 visions was formulated as following:

a) a title
b) a short description
c) a list of the associated stakeholders (target audience)
and d) a list of standards that were associated with the vision.

Five visions for outcome-based education were included in a questionnaire which was sent to the experts invited to the Leuven Summit in April 2010. The experts were asked to validate the visions, to identify standards or specifications that were or might be missing from the list and assess their relevance to the outcome-based education criteria. The Experts could also add any other information they thought important or missing. Based on the answers of the questionnaires the visions were updated and became the five sessions of the Experts Summit. (see Section 6 for further details and for the detailed descriptions of the 5 visions.)

6.1 The five visions for outcome based education

- ✓ ***Vision 1:*** Sharing Learning Outcomes – From the Study Programme into the Lecture into the Learner Profile
- ✓ ***Vision 2:*** Sharing Learning Designs: Collaborating around the Design of Courses
- ✓ ***Vision 3:*** Sharing Learning Content: An Authoring Round Trip
- ✓ ***Vision 4:*** The Life Cycle of an Assessment Resource: From the Authoring to the Learner's Personal Achievement Profile
- ✓ ***Vision 5 (future Vision):*** Adaptive Study Programme Design and Delivery

These five visions are described in more detail in the following section. They have formed the basis for the five interoperability scenarios and were evaluated during the "Experts Summit" in Leuven on May 31st 2010.

7 The Expert's Point of View – Leuven Experts Summit

7.1 Objective and Methodology

The ICOPER consortium has identified a number of experts to help evaluate strengths and weaknesses of standards and specifications related to competency-based learning and teaching, both, from a researchers' *and* a practitioners' points-of-view. The conclusions drawn from this activity are summarized in this section.

A meeting in Leuven, referred to as ICOPER "Experts Summit", was organised where a highly interactive workshop style format was adopted. In the pre-phase of the meeting the invited experts were asked to go through a short questionnaire. This allowed us to collect their opinion on the importance of some interoperability issues ***contextualized in the final five, ICOPER-relevant visions we call interoperability scenarios for learning outcome (competence-based) learning***.

Based on their interest in one or the other scenario an expert was assigned to a work group. At our face-to-face meeting that took place in Leuven on the 31st May 2010 we further condensed the findings and conclusions in work groups that were inspired by short introductory presentations on the issues and candidate solutions including prototypes. The experts were asked to carry out a scenario-driven assessment of standards and specifications by evaluating:

- internal strengths and weaknesses of the solution,
- opportunities and threats the solutions create for the stakeholders of an implementation, as well as
- underlying assumptions and alternative solutions.

The assessment documented in the meeting was further analysed using a qualitative text analysis approach following Mayring 2010.

Appendix 2 collects the background material used for implementing this methodology such as pre-phase questionnaire, the list of experts, the analysis template, as well as the conclusions drawn in the various working groups.

7.2 Results

The following section documents the results of the experts evaluation. While the first two sections are devoted to the critique with respect to the ICOPER Reference Model and the evaluation methodology, respectively, the following sections are devoted to the various interoperability scenarios.

7.2.1 Critique of the ICOPER Reference Model

The experts commented that the underlying pedagogical assumptions of the ICOPER Reference Model (IRM) are not sufficiently documented or as one of the experts put it "Learning as main concept of the IRM is missing in the domain model". Some experts

commented that the IRM constitutes an important contribution to the field. However, the IRM's underlying focus on education and the teaching perspective of learning needs to be made more explicit. Other experts recommended to focus more on the (independent) learner and to improve the linkage between the models presented and the cognitive processes on the learner side.

The experts also emphasized the transformative effect of outcome-based learning, stressing that such a way of teaching and managing higher education has profound impact on the European Higher Education Area. The experts recommended that this transformative effect and accompanying measures required for implementing outcome-based learning shall become part of the reference model.

The critique by the experts also emphasized the importance of assessment in an outcome-based higher education area and recommended that the IRM needs to provide some answers with respect to the linkage between assessment and learning as well as assessment and learner's achievement profiles, respectively.

7.2.2 Methodology Critique

Instead of trying to evaluate standards and specifications without any context, the ICOPER group applied a scenario-driven approach (see Section 5: Revision of the Future State and final vision identification). The experts appreciated this approach. One expert commented "Evaluating standards is a fuzzy subject, since evaluating standards is hardly about identifying 'broken' standards, but rather to evaluate whether they are capable to serve a need".

"A scenario-driven approach", so one of the experts, "puts a standard in the context of a need". Hence, a scenario-driven approach is a first step for charging the usefulness of a standard or a specification. However, our experts also commented that the feedback from the people working with the standard – in most of the cases: developers – also need to be considered and constitutes an important source for improvement.

Some experts believe that "the market" addresses the evaluation question to a large extent. Broken standards – i.e. standards that have significant flaws – do not survive on the market. Beyond being flawless, it also seems to be important for a standard's success to solve a relevant issue efficiently and effectively. ICOPER is advised to focus on standards and specifications that fulfil this requirement.

7.2.3 Vision 1: Sharing Learning Outcomes: From the Study Programme into the Lecture into the Learner's Achievement Profile

This first scenario is based on the key concept "Learning Outcome" that is described as follows:

> Learning Outcomes refer to statements of what a learner knows, understands and is able to do on completion of a Learning Opportunity (European Commission 2008). "The student is able to list a number of learning technologies and their properties." is an example of a Learning Outcome. The ICOPER Project is concerned with the interoperability of Learning Outcomes, for example, when Learning Outcomes are provided for re-use in the planning of courses, i.e. the creation of Learning Designs, or when students after successful completion of a course aim at including these Learning Outcomes in Personal Achievement Profiles.

Target audience involved in this scenario:

- Programme Director (where required to design study programmes)
- Faculty (to prepare the courses)
- Learner
- Third party (in order to identify a learner's obtained learning outcomes

Standards and specifications relevant for this vision:

After the expert evaluation the following standards were identified as relevant to this scenario (the standards in italic were added by the experts):

- IEEE LOM and Profiles
- DC and other specifications concerning metadata
- IEEE RCD and Profiles
- Personal Achieved Learning Outcomes - PALO (ICOPER Draft Specification)
- ICOPER Middle Layer Specification
- *IMS LODE (ILOX part)*
- *Vocabulary standards: CEF, SKOS, ESCO and other ways of expressing vocabularies*
- *Various portfolio specifications*
- *Curriculum Exchange Format*

The summary of the results from the a SWOT analysis can be seen in Table 3:

Table 3: *SWOT summary of vision 1: Rapporteur G.S. Csanyi*

Strengths of Proposed solution	**Weaknesses of proposed solution**
o Transparency and portability across sectors (HE, employers) o Learning outcomes can be attached to different documents (e.g. Europass, diploma supplement …) o Large set of data used for testing specifications and services o Achievements (Achieved learning outcomes) are personalized and can be collected over lifetime period across institutions	o Missing guiding principles how to use the data model (link to VIRQUAL) o Semantic relations between learning outcome definitions (IEEE, RCD) o Even if it is principally possible learning outcomes cannot describe all competences of a person according to the current development o Unsolved problem: When learner leaves university – who holds his/her data o Some tools are not user friendly (e.g. GLM)
Opportunities for implementers	**Threats for implementers**
o Bologna process / EQF (2012!!!) o Integration with existing projects (IEEE, ACM) o Economic crisis	o No necessity to apply ICOPER solutions at the moment o Mind set of concerned persons: input based – and not outcome oriented o The shift from teaching to learning is (only) a top-down initiative o Lack of widely used taxonomies for competences and relevant vocabularies (crucial for translations)

Eleven out of the 18 experts participating in the pre-meeting evaluation (61 percent) considered the interoperability issue described above as relevant in the context of a higher education institution. However, our experts also commented that this interoperability scenario tightly connects with the Bologna process and can therefore also be considered as a political

or governance issue. This concludes that interoperability of learning outcome definitions shall be

a) integrated into the bigger picture for example by linking it with ECTS or the European Diploma Supplement
b) carefully presented in order to avoid that the good ideas of introducing learning outcomes into higher education are rejected because of associations with negative effects related to bad practice implementations of the Bologna ideas.

It has become apparent that the Bologna process constitutes, both, an opportunity and a threat for the ideas put forward by the ICOPER consortium. Interestingly, the economic crisis was also mentioned as a positive driver for the need for a quality assured learning process on the higher education level.

Although outcome-orientation has a clear strength when it comes to increasing transparency of higher education and portability across sectors (e.g. higher education, employer market), our experts question whether academic institutions are ready for outcome-based learning. An important prerequisite for this "readiness" is related to university managers and politicians awareness of the concept of learning outcomes. The mind-set of the people in charge – also including faculty – is still quite focused on the input (i.e. what will be thought) rather than being focused on the results (i.e. what will a learner be able to do after she took the course). Changing things on that front most likely requires a top-down initiative.

Therefore, experts questioned the necessity for higher education institution to adopt ICOPER solutions. Or as one expert put it, learning outcomes are "more than an interoperability problem", an observation that has been nicely summarized by another expert as follows:

> "Frameworks [of Learning Outcome Definitions] are valuable in being formalised statements made by one person or organisation about another person's ability to perform a task in a context. Because they are explicit, they are also (potentially) negotiable and subject to democratic control (in my view a good thing). Clearly learning objectives are also important in managing courses, and learner's participation. But I am not enthusiastic about restricting education to 'has attended course, has passed, therefore has obtained such and such a learning outcome'. It is not so easy to look inside people's heads. The danger is that there can be a slide into reducing education to that which can be easily defined and calibrated, and of a tick box approach to learning. … So, yes, [the discussion around Learning Outcomes are] highly relevant, but not the whole story."

Our experts emphasized the importance of quality standards for learning outcomes. One expert commented: "I can see two problems with this kind of learning outcomes: 1) they tend to become too general and 2) they tend to miss tacit knowledge and knowledge that can be considered to be a part of a 'hidden curricula'. It is very hard to make those definitions detailed enough in order not to miss important aspects and in a way that says what skills the student has 'really' acquired.". Hence, it is of paramount importance to provide educators with a good guidance on how to design learning outcomes. Such design principles are for example developed by the VIRQUAL Project (http://virqual.up.pt/).

On a more technical level, the experts commented that important semantic links between learning outcome and related concepts such as achievement, context, and learning design has been introduced by the work of ICOPER – a link that has not been there in standards such as

IEEE RCD. Incorporating standards like SKOS into PALO has also been identified as a good solution for expressing relations between learning outcomes.

