TIME2LEARN

D1 Status Report on research 'state-of-the-art' and the European situation as compared to North America

DATE	30 June 2003
ABSTRACT	This document presents the findings of the survey conducted by the Time2Learn partners recording and assessing the current state-of-the-art in the field of eLearning, both on National and European level. Moreover a comparison between the European situation and North America is included in the document.
EDITOR	NCSR "Demokritos"
AUTHORS	NCSR "Demokritos", UCY, IMC AG, OUNL
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1 Executive summary

This document presents the findings of the survey conducted by the Time2Learn consortium recording the state-of-the-art of eLearning in Europe, as well as a comparison between the European situation and North America.

Data analysis reveals that asynchronous collaborative learning is currently the dominant learning method. On the other hand the collected data identifies that some particular learning methods, have not been explored yet within the framework of European and National eLearning projects.

Primary effort in most projects is allocated to the investigation of Learning Management Systems and Learning Content Management Systems. In national projects, self-developed tools are identified as a substantial tool in the majority of the projects, whereas in European projects many self-developed applications classified as supporting tools.

The acceptance of the standards from the eLearning Community and the significant research activities in the topic of wireless networks imply an ambient access trend. XML and content specifications related topics are among the most popular research trends. On the contrary API's and Middleware are quite unknown topics, while they constitute very useful tools in reducing costs in the implementation of an interoperable system.

In the field of eLearning, America has gained ground compared to Europe due to common cooperation between the states and businesses. Common language is one of the major advantages America has over Europe. Areas that America is in a leading position are delivery systems, conventional courses online, networked colleges, aligned systems and independent virtual universities.

2 Introduction

The “New Economy”, whether it is described as the information economy, knowledge economy or even digital economy, has reinforced on the labour force the demand for effective and measurable - in terms of performance improvement and return on investment - education and training. The European citizen faced with the use of Information Technology on day-to-day work basis, has now a relentless need and demands new skills in order to correspond effectively to a dynamic and constantly evolving market. Professional eTraining either in the form of Company Led Training supporting goal oriented change in an organization, or in the form of Personalized Training on Demand as an extension of performance support or in the form of Continuous Professional Development, offers a constant updating and upgrading of knowledge for individuals seeking career advancement, professional development and skills enhancement. On the other hand, Information and Communication Technologies have changed the access to knowledge, the process of acquiring new skills as well as the delivery of education and training.

The competitive advantage will be earned by those who will manage to correspond to the new economy’s needs by being able not only to acquire in time demanded skills but also apply them effectively in the working place in a very short period of time.

On this basis Time2Learn project aims at providing a roadmap for the development of European professional and vocational training enhanced by effective and andragogically sustainable use of ICT to reduce the ‘time to performance’ of the European labour force, enabling them to be more effective, adaptable and employable.

Within the framework of the Time2Learn project, the main objectives of WP1 are to identify, catalogue and assess the current research trends and research results in EU and third countries in the area of eLearning and create a state-of-the-art status report.

The identification of the State-of-the-Art Research and Development in eLearning was carried out by examining the following eLearning focused areas:

- Research projects (ongoing and completed), i.e. EU funded projects (UNIVERSAL, ARIADNE), nationally funded projects (University for Industry in UK, the Institute of Training and Occupational Learning), projects initiated and funded by the private sector as industry collaboration projects, etc.
- Scientific research and professional organisations and bodies, i.e. European education brokers (PROMETEUS, EuroPACE 2000, CEN-ISSS, CETIS, CEDEFOP, EDEN), Standard-working groups (IEEE, AICC, ADL, IMS, ETSI), other working groups such as Career-space with a consortium comprised of eleven major ICT companies.
- Literature reviews, i.e. reports, research publications and White papers case studies, and surveys.
- Major Conferences and Exhibitions: i.e. Online Educa, eLearning Expo, Learntech, World Education Market, etc.

All above-mentioned subjects indicated the key players in eLearning active in Europe. Moreover, all subjects were extensively analysed separately for each one of the identified technology axis:

Methodological Approaches: This axis focuses on end user (content provider, learner, etc) specific processes that allow the implementation of a business model. In most cases the technological solution is transparent to the user and several alternatives could be used, e.g., Collaborative Knowledge building, ASP based e-training, etc.

Enabling Technology Services: This axis focuses on eLearning specific tools and components that are used for application development, i.e. LMS tools, Authoring Tools, Delivery platforms.

Infrastructure: This axis focuses on the technologies used to build, interconnect and manage technology services, i.e. databases, data networks, web services, user authorization technologies, smart agents.

A primary categorization was carried out using a predefined set of criteria from EU Open Consultation Process report ("New research challenges for technology supported learning", Report, 2001). In combination a review of reports, research publications, white papers, case studies, and surveys [1, 2, 3, 5, 6] was carried out, resulting in the outlining of the Status of ongoing research and the recording of the current research trends.

The assessment of current research in eLearning followed. The aim was to observe and record the maturity level and the applicability status of specific Technologies developed within the framework of research projects. This was done by using taxonomy of the proposed concept according to predefined criteria such as: compliance to existing standards, costs, type of technology services, type of methodological approach, and type of infrastructure. A large portion of the collected projects was extensively analysed separately for each axis, i.e. methodological approaches, technology services, and infrastructure.

The findings of the research conducted by the members of our consortium at a National and a European level, to investigate the state-of-the-art research in the domain of eLearning, are presented in this deliverable.

Chapter one contains the rationale of the research conducted as well as the project's structure to support this research. Chapter two presents the initial data collection process along with the corresponding statistical findings. In chapter three we provide an introduction to the subsequent in-depth data collection and analysis process on a per project basis and the assessment reports. Chapter four presents a report about the educational philosophy and learning methods applied in current research and development in eLearning.

Chapter five gives an analysis on tools and components that are used for eLearning application development. Chapter six includes a report regarding the enabling technologies used in current eLearning research. In chapter seven we outline the conclusions that are derived from the state-of-the-art research in the field of eLearning at a European level. A comparison between the European situation and North America is included in chapter eight. In appendix A the applied methodology for the work contained in the deliverable is presented in detail. Finally in appendix B we include a summary of the results and the conclusions found in external reports originated by other similar initiatives.

3 Rationale

The "New Economy" has brought many structural changes that have profound implications in industry, occupation, competition, and the dynamics of the individual worker. There is a pressing need for companies to be more competitive, while maintaining a high quality of service and performance. This is being hindered in Europe by a growing skills gap, as the 'time to performance' of our human capital is too long and costly. There is an urgent need to make the current training systems better available, more effective, accurate, and flexible in order to enable true training on-demand services for the individuals and their work-organizations. The competitive challenge is to reduce the time needed to train the Europeans for the jobs of tomorrow and improve their current knowledge base and expertise and most importantly to make this practice of professional development a continuous one.

Time2Learn-project addresses this need by developing a roadmap for European professional and vocational training enabled through ICT to reduce the 'time to performance' of citizens, enabling them to be more effective, adaptable and employable. Time2Learn is a Thematic network within the scope of the last *IST* call in FP5. The overall goal is to bring together a large community of European Research, Higher Education Institutions, and industry experts in the field of professional eTraining and identify the major trends for the next 7 years.

Time2Learn roadmap is an important step towards an initiation to identify, develop and deliver advances in eLearning that will enable European citizens to become more competitive by reducing the time needed for their training without compromising on the effectiveness and quality of training.

In order to achieve these goals:

Within WP1 (Work Package 1): data was collected from the R&D community in order to identify the current state of the art, major trends and research areas. Some of these results will be translated to mainstream technologies in the coming 7 years. The research was conducted at European and at National levels and it is presented within this deliverable including a comparison with North American situation in order to put Europe in a global perspective.

Within WP2 (Work Package 2): identification of market needs was carried out by collecting data from Corporations with a geographical segmentation in order to take into account the different level of maturity of each National Market. A presentation of the findings could also be found within the respective WP2 deliverable.

Within WP3 (Work Package 3): Taking into consideration the main directions and dimensions change identified in WP2 a set of scenarios representing the desired futures were created. The scenarios were presented and validated at the Time2Learn public seminar, organized in Stuttgart, Germany 2nd of June 2003.

The final project goal is to prepare a comprehensive roadmap that integrates business drivers with enabling technologies to provide a logical framework for co-ordinating R&D to meet the grand challenges of European eTraining. This will be achieved by comparing the current state-of-the art in R&D and market needs (WPs 1 & 2) with the requirements derived from the desired future states.

Roadmapping should be considered as a tool for collaborative strategic planning and as such it enables us to derive concrete actions needed when reaching for the desired futures. Like any documented strategy the roadmap as an end-result of the process should be continuously tested and improved. The success of an industry roadmap is measured against how effectively it has been communicated to and recognized by the relevant stakeholder groups. The value of roadmapping lies largely behind its capabilities to enhance consensus building. A review of several roadmapping guides was carried out within WP3. These reports originating from Canada, US and Australia aimed at giving advice mostly to governmental officials on what should be considered when preparing industry roadmaps. The Integrated Roadmapping method

(see Figure 1) was originally developed by the Integrated Manufacturing Technology Initiative (IMTI), a non-profit corporation chartered in 2000 (USA). This method has been adopted by a group of experts in WP3 so as to become more suitable for the scope of this project (October 2002).

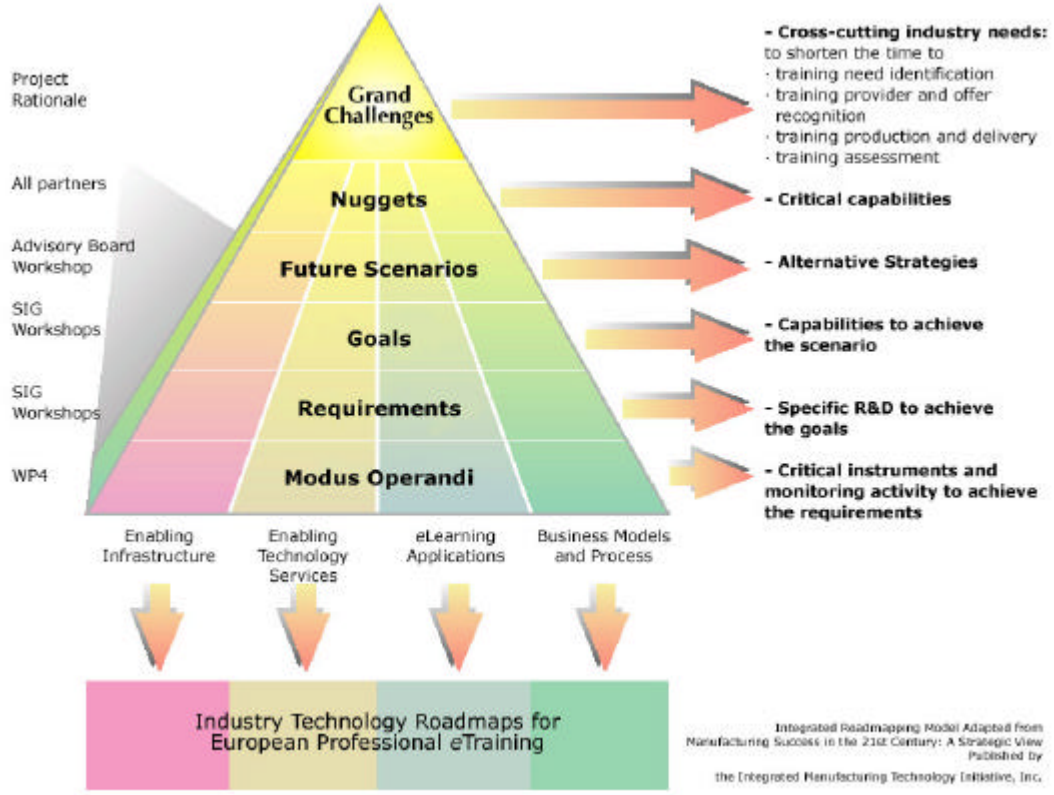


Figure 1: Roadmapping model rationale

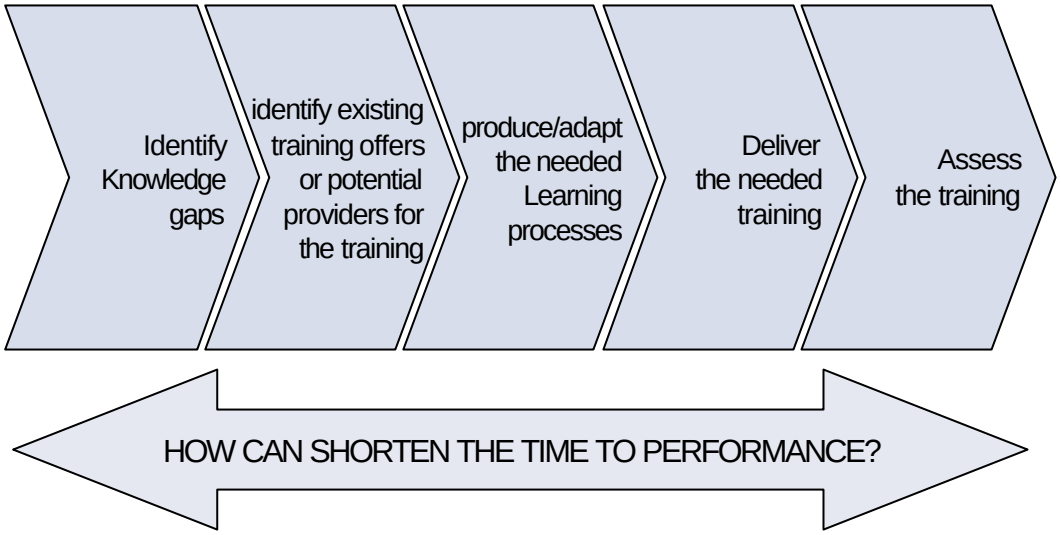
The roadmapping model consists of six levels employing a top-down approach[1], which begins from the identified grand challenges that are worked into critical technology capabilities (nuggets), to concrete goals and requirements and finally produce a viable modus operandi for the R&D EU eTraining.

The overall grand challenge that this roadmap addresses is about reducing the time to performance by means of training. In other words reducing the period of time that elapses from the initial creation of the knowledge to the ability to apply that knowledge in a particular situation by a particular learner. It encompasses the entire learning and training value-chain from content creation to production and delivery of the ICT enhanced training service and learner support. How can we shorten the time needed to:

- identify knowledge gaps
- identify existing learning/training offers or potential providers for the needed educational scenario
- produce/adapt the needed learning processes
- deliver the needed training

[1] The pyramid model in figure 1 was adopted by T2L project, and illustrates the roadmapping process for the Manufacturing Success in the 21st Century, as recommended by Finnish Roadmapping expert, Mika Naumanen.

- assess the needed training



Core sectors of the roadmapping

Time2Learn roadmapping scope is divided into four (4) core sectors:

Technology Area	▪ Infrastructure (WP1 - Enabling Infrastructure) ▪ Technology (WP1 - Enabling Technologies) ▪ eLearning Applications (WP1 - Authoring, delivery, management, etc.)
Business Area	▪ Business Models, Value Chains (WP2 - content providers, technology providers, service providers, learner communities)

For the technology areas, three (3) Special Interest Groups (SIGs) have been formed in WP1.The technology areas covered by each SIG are defined as follows:

SIG 1 (Methodological Approaches, i.e. eLearning Applications): This SIG focuses on end user (content provider, learner, etc) specific processes that allow the implementation of a business model. In most cases the technological solution is transparent to the user and several alternatives could be used, e.g., Collaborative Knowledge building, ASP based e training, etc.

SIG 2 (Enabling Technology services): This SIG focuses on eLearning specific tools and components that are used for application development, i.e. LMS tools, Authoring Tools, Delivery platforms.

SIG 3 (Infrastructure): This SIG focuses on the technologies used to build, interconnect and manage technology services, i.e. databases, data networks, web services, user authorization technologies and smart agents.

The special interest groups were responsible for producing a report focused on its assigned sector. All the results presented in these SIG reports will be used for the creation of the roadmap in order to determine in what extend current R&D matches the Time2Learn goals and

identify major gaps in terms of methodological approach, technology services and enabling infrastructure (see figure below).

As a first step to the roadmapping process an identification of the critical capabilities (called also "nuggets") necessary for the fulfilment of the desired grand challenge, was carried out, i.e. in order to shorten the time to performance we need to be able to have easy access to digital repositories, ways to manage the learning process, create personalized learning maps, put the learner in the centre of the learning process, establish market transparency, have broadband infrastructure available, etc.

The outcome of this procedure, carried out mostly by our consortium experts was a list of more than 80 nuggets. Using this list of nuggets a categorization was performed with respect to the defined roadmapping core sectors (see tables 1, 2 and 3).

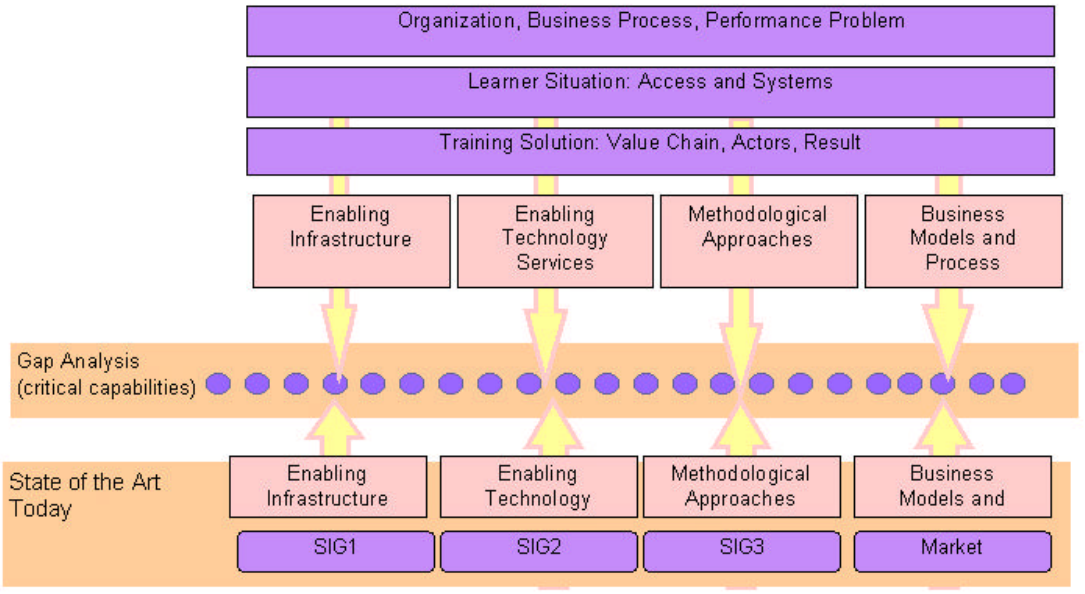


Figure 2: GAP analysis

In order to be able to draw the roadmap between the current situation and the desired future the possible future scenarios must be analyzed and studied. We have used this approach in order to rank the critical capabilities and get an indication of the key future developments in infrastructures, technologies, methodologies and markets and compared it to the current state of the art.

Critical capabilities (nuggets)

The "Nuggets" depicted in figure 1 are defined as the critical technology capabilities necessary to implement the grand challenge. The "Future Scenarios" are defined as the desired future states. The goals are the capabilities to achieve the vision. The requirements are the specific R&D needed to achieve the goals the detailed actions to achieve the requirements.

Nuggets are presented in groups defined by the respective SIGs. More specifically, SIG 1 includes nuggets with a wide range of technology dependences. Since, SIG 2 and SIG 3 are by definition technology oriented and thus are in a better position to grasp the future trends of the pertinent technologies, it has been decided for SIG 1 to focus only on the more technology independent nuggets, although, the whole range of nuggets has been taken into consideration during a first categorization and analysis.

In following tables the critical capabilities (nuggets) are presented per SIG:

METHODOLOGICAL APPROACHES (SIG1)	
CATEGORIES	NUGGETS
Creation, Storage and delivery of personalized re-usable, shareable content	▪ Database of eLearning opportunities ▪ Expert database ▪ Corporate repository ▪ Capturing expertise ▪ Rights management methods for creators, authors and publishers ▪ Dynamic management of content (content that is continuesly assembled on demand)
Learner modelling, profiling and personalization	▪ Customized e-training ▪ Easy customisable content ▪ Knowledge gap analysis ▪ Precision predictability to match user needs and learning requirments ▪ Portable performance portfolios ▪ Learner Personal Planning and achievement support ▪ Competency skills assessment -systems and processes
Managing the Learning Process	▪ Collaborative knowledge building ▪ eModeration method ▪ Performance Tracking system ▪ HRD system integrated learning system ▪ Exploratory Learning ▪ Simulation based Training ▪ Drill and Practice ▪ Self Directed Learning
Mobile access and intercommunication to learning content	▪ Integration of knowledge management and learning system ▪ Different possible channels for learning a topic ▪ Sutomatic system configuration according to user situtations and communication infrastructure availability
Learning and work	▪ Expert trains the trainers ▪ Just in time access to knowledge information ▪ Learning by doing capabilities

Table 1: Methodological approaches list of nuggets.

ENABLING TECHNOLOGIES AND TOOLS (SIG2)	
CATEGORIES	NUGGETS
Virtual Learning Environments and Content Management	▪ Learning management tools ▪ Learning content management tools ▪ Virtual Classroom ▪ Reuse of learning content (fragments)
Authoring Tools, Content Creation	▪ Collaborative authoring tools ▪ Authoring tools ▪ On-the-fly authoring ▪ Language translation
Distance Interactive Learning – Delivery Tools	▪ Delivery tools ▪ Help desk ▪ Inteligent tutors ▪ Assistive technologies
Collaboration Software	▪ Collaboration tools - Chat, Bulletin Boards
Learning Brokerage Platforms	▪ Learning brokerage tools
Knowledge Management Tools	▪ Knowledge management tools
Assessment Tools	▪ Assessment tools ▪ Real time assessment ▪ Tracking and performance recording software ▪ People-qualification profile mapping tools

Table 2: Enabling technologies and tools list of nuggets.