On a conceptual level a reviewer recommended to differentiate between learning objectives and learning outcomes. While learning objectives are intended learning outcomes, learning objectives are used in the planning phase, such as in a curriculum document, a course description or a syllabus.

ICOPER is investigating the possibility to attach learning outcomes to different types of documents (e.g. diploma supplement). Our proposed solution allows learners to personalize and collect learning outcomes over a lifetime – even across institutions. All this was clearly identified as a strength of the ICOPER results. Experts were further impressed that we already have a large set of data that can be used for testing our ideas. However, some technical problems still remain, for example, when it comes to providing a persistent storage of learning profiles or the development and adoption of common taxonomies for learning outcomes.

7.2.4 Vision 2: Sharing Learning Designs: Collaborating around the Design of Courses

We investigated a scenario around the key concepts “Learning Design” and “Teaching Method” that was described as follows:

> A Learning Design is a re-usable representation of a concrete Learning Opportunity. A Learning Design arranges Teaching Methods, Assessment Methods, Learning Content and Learning Tools towards Learning Outcome attainment. A sketch of a Learning Design can for example be described as follows: "After taking this course a student is able to list a number of learning technologies and their properties. In order to achieve this learning outcome we will ask the students to attend a presentation on learning technologies that will also include some demos. After the presentation the student will be confronted with a short test."
> In the context of such a scenario ICOPER aims at facilitating collaboration around Learning Designs starting with the creation of Learning Designs out of respective Learning Opportunities, the sharing of Learning Designs as well as finding peers based on Learning Designs.

Target audience involved in this scenario:

- Programme Director
- Faculty
- Learner

Standards and specifications relevant for this vision:

After the expert evaluation the following standards were identified as relevant (the standards in italic were added by the experts):

- IEEE LOM and Profiles
- IEEE RCD and Profiles
- IMS Learning Design
- Personal Achieved Learning Outcomes
- PALO (ICOPER Draft Specification)
- ICOPER Middle Layer Specification

- *SCORM Sequencing and Navigation*
- *Curriculum Exchange Format*

The summary of the results from the a SWOT analysis can be seen in Table 4:

Table 4: *SWOT summary of vision 2: Rapporteur Dai Griffits*

Strengths of Proposed solution (IMS LD)	**Weaknesses of proposed solution**
Interoperability strength: o you can make a description of a learning activity which is abstract and interoperable. You can share this, and if you know the specification you can understand it *Strength of specification capabilities:* o The specification is open, and can link to other specifications. o Can create adaptive learning flow, and orchestrate activities. o The specification is powerful. It can describe prerequisites, learning objectives (and outcomes, using properties) and a learning activity (includes roles and differential learning activities). o The elements of IMSLD are understandable by teachers, and relevant to describing a teaching method. Using applications is another question! *Strength in tools:* o There are a number of tools available.	*Weakness in conception of scenarios:* o One of the roadblocks is not just the tools, but more understanding of scenarios where IMS LD could be beneficial. The IRM has an ex cathedra feel, restricting scenarios. o IMS LD gives the teacher no possibility to explain how and why a learning design should be used in a particular educational context (reverse of the "abstraction" strength). You could use metadata on the UOL for this, but you really need an additional document for this. *Weakness in supporting practice:* o The teacher is personalising learning at runtime, especially in schools. o You can't capture the tacit knowledge about how teachers use a learning design *Weakness in tooling:* o Tools are a problem. Link to runtime is essential. The specification is complex to implement, and you can't start with a small implementation. It is not easy to create a system which is generic, but also useful for individual institutions. But there does not seem to be any problem in principal.
Opportunities for implementers	**Threats for implementers**
Opportunities in pedagogic management: o A description of the teaching method which learners can comment on makes it possible for learners to provide feedback which can be acted on. At the moment the feedback cannot be systematically acted on. A systematic description of methods could be helpful. o Could be a knowledge base for an institution which manages its pedagogy activities. *Opportunities in Communication:* o Aha, that's the way you are teaching that! We need to encourage that. o Communication and evaluation can be enhanced if the learner can participate in course design, though we don't know how it can be done in practical terms. o Could be a communication tool between study programme managers and teachers. And between teachers and teachers "in this position in a class, how would you handle this..." *Opportunities in Design:* o Could the learner be involved in the design. University of Plymouth they are involved in the assessment process definition. Two experts said learners should be included in the target audience. o The system could record teachers changes to a learning	*Threat from complexity* o iClass tried to implement IMS LD, but it was not suitable. The teachers needed something simpler, as a planning tool, just a word document. This is a function of the regulatory framework. o Nevertheless the problem of the tools has been going on for many years. The tools have some dangers but we can use them for the way of thinking about learning. *Threat from non-applicability to face to face practice* o Institutions don't see a need to describe their learning activities in an abstract way o We have the assumption that you take the ideal scenario, outcomes, teaching method then you end up with an ideal learning process. It is not true. o The type of class is important. Using a learning outcome approach we can leave freedom for the teacher, where appropriate. In some cases we need to make it clear how it is done. How do you get "critical reflection"? o How do we get the context into a tool for decontextualising. Teachers think of pedagogy in terms of curriculum contents and specific learners.

design and create a new one. o In HE teachers mix and remix materials, in school teachers use lesson plan sharing sites. IMS LD could facilitate this. o Our teachers ask for templates for lectures, seminars, etc. Our administrators ask for control. *Opportunities in Professional practice:* o Teachers need to get descriptions of teaching methods they could choose. Most teachers just do anything and they are not sure if what they are doing is good. They need to know that what they are doing is good or appropriate. o Teaching needs to be a career and valued, but we have no evidence of what teachers are doing in the classroom. o Using IMS LD / learning design approach you have to make an informed decision about your teaching. o The unintended consequences of the tool are upskilling the teachers, even if they don't use the school. *Opportunities in strategy:* o Unless we can represent what teachers do better, they are in a vulnerable position o We need a process description, or we will have a skewed picture of education. Outcomes and documents. o use IMS LD to create self study units, and institutions focus on tutoring, learning support, certification.	

Nine out of the 18 experts participating in the pre-meeting evaluation (50 percent) considered the interoperability issue related to sharing and reusing learning designs as relevant in the context of a higher education institution.

Creating and sharing learning designs is all about "creating more flexible and effective learning activities", often mediated by computers, and modelled in an interoperable format.

The potential benefits of this approach are:
a) more effective teaching
b) more sophisticated orchestration of learning activities
The experts' assessment of this scenario is very much related to IMS LD, which has been described as "clearly powerful, clearly has potential applications, and clearly is not being used".

In particular, IMS LD gives - so our experts - the teacher no possibility to explain how and why a learning design should be used in a particular educational context. One of the roadblocks is more understanding of scenarios where IMS LD could be beneficial. The IRM shall not restrict those scenarios. Ideally, these scenarios also address one of IMS LD major weaknesses successfully, namely the separation of design time (i.e. before the course) and run time (i.e. during the course delivery). In practice, teachers are personalising learning designs at runtime – and a lot of implicit knowledge is involved here. Processes around the creation and delivery of learning designs should put a particular emphasis on developing strategies for partly capturing this implicit knowledge, both, on run-time and design time.

Our experts also differentiated the institutional from the individual perspective in this context. For example, a repository of learning designs could constitute a unique knowledge base for an institution, which effectively manages its teaching activities. At the same time a description of

the teaching methods, which learners can comment on makes it possible for learners to provide instructors with feedback, which can be acted on – even already in the design phase.

At the moment the feedback cannot be systematically acted on; a systematic description of teaching methods could be helpful. Besides the institution and the learner, faculty development would benefit from a peer learning that is supported by making teaching methods and learning designs transparent, e.g. in a lesson plan style. This would also include the documentation of changes made, especially changes done in run time. In theory, such a development could serve, both, instructors that ask for templates for lectures, seminars, etc. and an institution's administration that asks for more transparency "evidence of what teachers are doing in the classroom".

Improving the documentation of teaching constitutes an important prerequisite for enhancing the value assigned to teaching in higher education institutions. At the same time, the introduction of learning designs would require instructors" to make an informed decision about one's teaching". This could result even in an "up-skilling" of instructors or as one expert put it "We need a process description, or we will have a skewed picture of education: outcomes and documents [only]."

With respect to the technical capabilities provided by the predominant standard IMS LD, experts have different points of views. Some experts stress IMS LDs unique capabilities for describing learning activities. Particular strengths of IMS LD are:

- The specification is open, and can link to other specifications.
- The specification supports the creation of adaptive learning flows, and orchestration of activities.
- The specification is powerful. It can describe prerequisites, learning objectives (and outcomes) and a learning activity (includes roles and differential learning activities).
- The elements of IMSLD are understandable by teachers, and relevant to describing a teaching method.

On the other hand, some of the experts are not convinced that IMS LD is the right instrument for achieving interoperability of learning designs, since they consider the specification as too complex for really attracting the targeted audiences.

IMS LDs complexity could be hidden in the right tools supporting (simplified) application profiles of IMS LD. However, "the specification is complex to implement, and you can't start with a small implementation". With the target audiences in mind there is a need for tools that are both flexible and really easy to work with. At the tools front, the link between design time and runtime seems to be essential in order to support the complete picture.

Our experts recommended that on top of all the technical work done in the context of the IRM (especially metadata), guiding principles on the use of learning designs could be helpful. At the end – especially in traditional higher education institution that value the freedom of teaching – the issue remains that "learning designs are seldom formalized and there seems to be little tendency to change this". It looks like that, at the moment, only some institutions and their faculties start to see a need to describe their learning activities in an abstract way, for example, as part of their quality management activities.

However, maybe the guiding principles mentioned above might have the potential to change this. There it should be addressed how an approach that is all about de-contextualization, also takes context into account – especially during design time. In addition, teacher education might be an appropriate field for a break-through, since it seems that many instructors are still not highly aware of a concept such as "Learning Design". Teacher education also seems to be important with respect to addressing the natural limitations of this scenario, which is tied to the fact that even the best learning design does not guarantee excellent education. On top of all this, our experts agreed that a cultural shift that would value teaching and reward sharing of teaching expertise (e.g. via learning designs) would maybe also be required.

7.2.5 Vision 3: Sharing Learning Content - An Authoring Round Trip

We investigated a scenario around the key concept "Learning Content" that was described as follows:

> Learning Content refers to any digital and non-digital material that can be used in Learning Opportunity such as a course. An example of a Learning Content is a PowerPoint Presentation providing an overview of existing learning technologies. ICOPER aims at facilitating the sharing and re-use of Learning Content.

Target audience involved in this scenario:

- (Institutional) Content Providers
- Programme Directors (responsible for a standardize programme delivery)
- Faculty
- Learner
- eLearning Support Units
- Libraries

Standards and specifications relevant for this vision:

After the expert evaluation the following standards were identified as relevant (the standards in italic were added by the experts):

- IEEE LOM and Profiles
- CEN SQI
- CEN SPI
- OAI PMH
- ICOPER Middle Layer Specification
- *Dublin Core,*
- *ISO Metadata for Learning Resources (MLR)*
- *IMS QTI*
- *Various packaging specifications: Common Cartridge, CC, SCORM etc*
- *Tools Interoperability, Mash-ups, SRU, SWORD, OpenSearch, ATOM, RSS, SOAP, REST*
- *Specs. related to vocabularies, taxonomies etc.*
- *IMS LODE*
- *CEN Interoperability of Registries*

16 (89 percent) out of the 18 experts participating in the pre-meeting evaluation considered the interoperability issue described above as relevant.

The summary of the results from the a SWOT analysis can be seen in Table 5:

Table 5: *SWOT summary of vision 3: Rapporteur Phil Barker*

Strengths of Proposed solution	**Weaknesses of proposed solution**
o Middle layer abstraction: o Service independent from standard/protocol o Standards used are widely implemented in TEL o Domain	o We use "niche" standards
Opportunities for implementers	**Threats for implementers**
o We use web 2.0 hosts o Expose services in way that remains compatible o With web 2.0	o Target audience use web 2.0 hosts, not ICOPER

In ICOPER we developed a middle layer API for connecting various kinds of repositories and tools in order to share content. Our experts explicitly mentioned this as a strength contributing to the sustainability of such a solution, since the solution abstracts from specialized protocols. At the same time, it was further emphasized that the middle layer's underlying standards are widely implemented in the technology-enhanced learning domain. However, they are still considered to be niche standards although ICOPER is partly relying on Web 2.0 'host standards'.

The experts therefore recommended to remain connected to or to improve the interoperability with the Web 2.0 world. Have a look at "Web-wide" standards and thinking about using them to create interoperable repositories and tools is the way to go according to one of our experts. This expert further recommended to keep a close eye on quasi-standards (i.e. well-documented, widely adopted APIs) and to assess such specifications with respect to their potential for improving interoperability also in the technology-enhanced learning domain. One of the experts emphasized that content and learning design needs to be brought together, since "The teacher does not think in terms of learning content but in terms of courses or units of learning. Interoperability should be achieved by means of […] different instructional templates, from simple behaviourist models to more complex collaborative, constructivist models."

7.2.6 Vision 4: The Life Cycle of an Assessment Resource: From the Authoring to the Learner's Personal Achievement Profile

We investigated a scenario around the key concept "Assessment Resource" that was described as follows:

> An Assessment Resource is a special type of Learning Content used for the assessment of a learner's learning activities, thus stimulating some kind of interaction or reaction by the learner. An Example of an Assessment Resource is a test question such as the following: "What is typically used for training high-level skills such as flying an airplane? ( ) Simulations ( ) Talent Management Systems ( ) Assessment Tools ( ) Authoring Tools"

Assessment Resources are authored by using all kinds of authoring tools and deployed by learning management systems or other Learning Tools. Based on the Assessment Resource a normalized Assessment Record is created, which provides evidence for a learner's Achievement.

Target audience involved in this scenario:

- Faculty
- Learner
- Mobility managers (in charge of ERASMUS and other exchange programmes)
- Management (responsible for the accreditation of student records)

Standards and specifications relevant for this vision:

After the expert evaluation the following standards were identified as relevant (the standards in italic were added by the experts):

- IMS QTI
- IEEE LOM and Profiles
- CEN SQI
- CEN SPI
- OAI PMH
- ICOPER Middle Layer Specification
- *IMS Common Cartridge*
- *IMS LODE*

The summary of the results from the a SWOT analysis can be seen in Table 6:

Table 6: *SWOT summary of vision 4: Rapporteur Adam Cooper*

Strengths of Proposed solution	**Weaknesses of proposed solution**
o Open, non-proprietary o No obvious competitor o Embeddable (CP, LD, …) o Disaggregatable o Suited to dispatch to specialised engine	o Some benefits of v2.1 but existing base of v1.2, e.g. usage metadata, templates o Implementers easily fail to cover variations
Opportunities for implementers	**Threats for implementers**
o Joint assessment (x-faculty) o Exchange between Universities o Self-assessments o Specialised authoring tools	o Diverse existing implementations o Generalised author tools hard to use (manifestation of spec complexity?)

13 out of the 18 experts participating in the pre-meeting evaluation (72 percent) considered the interoperability issue described above as relevant in the context of a higher education institution. The interoperability of assessment resources seems to become increasingly important as content becomes more and more interactive. At the same time assessment resources play a crucial role when it comes to the accreditation of student achievement records. However, the exchange of assessment resources seems to be much more realistic in the current organizational context than the exchange of normalized assessment records,

according to one of our experts. Since assessment is considered to be the key mechanism of quality control in higher education, interoperability on the process level will be difficult to achieve.

Exchanging assessment resources creates new opportunities for higher education institutions such as carrying out joint assessment or separating the development effort between universities, faculty members, and publishing houses.

However, all these benefits are threatened by a diverse set of existing implementations creating proprietary variations. Since implementers seem to fail to achieve specialized implementations that remain compatible with a standard model, interoperability is at risk. On the other hand, interoperable, generalized authoring tools are too complex to be used at the moment (due to the complexity of the underlying specification).

Our experts analyzed the interoperability scenario from the point-of-view of IMS QTI and assume a similar scope of functionality to be addressed by ICOPER.
With this in mind the ICOPER solution bears the following strengths:

- Open, non-proprietary
- No obvious competitor
- Embeddable (e.g. in IMS CP, IMS LD)
- Disaggregatable
- Suited to dispatch to specialised engine

7.2.7 Vision 5 (future vision): Adaptive Study Programme Design and Delivery

A Study Programme is a definition of an educational offer that aims at the development of a set of Personal Achieved Learning Outcomes that are aligned with learning requirements from job profiles or society as a whole. Study Programmes are described via a set of Learning Outcomes. In this scenario we assume that Learning Outcomes are strongly inspired by Job Offerings.

In this scenario, we envision technologically-support for identifying relevant learning outcomes based on job profiles and job applications. We foresee that interoperability between CV authoring environments, electronic job markets, Study Programmes, and Learning Opportunities focusing on the Learning Outcome artefact, which is developed, shared, and reused in all the different applications.

Target audiences involved in this scenario:

- Programme Director
- Faculty
- Learner
- Third party

Standards and specifications relevant for this scenario:

- IEEE LOM and Profiles
- IEEE RCD and Profiles
- Personal Achieved Learning Outcomes
- PALO (ICOPER Draft Specification)

- ICOPER Middle Layer Specification

When we started to analyse this scenario we took a different approach from the other four interoperability scenario groups in the sense that we had to redefine the issues addressed in this scenario along 2 perspectives: a) a short term perspective (vision) and b) a long term perspective (vision). First we had to understand two things: a) how the standards could help in such scenario and b) who are the third parties involved. The Experts agreed that this scenario addresses different stakeholders with very different motives and requirements. In some cases, these different motives could also appear to be in conflict and even create some tensions among the stakeholder groups in terms of what is important for competency-based learning.

For example, ***the industry*** as a stakeholder group is more concerned with more efficient matching of job offers and employee profiles. Therefore, interoperability standards between CVs and job offers are important. Companies would benefit from Multilingual vocabularies for competencies, especially in large, multinational corporations. The current state of the art seems to provide "too little matching, too late". Improved business intelligence frameworks for tracking needed competencies are needed. (e.g. APTS in Learning project).

On the other hand, the question that we need to ask is: should ***higher education*** be led by industry or should education create the leaders that create the job offers of tomorrow? There is a tension here in the sense that education should train European citizens for mobility and reskilling with a focus on continuous adaptation to day to day changes in the current job market and therefore sustain their employability, but on the other hand, education should also educate the leaders of tomorrow who will shape society and business, and lead tomorrow's innovations, by putting the emphasis on humanities, rather than technical skills.

In addition, ***European citizens*** as learners need to be educated and trained to cope with the challenges of changing world and society. Today society faces a problem of having many overqualified degree holders with no jobs. Therefore, learners need to be able to increase their employability and resilience. They need to be educated in entrepreneurship on how to create their own business, and companies. The impact of social networks and communities of practice will also influence the hiring and firing, therefore, training in creating, operating and manage these networks is also very important for the citizen's future employability.

The above analysis leads us to the following understanding: *s*ociety is facing important challenges and programme of studies need to breed leaders who can face and resolve these challenges. It would be a mistake to design a programme of studies based only on today's job descriptions. On the other hand, higher education has to look at harmonization and find a common framework for increasing learner's mobility and their relevance to the market offers. Existing frameworks for professional competences are already developed for the industry. The same approach could be taken by Higher education. Industry does this on a yearly basis. This information is sensitive but Universities should be a partner in those discussions, e.g. Second skills councils in the UK, IPTS (ipts.jrc.ec.europa.eu), ESCO (www.destree.be/esco/report.pdf)

The two visions for this scenario: a Long term and a short term vision

This analysis also leads us to define 2 visions for Higher Education related to its role for competency-based learning: A short term vision and a long term one.