ENABLING INFRASTRUCTURE (SIG3)	
CATEGORIES	NUGGETS
Standards, Specifications, Reference Models	▪ Standard knowledge representation framework used ▪ Open standards for the development, storage, search and retrieval, exchange of reusable educational objects (RLO's) ▪ Open standards supporting the use of a wide range of pedagogies in online learning ▪ Open standards to describe questions and tests ▪ Open standards to describe data structures that are used to provide interoperability of Instructional Management systems with other Enterprise systems ▪ Open standards to addresses the interoperability of Learner Information systems with other systems ▪ Common shared taxonomies ▪ Open standards for communication protocols

ENABLING INFRASTRUCTURE (SIG3)	
CATEGORIES	NUGGETS
	▪ Common standards in use of technologies such as interfaces, objects, platforms ▪ Dynamic user profile can foresee demand (comparison with other similar profiles)
Integration (APIs)	▪ Plug and play interoperable systems components ▪ Integration of eLearning systems with existing back-office system ▪ Seamless model interoperability ▪ WEB-services ▪ Interfacing repositories (data storage) ▪ Software development architecture
Storage	▪ Ubiquitous access to RLO's and/or their metadata ▪ Easy (better) ways to find, select and retrieve information from huge amounts of data like available on the WWW ▪ Secure transmission and storage of (personal) data ▪ Data storage and processing hardware ▪ Dynamic content simulations ▪ Skills and competency libraries
Networks	▪ General use of broadband communications ▪ Connectivity between different Network Operation Systems (NOS) ▪ Single Logon to different systems and networks ▪ Adequate connectivity anytime and anywhere when needed, both wired as wireless ▪ Natural language queries ▪ Intelligent Search Agent, Intelligent Agents ▪ Anytime, anywher access and Delivery capabilites ▪ virtual reality technologies ▪ Augmented intelligence ▪ Transparent embedded background
Communication	▪ Videoconferencing ▪ Peer2Peer communication ▪ Privacy tools
Middleware	▪ Diverse learning architecture can be supported and communicate ▪ Adequate protection of peoples privacy, both online as offline
Devices	▪ Devices suited for the task ▪ voice recognition and control ▪ biometric feedback

Table 3: Enabling infrastructure list of nuggets.

4 Project recording and classification

Project recording and classification is the result of 1st scan analysis. The 1st scan analysis (as shown in appendix A) included both a recording activity of the recent and ongoing R&D projects in Europe and a draft categorization of the received data. This procedure was conducted at a European and National level. After reviewing a set of surveys, white papers, reviews, etc. [1,2,3,5,6] the information collected during the first scan analysis was placed in wider perspective, in order to reach, as far as possible, a representative view of the eLearning Status in Europe and the current research trends.

4.1 Recording activity

Research data was recorded by means of specially designed templates. In order for the R&D projects to be taken into consideration they should have a starting date of no earlier than year 1999. The sources used for the collection of the data include public sources such as Web sites (Proacte, Cordis, Prometeus, INFORM projects, projects websites), Government databases, National contact points, etc

This procedure created the results stored and organized a database with web interfaces (http://www.altsol.gr/time2learn/main.php). Using this database we have completed a draft statistical analysis of the results.

The draft data analysis included a categorization using the following data fields (presented in figures 1, 2 and 3):

- Funding resource (EU/National/Industrial/Other)
- Programmes
- Country

Using the created web template of the database one can easily have access to all the collected data and he/she is able to use the following automated categorizations:

- EU projects (titles, number of projects) – Project website URL, access to template
- Programs – list of Programs and projects per program
- National projects (titles, number of projects)
- Per country (list of countries – number of projects per country and projects titles)

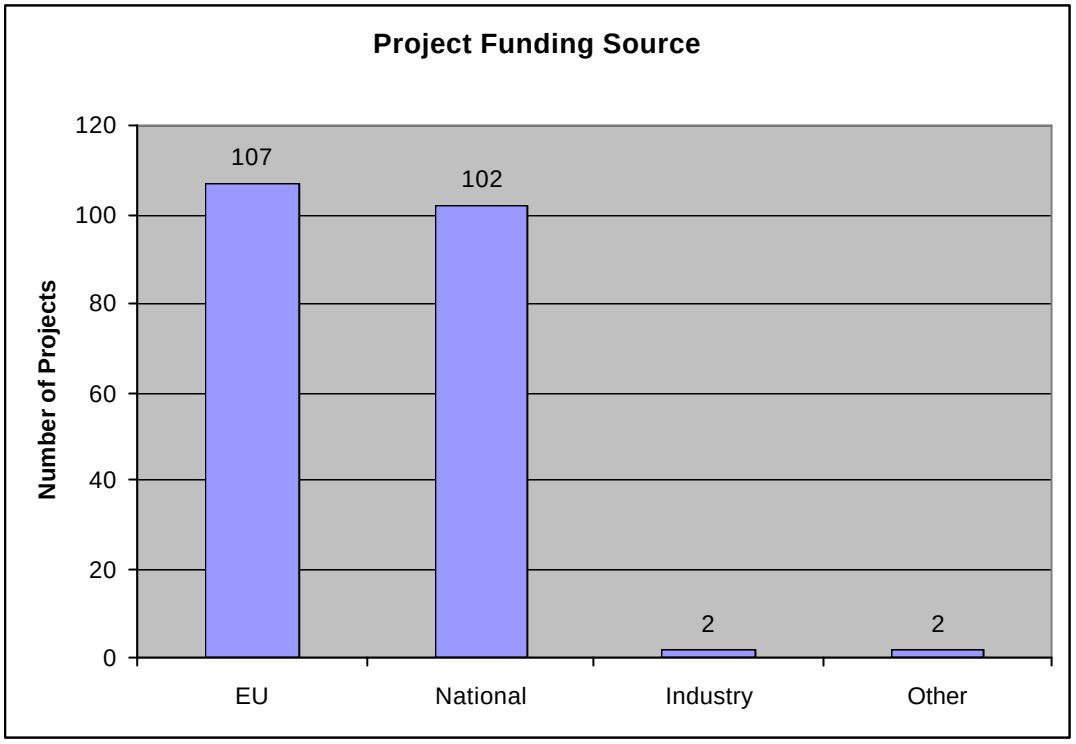


Figure 1: Project categorization per funding source.

Figure 1 presents the funding source for the recorded research projects. In order to get homogeneous results in the distribution of the selected research projects, balance was kept between the recorded European and Nationally funded projects. In total 213 projects were collected. The large number of the collected projects comprises a significant portion of the research activity in the field of eLearning in the European region. As can be seen in the above figure 107 European funded projects were collected and almost all of them are from the IST initiative for reasons that are explained in the next paragraph. The number of collected European projects is more than satisfactory for the needs of this survey. The number of nationally funded projects, on the other hand, is rather limited. The 102 recorder National projects are not enough to depict the research activity in a per country basis, but are very useful to draw conclusions for the European research activities on national level in general. Industry funded projects were scarcely recorded and were not taken into consideration for further analysis.

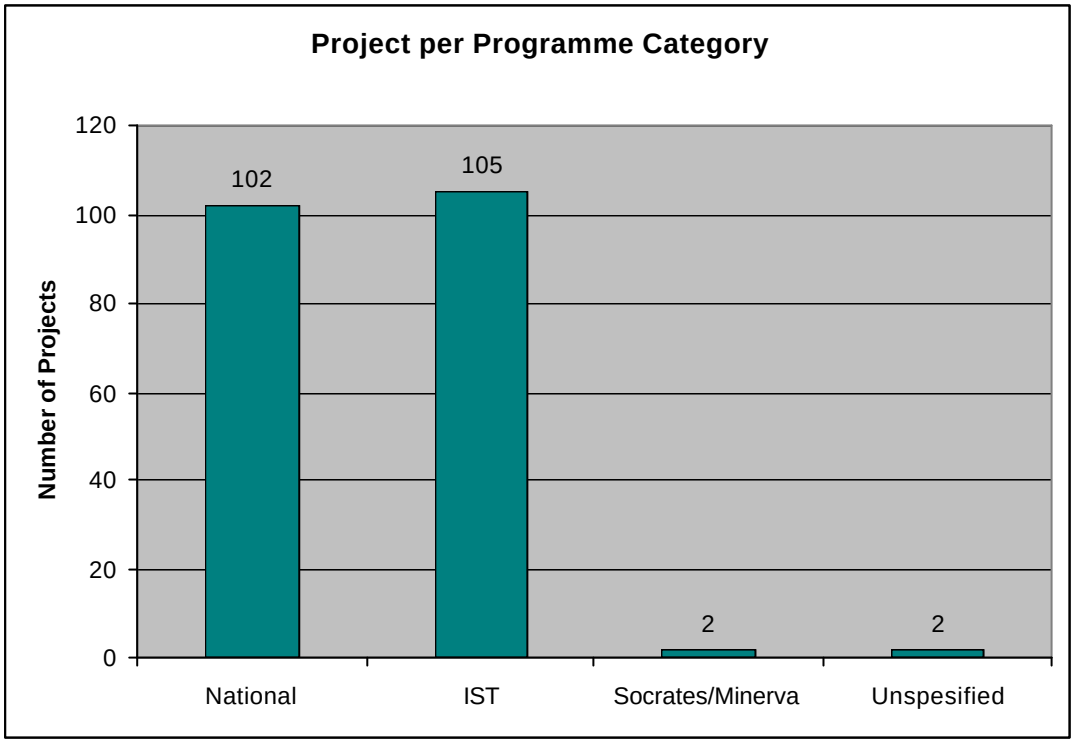


Figure 2: Projects distribution per Programme Category.

Within the EU funded projects, a conscious decision was made to focus on IST projects due to the extensive funding resources allocated for eLearning research, the pan European dimension of the projects, and the specific thematic priorities addressed. IST initiative had a large-scale call for eLearning within the FP5. In FP5, Theme 2 (Creating a User-Friendly Information Society) - Key action 3 (Technology Enhanced Learning) had a total budget of 138.2 MEuro allocated in various activities in the field of eLearning.

Action lines within this programme were:

- Open Platforms and Tools:

Aiming at developing those tools and systems that will enable education and training centres, companies or service providers to implement and maintain integrated learning services based especially on re-usable learning objects.

- Advance Training Systems:

Looking to develop and demonstrate new ways for improving the future training and retraining of the workforce, building on new approaches enabled by emerging technologies.

- Flexible University:

With the objective to integrate and demonstrate emerging technologies for the flexible university of the future through experiments. Moreover, the idea of Virtual Campus has been further developed in this framework.

- School of Tomorrow:

Aiming at improving the quality and accessibility of learning at primary and secondary school level through embedded IST, in particular addressing knowledge and skills required by future citizens of the Information Society.

- The Learning Citizen:

With the objective to develop, demonstrate and evaluate new IST-based approaches for enhancing and facilitating lifelong learning for individuals outside formal education and training settings, including the potentially socially excluded.

- eLearning for Work:

Aims to empower individuals to define, procure and manage their learning for work, in response to rapidly changing organisational, business and employment needs. The research is evaluating the added value of the new ways of learning and its socio-economic impact.

Taking into account the above it is obvious that projects within the IST framework constitute an indicative data pool of the eLearning research conducted in Europe using funds from EU.

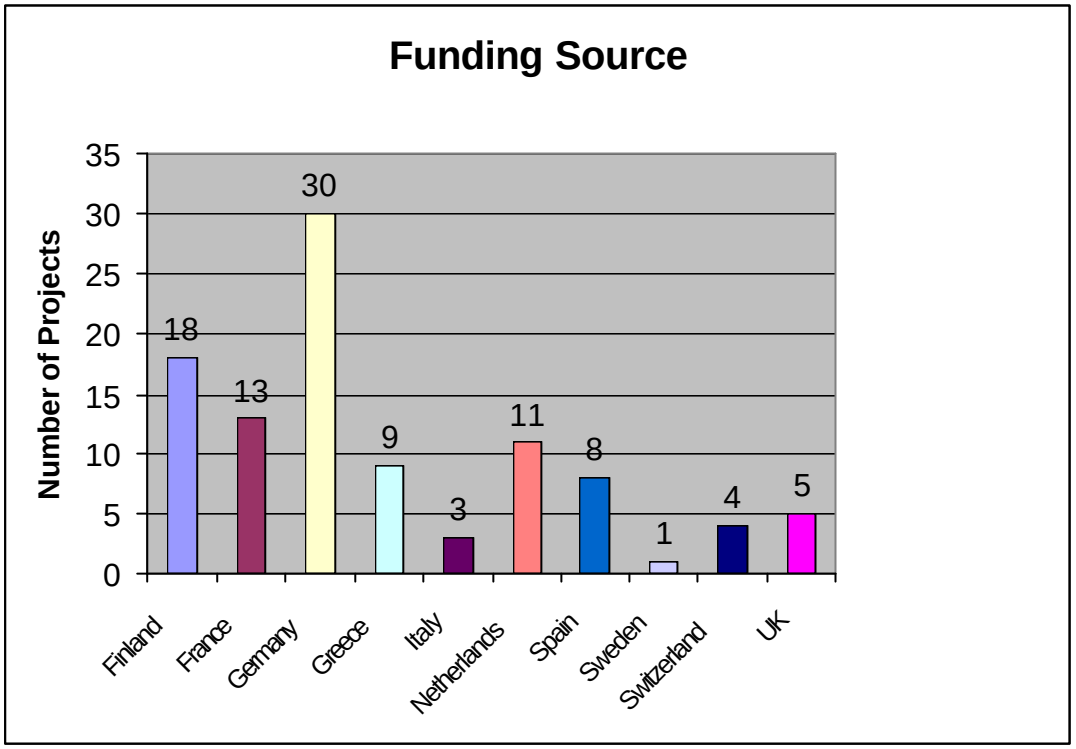


Figure 3: Nationally funded projects distribution per Country.

Figure 3 presents the nationally funded projects, as they were collected in this study, distributed per funding country. The data presented in figure 3 have not been used for quantitative analysis, since they do not represent the actual research in the field of eLearning, in a per country basis. In order to conduct a qualitative analysis in a per country basis a collection of a representative portion of projects related to eLearning from every participating country is needed. No such data were available during this survey due to time and cost limitations. Nevertheless, the collected projects compose an indicative subset of the recent and present research activity in the field of eLearning on a European level using National funds.

4.2 Categorization

This section concentrates on the need to formulate a framework, which would group and categorize eLearning research topics, aims and objectives according to an identification of their innovative perspectives. The categorization is based on the report of the Open Consultation Workshop “New research challenges for technology supported learning, 2001”. This report summarises the conclusions and the recommendations resulting from the Open Consultation Process established by the European Commission (Information Society DG – Directorate “Multimedia Content and Tools” – Unit “Multimedia Applications for Education and Training”) to further the development of the research agenda for work in the area of “Technology Supported Learning” to be carried out in the Sixth Framework programme (FP6). The report of the

workshop constitutes an advisory document providing recommendations for the future European research in technology-supported learning.

In the framework of this open consultation process experts in the field of eLearning were invited to submit their contributions to an open web service as the basis for discussions at a consultation meeting held in Luxembourg in 1 October 2001. This open web service received 66 contributions from 120 authors prior to the above date. During the consultation meeting three parallel sessions took place. Each of the parallel sessions had focused on one of the three multiple interconnected "pillars":

- Pedagogical and organizational aspects
- New Applications for ubiquitous Learning
- Technologies and Infrastructure

In our view the categorization held in the report suits our methodological and technological driven survey. In this categorization five clusters were created, each one representing different aspects of the technology assisted learning. The clusters are given below including some indicative subcategories.

A. Creation, Storage and Delivery of Personalized, Reusable, Shareable Content.

- Enabling Technologies (Methods, Standards, Tools & Architectures)
- Learning Content Management Systems
- Business and Organizational Models
- Set Up, Publishing & Brokerage of Digital Inventories and Repositories of accessible Knowledge, Content and Tools

B. Learner modelling, profiling and personalization

- Enabling Technologies (Methods, Standards, Tools & Architectures)
- Learner Styles
- Certification Records
- Profiling and Personalization Models
- Set Up of Competency and Profiles Registries

C. Managing the Learning Process

- Enabling Technologies (Methods, Standards, Tools & Architectures)
- New Learning Models
- Self-Managed Learning
- Institutional Managed Learning
- Community Managed Learning (e.g. collaborative learning, peer-to-peer learning)
- Assessment Models and Technologies
- Competency Modelling

D. Mobile Access & Intercommunication to learning content

- Hybrid Environments (on/off line)
- Portable Learning Records
- New Models, Technologies and Applications for Just in Time Learning and Knowledge on Demand Applications
- Multilinguality and multimodality

E. Learning and Work

- New Models for Working (including Mobile workers and Office-less workers)

- Integration with Business Procedures (including Knowledge Management, Customer Relations Management, Enterprise Resource Planning etc)
- Just –in-Time Training Trials

For further Analysis and a more detailed description of each Category apart, please refer to aforementioned Document.

Overall the collected projects were classified according to their identifiable project objectives. Some kind of limitations associated with the above projects classification must be acknowledged. It was anticipated that the classification of the projects according to their objectives, could be interpreted differently depending on personal bias, furthermore, they could not be properly assigned to one of the 5 initially prescribed categories. Therefore, in order to guarantee the highest accurate interpretation level and to generate most meaningful results, the proposed methodology was extended by two further decision fields:

F. Horizontal projects, including projects aiming at disseminating and communicating results of other R&D projects, these projects where not taken into consideration to the 2nd scan analysis

G. Other projects, referring to projects that cannot be categorized in the aforementioned clusters.

4.2.1 Area of research distribution

Projects could be classified to more than one category according to their identified objectives, with the exception of categories F and G.

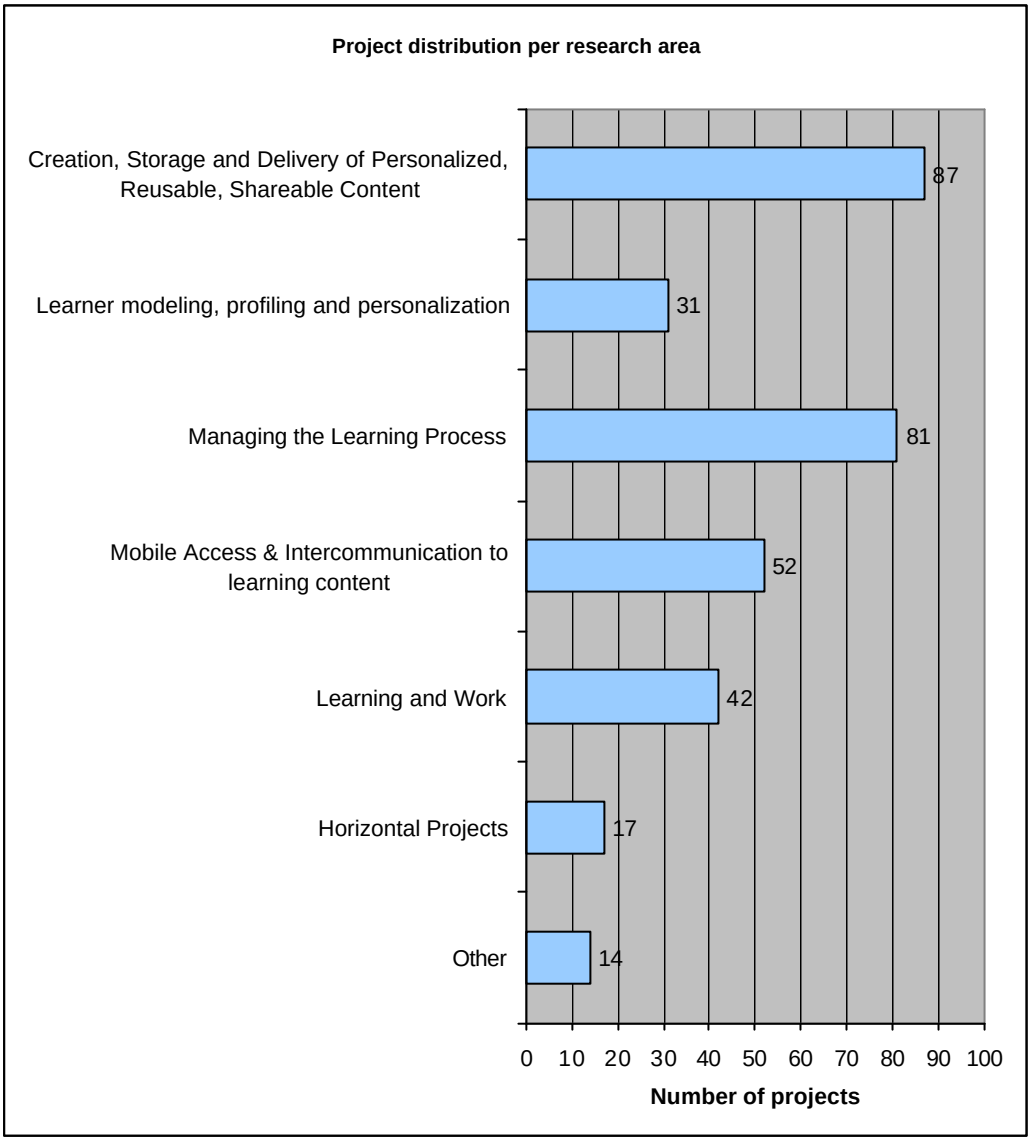


Figure 4: Project distribution per research area.

From figure 4 derives that two categories A (Creation, Storage and Delivery of Personalized, Reusable, Shareable Content) and C (Managing the Learning Process) gain a broad research popularity and interest, within the eLearning Community. This seems quite logical due to research concentration of the most projects in the areas of content sharing and reusability, Learning Management Systems (LMS) and Learning Content Management Systems (LCMS).