1. **Short term vision:** in the short term, helping HEIs and industry express learning outcomes jointly would make the job market more fluid and address issues such as:
   - ✓ Increasing number of overqualified graduates with no jobs
   - ✓ Add business intelligence to employers; make an analysis of professional career paths, in business in HEIs
   - ✓ Need for one joint Semantic space for National qualifications: Industry speaks the same language as Higher Education; learning outcomes should be understood in the same way by HEIs and companies
   - ✓ Provide learners with feedback, about study programme, about career path
   - ✓ Students need consulting services to help them make decisions, evaluate their personal paths against existing professional paths. Provide information for students to reflect on. Need raw data now coming from industry available. Provide access to raw data, not edited data: statistics.
   - ✓ Machine scan data about profiles on the web
   - ✓ How to certify what learners have learned? Need to produce evidence records

2. **Long term vision:** HEIs provide the leaders who will shape the jobs of tomorrow and face the big challenges of the future. Social networks and communities of practice will complement this goal.
   - ✓ Set up a context to learn, to be flexible and adaptive (need for adaptive learning designs)
   - ✓ Need to set up a flexible study programme
   - ✓ University programmes need to adapt to learners desires
   - ✓ Focus on long-term employability
   - ✓ Big challenges should be the responsibly of HEIs

Concrete examples of future challenges:
- ✓ Climate change and pollution problems
- ✓ Conflict control
- ✓ Fight against organised crime identification
- ✓ Economic shifts and economic crisis avoidance and management
- ✓ Financial sector crisis and, in general, market control
- ✓ Debt control
- ✓ Shifting to renewable energy sources
- ✓ Societal values (justice, freedom of expression, equal chances for all citizens, social protection, etc..;)
- ✓ Maintaining bio-diversity
- ✓ Aging population and health care
- ✓ Quality of life: pollution control (air, water,…) , quality of food, obesity, culture,
- ✓ Protection of private data, democratic life and citizens rights
- ✓ Managing European integration

Remarks on the list of standards that are provided in this scenario
Some standards are missing in areas such as identity and access management standards that provide access control to personal information. Although we need to generate a personalised profile (or CV) according to job offers, we need at the same time to protect privacy. Employer should be able to have access to this type of information. With degrees it is easier, since the data belongs to the university and can be checked. We also need standards for checking

employee's record. (e.g. Trusted Architecture for Securely Shared Services http://www.tas3.eu/). Finally, other standards besides PALO should be added to cover education and professional evidence such as HR XML, Friend of a friend, FOAF, RDFA, Xri, Xdi etc. Link data based on RDF could also be an approach. We also need to point that most of the standards in the updated list are *syntax standards* and the difficulty of the task at hand is that *the problem is related to semantics*. In a sense that, most of the definitions of the attributes of the concepts uses are made in natural language and need to be read and cannot be processed automatically. There is no shared vocabulary.

Regarding EQF: We believe that this standard fits better for creating harmonization of levels for Higher education. (Normalization level). In order to achieve our visions, a bottom-up approach is also needed for defining and describing competencies. Definitions should be public and external to the application. We need also to establish URIs for each competency. We already have noticed that there is a problem of common understanding amongst universities and what is required in the learner's professional life. External definitions facilitate shared understanding of competency descriptions. For this, we need to put competency descriptions in a repository and reuse definitions when they fit, or modify or create new ones as needed. A major precondition would be access to raw, unedited data. OKKAM technology could be used for achieving this.

Regarding IMS-LD: IMS –LD should be called Teaching Design instead of Learning Design since it is focused more on the set-up and collection of information. In order to implement the long term vision (which no longer implies a single study programme anymore but requires an adaptive and more flexible study path), we need to move toward a self modified learning design and help the learner who is a self-directed learner on how to organize their learning, their sources, networks, information, assessments, information etc. This implies the use and development of standards for a Personal Learning Environment. In this sense, the LD and PLE should be connected.

Summary of SWOT analysis for Scenario 5: Rapporteurs (Michel Klein, Katherine Maillet)

STRENGTHS of the proposed solution:

- Syntactic interoperability, interoperability between CV and job offers
- EU-wide uptake of PALO could support business intelligence frameworks to track needed competencies and support more efficient matching of job offers and employee profiles: Example Employability Platform Limbourg.

WEAKNESSES of the proposed solution:

- Using PALO could have long-term weakness. HEIs should train leaders of tomorrow who will shape society and business. Society is facing important challenges, programme of studies need to generate leaders who can face and resolve the challenges: Climate change, Economic shifts, Societal values, Maintaining bio-diversity, Aging population, Quality of life: obesity, culture.
- It would be a mistake to design a programme of studies based on today's job descriptions.
- Education should train European citizens, train for reskilling, mobility.
- Programmes in HEIs should be flexible, train citizens to cope with challenges of changing world and society. Standards could introduce rigidity in the process.
- Learning outcomes are just one form of evidence. Competences should be complemented by evidence records (link to university diploma, employer records,

social networks and communities of practice), example: QCF (Qualifications and Credits framework) from UK
- Students should be able to make academic and career path decisions based on the experience of others: machines can scan web profiles http://www.okkam.org/ to support decision making: Feed-forward rather than feedback.
- Most of the standards are syntax standards and the difficulty of the task is that competency mapping is related to semantics.

OPPORTUNITIES for implementers:
- Symmetrical system where individuals can easily change role from employee to employer.
- Problem of over-trained citizens with no jobs, recent graduates need training in entrepreneurship to create companies as a solution limited job opportunities
- PALO can be a brokerage service for clients, employees, and employers.
- Promote a common understanding of competency definitions amongst institutions of higher education and adapt a common framework, building on and enhancing ECTS.
- Multilingual vocabularies for competencies can facilitate competency matching across borders and for multi-nationals.
- PALO could contribute the Bologna process by introducing a means to harmonise ECTS and/or Diploma Supplement
- Promote a common understanding of competency definitions amongst HEIs and industry and adapt a common framework. Examples: http://ipts.jrc.ec.europa.eu/, http://www.destree.be/esco/report.pdf.
- Should be associated with HR XML, FOAF, RDFA Xri, Xdi, Link data based on RDF.

THREATS for implementers:
- Should higher education be lead by industry or should education create the leaders that make the job offers.
- PALO may never really be adopted.

References

– Mayring, P. (2010), Qualitative Inhaltsanalyse - Grundlagen und Techniken. Beltz, Weinheim.

8 Relevant LET[1] standards

The following section presents a short overview of standards in the ICOPER project. Please note that not all of these standards have been evaluated during the expert summit (previous Section 6). The reason for this was that they were not deemed relevant to the scenarios used for the evaluation. If the scenarios used had been different other standards would have been evaluated. Nevertheless, these standards were taken into account and investigated by the consortium within the ICOPER WP1-7 work and were referenced in the respective ISURE documents.

1 LET – Learning, Education and Training

8.1 ICOPER standards

OpenID
URL: http://www.openid.net/
Description: OpenID is a shared identity service, which allows users to log on to many different web sites using a single digital identity. The specification is still in the adoption phase and is becoming more and more popular.
ICOPER relevance: OpenID for the Open ICOPER Content Space. The ICOPER content space is meant to act as a gateway to the different repositories operated by the members of the consortium.

Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH)
Url: http://www.openarchives.org/pmh/
Description: OAI-PMH is a low-barrier mechanism for repository interoperability.
ICOPER relevance: OAI-PMH will be investigated as the base for replicating learning object metadata from the content providers to the ICOPER content space.

Simple Publishing Interface (SPI)
Url: http://ariadne.cs.kuleuven.be/lomi/index.php/SimplePublishingInterface
Description: SPI is meant to make it easier for content developers to publish work into content repositories, and at the same time introduces a new approach to the exchange of information between repositories.
ICOPER relevance: Since the aim of the Open ICOPER Content Space is to integrate as tightly as possible the resources provided by heterogeneous content providers, it will become the testbed for a reference implementation of SPI and thus contribute to its adoption as a CWA

DOI/OpenURL
URL: http://www.doi.org/ and http://www.oclc.org/research/activities/openurl
Description: The DOI or Digital Object identifier is a unique identifier given to a scientific publication. The DOI system provides a framework to: manage content and metadata, and links content providers with final users.
OpenURL is a standard that, by using a Uniform Resource Locator (URL), provides an easy resolvable link for resources from a library service. Currently, it is most heavily used by libraries in order to connect users to subscribed content..
ICOPER relevance: Resources published in the Open ICOPER Content Space need to be associated with a persistent identifier, in order to permit the use of the Open ICOPER Content Space as a reliable gateway. We will investigate all existing standards for defining identifiers, such as DOI and OpenURL.

XML Schemas of Human Resource XML (HR-XML)
URL: http://www.hr-xml.org/
Description: A standard suite of XML specifications to enable e-business and the automation of human resources-related data exchanges.
ICOPER relevance: Currently Higher Education Institutes such as Jisc & CETIS (UK) and SURF (NL) are starting to take HR-XML specifications into consideration as a candidate to improve the transfer from HE to the labour market; HR-XML itself is - for its upcoming version 3.0 - focussing on (1) unique data naming of “core components” and setting up an (2) employability data set, which could also help to bridge HE and industry.

Open Applications Group Integration Specification (OAGIS)
URL: http://www.oagi.org/
Description: Standards development organization focused on building enterprise ready process-based business standards for both B2B and A2A integration
ICOPER relevance: Parts of the upcoming HR-XML 3.0 specifications will be based on OAGIS core elements

IEEE Reusable Competency Definitions (IEEE RCD)
URL: http://www.cen-ltso.net/Main.aspx?put=264
Description: Defines a data model for describing, referencing and sharing competency definitions, primarily in the context of online and distributed learning
ICOPER relevance: IEEE published its RCD (Reusable Competency Definition) specification (IEEE 1484.20.1) which now has been accepted as the 'definition' part of the HR-XML competency standard. An application profile of IEEE RCD is used in ICOPER; by extending IEEE RCD with one metadata element, type, to identify if the learning outcome described is a knowledge, skill or competence (following EQF).

IMS Learning Design (LD)
URL: http://www.imsglobal.org/learningdesign/
Description: Provides a generic vocabulary for describing any pedagogical approach in technology-enhanced learning
ICOPER relevance: Investigate the applicability of the specification in the context of describing generic and contextualized instructional models with respect to didactical expressiveness and diversity. The usage of IMS LD with communication and collaboration services in learning management systems will be tackled.

ISO/IEC 19796-1:2005 Information technology for learning, education and training - quality management, assurance and metrics)
URL: Not publicly available, could be bought from ISO (http://iso.org/)
Description: Framework to describe, compare, analyse, and implement quality management and quality assurance approaches.
ICOPER relevance: Use it to compare and analyse existing content development and reuse methodologies of the surveyed institutions and to harmonise them towards a common quality model.

IMS Content Packaging (CP)
URL: http://www.imsglobal.org/content/packaging/
Description: Describes data structures that can be used to exchange data between systems that wish to import, export, aggregate, and disaggregate packages of content.
ICOPER relevance: IMS LD and IMS CP will be used to combine an instructional design model with open content for execution in learning management systems.

IMS Question & Test Interoperability (QTI)
URL: http://www.imsglobal.org/question/
Description: Describes a data model for the representation of question and test data and their corresponding results reports.
ICOPER relevance: Investigate the applicability of this comprehensive standard in the context of item banks for student assessments and course evaluations.

SCORM
URL: http://www.adlnet.gov/Technologies/scorm/
Description: A reference model that constitutes a collection of standards and specifications for e-learning.
ICOPER relevance: ICOPER will investigate the limitations of the applicability of SCORM in the context of higher education institutions.

8.2 Standards mentioned in ICOPER deliverables

IMS Common Cartridge – D5.1
URL: http://www.imsglobal.org/cc/
Description: The Common Cartridge defines a commonly supported content format, able to run on any compliant LMS platform.
ICOPER relevance: Yet, before addressing tool developers to enable their IMS-LD editors, and players to support IMS-CC-compliant content, there primarily should take place a comprehensive discourse amongst learning designers, learning supporters, tool developers, and standardization bodies involved in the ICOPER consortium (and beyond) in how far current/good practice in IMS-CC (might) really differ(s) from, and consequently exceed(s) that of SCORM, and how current IMS-LD (editors, and) players might be enabled to fully support IMS-CC. As long as such a discourse is missing, the proofed potentials of IMS-CC in current/good practice will be limited to paper-based elaborations.

RSS/Atom – D1.1
URL: http://www.rssboard.org/rss-specification and http://www.ietf.org/rfc/rfc5023.txt
Description: «Really Simple Syndication" is a family of web feed formats used to publish frequently updated works. The Atom Syndication Format is an XML language used for web feeds, while the Atom Publishing Protocol (AtomPub or APP) is a simple HTTP-based protocol for creating and updating web resources.
ICOPER relevance: Used as alternative for OAI-PMH for harvesting of metadata.

DC / DC-Ed – D3.1
URL: http://www.dublincore.org/ and http://dublincore.org/groups/education/
Description: Dublin Core Metadata Initiative is to provide simple standards to facilitate the finding, sharing and management of information.
ICOPER relevance: Used for investigating the suitability as metadata standards in education, a comparison between LOM and Dublin Core to be used as a base standards for developing an application profile for TM/UoL metadata. ICOPER chose to use LOM instead of DC-Ed as the base standard for TM/UoL application profiles because fewer description fields could be mapped to DC-Ed.

SOAP – D1.1
URL: http://www.w3.org/TR/soap/
Description: Provides the definition of the XML-based information which can be used for exchanging structured and typed information between peers in a decentralized, distributed environment.
ICOPER relevance: Used as a binding for SPI messages

SPI (Simple Publishing Interface) – D1.1
URL: http://ariadne.cs.kuleuven.be/lomi/index.php/SPI
Description: Standard for transporting queries to Learning Object Repositories (LORs). Through this search protocol, very heterogeneous repositories can be connected.

ICOPER relevance: Used for harvesting metadata, and to exchange metadata between repositories.

IEEE CP (Competency Profile) – D2.1
URL: http://ltsc.ieee.org/wg20/
Description: Standard that specifies the mandatory and optional data elements, and relations among them, that constitute a Competency Definition as used in a Learning Management System, or referenced in a Competency Profile
ICOPER relevance: This is a proposal to a standard, but it is in very early stages to become a standard. IEEE CP standard does not distinguish between knowledge, skills and competences. This specification was considered as a starting point for designing the ICOPER Persona Achieved Learning Outcomes (PALO) specification for describing profiles of learners achieved learning outcomes.

JISC LEAP2A – D2.1
URL: http://wiki.leapspecs.org/2A/specification
Description: Specification intended to cover the representation of several kinds of information, centred around individuals, who collect, create, reflect on and use their own information for learning, development, self-presentation, or related purposes.
ICOPER relevance: In the ICOPER project, this specification can be used as an export format of learner achieved learning outcomes. However, further testing about how adequate is the data model and its vocabulary for capturing learning outcome data is needed.

8.3 Other identified standards

This is not an exhaustive list or other relevant standards to the ICOPER project
ELM – European Learner Mobility
CEF – Curriculum Exchange format
IEEE - RAMLET (Resource Aggregation Models for Learning, Education and Training)
IMS - LTI (Learning Tools Interoperability)
IMS – ePortfolio
IMS – Enterprise

9 Further work: lessons learned, how to evaluate standards and data models, input for the ICOPER IRM evaluation

This section provides a view on how standards and specifications are evaluated and how this might be achieved in the future. In summary, it expresses a finding that the current "state of the art" in evaluating standards is under-developed before making some general and specific proposals for a way forward to improve this situation.

9.1 Some Typical Past and Recent Practice

To avoid prematurely restricting our consideration, we will start out with an inclusive scope; rather than focus on a strict interpretation of "evaluation", we have considered its motivation – to recommend, advise, simplify-choice – and will include some systematic approaches to bring relatively-basic sense-making to the community of potential adopters.

Table 7: *Summary of typical manifestations of evaluation of LET standards*

Example	Approach to Evaluation	Comment
CEN LTSO1	The LTSO (Learning Technology Standards Observatory) does not attempt to evaluate the specifications and standards it lists; factual material based on the source specification is provided in summary form.	CEN LTSO helps people to identify candidate standards but does aid selection.
CETIS ProD2	The CETIS Project Database (ProD) does not include explicit evaluation but points to JISC-funded projects that have implemented or investigated standards and other technologies.	ProD is limited to JISC projects and does not synthesis findings from these projects. It is, therefore, a source of "raw material" for those people willing to do their own evaluation.
JISC Standards Catalogue3	The JISC Standards Catalogue (no longer being maintained) extends basic factual information with brief assessment of maturity, take-up and risk assessment. These assessments are a-contextual and the parameters used are not explicit.	The lack of context and detail in the evaluation or criteria used has been found to limit the practical utility of this catalogue.
CEN Workshop Agreements4	CEN Workshop Agreements rely upon expert input to the document such that it is generally close to what workshop members will agree to. Evaluation ultimately occurs in the form of "agreement" by participants in the workshop rather than by criterion or metric.	Criterion-free evaluation has merit in being ultimately flexible but has down-sides of lower consistency and efficiency.
SEMIC5	The Semantic Interoperability Centre Europe is concerned with eGovernment rather than LET. Registered assets are evaluated against well-defined criteria to judge maturity of the documentation.	The quality criteria6 applied are very limited to the documentation and dominated by "hard" measurables. It is questionable that this approach would be effective other than for standards created by and for government bodies.
Agency for Public Management and eGovernment (Difi)[7]	The Norwegian agency for public management is providing recommendations for mandatory standards within the public sector in Norway. To evaluate the applicability of standards for use they have developed a set of criteria the standard are judged by. The criteria have the following headlines: • Purpose of the standard • Development process • Market penetration • Public sector needs • Consequences of a recommendation	Since the criteria used are not contextualised to the domain of the standard, many of the criteria used are not relevant to the domain of the standard.

1 http://www.cen-ltso.net/

2 http://prod.cetis.ac.uk/query.php?standard=IMS_QTI

3 http://standards.jisc.ac.uk

4 http://www.cen.eu/CEN/sectors/sectors/isss/activity/Pages/wslt.aspx

5 http://www.semic.eu/

6 http://semic.eu/semic/view/documents/quality-framework.pdf

7 http://www.difi.no/om-difi/about-difi

9.2 Concerning "Evaluation"

Whereas there certainly has been activity that could be described as "evaluation" and there is some reflective literature on the topic, it is evident from the previous section that there are a number of shortcomings to the current state of affairs. The principle underlying feature is implicit and localised knowledge combining with over-generalised views of the purposes for and methods of evaluation. This is one of the lessons-learned from ICOPER; differing views have become apparent in the development and evaluation of the ICOPER Reference Model (IRM) where they were not anticipated. Later on, we will describe in brief one way ICOPER made progress but the principle feature remains.

In brief, we need to foster the creation of shared knowledge. This is, of course, the key aim of ICOPER but whereas the majority of this document and other ICOPER deliverables is concerned with the current and future specifications and models, our focus now falls upon the activity and methods (not products) of standardisation. i.e. to consider the "meta" level. Following the ICOPER road-mapping methodology, and its heritage from PROLEARN, we can recast the "ICOPER Foresight activities framework" (Figure 1) to suit this focus on the meta level.

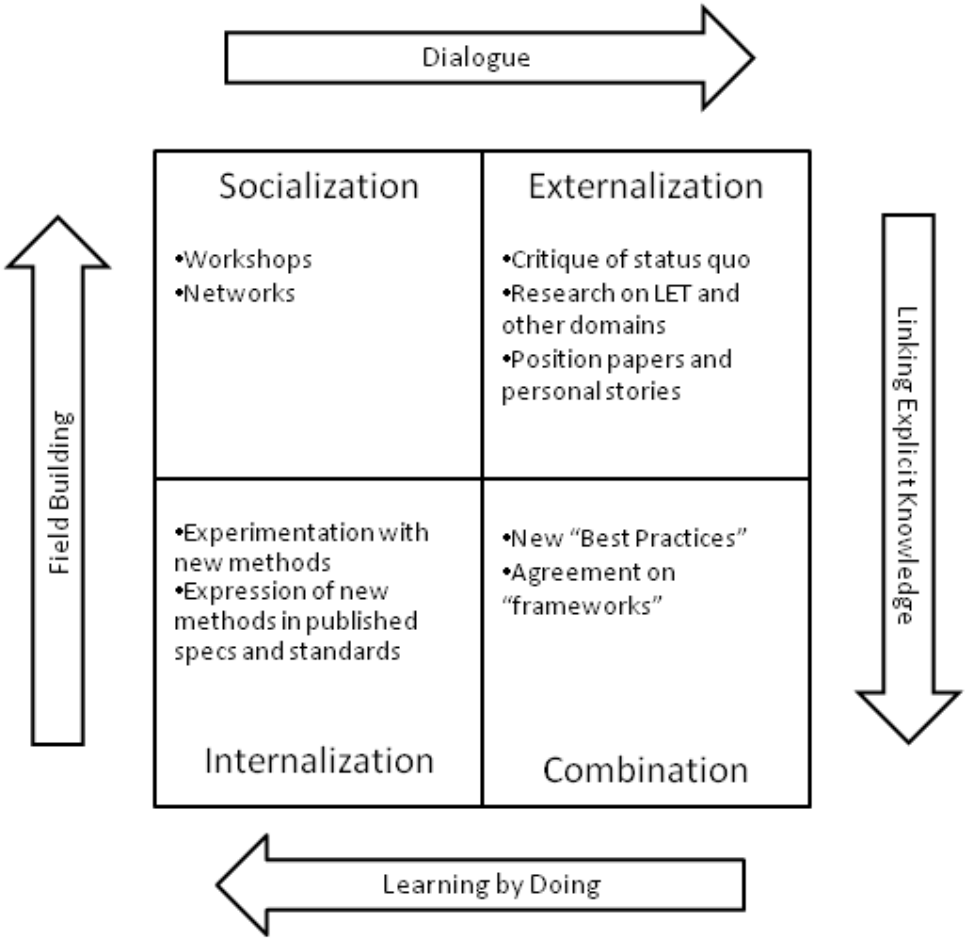

Figure 7: *A re-framing of the ICOPER Foresight activities framework for the activity of standardisation*

The important aspect of the SECI-derived model here is that it focuses on the creation of shared knowledge, on a description of those aspects of process necessary to move from personal or local beliefs and implicit values to more-developed shared beliefs and explicit values as a platform for further growth. Individual researchers are making contributions at various points, for example Pawlowski & Koslov[1] draw on the literature and make propositions towards the "Combination" stage followed by some "Learning by Doing" in the context of ICOPER. In the concluding section, "Requirement for Further Work", we summarise ideas for future interventions to promote the process in which this and other work become transformed.