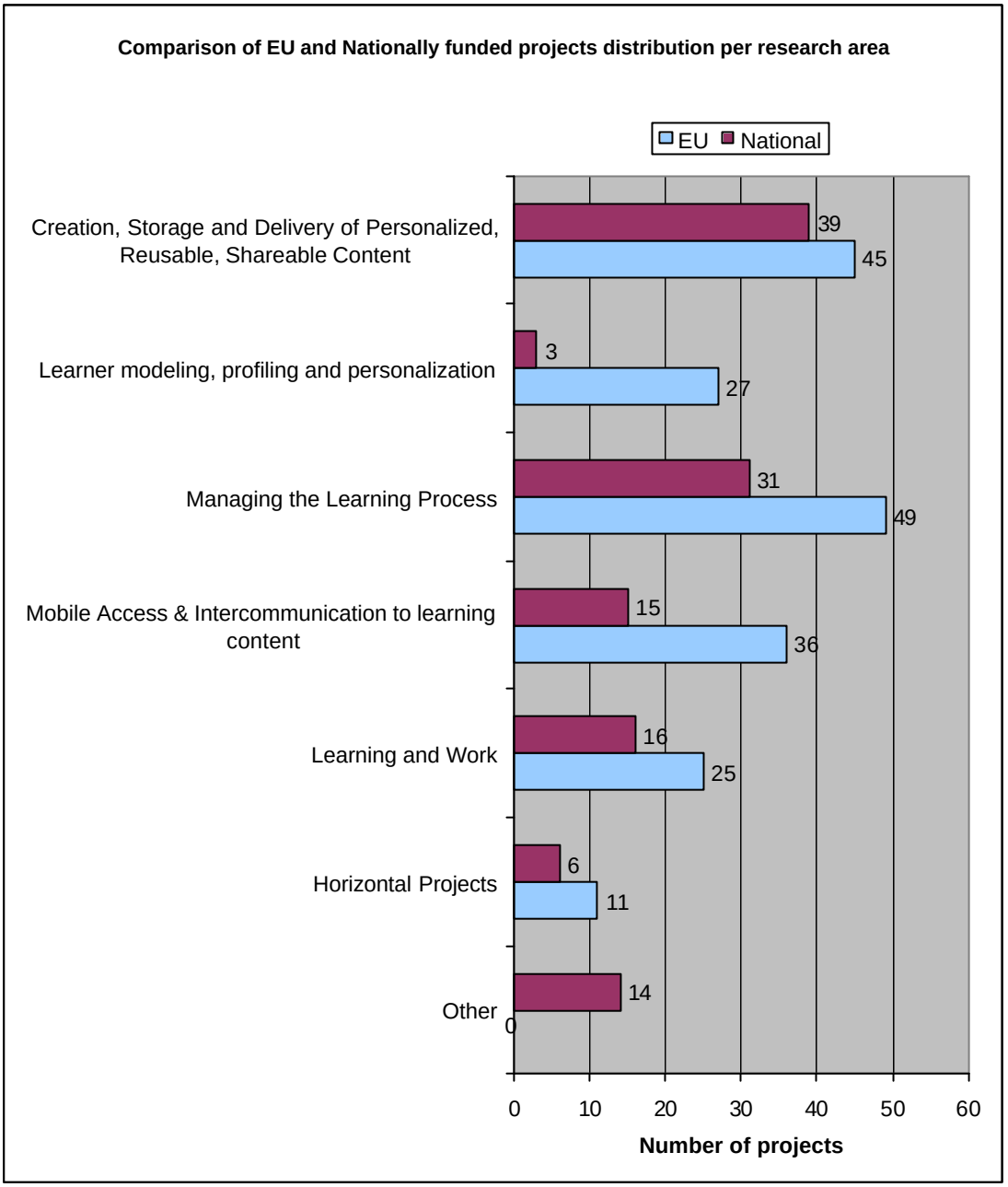


Figure 5: Comparison of EU and Nationally funded projects distribution per research area

In figure 5 we provide a comparison of the distribution per research category, between European and nationally funded projects. We notice that the EU funded projects keep a more homogenous distribution between the first five categories than the nationally funded ones. Thus, suggesting that EU funded projects are in general terms better balanced between the various aspects of eLearning, compared to the nationally funded projects that outline a less homogenous behaviour. In particular, nationally funded projects are almost absent from category B (Learner modelling, profiling and personalization) and mainly focus on the categories A and C. Using a balanced pool among EU and Nationally funded projects, (about 100 nationally funded projects and about 100 EU funded projects) meaningful comparisons between them can be made. The funding participation level per cluster can be identified. It derives that in category A, 47% of the projects addressing this cluster are funded from National budget and 53% are EU funded ones. In category B, only 10% of the projects categorised in

this cluster are nationally funded and EU funded projects are dominating this category with 90%. Within the “Managing the Learning Process” category, EU projects participate with 61% and National projects with 39%. Category D is addressed by 51 projects, 30% of which are National and 70% EU funded projects. “Learning and Work” cluster is addressed by 41 projects 39% of which are National and 61% are EU projects. 17 horizontal projects were counted, 35% of them are National and 65% are EU projects. A small group of nationally funded projects was not possible to be distributed in one of the first 6 categories, therefore populated category F (Other). In general, we observe that categories E (Learning and Work) and D (Mobile Access & Intercommunication to Learning content) play an equally significant role for National funded projects, while European projects show a significant preference to category D.

In total, all the nationally funded projects addressed the first 6 categories 124 times and EU projects 183 times. These findings indicate that National projects have a more narrow approach to the various aspects of eLearning, while EU projects keep a broader approach. This in some degree can be explained from the lower budget of the National projects in contrast to the EU funded projects and the Pan European aspects of the EU funded projects.

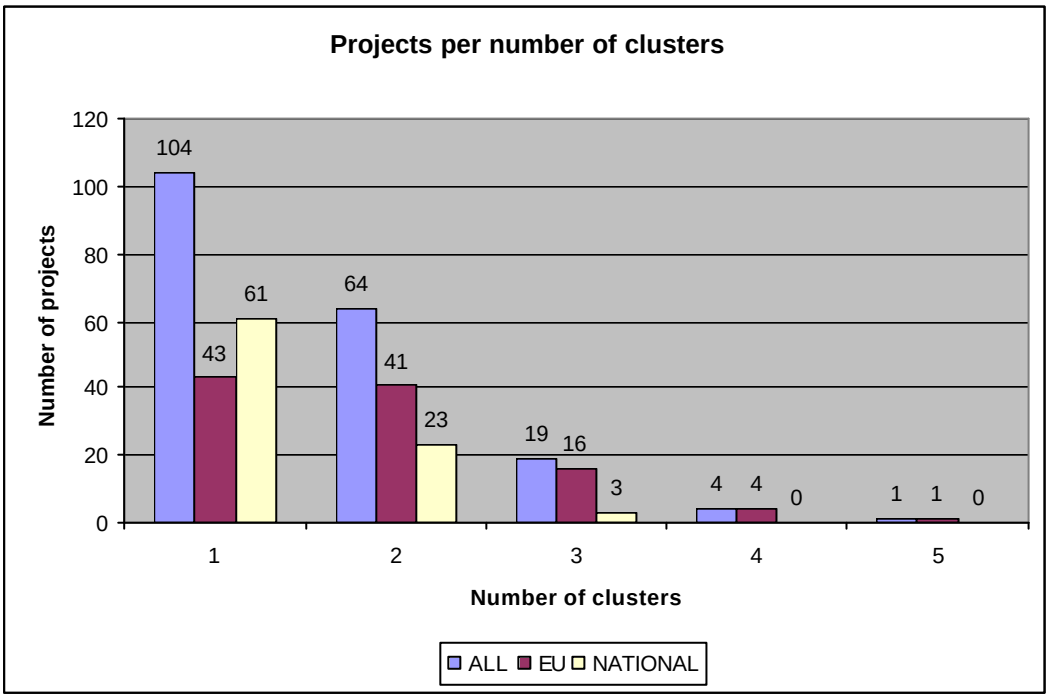


Figure 6: Projects per number of clusters.

Figure 6, supports in a numeric fashion the argument that national projects tend to have a narrower focus than the European ones. This figure shows how many projects have been categorized in 1,2,3,4 or 5 clusters at the same time. A look to the figure above shows that most of the national projects (60%) are addressed in a single cluster while only 41% of the European projects have the same attitude. Another 41% of European projects where categorized in two clusters, while the percentages of the national projects drop dramatically, in this group, with 23%. Three clusters were addressed by an almost equal portion of European and national projects. Finally someone can observe that only five European projects addressed 4 or 5 clusters and none from national projects.

4.2.2 Budget range distribution

The budget distribution of the eLearning research projects in Europe is presented in this section. Eight clusters were made to categorize the various budget magnitudes. From the total

213 recorded projects the 168 provided data regarding their budget size. The most popular category among the eLearning initiatives is ranging between 2 and 3 MEuro, 31% of the projects reside in this cluster. A further 23% revealed that their project budget was between 100,000 and 500,000 Euro. Only 2% of the projects were found in the top budget cluster ranging from 6 to 7 MEuro.

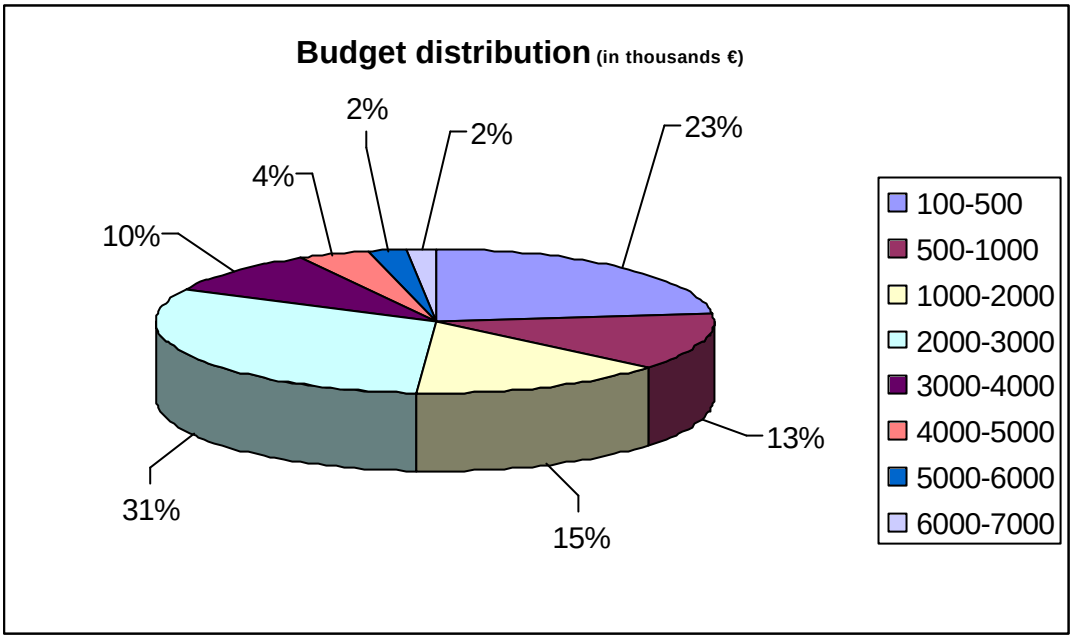


Figure 7: Budget distribution of the collected projects.

The general pattern that can be extracted is that almost 82% of the project budgets ranges between 500,000 and €4 Million indicating that eLearning financing provides the necessary resources to enhance further research and implementation development. Note that the data concerning the budget distribution derives mostly from the European funded projects, since many of the nationally funded projects indicated no data on their dedicated budget.

4.3 Results on a wider perspective

Findings from the recording and categorisation activity were correlated with results from various studies, surveys and reviews conducted at a European level [1,2,3,5,6] This correlation allows for a more holistic view of the Status of eLearning in Europe as well as the current research issues and trends.

There is common ground underlying a major part of research activities carried out in Europe in the area of professional eLearning. Research, regardless of the type of initiative and mobilization (independent researchers, consortia activities both at European and National level), is recurrently concerned with the following specific issues:

1. Equitable Access: Access from everywhere to everyone is considered to be one of the most important issues. This includes aspects of ensuring access to computers and the Internet to all socio-economic groups from multiple "points of entrance".
2. Reusability: Developing and implementing common standards in the use of technology, such as interfaces, learning objects, platforms that will enable its reuse in different environments.
3. Interoperability: Promotion of several eLearning interoperability specifications and standards as a vital component in the successful implementation of various eLearning environments. Research issues within this category include learning objects metadata, content packaging, learner profiling, learner registration, and content communication.
4. Pedagogy: Research places emphasis in the pedagogical aspects of eLearning in order to create a theoretical framework that recognizes the diversity of personal learning styles and behaviours in different contexts and applications.
5. Assessment and Certification: Creation of Systems and Processes for assessing the effectiveness of ICT based learning solutions, support the learner's progress and provide certification of knowledge acquisition.

5 State-of-the-Art investigation methodology

During the 2nd scan analysis a more in-depth examination of the data collected in the 1st scan was performed (see Appendix A). In this process, WP1 partners reviewed the available data from the 200+ relevant R&D projects and selected an indicative subset. In total 64 projects were interviewed representing the 30% of the recorded projects. Almost a quarter of the interviewed projects were European funded and 74% were nationally funded projects. The above combination was used due to the fact that European projects reflect the planning of a central authority in comparison to the National projects that represent a far less homogenous planning and decision-making structure. Therefore more National projects than European ones are necessary in order to draw conclusions regarding the trends of the eLearning research.

The time2learn consortium partners selected a specific set of projects in their countries in order to perform a more in-depth analysis (the 2nd scan analysis) at a national level, according to their view of the significance that each project illustrated. The selection of the European projects was carried out based on a set of criteria:

- Include projects that are allocated in the action lines (Key Action 3):
  - Open Platforms and Tools for Personalised Learning
  - The Flexible University
  - Advanced Training System
  - The Learning Citizen
- Keep the ongoing/completed ratio constant, with respect to the 1st scan analysis collected data, but use the most recently (within 2002) completed projects.
- Cover all the budget range.

Using the formulated subset of the recorded projects, an in-depth analysis was realized, based on the three predefined technology related roadmapping sectors (Methodological Approaches, Technology Services, and Infrastructure).

In order to collect the necessary information from the selected projects three SIG questionnaires were created[2] each one focusing on one of the three axes:

- Methodological approach,
- Technology services and
- Infrastructure.

Each questionnaire depicts an analytical breakdown of all components belonging to the corresponding axis.

Using these questionnaires involved partners conducted a second phase of data collection in order to record all the needed information. Each project was asked to complete the entire set of questionnaires (SIG1, 2 and 3 questionnaires). In order to have the questionnaires completed two approaches were used: The first one was to mail the questionnaires to the project contact persons and have the completed questionnaires mailed back to us. The second one was to contact the project's contact persons directly and arrange a telephone interview, during which our representative filled-in the data into the questionnaires according to the answers provided by the project's contact person.

Each SIG reviewed the entire set of the in-depth recorded projects with respect to its area of interest resulting in a final assessment report. Figure 1 presents the number of projects per funding source that were interviewed during the in-depth analysis by the Special Interest Groups.

[2] See appendices D, E and F of the current document

In general, Special Interest Group one (SIG1) recorded the level of integration of specific learning methods in their learning environments. The quantitative and qualitative results of this study will help R&D groups in identifying areas that indicate a lack of research activity.

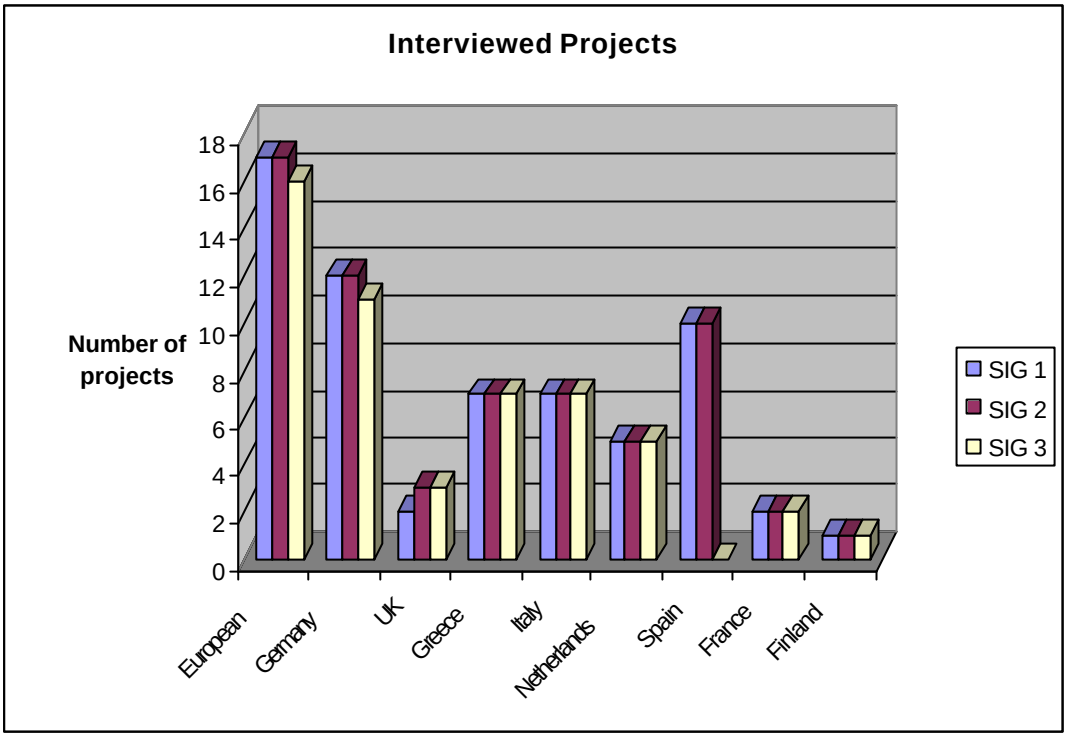


Figure 1: Number of interviewed projects per funding source and SIG

The second Special Interest Group (SIG2) examined the enabling technologies axis in the field of eLearning, using a taxonomy based on the book “Lernplattformen für das virtuelle Lernen, Evaluation und Didaktik”, R. Schulmeister and on various online product analyses. SIG2 compiled the results as diagrams that visualize different tendencies in the collected data on one hand, and as a complete list of enabling technologies including both, commercial products and self-developed tools, on the other.

The Special Interest Group three (SIG3) examined the infrastructure axis of the eLearning domain. It identified enabling technologies and researched the importance and maturity of those technologies by looking at the role they play for current research projects in Europe.

These reports are presented analytically in the following chapters.

6 Report on Methodological Approaches in eLearning

6.1 Introduction

This evaluation study aims to identify trends in the educational philosophy of various researchers, educators, and policy makers that have been involved in research and development (R&D) projects in eLearning. Participants in this study were asked to note the level of integration of specific learning methods in their learning environments. The qualitative results of this study will help R&D groups in identifying areas that indicate a lack of research activity. They will also show which methods have been applied quite extensively.

6.2 Theoretical underpinnings

The development and the exploitation of learning technologies have been inextricably linked with the development of learning theories. However, this link is not a causative one nor is it simply in nature, since lots of factors such as progress in hardware technologies, software engineering advances, societal changes and decisions of policy makers influence the theory and practice in the instructional process.

There are multiple reports that describe the relationship of learning theories to applications of computer technologies (e.g. by NGfL initiative in Scotland such as “ICT Into the Classroom of Tomorrow”, by the College of Education at Michigan State University, by the National Center for Research on Teaching & Learning (NCRTL), USA, etc.). However, only few reports indicate whether researchers, practitioners, developers, etc. have integrated learning methods or not and to what extent. This current report aims to show how a sample of R&D groups in Europe has applied of learning methods and to which extent.

Thus, we asked R&D groups to mention whether or not and to which level they apply a variety of learning methods. Unfortunately, there is no absolute consensus on the definitions and meaning of learning methods. As a proof, one could read about exhaustive lists of learning theories and models from various sources e.g. Greg Kearsley [http://tip.psychology.org/], Leilani Carbonell [http://www.my-ecoach.com/idtimeline/learningtheory.html], Learning with Software - Pedagogies and Practice. Open Learning Technology Corporation Ltd (OLTC). [http://www.educationau.edu.au//archives/cp/].

Thus, in order to eliminate the possibility of misunderstanding among the people who participated in this study, we circulated the list of methods among a diverse group of people to get a preliminary feedback. Based on this feedback, we proceeded in creating the questionnaire that can be found as Appendix C of the current document.

The learning methods that had been included in the questionnaire fall into five (5) broad categories:

1. Exploratory learning
2. Collaborative learning
3. Simulation based learning
4. Drill and practice
5. Self-directed learning

All the above categories can be supported by the use of learning technologies. In the analysis of these categories, we present the respective learning technologies. Moreover, we can identify three reasons for choosing these categories:

1. The learning process is comprised of sub processes that concern: studying of learning material communication/collaboration, and assessment.
2. Learning process concerns acquisition of knowledge and skills as well as changes in behaviour and habits. Thus, we had to find the learning methods that support them in conjunction to the different preferences/styles in learning.
3. The categorisation should embrace the learning process for diverse types of learning material, e.g. hypermedia, self-assessment tests, stand alone multimedia learning content, virtual reality resources, stand alone simulations, adaptive learning applications, etc.

The above taxonomy is technological oriented since we wanted to examine whether and to which degree various groups utilise specific technologies for supporting the application of learning methods.

More specifically, the categorisation of learning methods is the following:

6.2.1 Exploratory learning

In exploratory learning, the learner investigates the subject domain/learning resources on his or her own initiative, often in pursuit of a real or artificial task, having either direct or indirect guidance. The learner starts with a specific intention and explores the learning material in various ways.

- *Direct instruction (guided discovery)*: Direct statements of objectives, sets of activities clearly related to the objectives, careful monitoring of progress and feedback about achievements and tactics.
- *Non directive teaching (non guided discovery)*: learners handle information at a variety of levels of freedom, not directly guided

Exploratory uses of technology tend to deal with complex learning activities. Through the process of exploratory learning, guided discovery or not, the student learns facts, concepts, and procedures. For example a broad type of technology used for exploratory learning is computer-based information retrieval systems (e.g., electronic databases). It provides a context in which the learner may access, discover, and construct knowledge and acquire skills. Learning environments that utilise computer-based information retrieval systems provide learners with a way to access large bodies of information quickly and in a query-selected manner. In addition to serving as information retrieval systems, such systems (can be regarded as electronic databases) can provide learners with capabilities for organizing and manipulating data that they have accessed or entered. Within the physical and social sciences, databases can be used to explore and test the relationships between variables within complex systems. The educator can either directly guide learners in making queries and correlate the search results or give a learning objective/problem as well as links to databases so that the learners could look for and handle information at a variety of levels of freedom.