A Necessary Unity

Perspectives on LET standardisation and consequently on evaluation are many-fold. This is not a new assertion but one to consider in relation to the above-mentioned aim of knowledge creation. Of the many possible perspectives, seven are highlighted in Figure 8.

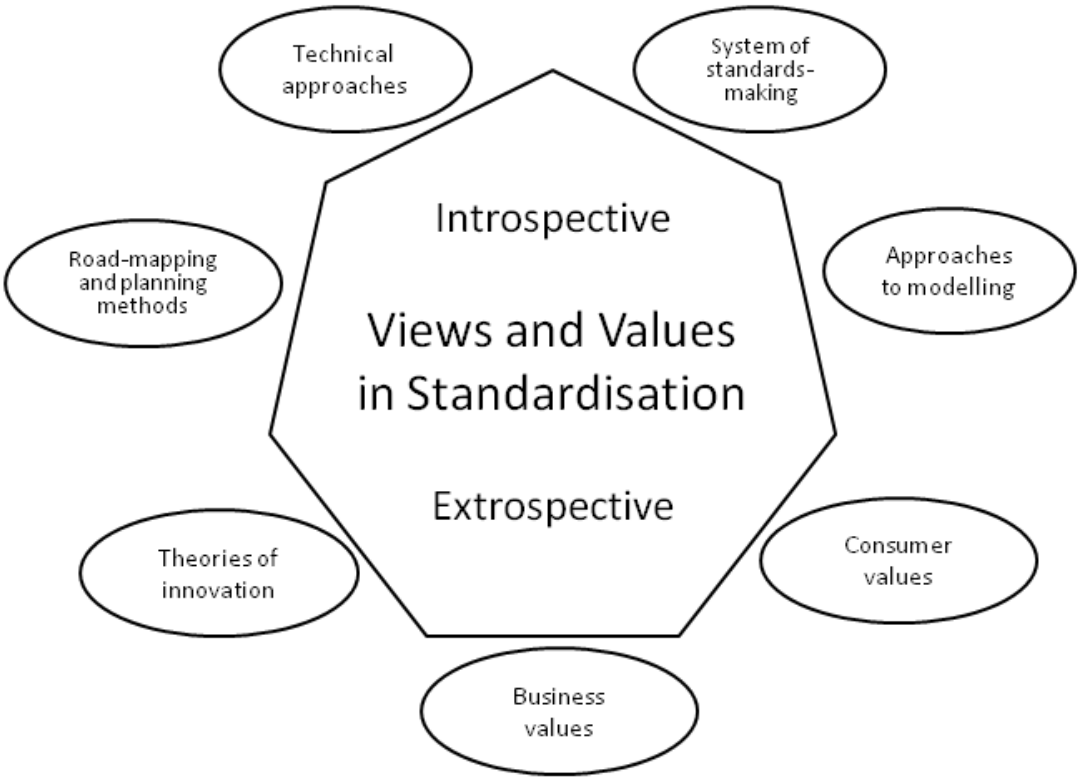

Figure 8: *Seven Perspectives on Value in Standardisation*

From an introspective stance, i.e. from workers in the field of standardisation, consideration of technical approaches, gap analysis and the practices of workers in the field are more to hand. Looking outside our world we recognise that our beliefs should be coloured by theories

1 In preparation for JITSR, "Analysis and Validation of Learning Technology Models, Standards and Specifications: The Reference Model Analysis Grid (RMAG)"

of innovation, grounded descriptions of the marketplace and the all-critical structure and agency of the ultimate users.

While analysis and description frequently take one perspective or another, our intention here is to convey the idea that there is a necessary unity between them. Yes, each perspective will have its own description and distinct choices for judging value but they are never entirely independent and the evolution of the description in time is not a matter of simple progress and refinement but one of coupled change and sometimes-disruptive inter-relation.

A simple example may help to illustrate the "necessary unity". For some time it has been assumed that XML with a broadly-hierarchical implicit or explicit schema is *de rigeur* for exchanging data over the web and for interoperability generally. There is an implicit value judgement borne out of recent history and common practice. We can see the historical changes that brought us here and identify trends in how XML is used, for example a move from SOAP and method-oriented thinking to REST. We could project this trend forward in a first-order analysis, i.e. one taking a "technical approach" perspective. But what of other factors that might exert a second-order effect on technical practice? We know these do happen. For example, government policy decisions to make public sector data available on a large scale coupled with their promotion of Semantic Web technologies seems likely to disrupt the XML assumption as more people work with open-schema RDF expressed in Turtle1.

Recollection of the necessary unity should prevent us from being overly neat-and-tidy in our intellectualisation about technical approach "X" etc. Similarly, it reminds us that we are not evaluating as part of a linear process of rational design but as part of a branching and sometimes-chaotic process of resolving forces and tensions in the "necessary unity".
With some possible exceptions, we have so far paid little attention to actively developing shared knowledge in the "seven perspectives" let alone to an integrated view. We must accept that our evaluations are, therefore, at best provisional from two perspectives: methodologically (our shared understanding of standards-evaluation is evolving) and contextually (the environmental context of evaluation is evolving).

Diverse Purpose for Evaluation

The papers by Cooper (2009) and Pawlowski & Kozlov[2] both omit to develop the idea of the purpose of evaluation. Both indicate that the parameters they enumerate should be selected and prioritised according to actual cases of use but neither explores the questions that arise in that process. The above authors are not unusually negligent; conversations within the wider LET standards community are similarly implicit. This state of affairs indicates that we need to collectively reflect, to try to identify the diverse purposes for evaluation and to consider how each implies different value-judgements.

What follows in this subsection is a putative list of purposes for evaluating standards. The following section offers some caricatures of evaluation approaches to illustrate errors caused by over-focus on certain kinds of value-judgement.

1 Terse RDF Triple Language, http://www.w3.org/TeamSubmission/turtle/

2 Pawlowski and Kozlov, "Analysis and Validation of Learning Technology Models Standards and Specifications: The Reference Model Analysis Grid (RMAG)", the paper is due to be published in the forthcoming special edition of the International Journal of IT Standardization Research.

Generic Guidance
This is an attempt to give general recommendations, to summarise in order to make a confusing diversity of choice more comprehensible. No scenario of use explicitly limits the evaluation in order to address the widest audience but it is usually implicit in the evaluation or adopted from the standard.

Public Sector Mandate or Recommendation to Improve Efficiency
This is an evaluation with an assumption that some level of coercion can be applied to some stakeholders in order primarily to achieve improvement in efficiency across one element of the public sector such as education. Evaluation is strongly coupled to a "business case".

Public Sector Mandate to "Manage" a Market
This is an evaluation to judge the suitability of a standard to reduce monopoly and increase competition and innovation in a marketplace. Testability of the specification, availability of conformance regimes and governance are likely to be valued highly.

Community-specific Guidance
This is similar to "Generic Guidance" but is explicit about the scenario in which the standard is being considered. The audience will be correspondingly more limited to a community, typically characterised by culture and practices. The scenario might apply to present-day mainstream practice or embody progressive or futuristic views.

Selection for Adoption (software developer)
A software developer may, independently of directive or explicit intention to interoperate, consider standards for their value as core models to their application.

Selection for Adoption (standards body)
A candidate specification may be proposed to a standards body for further development and adoption. Present practice is generally to use a surrogate for evaluation, absence of significant and sustained opposition from a National Body, rather than a principled approach.

Selection for Adoption (commercial or OSS project)
For both commercial and OSS projects, this comes down to a business case in relation to a core mission, which may not always be profit.

Standards Body etc Quality Assurance
The viability of a standard or specification created by an organisation other than a formal standards body should be of prime concern to that organisation. This kind of evaluation is potentially the most complicated in this list as it may need to consider multiple scenarios and to support iterative optimisation of the scope, technical approach and participation in the development effort.

Road-mapping and Gap Analysis
This is a special case adoption of the methods for either "Generic Guidance" or "Community-specific Guidance".

9.3 Some Caricatures of Evaluation Approaches

"Caricature" is chosen to signify that the following descriptions intentionally emphasise certain features.

Caricature 1: Selfish Evaluation

The evaluator considers a design requirement to "provide data about X from the software system". The elements of data in X are defined either explicitly or implied by the data related to X in the software.

Strengths	Weaknesses
Quick and easily achieved by comparing the element decomposition in the candidate standard and the explicit requirement or the database. Given prioritisation and tick-counting, a simple measurement can be achieved.	Very many factors are neglected that may hide threats and opportunities. What is the market-place doing? What about future strategy for the software? What are others adopting? What about IPR and patents? What technology trends are visible? Are the same information entities used in other software?

Caricature 2: Pilot

A standard is to be evaluated against its capability to support adaptive testing. Two pieces of Open Source Software are selected that claim to support the standard and a pilot organised in two colleges. Professional evaluators are engaged to interview the technical staff involved in setting up the system and to observe and interview teachers and learners involved in the pilot.

Strengths	Weaknesses
This is certainly a test of practical interoperability and success would be sure to demonstrate suitability (assuming the software developers had not previously colluded to introduce extensions and modifications).	Lack of success doesn't indicate unsuitability. There are too many alternative reasons for failure: poor implementation or lack of testing, poor software usability, users expected to undertake unusual or complicated tasks… Without careful capture of information about the specific context of the pilot, the findings are difficult to translate to other contexts (e.g. mathematics and mathematics professors is a much more promising context for adaptive testing than high school French Literature)

Caricature 3: Domain Analysis

Standards for course information are to be evaluated so experts and practitioners who deal with course information are assembled and a concept map created for the domain of course information. Candidate standards are judged according to how many of the concepts in the map can be closely matched with element descriptions in the specification.