6.2.2 Collaborative learning

Collaborative learning is a method of learning in which a group of learners work together (or learners collaborate with teachers, staff, experts, scientists, practitioners, etc.) in order to explore a significant question or to complete an assignment.

- Via simple E-mailing lists

- Via asynchronous Discussion forums
- Via newsgroups
- Via Chat rooms
- Via Video conference
- Via Voice conference
- Via Shared white board
- Via Application Sharing
- Via argumentation tools (These tools is used for enhancing knowledge acquisition within ill-structured domains via is to empowering learners´ argumentation or critical thinking skills. Argumentation tools are combining hypertext and argumentation and investigate how to foster hypertext-based argumentation skills. An example is “gibis: a hypertext tool for team design deliberation”
- Via cooperative environments (Cooperative environments (groupware) which enable a group of users to cooperatively perform a task, allow multiple learners interact with a groupware application and jointly manipulate a common set of learning problem and data. During the course of this work each user has to be able to receive up-to-date information about all other learners' activities (this functionality is known as group awareness. For example such tools support online courses on Engineering activities, enabling collaborative design, verification and review in prototype implementations. A framework for building cooperative learning environments is the COAST framework that is available as open source software, www.opencoast.org)

6.2.3 Simulation based learning

Simulations are constructed from descriptions of real life situations. A less than real life situation is created for the instructional situation. The learner is engaged to achieve the goal of the simulation with realistic factors until the goal is achieved. This technique is especially valuable in subject domains that real experiments cannot happen (due to physical hazards, logistic constraints, etc.)

- *Role-playing*: Role-playing helps learners to understand social behaviour, their role in social interactions, and ways of solving problems more effectively. It also helps them collect and organize information about social issues, develop empathy with others, and attempt to improve their social skills. The model requires of the learners to "act out" conflicts, learn to take the roles of others, and observe social behaviour. Role-playing of workplace situations allows learners to practice applying their new knowledge before they have to face the real world. Role-playing enhances learning in several important ways: a) learners practice public speaking in a more relaxed format than that of a formal classroom presentation, and b) role-playing gives learners an opportunity to respond to unanticipated questions or situations. Effective scenarios require learners to integrate learning from various courses as well as from their work experiences. For example, this learning technique could be used in simulation of law practice.
- *Business Simulation Activities*: BSA is an alternative or a complement to on-the-job training activities in technical professional education. In a business simulation, learners perform tasks such as starting a company, creating a production strategy, and defending an investment plan to a board of director. The point in a business simulation is that students learn by doing. The actual work environment is simulated and they perform tasks that they will have to perform on the real job. Learning environments/tools that apply BSA techniques look like the SimCity game.

- *Virtual Laboratories*: Virtual Laboratories allow learners to conduct laboratory experiments anytime and at anyplace. Students can conduct tests as if they were in a real laboratory, interpret the results and apply them to practical situations using 3-D simulated apparatus. Virtual laboratories allow learners to explore real- life, real-time phenomena. Typically, they consist of measurement equipment or sensors connecting a computer and the environment. For example, the equipment (sometimes called "probeware") could measure physical phenomena, such as sound, light, or temperature, and records data that can be displayed as it is being recorded, or saved and analyzed at a later date. This real-time measurement with real-time display capabilities offers learners an opportunity to better understand the connection between a phenomenon and its graphic or mathematical representations. Learners utilize the tools of the scientist to engage in the processes of hypothesis testing, data collection, and data analyses.
- *Microworlds*: Microworlds are exploratory environments that systematically model relationships between abstract components such as Logo, ThinkerTools, Model-It, etc. Moreover, Stagecast Creator is an example of a customized programming environment developed for younger learners, allows analogical programming to be applied to the development of simulations, animated stories or instructional tutorials, and games. Activities using this programming environment could be integrated into many content areas and thus encourage the dual agenda approach of developing content area knowledge and higher-order thinking. On the other hand, PowerSim is an integrated platform for developing and running simulation models. It Includes connection to spreadsheets and internal datasets and includes sensitivity analysis through Risk Assessment.
- *Virtual Reality & Active Worlds*. Active Worlds, the webs most powerful Virtual Reality experience, allows the learner to visit and collaborate in 3D virtual reality environments that could have been built by other learners. Multi-User Domains(MUD), MUD Object Oriented (MOOs), Multi-User Shared Hallucination (MUSHs) are internet accessible, text mediated virtual environments, well suited for distance teaching and learning.

6.2.4 Drill and practice

A drill activity provides learner with practice over materials already learned, in order to strengthen or maintain the knowledge

- Self-assessment quizzes (multiple choices, fill-in the blanks, puzzles, etc.)
- Adaptive and personalized quizzes
- Open type assessment
- Problem solving tasks

6.2.5 Self-directed learning

As Knowles states (1975)."self-directed learning describes a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. The main difference from exploratory learning is that the latter happens within a very well described learning context (as a learning subprocess with specific learning objectives) while in the case of self-directed learning the learner has the flexibility and the levels of freedom in setting up his/her learning goals and objectives.

- Via hypermedia stand alone tutorials
- Via Intelligent Tutoring Systems
- Case-based learning: Case studies help learners understand the subject domain from solid examples, to compare a given problem to an existing one in order to find the proper solution.

- Scientific inquiry: The learner is brought into the scientific process and is helped to collect and analyse data, check out hypotheses and theories, and reflect on the nature of knowledge construction.

6.3 Evaluation framework

Educational innovations, which make use of technology, come in a broad variety of forms and functionalities. While computer technology is quite a plastic medium in many respects, the range of utilisation of existing technologies in applying certain learning methods is not obvious. In this respect, this study was addressed to R&D people who use technologies in learning in order to find out which learning methods they practice.

For each one of the learning methods mentioned in the previous section, the participants in this study had a number of options to select from for indicating whether or not they had integrated a method and to what extent:

The options were:

1. High expertise in using it
2. Experimental usage
3. Subject of research
4. Not applicable
5. Don't know / never heard of it

As toolkit in this evaluation study, we used a simple questionnaire that can be found in Appendix C. 64 people from various countries participated in this study. All of them had been involved in R&D projects where the utilisation of technologies in learning was the key aspect. Some of them have also been academics and/or researchers in the eLearning field.

The main purposes of this study are: a) to present the quantitative and qualitative results of the level of integration of learning methods, and b) to identify research and development areas on which more emphasis should be given. This study is addressed to the R&D community as well as to policy makers interested in having a view of some trends regarding the level of integration of learning methods in technology based education. The results of this study could motivate stakeholders to emphasize on R&D in less thoroughly researched areas of eLearning.

6.4 Data Analysis

Design experiments are challenging to pull off not only for theoretical reasons, but also for very pragmatic ones. This section tries not only to present the results from the analysis of the data gathered but also to make comments on them.

As aforementioned, 64 participants filled in the questionnaire. Experts in learning technologies reviewed the questionnaires (and exchanged opinions via email) before distributing it to the participants in order to ensure that the chosen items were representative with the focus of the subjects in this study. The main focus was to identify trends in the data and not precisely measure what is going on in the eLearning field at European level since the number of participants was small. Thus, the emphasis was given to expert review rather than a thorough statistical validation.

The first step of any data analysis –including this one– is to inspect the data for "bad" values. Bad data points are entries in a data file that are unreasonable and represent clerical errors or misunderstandings by persons collecting or reporting the raw data. This is known as "cleaning

the data file". Indeed the answers in 6 questionnaires had not been valid since those participants answered that no learning methods were applicable. In fact, this fact was a bit awkward since all R&D groups that participated into this survey had been selected carefully due to their involvement of current state of the art in R&D projects concerning learning technologies. The best explanations are that either these groups had been too much focused on a specific learning method without dealing with others, or they had been too techno-centric and did not pay attention to the learning methods but rather on the technology itself. In any case, we considered these data as “noise” and we decided to keep them out of the statistical analysis. So, the data file comprised of answers by 58 participants.

The mean values of the answers and the standard deviation per learning method and level of integration in this evaluation study are shown in Table 1. Since the data collected do not allow us to do very sophisticated quantitative analysis, we use the mean values and standard deviation as metrics for showing the trends in applying the learning methods.

Table 1. Number of answers, mean values and standard deviation per learning method and level of integration

	high expertise (1)	experimental usage (2)	subject of research (3)	not applicable (4)	never heard (5)	AVG	STDV
Exploratory learning						**2.23**	
Direct instruction	31	6	2	18	1	2.17	1.40
Non directive teaching	23	13	4	18	0	2.29	1.28
Collaborative learning						**2.73**	
Via simple E-mailing lists	37	6	2	13	0	1.84	1.25
Via asynchronous Discussion forums	33	13	4	8	0	1.78	1.08
Via newsgroups	18	10	2	23	5	2.78	1.46
Via Chat rooms	16	14	5	22	1	2.62	1.30
Via Video conference	10	9	4	33	2	3.14	1.25
Via Voice conference	11	9	4	31	3	3.10	1.29
Via Shared white board	8	13	6	28	3	3.09	1.22
Via Application Sharing	7	15	6	25	5	3.10	1.24
Via argumentation tools	8	4	3	30	13	3.62	1.30
Via cooperative environments	26	10	5	16	1	2.24	1.33
Simulation based learning						**3.19**	
Role playing	18	13	3	22	2	2.60	1.36
Business Simulation Activities	15	13	1	26	3	2.81	1.38
Virtual Laboratories	9	11	4	31	3	3.14	1.25
Microworlds	4	5	3	36	10	3.74	1.07
Virtual Reality & Active Worlds	4	4	4	41	5	3.67	0.98

	high expertise (1)	experimental usage (2)	subject of research (3)	not applicable (4)	never heard (5)	AVG	STDV
Drill and practice						**2.26**	
Self assessment quizzes	30	9	6	13	0	2.03	1.24
Adaptive and personalized quizzes	17	16	8	15	2	2.47	1.26
Open type assessment	14	16	5	21	2	2.67	1.29
Problem solving tasks	33	11	2	12	0	1.88	1.20
Self-directed learning						**2.28**	
Via hypermedia stand alone tutorials	38	10	3	7	0	1.64	1.04
Via Intelligent Tutoring Systems	19	14	4	20	1	2.48	1.31
Case-based learning	34	10	2	11	1	1.88	1.24
Scientific inquiry	12	11	0	29	6	3.10	1.40

The following Figures, (Figure 1a-1e) illustrate the percentage of level of integration of each learning method within each of the five categories. More specifically,

In the category of exploratory learning there is quite high expertise, especially in direct instruction. However, a number of groups have not applied this method. Definitely, both of these methods are not the main subject of research. Research topics in this area are new pedagogical models, new instructional design paradigms. Perhaps the R&D groups are more technologically oriented than theoretical oriented.

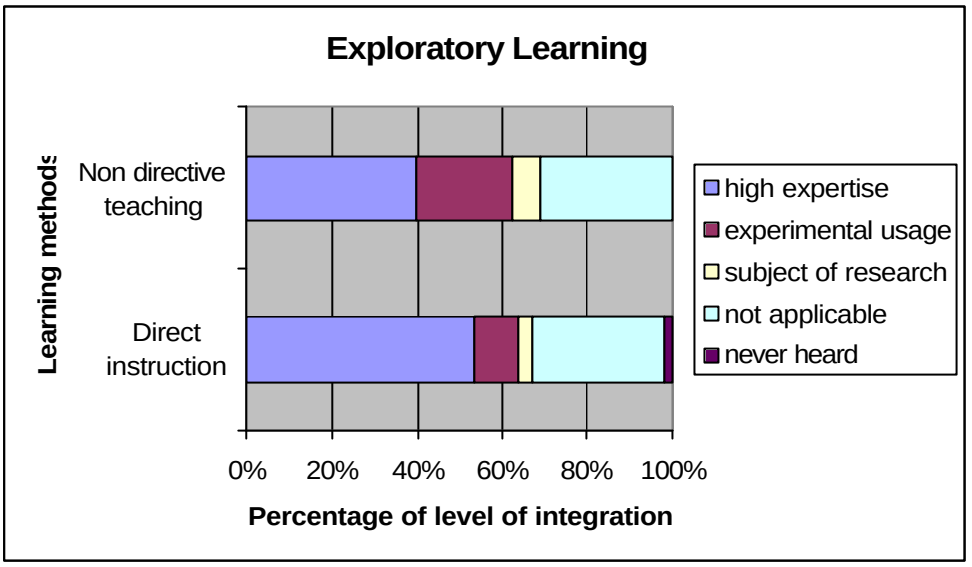


Figure 1a. Levels of integration in exploratory learning

In the category of *collaborative learning* there is higher expertise in asynchronous methods than the synchronous ones, especially concerning the use of e-mail and discussion forums. It is also interesting that cooperative learning tools are popular. A large number of groups have not applied synchronous learning methods. It should be noted that significant R&D trends in Video/Voice conference systems, Shared white board and Application Sharing have been identified.

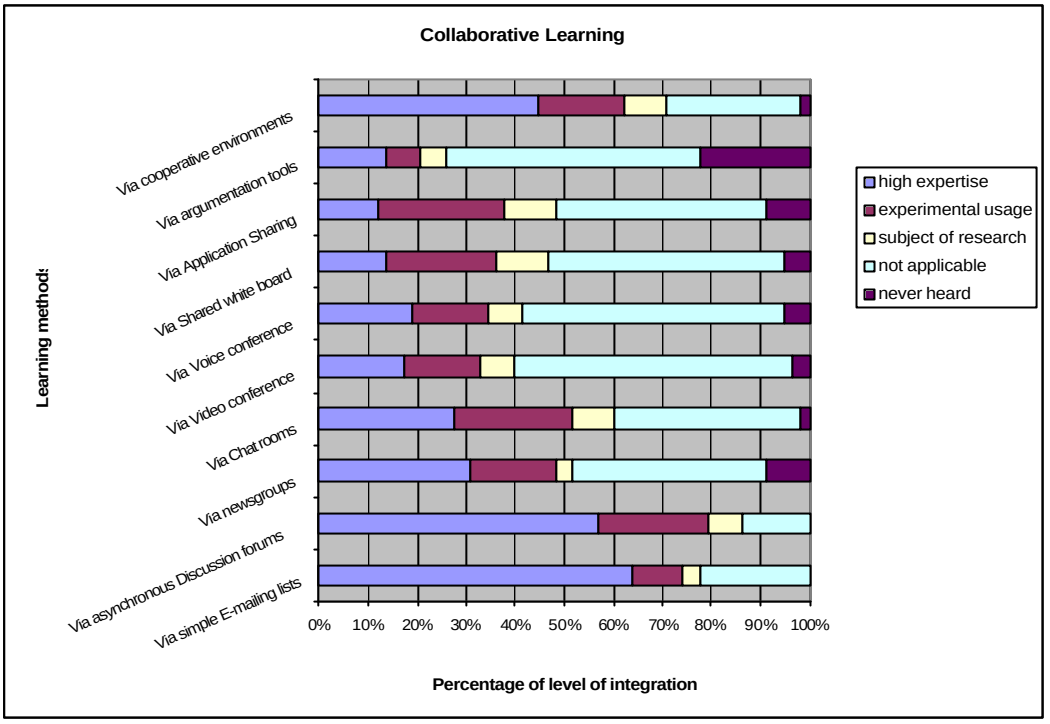


Figure 1b. Levels of integration in collaborative learning method

In the category of *simulation based learning* the percentages of experimental usage is higher that the high expertise, when applicable. However, the methods in this category are mainly inapplicable for a large number of groups. Moreover they have not applied synchronous learning methods. In general, in this category, the percentage of inapplicable methods is high. The percentage of unknown methods is quite high relatively to other categories, especially for microworlds.

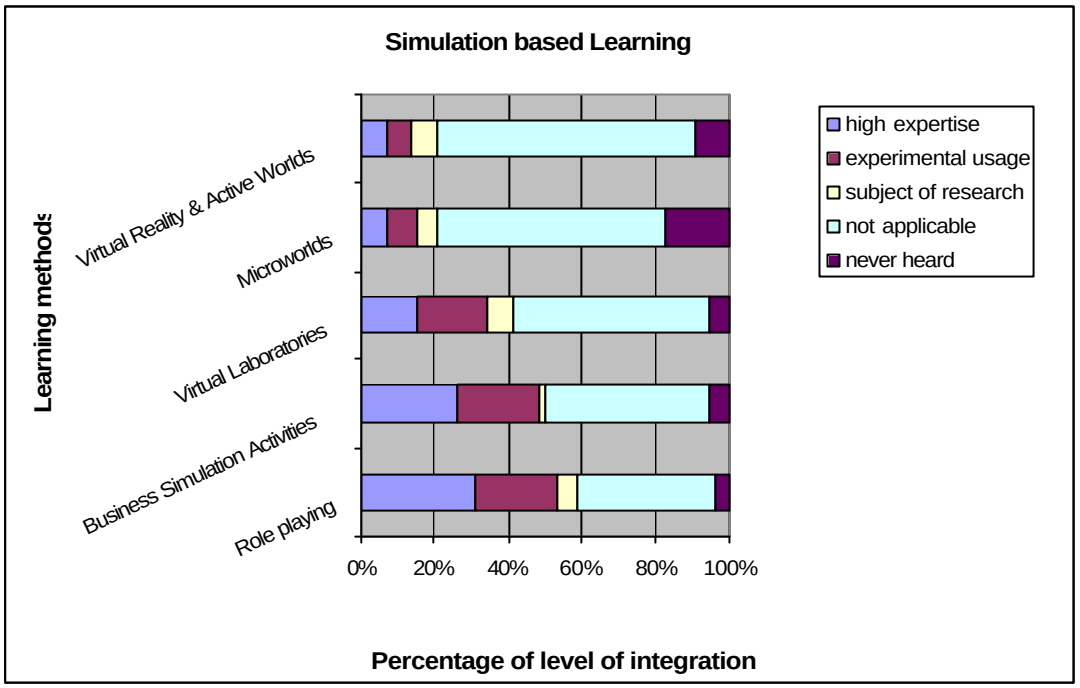


Figure 1c. Levels of integration in simulation based learning method

In the category of *drill and practice*, the results show that R&D groups are experts or use at quite extent methods that support self-assessment and problem solving tasks. It seems that this category is prosperous for subject of research especially for the adaptive and personalised self assessment. This accords to the fact that a lot of experimental self assessment tools exits and that IMS QTI specification is one of the few stable learning technology standard.

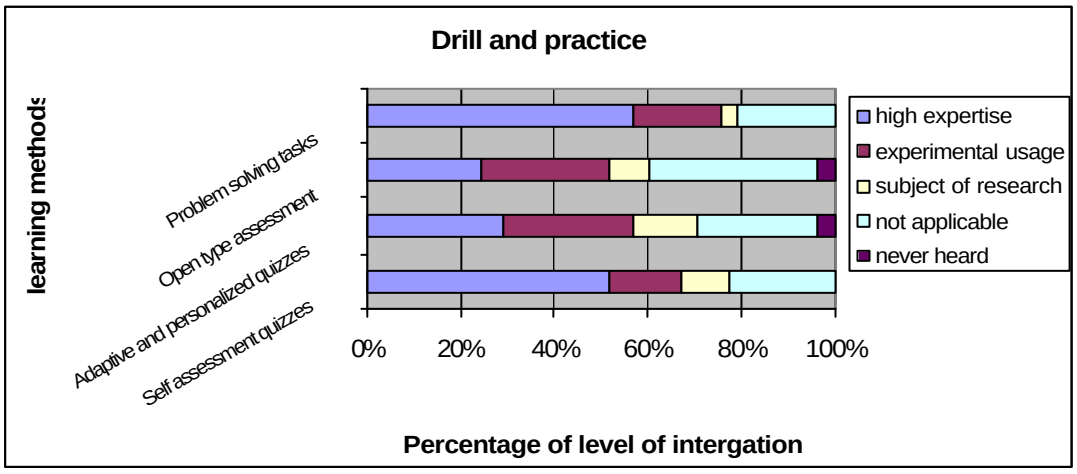


Figure 1d. Levels of integration in drill and practice learning method

In the category of *self-learning*, there is high expertise with the exception of inquiry learning, which is basically inapplicable. Moreover, the level of integration of the method using intelligent tutoring systems is almost shared among high expertise, experimental usage and not applicable.

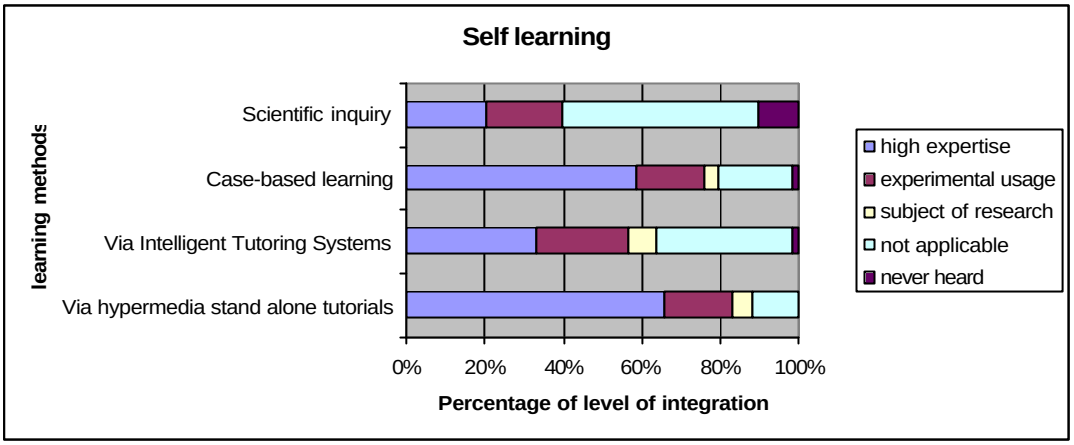


Figure 1e. Levels of integration in self-learning method

Further analysis of the values of data file can help us categorise the learning methods per level of integration. The following five figures (Figures 2 through 6) show this categorisation per level of integration. Please note that the numbering in the learning methods is the following:

1. Direct instruction
2. Non directive teaching
3. Via simple E-mailing lists
4. Via asynchronous Discussion forums
5. Via newsgroups
6. Via Chat rooms
7. Via Video conference
8. Via Voice conference
9. Via Shared white board
10. Via Application Sharing
11. Via argumentation tools
12. Via cooperative environments
13. Role playing
14. Business Simulation Activities
15. Virtual Laboratories
16. Microworlds
17. Virtual Reality & Active Worlds
18. Self assessment quizzes
19. Adaptive and personalized quizzes
20. Open type assessment
21. Problem solving tasks
22. Via hypermedia stand alone tutorials
23. Via Intelligent Tutoring Systems
24. Case-based learning

25. Scientific inquiry

Figure 2. Methods with high expertise

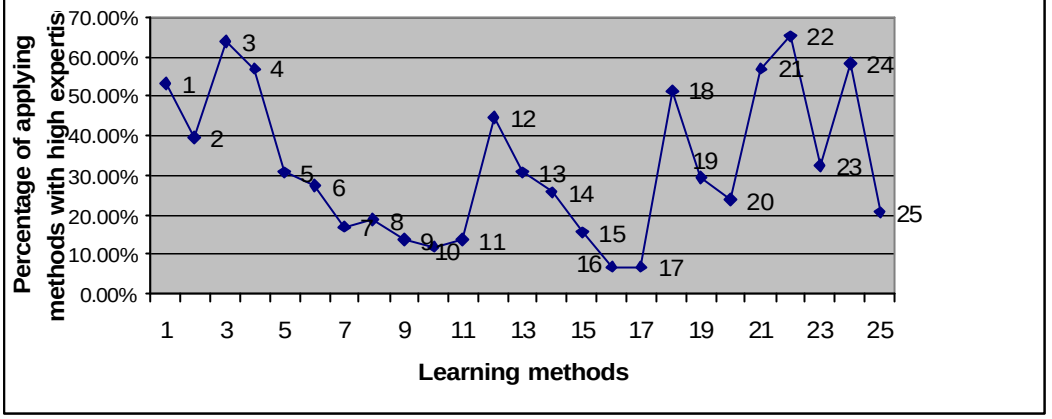


Figure 3. Methods in experimental usage

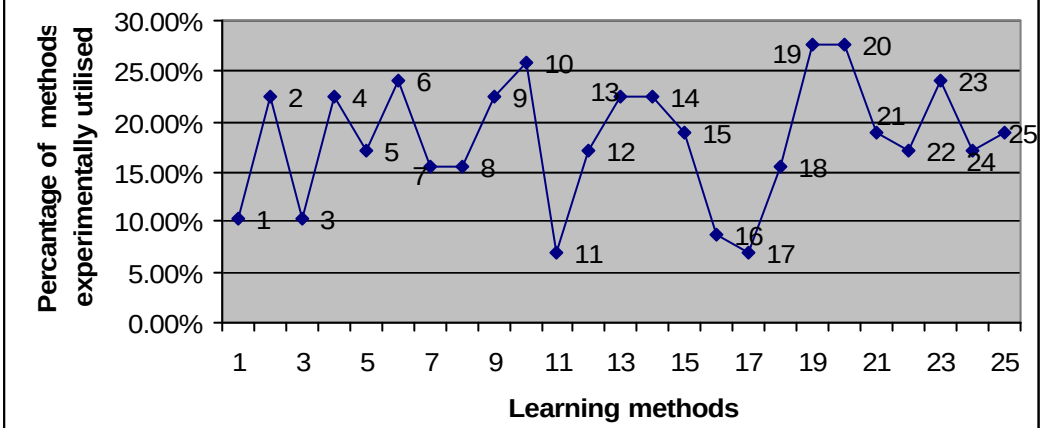
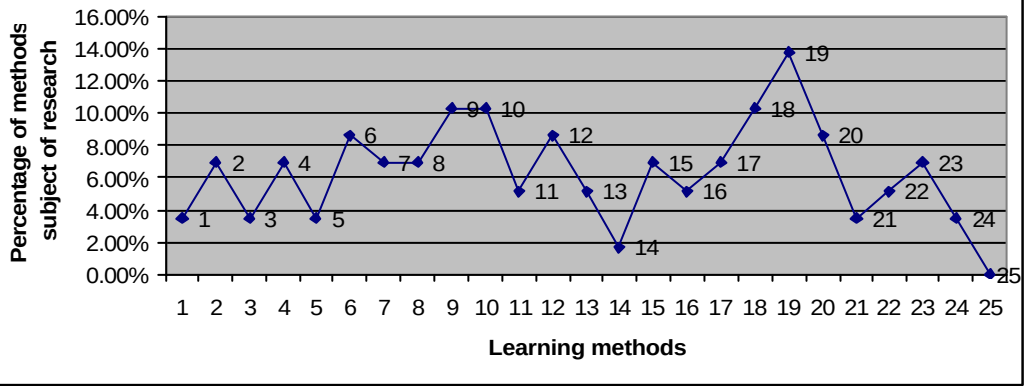
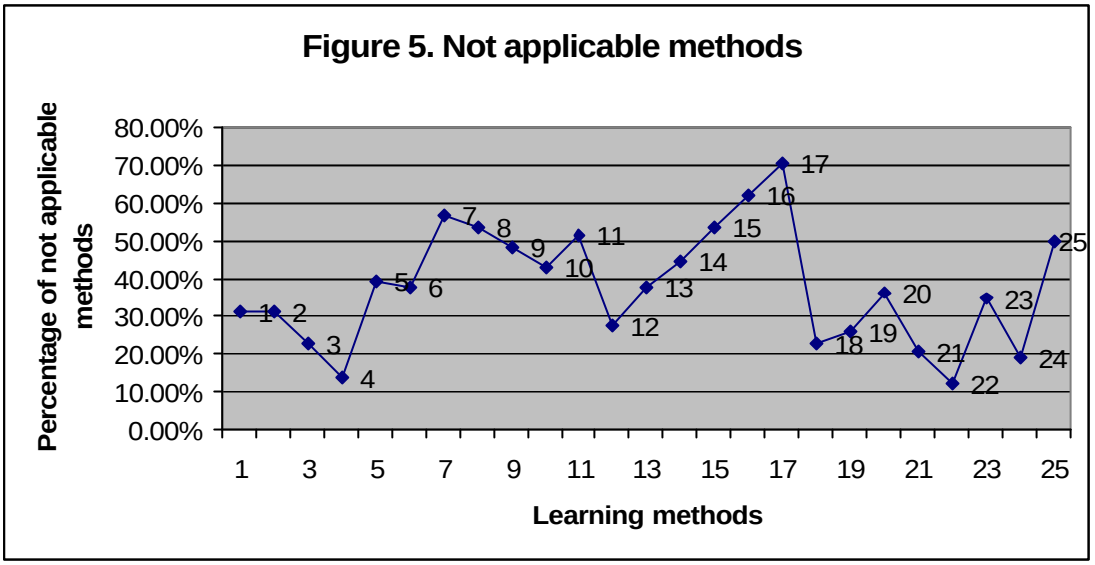
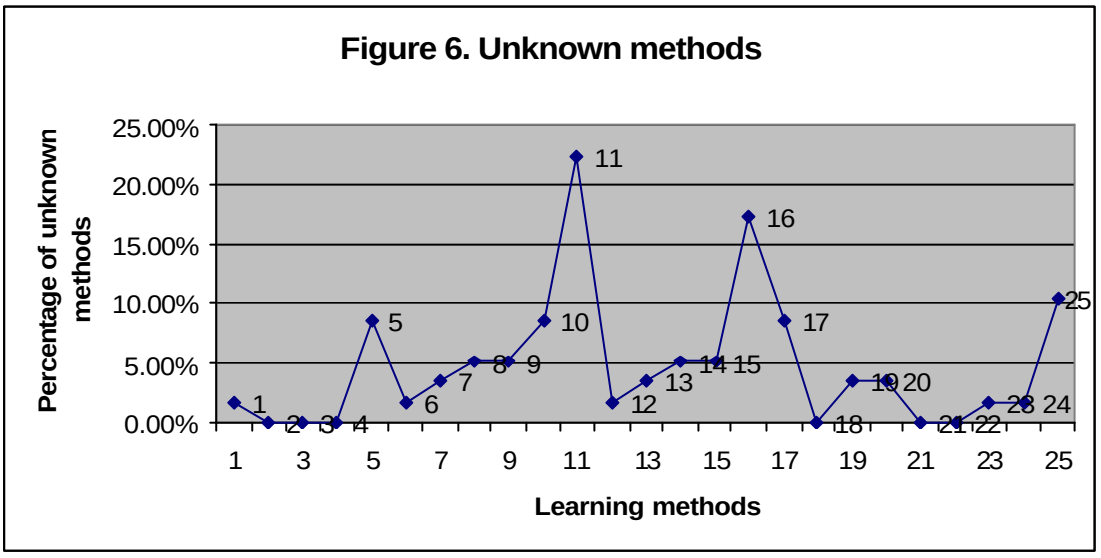


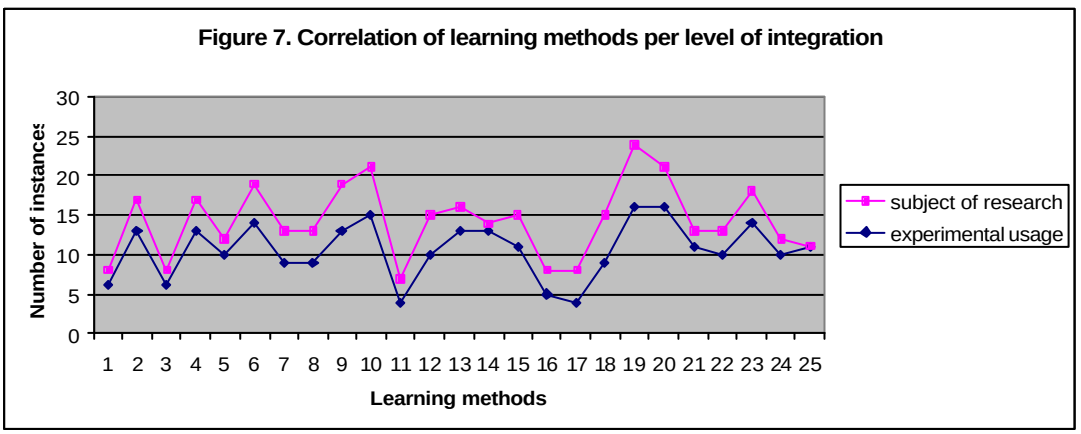
Figure 4. Methods Subject of research







Finally, Figure 7 is a compound chart of "experimental usage" and "subject of research" learning methods which could offer indications to R&D trends. It is evident that these level of integration go together, meaning that where there is high value in experimental usage, significant effort is given in research in this area.



	Learning methods	
Level of integration	**Highest value**	**Lowest value**
High expertise	Via hypermedia stand alone tutorials	Virtual Reality & Active Worlds
Experimental usage	Adaptive and personalized quizzes, Open type assessment	Virtual Reality & Active Worlds
Subject of research	Adaptive and personalized quizzes	Scientific inquiry
Not applicable	Virtual Reality & Active Worlds	Via hypermedia stand alone tutorials
Don't know	Via argumentation tools	Non directive teaching Via simple E-mailing lists Via newsgroups Self assessment quizzes Problem solving tasks Via hypermedia stand alone tutorials

Table 2: Highest/Lowest "integration into projects" values of learning methods used

The findings in Table 2 are more or less anticipated. In fact, the first form of eLearning has been the hypermedia tutorials and therefore it is reasonable to have them as the most widely applied method within the projects. Moreover, most of the methods for applying the collaborative learning theory (i.e. mailing lists, newsgroups, etc.) are widespread.

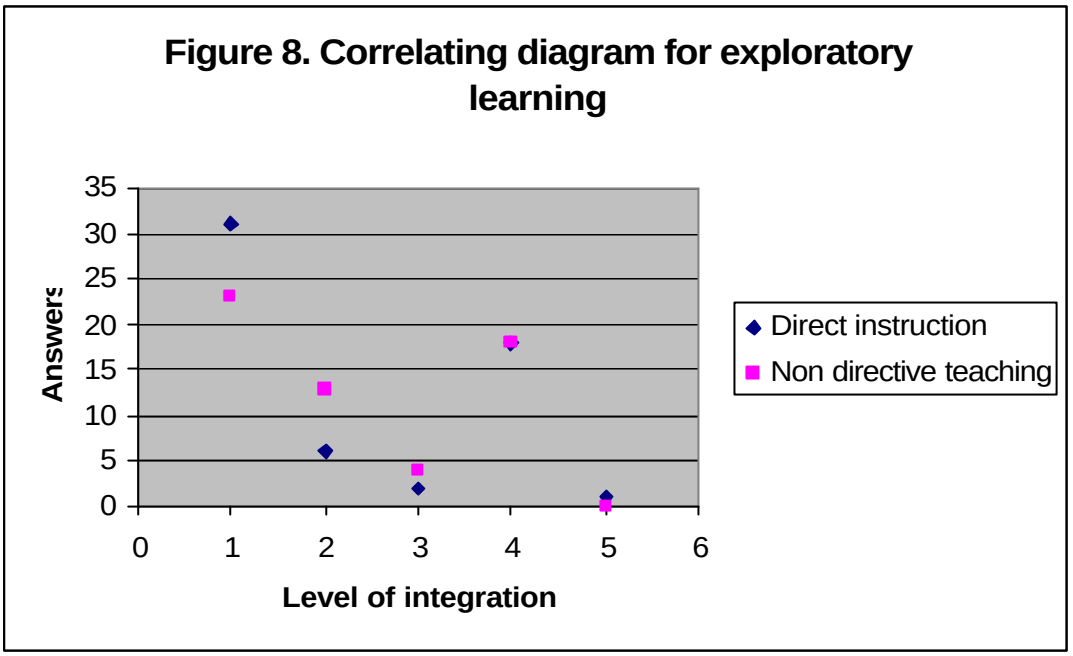
As predicted, the learning method via virtual reality has not been applicable. In this sample of participants, it seems that not much research is being done in this area. This is not surprising either since there are a lot of technical, administrational and financial constraints that do not permit research experiments at large extent.

Furthermore, the area of adaptive learning has high research priority. This complies with the R&D trends as they derive from the recent literature. Many groups have been recently involved in this area in comparison to the situation 5 years ago. Nowadays, sessions, workshops, tutorials, etc. are organised in all big conferences related to learning.

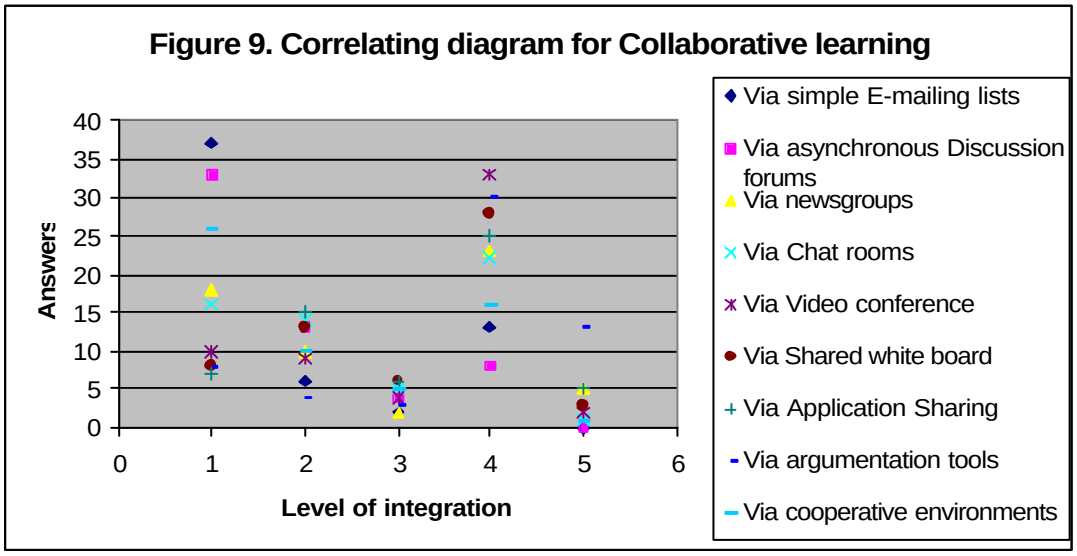
In general, learning methods supported by innovative technology require more technical support than off-the-shelf solutions. Moreover, innovative learning methods usually require more conceptual support for learners and teachers as well. For example, the scientific inquiry method involves engaging learners in a hands-on introduction to the different representations of physical phenomena before they understand how they are going to apply this method using specific tools.

Further analysis on this data file has been made in order to identify possible associations among learning methods in each category. We did not try to examine if learning methods in each category are causally related, since it did not make any sense because they are not independent variables. However, we tried to examine whether the levels of integration of various methods within a learning category are correlated/associated. In this way we could find small groups of methods within a category to which R&D groups show preferences in development or research or they do not apply. In that effort we created correlating diagrams (see Figures 7-10) that can be regarded as an alternative version of scatter diagrams/plots.

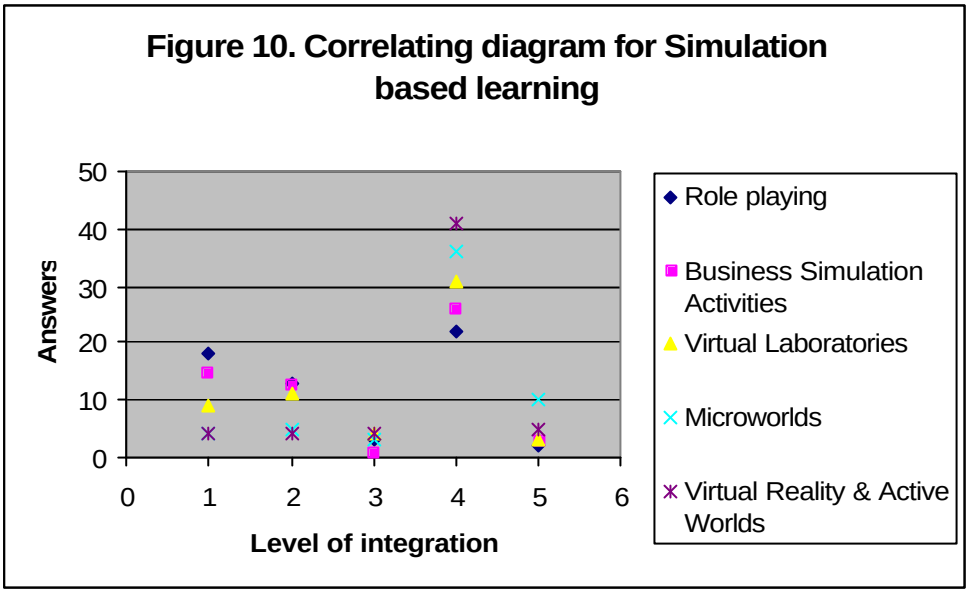
For the category of *exploratory learning*, we can identify some kind of correlation between the two learning methods, especially at the levels of integration 3, 4 and 5. (I remind that 3=subject of research, 4=not applicable and 5=don't know/never heard of it)



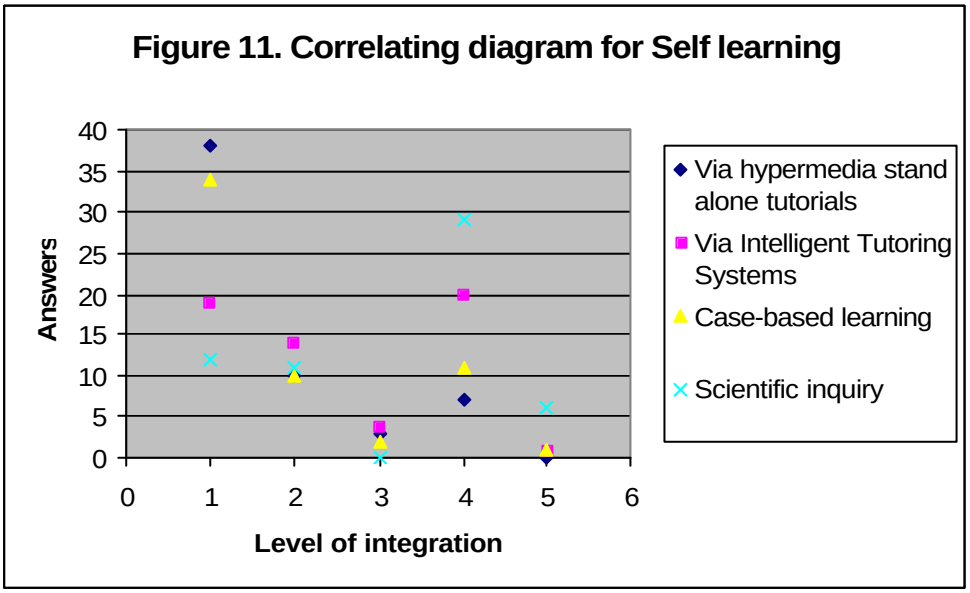
For the category of *collaborative learning*, we can identify some kind of correlation between the asynchronous and synchronous learning methods. For example the groups that have limited expertise in video conferencing, shared whiteboard and application sharing have high expertise in simple mailing list and discussion forums. At the levels of integration 3 we can see that when a group is involved in research activities in this category, it deals with all the methods. Finally, it seems that there is not enough correlation between argumentation tools and the rest of the methods. This is understandable since the argumentation method is not as popular as the other ones and the tools that support it, are not that advanced.



In the area of simulation based learning, there is a clear correlation between microworlds and virtual reality. We speculate that this is a symptomatic outcome since they are totally different learning methods.