Strengths	Weaknesses
The involvement of domain experts and practitioners gives us reason to believe that standards with a high degree of match are relevant to real use cases. The procedure is relatively simple so long as the experts/practitioners group is relatively uniform (e.g. a region and education sector) and can lead to quantitative measures.	As for caricature 1, many factors are neglected. No prioritisation of the implicit use cases occurs so a key aspect of user-value is neglected. No consideration is given to the reality that course information exists in a continuum of concepts. Large-coverage standards are favoured over smaller ones whereas there is often a benefit in a modular approach.

9.4 The ICOPER Gap Analysis Approach

Sense-making and value-judgement – evaluation - are at the heart of ICOPER. ISUREs (ICOPER Suitability Reports) are one manifestation. The work reported in this document, D8.6 "Gap Analysis Report - conclusions of strengths and weaknesses of current specifications and standards" are another manifestation. In both cases, the work has been non-trivial and has exposed limitations in current "best practice" in evaluation of standards, some of which are described or alluded to above. ISUREs will not be discussed here; our focus is on the methods that were developed in ICOPER for the Gap Analysis.

The evaluation approach used for the Gap Analysis expresses the level of shared belief *circa* 2010 within the ICOPER project about how this kind of evaluation should occur. It is not the "final word" on how this should be done but it is a step forward and a contribution to the process of creation of shared knowledge.

The May 31st 2010 Experts Summit in Leuven, Belgium, set out to gain intelligence as to the strengths and weaknesses of current specifications and standards as an input to the Gap Analysis and this Report. The method revolves around four components, which are listed in Table 8, along with a rationale for each.

Table 8: *Components and Rationale for the Experts Summit Method*

Component	Rationale
Use Scenarios	Scenarios were created as part of the systematic approach to modelling the current and possible future states taken in ICOPER. ICOPER is focussed on "Interoperable Content for Performance in a Competency-driven Society", so our purpose is "community-specific guidance" (see above) and the context is vital. Current state scenarios provide an accessible encapsulation of the context.
Indicate Standards	The purpose of the Gap Analysis is to consider standards so indicating relevant standards identified by ICOPER partners and inviting additions from the experts provides the necessary focus for the evaluation.
Engage Experts	As previous sections indicate, we believe that meaningful evaluation should address a complex "necessary unity". Mechanical, criterion-based, approaches to evaluation are unlikely to capture this complexity and to miss the value of connections. Experienced humans are much better at dealing with complexity and fuzziness and by engaging experts with different perspectives in dialogue we hope to arrive at more reliable conclusions.
Use SWOT	SWOT (strengths, weaknesses, opportunities and threats) analysis provides a framework to structure discussion and capture of conclusions that is widely understood by the invited experts yet does not prejudice their evaluation through criteria imposed by ICOPER. This is both philosophically-desirable as we recognise evaluating standards in LET is not fully-developed and practically-desirable as we wish to engage rather than alienate our expert guests.

During the design of the above method, a critical trade-off was identified. "Why would experts participate?" is a key question. Meaningful evaluation is time-consuming and sufficient time is required to familiarise experts with the ICOPER context and scenarios. Experts are in short supply and generally not available for extended periods. Our trade-off was one full day of face-to-face activity with a written questionnaire. This was just sufficient but less than our ideal. One conclusion from observing the proceedings of the Expert Summit was that conversations often strayed into a SWOT analysis of the real-world represented by

the scenarios. Thus, care is needed on the part of the facilitator and in the use of the SWOT conclusions to avoid contaminate by evaluation against an implicit preferred future state in the mind of one or more experts. This observation could be interpreted as strong validation for the use of scenarios; it seems clear that the question of evaluation is only meaningful to the experts in context.

9.5 Requirement for Further Work

Requirements for further work to support shared knowledge creation and hence improved recommendations, advice and sense-making across the diversity of purposes for evaluation should cover all aspects of the SECI-derived model, although not necessarily imply interventions dealing with a single phase of the cycle.

It would be beneficial if:

Key stakeholder groups with interest and influence develop a shared understanding of the mixed role/purpose of evaluation.
This should include national public sector (governmental and non-governmental) stakeholders, the European Commission, standardisation workers and academics. The LET community should engage with the eGovernment community (e.g. represented in SEMIC) to understand and exploit similarities while recognising necessary differences.

Analysts and researchers are supported in collaboration to better understand the LET standards and specifications ecosystem.
This structural intervention should cover all of the "seven perspectives" and preferably be of worldwide scale to achieve critical mass, although European-scale action by itself would have value. This should promote integrated research – i.e. a consideration of the "seven perspectives" in real LET contexts – rather than isolated research.

More information is made available more information on the actual use of open specifications and standards.
This should be provided by Standards Bodies, consortia and informal collaborations as well as public sector organisations and projects concerned with LET standards.

Specific analysis and research on critical weaknesses be undertaken.
Existing global and European networks such as ICOPER have generally not focussed on the "meta level" questions but instead reveal that there are key areas where evidence is lacking. Effort should be targeted at prioritising and addressing these deficiencies.

Opportunities for discourse continue to be promoted.
ICOPER and its partners have convened and promoted a small number of meta-level-focussed and generally-introspective (see the "seven perspectives" Figure 7) events to promote the "dialogue" transformation in the SECI-derived model. These should be sustained and new efforts made to include the extrospective components through close association with actors in projects such as TELMap.

References

– Cooper, A. (2009). Evaluating Standards - A Discussion of Perspectives, Issues and Evaluation Dimensions. JISC CETIS. Located@ http://wiki.cetis.ac.uk/images/e/e7/Evaluating_Standards_Public_v1p0.doc

10 Annexes

10.1 Annex 1: Future Scenarios list

1. "Constance G" (Constance) by Yann Denoual, HEC
2. "Computer supported cooperative work and course design and delivery" (MK) by Michel R., HEC
3. "Scenario 1 – Visit to an art gallery; Scenario 2 – First-aid workers; scenario 3: Orientation Week for student beginners" by Elisabetta Parodi, Giunti Labs
4. **"**Learning Speed breakthrough i SMEs in Northern Europe" (Re-skilling - Lean Production)
5. **"**Scenario Sarah – Work-focused learning" (Sarah), by Stephen Powell, Richard Millwood, Adam Cooper
6. **"**Continuing education needs of medical professionals" (Panos), by Panagiotis Bamidis
7. "Life-Long Learning" (FESTO AG), by Martin Wolpers
8. "Personal Competence Development in Competence Networks" (Julia), by Milos Kravcik
9. "A narrative use case to illustrate the results of the DSSC methodology" (Sonja), by Bernard Blandin, Geoffrey Frank, Kenji Hirata, by Simone Laughton
10. "Learning Scenario MAICh, Crete, Greece" (Florin), by Nikos Manouselis
11. "Pervasive and Personal Learning Environment" (Sally), by Yvan Peter
12. "ProCar Case Scenario" (ProCar), by Dimitra Pappa

Scenarios guidelines

- A scenario is a story-telling document
- Begin with **the title** and **the executive summary** listing the following points which are detailed in the scenario (one paragraph)

Scenario story

- Define the place (locations), date (around in 10 years)
- The context : Higher education, work environment, informal learning, levels, domain, learning outcomes (required, actual, desired)
- Characters of the scenario (actors), roles
- Goals and objectives (e.g. selecting participants to determine which may be candidates to fill specific roles)
- Define the actions taken, tools and services used to address the goals (in a creative way)
- Interactions with actors, content, systems
- Define the problems/challenges faced by the characters
- Write in the margin what are the pre-conditions, issues, ideas at stake for the success of the scenario's implementation (main topics of interest)

Note: The above mentioned scenarios are included in Annex 1 of the D8.5 deliverable

10.2 Annex 2: Documentation of Experts Summit

Pre-phase Questionnaire

Start Page:

Higher Education is currently confronted with many changes: The European Commission, for example, is advising its member states to create a new European Higher Education Area by introducing ***outcome-oriented teaching***. Parallel to this activity our students have been raised as digital natives and are confronted with a technological revolution based on **social media, open content, and Web 2.0 technologies**. In the light of these changes higher education institutions are forced to react and are required to create and are confronted with a new transparency with respect to their activities.

Standards and specifications are supposed to contribute to the solution of these challenges by providing guiding principles for the design of educational systems, both, on a technical as well as on a human level. The first ICOPER Experts Summit is aiming to **assess existing standards and specifications with respect to their problem solving potential**.

Making educational resources such as learning outcomes, personal achievement profiles, learning content, assessment resources, teaching methods, learning designs, and learning opportunities ***interoperable is the main vision of the meeting***.

In order to study strength, weaknesses, opportunities and threats of standards and specifications we would like you to assess the following 5 scenarios with respect to

- your personal interest in studying a scenario as well as related standards and specifications in more detail
- relevancy to higher education institutions
- relevancy of selected standards and specifications
- missing standards and specifications

State-of-the-Art Interoperability Scenario 1:

Sharing Learning Outcomes –
From the Study Programme into the Lecture into the Learner Profile

Learning Outcomes refer to statements of what a learner knows, understands and is able to do on completion of a Learning Opportunity (European Commission 2008)**. "**The student is able to *list* a number of learning technologies and their properties." is an example of a Learning Outcome.

The ICOPER Project is concerned with the interoperability of Learning Outcomes, for example, when Learning Outcomes are provided for re-use in the planning of courses, i.e. the creation of Learning Designs, or when students after successful completion of a course aim at including these Learning Outcomes in Personal Achievement Profiles.

Target audiences:

- Programme Director (when it comes to designing study programmes)
- Faculty (when it comes to preparing their courses)
- Learner

Third party (when it comes to recognizing learner's obtained learning outcomes)

I consider this interoperability scenario highly relevant for a higher education institution:
Please rate how much you agree with the following statement.
( ) I fully agree ( ) I partially agree ( ) I partially disagree ( ) I do not agree

The ICOPER Consortium has identified the following standards and specifications as relevant for this scenario:

IEEE LOM and Profiles
IEEE RCD and Profiles
Personal Achieved Learning Outcomes - PALO (ICOPER Draft Specification)
ICOPER Middle Layer Specification

I consider the following standards and specifications also relevant for this scenario:

I would like to investigate this scenario in more detail:
( ) Yes ( ) No

State-of-the-Art Interoperability Scenario 2:

Sharing Learning Designs: Collaborating around the Design of Courses

A Learning Design is a reusable representation of a concrete Learning Opportunity. A Learning Design arranges Teaching Methods, Assessment Methods, Learning Content and Learning Tools towards Learning Outcome attainment.

A sketch of a Learning Design can for example be described as follows: "After taking this course a student is able to *list* a number of learning technologies and their properties. In order to achieve this learning outcome we will ask the students to attend a presentation on learning technologies that will also include some demos. After the presentation the student will be confronted with a short test."