In the case of self-learning, no evident of correlation was identified.



6.5 Conclusions

A variety of different forces are present when applying educational technologies, including: (a) technological availability, capabilities, and constraints, (b) prior instructional goals and practices of the participants (teachers, researchers, and learners), (c) current instructional goals, (d) theoretical influences from conceptual and instructional frameworks, and (e) impacts deriving from research interests.

In this evaluation study we identified that some of the included learning methods are more preferable than others and there is higher expertise in them by a number of R&D groups who

have been involved in eLearning projects. Unfortunately some methods have not been explored as yet neither of them is subject of research, like the argumentation, virtual reality and active worlds. This might be explained by the fact that a) these methods have been applied to very specific subject domains like law for argumentation, b) they demand a lot of resources and technical expertise personnel, and c) the results from evaluation studies of the learning effectiveness of the application of these methods might not have been promising, as yet. Of course one might argue that if a method is unknown to many R&D groups, it is subject for research contribution. And this is true, especially for some cases e.g. argumentation tools, adaptive and personalised testing systems.

On the contrary, asynchronous collaborative learning seems to be the dominant learning method, thus mature enough, since a variety of mature tools exist nowadays and a lot of studies have proven the effectiveness of this method. In fact, the modern instructional models advocate that a mix and match of learning methods can lead to more effective learning experiences. This trend is basically followed by the R&D community. Future funds should be allocated in finding ways of supporting multiple learning methods within a learning environment. Some unexplored learning methods such as simulation based learning, and argumentation are definitely areas for future R&D.

7 Report on Technology Services

7.1 Introduction

SIG2 "enabling technologies services" aims at identifying trends in the use of eLearning specific applications and tools in European and national level, as well as identifying gaps and needs for further development of eLearning tools. In order to scan the current situation in the research field of eLearning, a questionnaire has been constructed, which has been filled out by the project coordinators. The construction of the questionnaire is based on an application categorization, containing an extensive list of eLearning tools. The same categorization has been further used as the basis for the analysis and visualization of the gathered information.

7.2 Questionnaires

First of all a categorization of applications and services in the field of eLearning has been developed, based on related literature like the book "Lernplattformen für das virtuelle Lernen, Evaluation und Didaktik", R. Schulmeister and on various online product analyses like online studies, market reports, brainstorming etc.

This learning management system (LMS) is a software application that automates the administration of distance learning and it is used to plan, implement, and assess a specific learning process. Typically, a learning management system provides an instructor with a way to create and deliver content, monitor student participation, and assess student performance. So an LMS provide the (administrative) basis for the implementation of distance Learning. For that reason LMS applications were used as the starting point for the development of the applications categorization.

Mainly because of reasons of market competition there is a trend of integrating LMSs with other Software – methods and functionalities. The most characteristic example is the integration of a Content Management System or a Knowledge management System. In this case the system is called Learning Content Management System LCMS and is considered as an extended form of LMS.

A learning management system may also provide students with the ability to use interactive features such as video conferencing, and discussion forums etc., though the most LMSs and LCMSs lack functionalities beyond the administrative ones.

Furthermore, applications, which are essential for distance learning and are available either as stand alone tools or as integrated components in an LMS, are classified as "Add on Tools". They assignment of add on tools into smaller categories, is based on their common characteristics and functionalities.

The resulting categorization has been used for the construction of the SIG2 questionnaire (Annex 2)

In total, 52 projects were selected as being relevant for this report, 18 European Projects and 34 National Projects.

For each application or tool the project coordinators were asked to indicate the role that this tool plays within the project or research activity. There are five possible choices:

The application is

1. substantial tool for the project (the application plays a major role in the project)

2. enabling tool for the project (the application plays a supportive role in the project)
3. subject of research (the application is under investigation)
4. not applicable (the application is not relevant)
5. don't know / never heard of this application

The questionnaire provided the project coordinators with the possibility of adding missing commercial applications as well as tools developed in the framework of the project. The project coordinators were furthermore asked to provide project related information. The questions provided are:

- Reason for development (the scope of the tool)
- Uniqueness - why is the tool unique (differences from existing tools)
- Development Cost.
- Readiness for marketing – exploitation plans.

7.3 Results

The gathered results were compiled in different ways, as diagrams which visualize different tendencies in the data and as a complete list of applications including both, commercial products and self developed tools (Annex1).

The results presented are based on the three options "substantial tool for the project", "enabling tool for the project" and "subject of research". Since the options "not applicable" and "don't know / never heard of this application" were not used in a consequent way by the

The following diagrams provide two different representations of the data, the project oriented and the application oriented representations. Both of them offer a separate view on European project and national project results. The visualization of the results is based on the following applications categorization, which at the same time represents the questionnaire structure (a representation of the results for each application is not in the scope of this report).

1. Virtual Learning Environments
    - 1.1. Learning Management Systems
    - 1.2. Learning Content Management Systems
2. Add on Applications
    - 2.1. Authoring Tools - Content Creation
        - 2.1.1. Multimedia Editors
        - 2.1.2. Web Editors
        - 2.1.3. Recording Tools
        - 2.1.4. Video Editing Tools
        - 2.1.5. Voice Recognition, Speech Synthesizers
        - 2.1.6. Course Development Tools (knowledge Management)
    - 2.2. Distance Interactive Learning - Delivery Tools
        - 2.2.1. Virtual Classrooms
    - 2.3. Collaboration Software
        - 2.3.1. Web Conferencing Tools
        - 2.3.2. Video Conferencing Tools
        - 2.3.3. Collaborative Tools
        - 2.3.4. Special Communication Tools
        - 2.3.5. Simulation Tools
        - 2.3.6. Information & Exchange Systems
    - 2.4. Learning Brokerage Platforms
    - 2.5. Knowledge Management Tools
    - 2.6. Assessment Tools

2.7. ERP/HRIS Software

7.3.1 Project oriented analysis and conclusions

In the project oriented data analysis we have tracked the information about the applications used in each project.

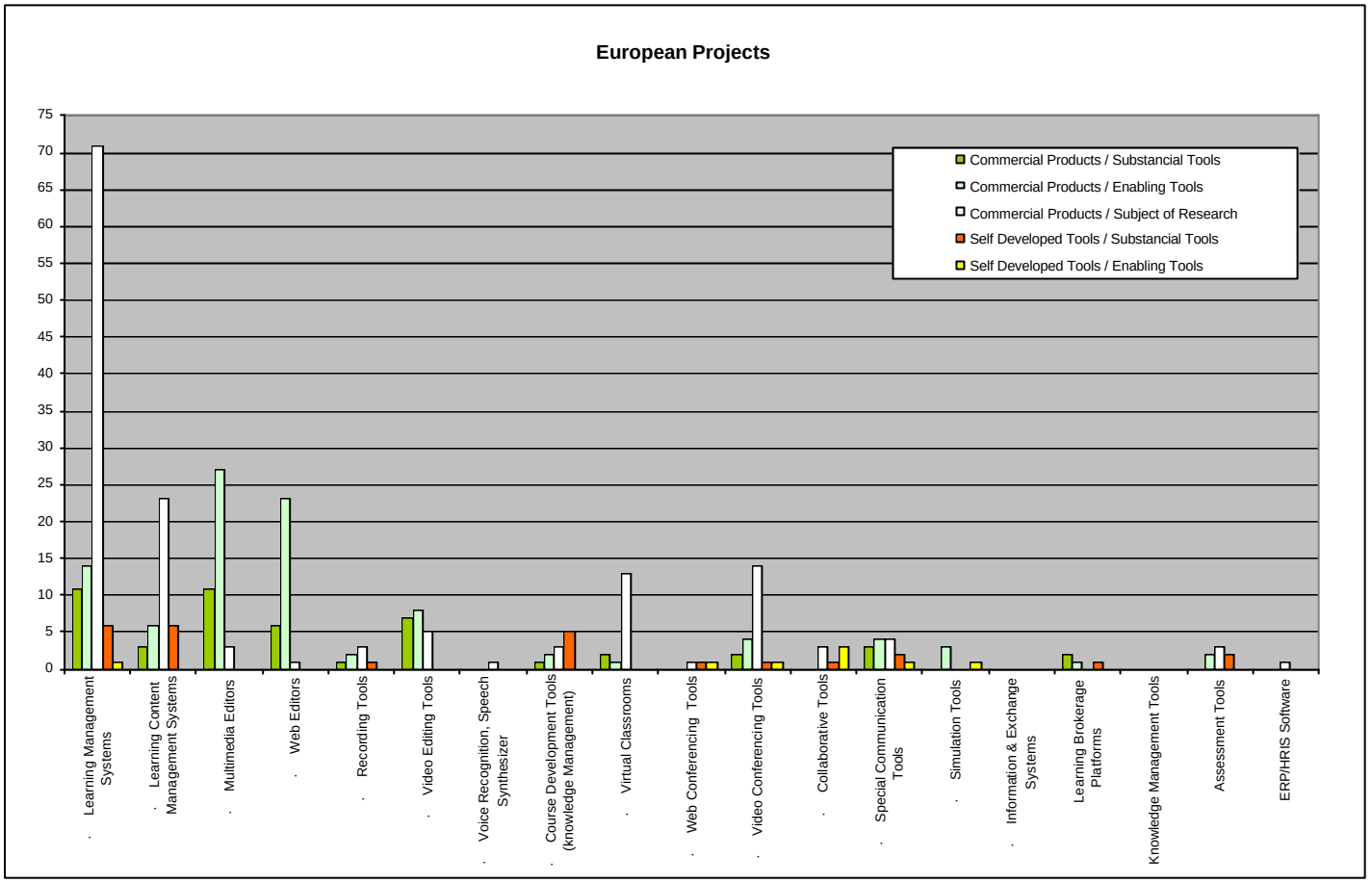
The following two diagrams show the use of different applications and their role in European and national projects. They provide both quantitative as well as qualitative information. (cumulative calculation-representation of the data e.g. all indications for the use of an applications from the category LMS were added regardless which application the interviewees were referring to) and reveal trends in the use of eLearning tools.

The results show that in European projects there is much more effort put in the investigation of applications especially in the categories LMS, LCMS, Virtual Classrooms and Video Conferencing Tools. On the other hand the development of LMS and LCMS seems to be a main target of many national projects. Self developed applications play in national projects in the majority of the cases a substantial role whereas in European projects there are many self developed applications classified as “enabling tools”. This might reinforce the assumption that the focus of European projects is not the development of applications itself. According to the project leaders, the main reason for the development of custom software is the insufficiency of commercial products in terms of functionalities needed to cover the needs of the specific teaching-learning activities. For the most of the self developed applications there are no plans for commercialisation.

The diagrams show that the role of Learning Management Systems, Learning Content Management Systems followed by Multimedia and Web Editors is in general in both European and national projects very important compared to other application categories.

In the National Projects Diagram apart from the LMS and LCMS categories an important role play Multimedia Editors, Video Editing, Video Conferencing and Assessment Tools.

In general in European Projects there is a more extensive use of, and experimentation on applications in all categories.


European Projects
75
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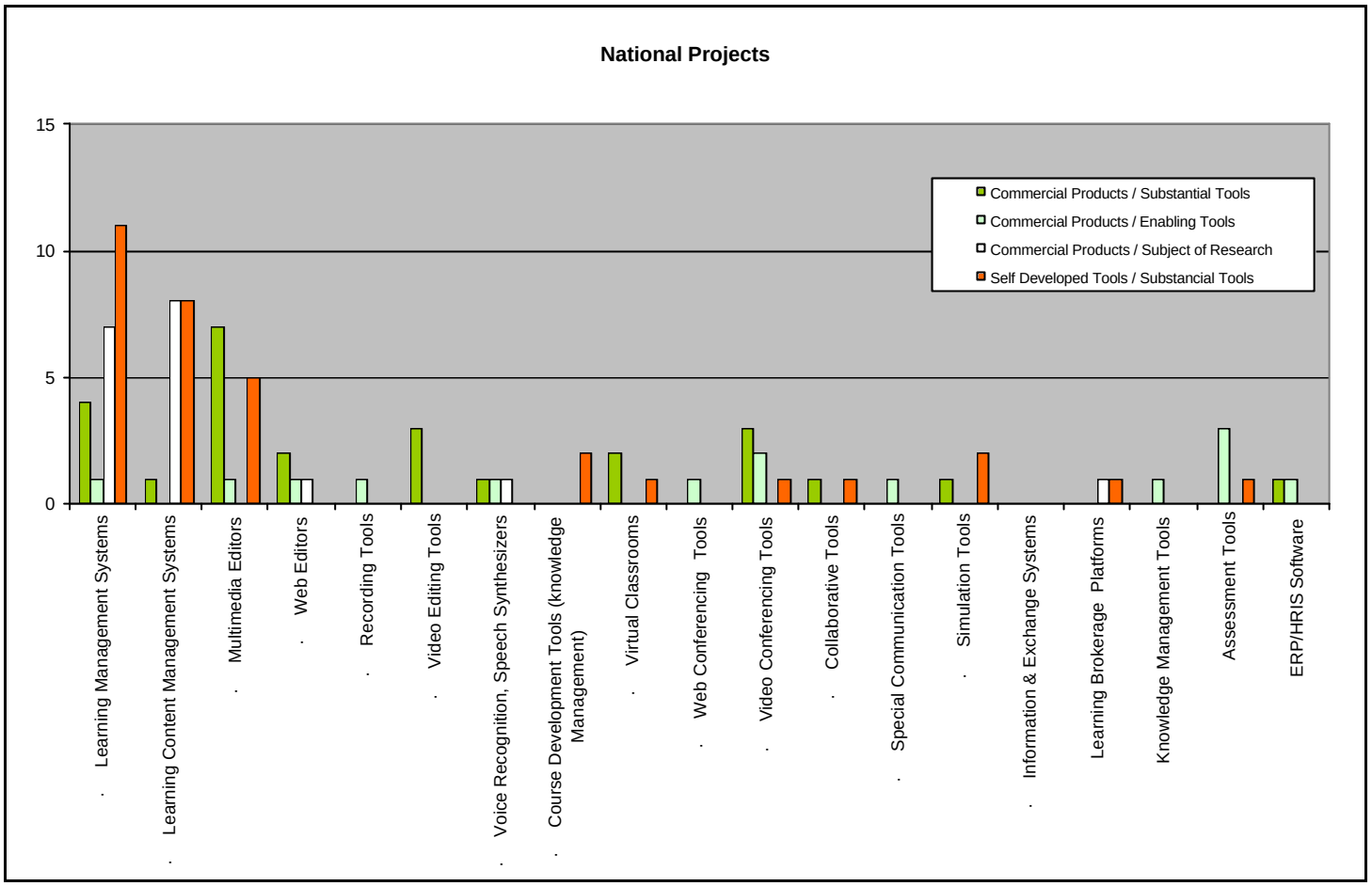
Commercial Products / Substancial Tools
Commercial Products / Enabling Tools
Commercial Products / Subject of Research
Self Developed Tools / Substancial Tools
Self Developed Tools / Enabling Tools
Learning Management Systems
Learning Content Management Systems
Multimedia Editors
Web Editors
Recording Tools
Video Editing Tools
Voice Recognition, Speech Synthesizer
Course Development Tools (knowledge Management)
Virtual Classrooms
Web Conferencing Tools
Video Conferencing Tools
Collaborative Tools
Special Communication Tools
Simulation Tools
Information & Exchange Systems
Learning Brokerage Platforms
Knowledge Management Tools
Assessment Tools
ERP/HRIS Software


National Projects
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Commercial Products / Substantial Tools
Commercial Products / Enabling Tools
Commercial Products / Subject of Research
Self Developed Tools / Substancial Tools
Learning Management Systems
Learning Content Management Systems
Multimedia Editors
Web Editors
Recording Tools
Video Editing Tools
Voice Recognition, Speech Synthesizers
Course Development Tools (knowledge Management)
Virtual Classrooms
Web Conferencing Tools
Video Conferencing Tools
Collaborative Tools
Special Communication Tools
Simulation Tools
Information & Exchange Systems
Learning Brokerage Platforms
Knowledge Management Tools
Assessment Tools
ERP/HRIS Software

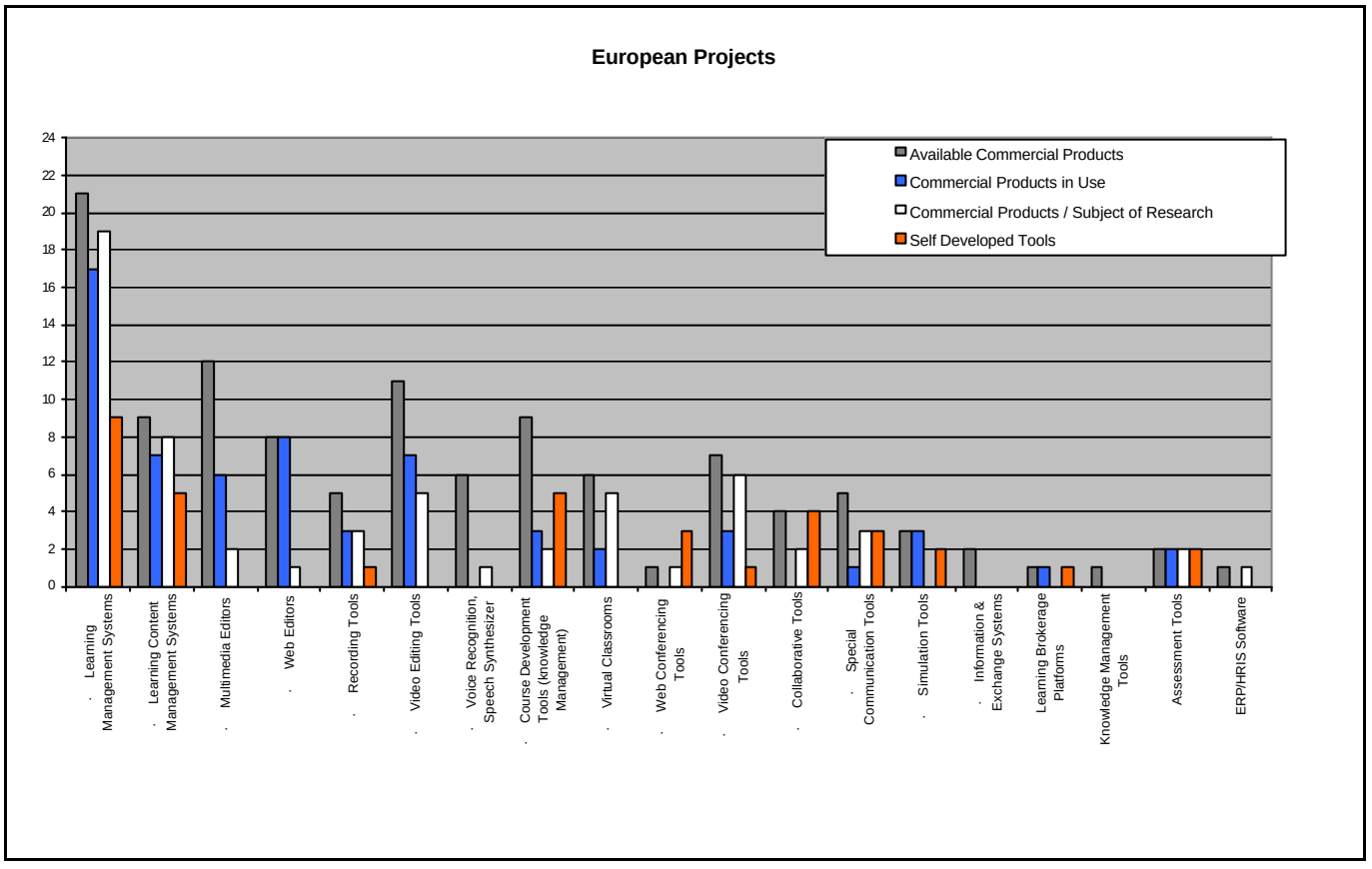
7.3.2 Application oriented analysis and conclusions

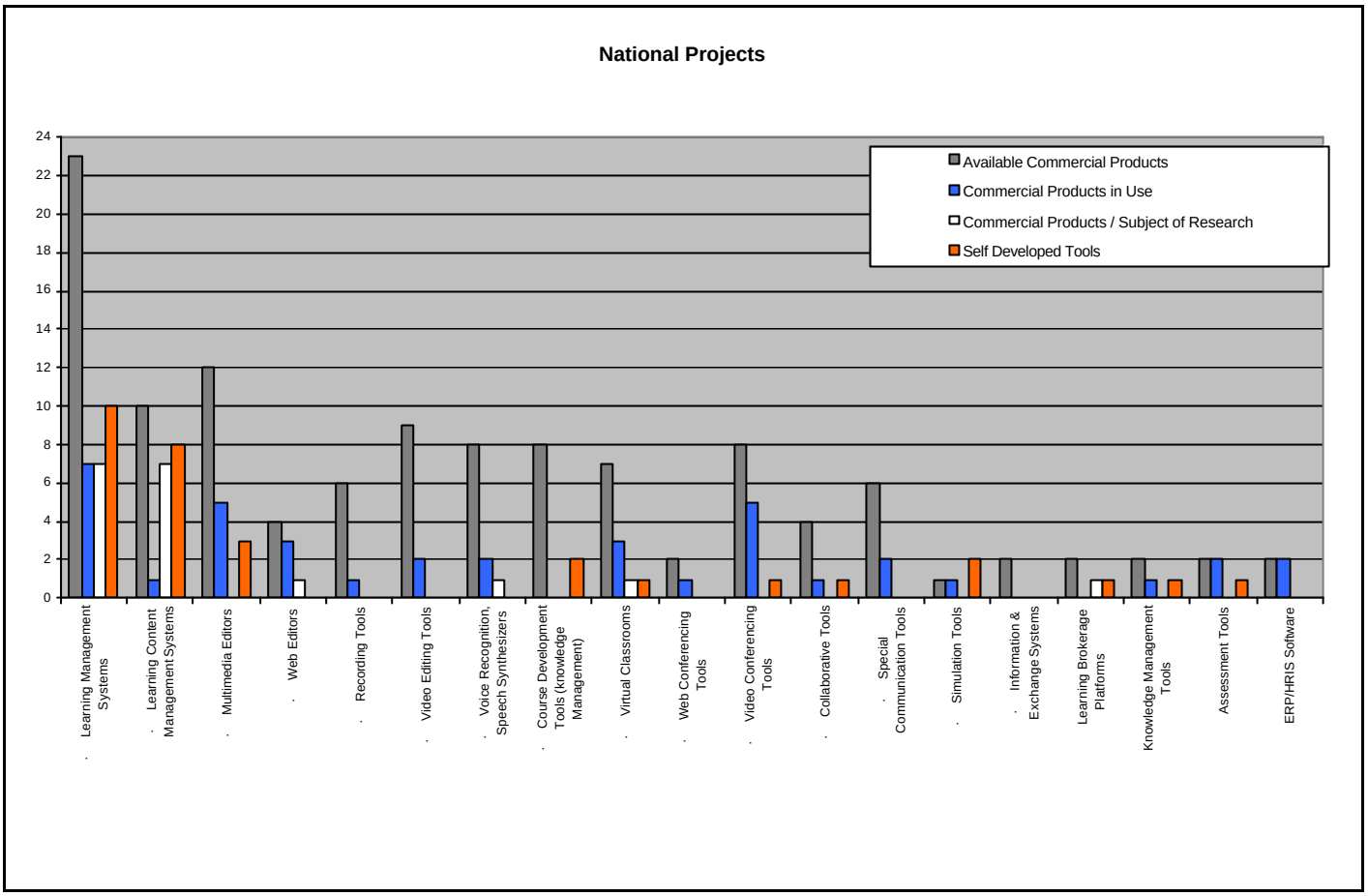
In the application oriented analysis we have tracked the number of applications or tools that have been used or were subject of research in order to check the relevance of the provided application list in the questionnaire, as well as to directly compare the number of commercial tools and self developed tools in each category.

The European projects diagram shows that almost all listed applications are “known” – either as “subject of research” or as application in use – except for the categories Multimedia Editors, and Voice recognition & Speech Synthesisers where the gab between the number of “Available Commercial Products” and the number of the Products used in the project is big.

Again, LMS, LCMS, Multimedia, Web and Video Editors, as well as Video Conferencing Tools are dominant.

In the European projects diagram we can read out, that in the categories Course Development Tools, Web Conferencing Tools, Collaboration Tools and Special Communication Tools, the self developed tools are significantly more than the number of commercial tools used. This does not apply to the national projects.




National Projects
Available Commercial Products
Commercial Products in Use
Commercial Products / Subject of Research
Self Developed Tools
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Learning Management Systems
Learning Content Management Systems
Multimedia Editors
Web Editors
Recording Tools
Video Editing Tools
Voice Recognition, Speech Synthesizers
Course Development Tools (knowledge Management)
Virtual Classrooms
Web Conferencing Tools
Video Conferencing Tools
Collaborative Tools
Special Communication Tools
Simulation Tools
Information & Exchange Systems
Learning Brokerage Platforms
Knowledge Management Tools
Assessment Tools
ERP/HRIS Software

8 Report on Technology Infrastructure

8.1 Introduction

The Special Interest Group three (SIG3) examined the infrastructure axis of the eLearning domain. It identified enabling technologies and researched the importance and maturity of those technologies by looking at the role they play for current research projects in Europe.

8.2 Methodology

A combination of methods was used in order to receive the results for this report. The following paragraphs explain the steps taken to get from first brainstorm to the final results.

8.2.1 Topic maps

First a topic map for the enabling infrastructures domain was constructed (see Figure 1). The topic map has been constructed using both brainstorming techniques and desktop research of topics related to infrastructures. Starting with the topics that came first to mind, topics closely related to them were added. Those topics were collected by answering questions like "what do I need to be able to have or use the already collected topics" and "what are subtypes of the existing topics" or "how can the existing topics be aggregated into a super-type". The topic map is multidimensional with different levels of detail in both the mentioned topics and their relations, meaning that 1) a topic can possibly be found on more than one detail topic map and 2) the topic may have different links depending on the level it is being displayed on. For example, the topic "Mobile internet" can be found on the topic map for the Networks domain (see 6.2.5) with links to m-Commerce, Internet, Communication, while the topic can also be found as main topic in the "Mobile internet domain" with links to "WAP", "I-mode", "UMTS", "GPRS", "Wireless". The "Wireless" topic on that topic map again has its own detailed topic map.

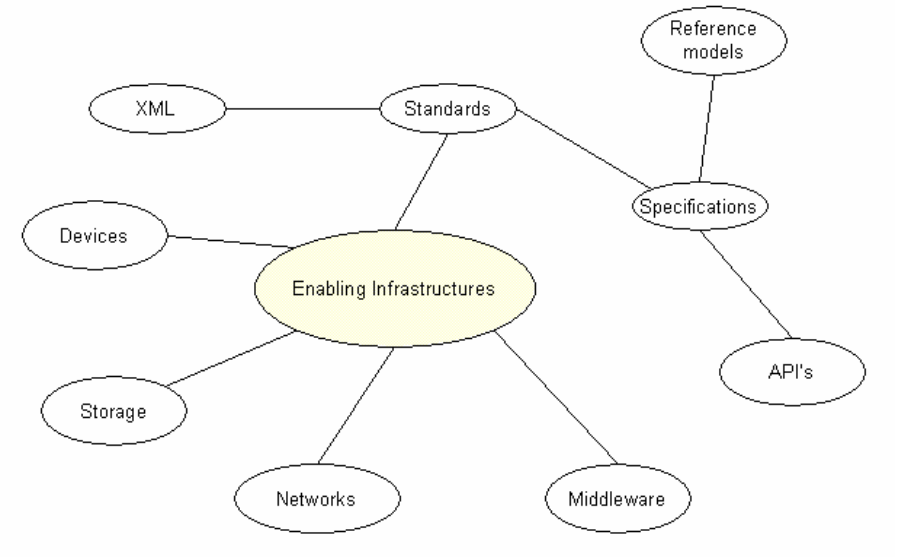

Figure 1 Topic map for Enabling Infrastructures

The topic maps were constructed both top-down as bottom-up, meaning that though "Enabling Infrastructures" (top-level) was the starting point, changed on a more detailed level could lead to changes in the higher-levelled (less detailed) levels and vice versa. The topic map has gone through multiple iterations before it reached it final form displayed below.

During the construction no special topic mapping tools were used.

Central topic in the topic map in Figure 1 is the Enabling infrastructures topic. An infrastructure consists of Applications, Devices to run the applications on, Networks and Middleware connect those devices and the data used by the applications needs Storage systems. Because the applications topic is subject of one of the other SIGs, so has not been researched as part of this SIG.

Besides these obvious topics, a couple of extra topics were added to the top-level topic map. The selection of these topics, Standards, Specifications, Reference models, API's, XML, was based on the expectation that they would play an important role.

This led to the global topic map for enabling infrastructures consisting of a number of submaps, one for each of the following main domains:

- Standards
- Specifications
- Reference models
- Networks and Network technologies
- Wireless networks
- Communication
- XML
- Devices
- API
- Storage
- Middleware

For each of the domains a topic map has been constructed and a number of topics per domain were selected for further research.

8.2.2 Glossary of topic definitions

Because not all topics were common knowledge, a glossary of the topics with a short explanation of each topic and a link to a website with more information about the topic was constructed. The glossary can be found in appendix F of the current document.

8.2.3 Topic map for the Standards domain

Standards are an essential component of enabling infrastructures. Without them the cost of exchanging data and resources between systems will be much higher due to conversion costs and cost of building converters between systems. Acceptance of products and systems by consumers is unlikely without standards.

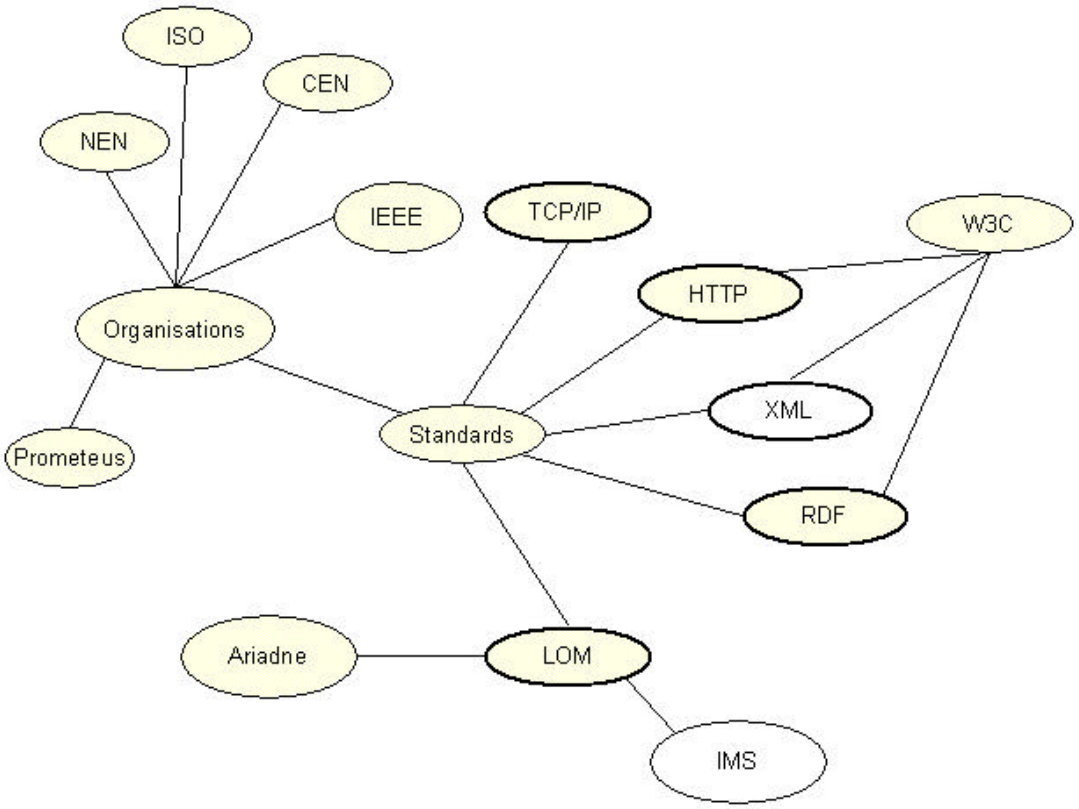

Figure 2 Topic map for the Standards domain

Figure 2 shows the topic map for the standards domain. Subtopics are the important standards: TCP/IP, HTTP, XML, RDF, LOM and Organizations that are involved in the standardization process (W3C. IMS, Ariadne, Prometeus, NEN, ISO, CEN, IEEE).

For the questionnaire the SIG focused on the standards and not the organizations because the importance of an organization is for a large part determined by the importance of the standards the organization is responsible for or contributes to.

The domain is linked to the XML domain, through the XML topic, and to the Specifications domain, through the LOM topic.

Topics chosen for further examination from the standards domain:

- TCP/IP
- HTTP – Hypertext transfer protocol
- LOM – Learning Objects Metadata standard
- XML – Extensible Markup Language
- RDF – Resource Description Framework

8.2.4 Topic map for the Specifications domain

Specifications play an important role because they are the building blocks for future Standards (see Figure 2 for the topic map of the Standards domain). Developing specifications takes relatively less time than the development of standards, making it possible for specification to address current and future needs more rapidly. Even though, when using specifications, many implementation issues will arise and will have to be addressed they are an important enabling technology.

The topics in the topic map for the specification domain consist mainly of the currently most important specifications: IMS Content packaging, IMS Simple Sequencing, IMS Question and Test Interoperability (QTI), IMS Enterprise, IMS Learner Information Package (LIP), IMS Repository, IMS Reusable Competency, IMS Learning Design, OUNL EML.

The topics Application Profiles and Reference Models (see also Figure 4) were added because they are important steps on the road from specifications to standards. For the metadata area, Dublin Core and CanCore are the most well known application profiles for the Learning Object Metadata (LOM) standard. Like for the standards domain, here too the specifications and application profiles were selected for further examination and not the organizations involved.

The topic map for the specifications domain is linked to the topic maps for the reference models domain and the standards domain.

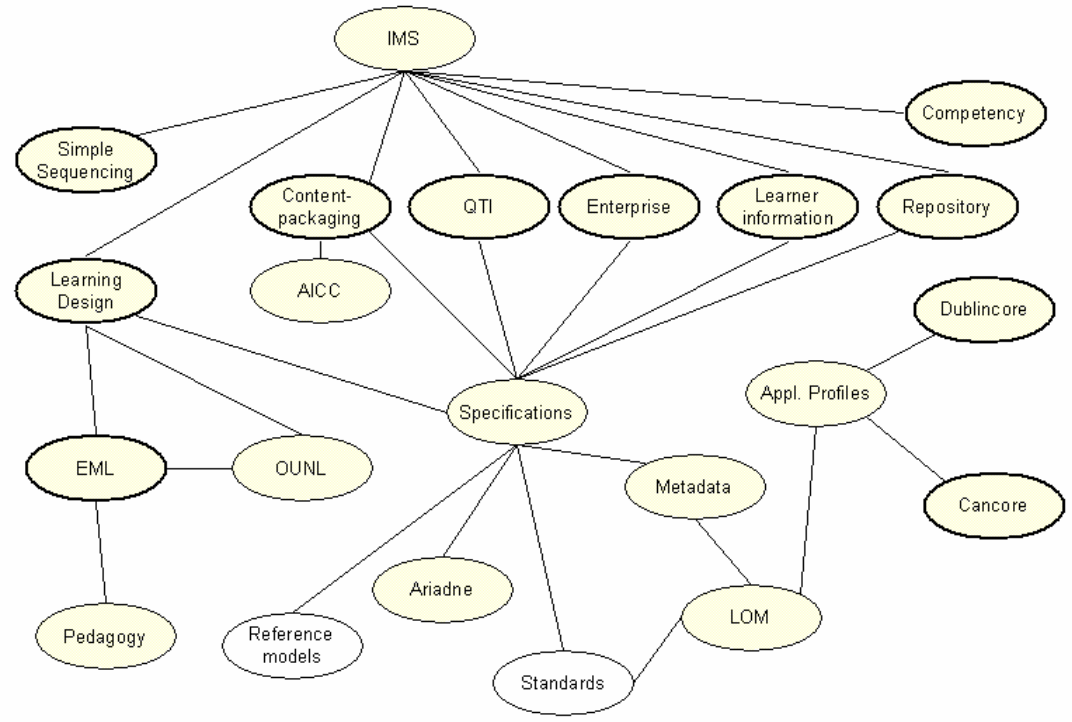

Figure 3 Topic map for the Specifications domain

Topics chosen for further examination in the specifications domain:

- IMS Content packaging specification
- IMS Simple Sequencing specification
- IMS Question and Test Interoperability (QTI) specification
- IMS Enterprise specification
- IMS Learner Information Profile (LIP) specification

- IMS Repository specification
- IMS Reusable Competency specification
- IMS Learning Design specification
- OUNL EML specification
- Dublin Core metadata application profile
- CanCore metadata application profile

8.2.5 Topic map for the Reference Models domain

The topic map for the reference models domain is, compared to the other models, relatively small. There has been some discussion whether or not this domain should have been integrated with either the standards or specifications domain. It was decided not to do this because of the specific nature of reference models. Best known reference model at the moment is the Sharable Content Object Reference Model (SCORM) developed by the Advanced Distributed Learning Initiative (ADL). It deals with reusable learning objects (RLOs), making them sharable and, amongst other things, storable in and retrievable from Repository systems.

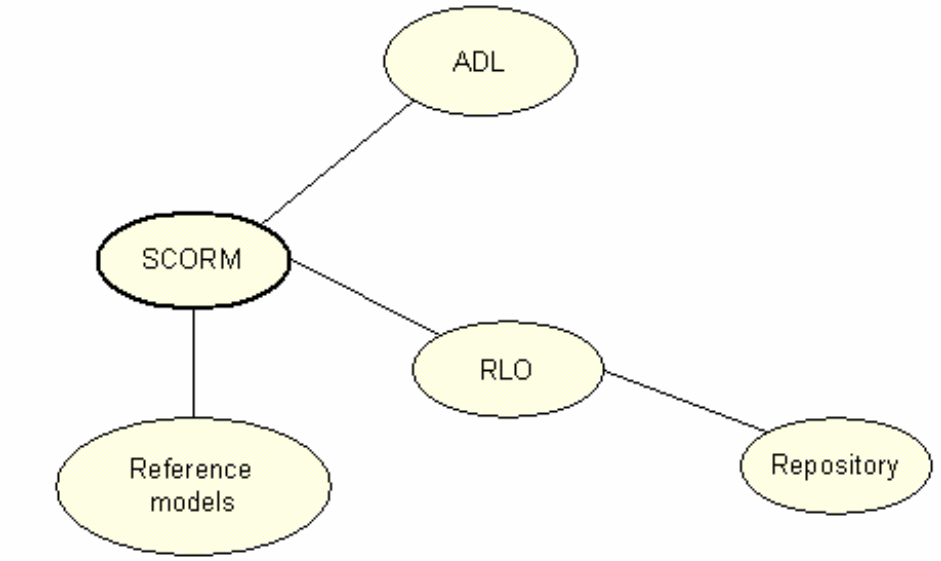

Figure 4 Topic map for the Reference models domain

- Topic chosen for further examination in the reference models domain: ADL SCORM

8.2.6 Topic map for the Networks domain

The networks domain is a huge domain, initially consisting of both Wireless and fixed networks. Because of the specific nature of the two, the domains were split into two domains:

- Networks domain, consisting of technologies for fixed networks
- Wireless domain, consisting of the sub domains Mobile internet and Wireless

Network Operating Systems (NOS); Windows, Unix/Linux, Netware determine the services that a network can provide. The ways a connection to a public network can be made: either through Dial-up, using a Broadband (Satellite, Cable, xDSL) connection or Wireless for a large part

determine the services the end user has access to. Most networks are TCP/IP based and are either public (Internet) or private (Intranet) networks. The World Wide Web is the best know application on the Internet. The Semantic Web now often only is a buzz-word but has the potential to be the hard needed solution to the chaos on the web. Networks play an important role in the Communication (see also figure 8) between not only systems, but also between people. Mobile internet has been an important enabler for not only communication but also for mobile commerce (m-commerce) as counterpart of the electronic commerce (e-commerce) conducted on the wired internet.

For Intranet and Wireless networks the security on those networks is an important issue, with Firewalls and a Virtual Private Network (VPN) being technical means to secure them.

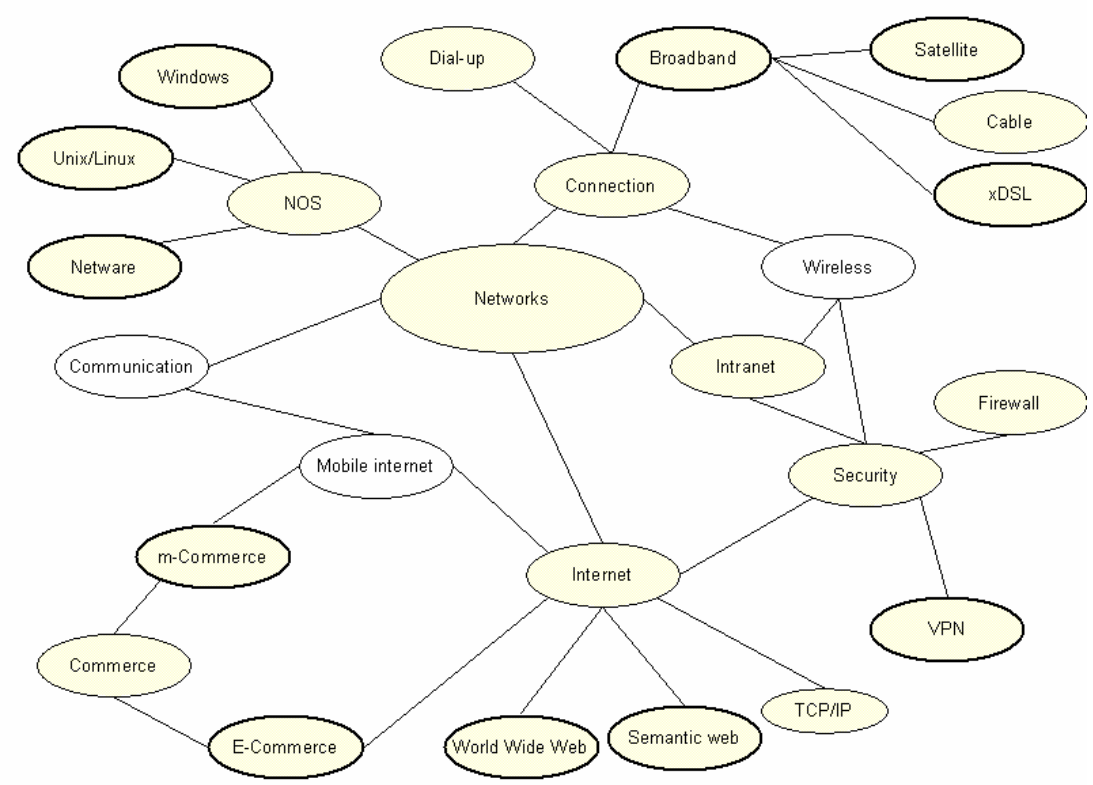

Figure 5 Topic map for the Networks domain

Topics chosen for further examination from the Networks domain:

- Novell Netware
- Microsoft Windows
- Linux
- Unix
- M-Commerce
- E-Commerce
- World Wide Web
- Semantic Web
- VPN – Virtual Private Network
- XDSL
- Broadband connections

- Satellite Internet connection

8.2.7 Topic map for the Wireless Networks domain

The wireless domain has been constructed of the two maps for the sub domains Mobile internet and Wireless. Both are sub domains of the Networks domain.