In the context of such a scenario ICOPER aims at facilitating collaboration around Learning Designs starting with the creation of Learning Designs out of respective Learning Opportunities, the sharing of Learning Designs as well as finding peers based on Learning Designs.

Target audiences:

Faculty
Programme Director

I consider this interoperability scenario highly relevant for a higher education institution:
Please rate how much you agree with the following statement.
( ) I fully agree ( ) I partially agree ( ) I partially disagree ( ) I do not agree

The ICOPER Consortium has identified the following standards and specifications as relevant for this scenario:

IEEE LOM and Profiles

IEEE RCD and Profiles
IMS Learning Design
Personal Achieved Learning Outcomes - PALO (ICOPER Draft Specification)
ICOPER Middle Layer Specification

I consider the following standards and specifications also relevant for this scenario:

I would like to investigate this scenario in more detail:
( ) Yes ( ) No

State-of-the-Art Interoperability Scenario 3:

Sharing Learning Content: An Authoring Round Trip

Learning Content refers to any digital and non-digital material that can be used in Learning Opportunity such as a course. An example of a Learning Content is a PowerPoint Presentation providing an overview of existing learning technologies.
ICOPER aims at facilitating the sharing and re-use of Learning Content.

Target audiences:
Faculty
Learner

I consider this interoperability scenario highly relevant for a higher education institution:
Please rate how much you agree with the following statement.
( ) I fully agree ( ) I partially agree ( ) I partially disagree ( ) I do not agree

The ICOPER Consortium has identified the following standards and specifications as relevant for this scenario:
IEEE LOM and Profiles
CEN SQI
CEN SPI
OAI PMH
ICOPER Middle Layer Specification

I consider the following standards and specifications also relevant for this scenario:

I would like to investigate this scenario in more detail:
( ) Yes ( ) No

State-of-the-Art Interoperability Scenario 4:

The Life Cycle of an Assessment Resource: From the Authoring to the Learner's Personal Achievement Profile

An Assessment Resource is a special type of Learning Content used for the assessment of a learner's learning activities, thus stimulating some kind of interaction or reaction by the learner. An Example of an Assessment Resource is a test question such as the following:

"What is typically used for training high-level skills such as flying an airplane:

( ) Simulations
( ) Talent Management Systems
( ) Assessment Tools
( ) Authoring Tools"

Assessment Resources are authored by using all kinds of authoring tools and deployed by learning management systems or other Learning Tools. Based on the Assessment Resource a normalized Assessment Record is created, which provides evidence for a learner's Achievement.

Target audiences:
Faculty
Learner

I consider this interoperability scenario highly relevant for a higher education institution:
Please rate how much you agree with the following statement.
( ) I fully agree ( ) I partially agree ( ) I partially disagree ( ) I do not agree

The ICOPER Consortium has identified the following standards and specifications as relevant for this scenario:
IMS QTI
Personal Achieved Learning Outcomes - PALO (ICOPER Draft Specification)
CEN SQI
CEN SPI
OAI PMH
ICOPER Middle Layer Specification

I consider the following standards and specifications also relevant for this scenario:

I would like to investigate this scenario in more detail:
( ) Yes ( ) No

Future Interoperability Scenario 1:

Adaptive Study Programme Design and Delivery

A Study Programme is a definition of an educational offer that aims at the development of a set of Personal Achieved Learning Outcomes that are aligned with learning requirements from

job profiles or the society as such. Study Programmes are described via a set of Learning Outcomes. In this scenario we assume that Learning Outcomes are strongly inspired by Job Offerings.

The ICOPER Project is envisioning technology-support for identifying relevant learning outcomes based on job profiles and job applications. We foresee an interoperability between CV authoring environments, electronic job markets, Study Programmes, and Learning Opportunities around the Learning Outcome artefact, which is developed, shared, and reused in all the different applications.

Target audiences:

Programme Director (when it comes to designing study programmes)

Faculty (when it comes to preparing their courses)

Learner

Third party (when it comes to recognizing learner's obtained learning outcomes)

I consider this interoperability scenario highly relevant for a higher education institution:
Please rate how much you agree with the following statement.
( ) I fully agree ( ) I partially agree ( ) I partially disagree ( ) I do not agree

The ICOPER Consortium has identified the following standards and specifications as relevant for this scenario:

IEEE LOM and Profiles

IEEE RCD and Profiles

Personal Achieved Learning Outcomes - PALO (ICOPER Draft Specification)

ICOPER Middle Layer Specification

I consider the following standards and specifications also relevant for this scenario:

I would like to investigate this scenario in more detail:
( ) Yes ( ) No

Agenda

1st ICOPER Experts Summit
2010-05-31, Leuven

Draft Agenda, Version 2

09:00 – 09:30 Welcome, expected meeting outcome («Gap analysis report») - Erlend, Vana

09:30 – 10:30 The ICOPER Reference Model and the ICOPER Scenarios

- ICOPER Reference Model: Results, Methodology and Prototypes (Bernd)
- Future scenarios (Michel)

10:30 – 11:00 Coffee Break

11:00 – 11:30 Scenario-driven SWOT Analysis: Overview of all scenarios

11:30 – 12:30 Scenario-driven SWOT Analysis: Presentation and Discussion of Status Quo
5 tracks: Jad, Petra, Michael T., Israel, Michel

1. Short introduction
2. Prototype demonstration
3. Present answers of questionnaire
4. Identify Rapporteur
5. Discussion based on a SWOT Template also documents assumptions and alternative solutions → Google Doc

12:30 – 13:30 LUNCH

13:30 – 14:30 Scenario-driven SWOT Analysis:
Consolidation of group discussions in a joint statement per group
5 tracks: moderated by Rapporteur

14:30 – 15:30 Scenario-driven SWOT Analysis: Presentation by Rapporteur and Results Integration

15:30 – 16:00 Coffee Break

16:00 – 17:00 Panel Discussion and Updating of Google Document (Bernd)

17:00 – 18:00 Methodology Evaluation and the Way Forward

- How to evaluate standards? (Adam)
- Evaluation of this meeting's approach (Bernd)
- Closure of meeting and follow-up actions (Vana, Erlend)

Support Material:

ICOPER Reference Model including context Scenarios, Middle Layer Specification Draft (Link), and PALO

Links to relevant standards and specifications

Anwsers of pre-phase questionnaire

List of Experts

Name	***eMail***	***Funded by***	***Question-naire filled-out***
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Eneli Sutt	eneli.sutt@eitsa.ee, enelisutt@hotmail.com	TLU	x
Erik Duval	erik.duval@cs.kuleuven.be	-	x
Eugenijus Kurilovas	eugenijus.kurilovas@itc.smm.lt	KTU	x
Francis Brouns	Francis.Brouns@ou.nl	OUNL	x
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Vana Kamtsiou	vana@dat.demokritos.gr	Consortium	

Template for Scenario-driven Evaluation of Standards and Specifications

Your Scenario:	Your Rapporteur:
STRENGTHS of the proposed solution:	OPPORTUNITIES for implementers:
WEAKNESSES of the proposed solution:	THREATS for implementers:
Alternative Solutions:	Your Assumptions:

Foto Documentation

http://www.educanext.org/dotlrn/clubs/icoper/new-lors/Meetings/2010-05-31

10.3 Annex 3: Analysis of Use cases developed in ICOPER (services, and Actors involved)

To facilitate the gap analysis work of the future and context scenarios we have also produced a summary of all the use cases developed in ICOPER and listed the related actors and services described in these use cases.

Use case	Author	Services	Extends	Actors
Content authoring	Roland Klemke, Marion Fischer	Retrieve content	Search, Browse	Content author
		Reuse content	Copy, reference	Content author
		Edit content	Modify/update, translate, add new variant	Content author
		Re-contribute content	Publish, share, invite	Content author
Create personal collection	Michael Totschnig	Create collection		Learner, teacher
		Add object		Learner, teacher
Discuss learning object	Michael Totschnig	Annotate learning object		Content author, content provider, learner, teacher
Search for learning resources	Effie Law	Search		Teacher
		Ask for recommendation		Teacher
		Personalized search		Teacher
Recommend resource	Michael Totschnig	Recommend resource		Learner, teacher, peer
	Zuzana Bizonova	Select learning outcome		Learner
		Choose learning method		Learner
		Take a course		Learner

		Take a test		Learner
Customise desired learning outcome	WP2	Customise learning outcome	Set qualifiers	Teacher, learner
Export profiles	WP2	Export learning outcome profile		Placement system
Generate learning outcomes profile	WP2	Generate learning outcomes profile		Learner, institution system
Manage profiles	WP2	Search, sort, import, export, modify		Placement system
Retrieve units of learning	WP2	Retrieve units of learning		Teacher, learner
Select context	WP2	Select context		Teacher, learner
Submit profiles to placement centre	WP2			Institution system, placement system
Select desired learning outcomes	WP2	Select learning outcomes	Search, browse	Teacher, learner
Search desired learning outcomes	WP2	Search desired learning outcomes		
Browse desired learning outcomes	WP2	Browse desired learning outcomes		
Update profiles	WP2	Update profiles		Recruitment system, institution system, placement system
Search for teaching methods/UoL	WP3	Search for teaching methods/UoL		Teachers, learning designers
Retrieve for	WP3	Retrieve for		Teachers,

teaching methods/UoL		teaching methods/UoL		learning designers
Upload teaching method/UoL	WP3	Upload teaching method/UoL		Teachers, learning designers
Document teaching method/UoL	WP3	Document teaching method/UoL		Teachers, learning designers
Annotate teaching method/UoL	WP3	Annotate teaching method/UoL		Teachers, learning designers
Link teaching method with UoL	WP3	Link teaching method with UoL		Teachers, learning designers
Integrate teaching method with content	WP3	Integrate teaching method with content		Teachers, learning designers
Book UoL	WP5	Book UoL		Learner
Learn with UoL	WP5	Learn with UoL		Learner
Match users to roles	WP5	Match users to roles		Teacher
Search for UoL	WP5	Search for UoL		Teacher
Teach within UoL	WP5	Teach within UoL		Teacher
Upload UoL	WP5	Upload UoL		Teacher
Create assessment	WP6	Create assessment		Instructor
Answer assessment	WP6	Answer assessment		Learner
Edit assessment	WP6	Edit assessment		Instructor
Search assessment	WP6	Search assessment		Instructor, learner

Store assessment	WP6	Store assessment		Instructor
Submit response	WP6	Submit response		Learner
Visualise assessment	WP6	Visualise assessment		Learner
Metadata harvesting	D7.1			