Being Wireless isn't much use if you need wires for the power supply, so long lasting batteries and Power management are important issues. Wardriving, Session hijacking, Man in the middle attack are Security threads specific for wireless networks, with WEP as wireless network specific protection next to Firewalls and VPN (see Figure 5). Where the protocols used for wired networks are stable, there is a growing number of 802.11x protocols being developed by IEEE. The WiFi consortium thrives to (better) enable the use of hardware from different vendors by checking the compliancy of the different devices.

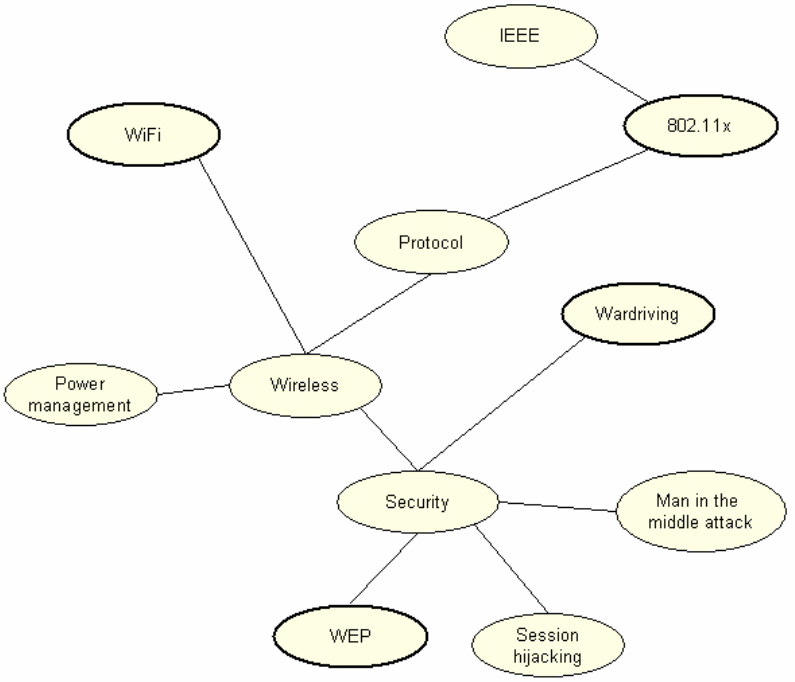

Figure 6 Topic map for the Wireless domain

For the mobile internet topic, consisting of non-pc devices used for wireless networks, a number of protocols and network connection methods (GPRS, UMTS, Ⱡmode, WAP) have been identified for further examination.

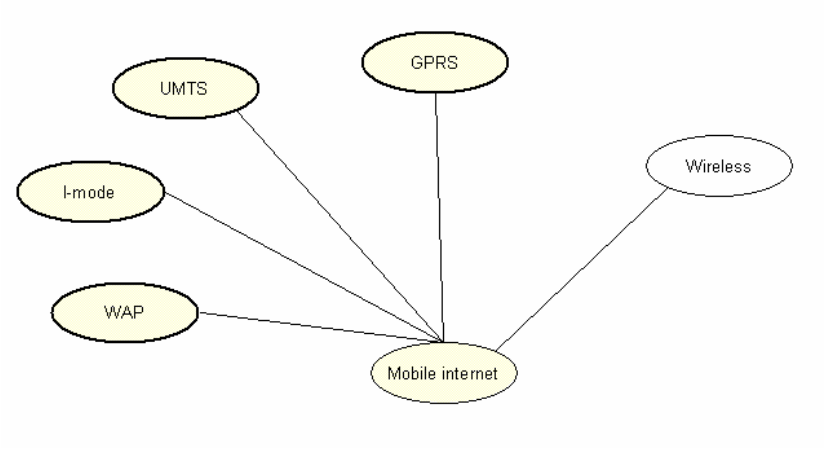

Figure 7 Topic map for the Mobile internet domain

The complete list of topics chosen for further examination from the Wireless domain:

- 802.11x
- WiFi
- WEP – Wired Equivalent Privacy
- Wardriving
- Mobile Internet
- WAP
- I-mode
- UMTS - Universal Mobile Telecommunications System
- GPRS - General Packet Radio Service

8.2.8 Topic map for the Communications domain

As said before, communication between people is an important application. Figure 8 shows the topic map for the communication domain. There is a direct link to the devices domain since communication needs applications and devices. E-mail is the most often used functionality of the internet, now closely trailed by Instant Messaging (IM) and Peer-2-Peer (P2P). Also shown are a couple of the currently important applications (KaZaA, Gnutella, Edutella), protocols (LimeWire) and platforms (JXTA). The increase of unwanted mail (SPAM) and use of tracking mechanisms (for example by using cookies), laws are being develop to ensure the privacy online. The P3P enables websites to communicate their privacy policy in an uniform way. Video conferencing is of the here listed communication related topics the one that comes closest to face-2-face communication.

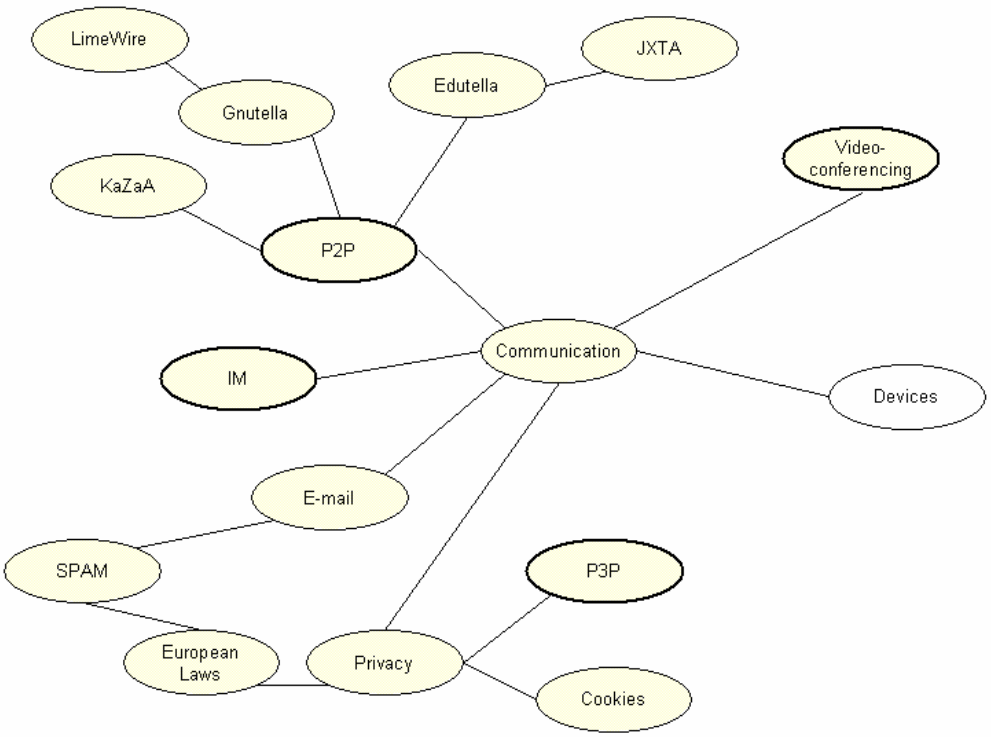

Figure 8 Topic map for the communication domain

It was decided not to include the different Peer-2-Peer applications in the questionnaire because of the current bad reputation of those applications. Topics chosen for further examination from the Communication domain:

- P2P – Peer to Peer communication
- Videoconferencing
- P3P - Platform for Privacy Preferences Project
- IM – Instant Messaging

8.2.9 Topic map for the XML domain

Figure 9 shows the topic map for the XML domain and the closely related topic Webservices. The XML domain, as far as eLearning is concerned, has close links with the standards domain, the specifications domain and the reference models domain where it is being used as primary means to create bindings. Besides that, XML is an important enabler for the creation of Webservices, either using Java or the .Net technology. UDDI, WSDL and SOAP are

technologies used for transport, description, discovery, integration of Webservices and messages.

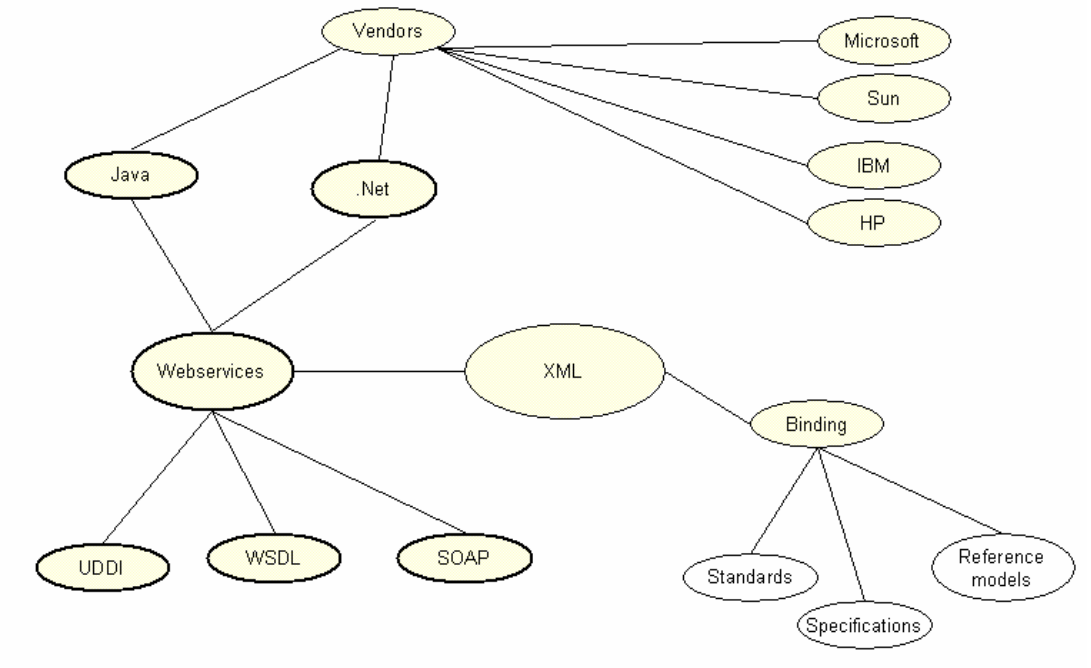

Figure 9 Topic map for the XML domain

Like in the other domains, vendors were excluded from the questionnaire and the opics chosen for further examination from the XML domain are:

- Webservices
- UDDI - Universal Description, Discovery and Integration project
- WSDL - Web Services Description Language
- SOAP - Simple Object Access Protocol
- Java
- .NET

8.2.10 Topic map for the Devices domain

Devices are needed to access the applications and services. Figure 10 shows the topic map for the devices domain with the links to the mobile internet sub domain, the networks domain and the communication domain. The most commonly known device without doubt is the Personal Computer with the PDA (based on the Palm OS or Pocket PC), Tablet PC and the Mobile Phone as promising newcomers. The O2 XDA is a combination of Mobile Phone and PDA.

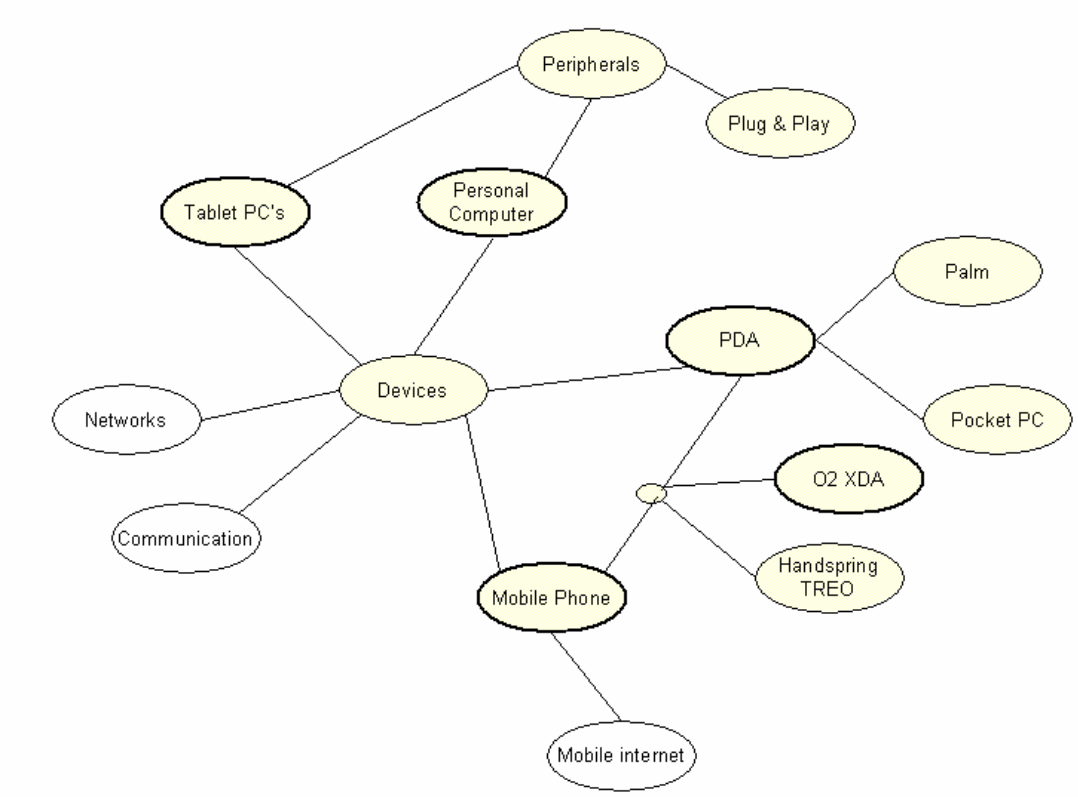

Figure 10 Topic map for the devices domain

Topics chosen for further examination from the Devices domain:

- Tablet PC
- O2 XDA
- PDA – Personal Digital Assistant
- Personal Computer
- Mobile Phone

8.2.11 Topic map for the API domain

Application Profile Interfaces (API's) are a way to provide (part of) the functions of an application to other programmers. They can then use those functions without having to know about the way those functions have been implemented. It simplifies the development of advanced applications because all the basic functions already have been taken care of. Examples of API's are: OKI, SAX, Uportal. Figure 11 shows the topic map for the API domain.

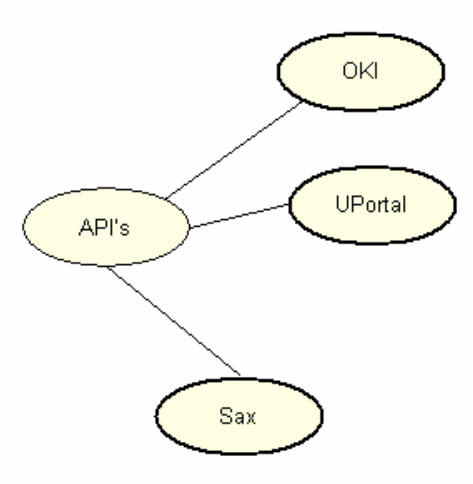

Figure 11 Topic map for the API domain

Topics chosen for further examination from the API's domain:

- OKI
- Uportal
- SAX

8.2.12 Topic map for the Storage domain

Storage of data usually takes place within Databases, either in Relational Databases or the newer XML Databases. A more technical view of storage makes a distinction between Network Attached Storage (NAS), Storage Area Networks (SAN) and the use of a Redundant Array of Independent (or Inexpensive) Disks (RAID). Linked to the application of databases are the Content Management Systems and the Learning Content Management Systems (LCMS). Figure 12 shows the topic map for the storage domain with the link to the XML domain.

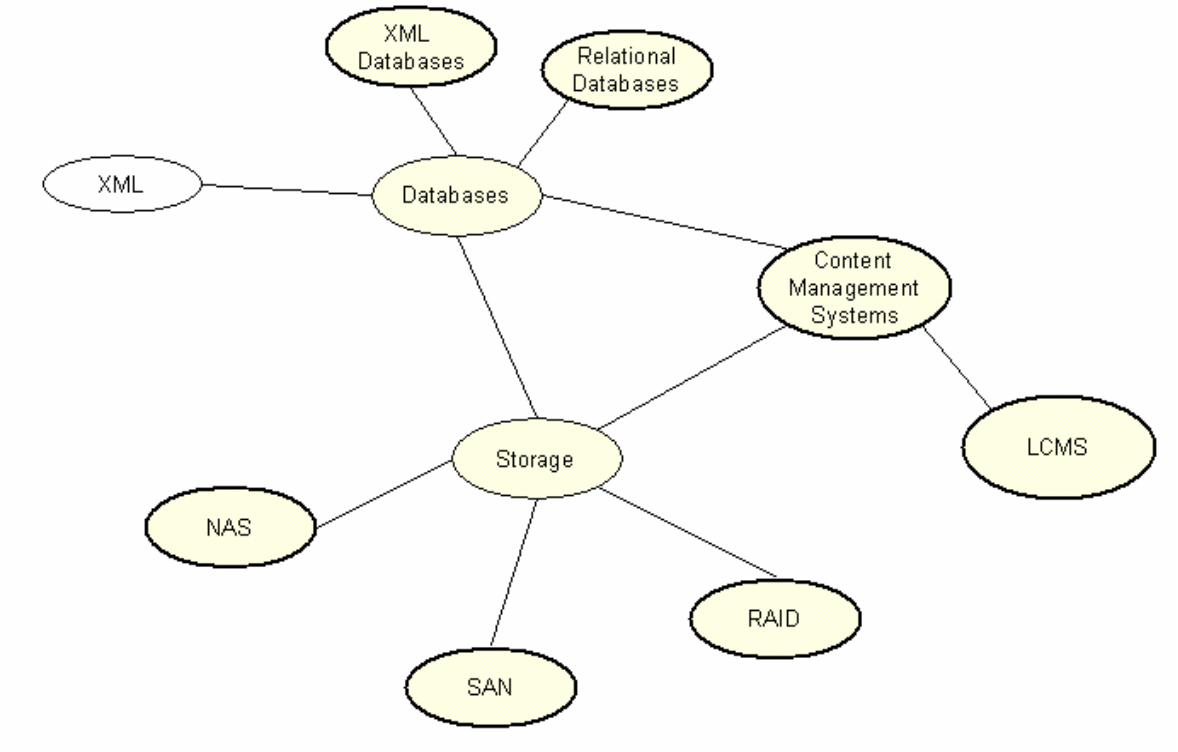

Figure 12 Topic map for the storage domain

Topics chosen for further examination from the storage domain:

- NAS – Network Attached Storage
- SAN – Storage Area Network
- RAID - Redundant Array of Independent (or Inexpensive) Disks
- Relational Databases
- XML Databases
- CMS - Content Management System
- LCMS - Learn Content Management Systems

8.2.13 Topic map for the Middleware domain

Middleware forms the glue between systems by specialising in the connection of different systems of different vendors and thus facilitating multi-vendor scenario's. The subtopics within the domain are the different types of middleware: Object Request Brokers, Transaction Processing, Remote Procedure Call, Message Oriented Middleware. Figure 13 shows the topic map for the middleware domain.

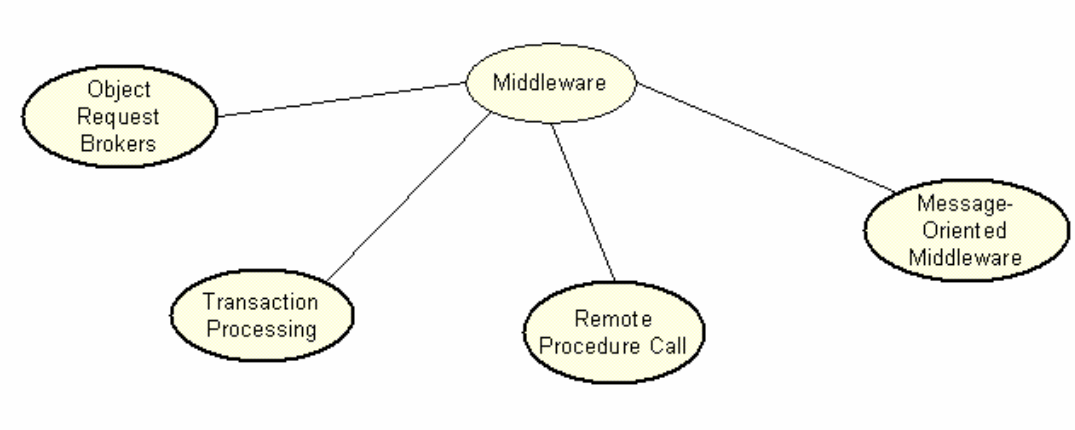

Figure 13 Topic map for the Middleware domain

Topics chosen for further examination from the middleware domain:

- Object Request Brokers
- Transaction Processing
- Remote Procedure Call
- Message Oriented Middleware

8.3 Questionnaires

Previously a great number of research projects had been identified and briefly described. Based on the topics selected for further research a questionnaire for the enabling technologies domain has been constructed[3].

For the projects in the Netherlands, the questionnaire, together with the questionnaires from the other two SIGs were merged and translated into Dutch. They were mailed to the selected project coordinators as Word-file (to fill in electronically and return by e-mail) and as PDF-file (to print, fill in on paper and return to a postage paid address). Also, a copy of the questionnaire was send by post including a postage paid envelope. If they wanted they could be contacted by phone to fill in the questionnaires together.

The project coordinators were asked to indicate the role that each topic in the questionnaire plays within the project or research activity. There were five possible choices:

1. Topic is considered proven technology
2. Topic is an enabling technology for the project
3. Topic is subject of research within the project

[3] See appendix D of the current document

4. Topic is not applicable for the project
5. I don't know / I have never heard of the topic

In total, fifty-three projects were selected as being relevant for this report. The results of the questionnaires were stored in a database application and are described in more detail in the next chapter.

8.4 Results

This chapter will look at the results of the questionnaires, both in detail as in generic terms. Each section will look at one of the domains. The final section of this chapter will look at the overall results.

8.4.1 Standards

As could be expected, both TCP/IP and HTTP are well known as either proven technology or enabling for most of the projects with little new research being conducted. With respect to the other standards, the Resource Description Framework is least well known, though more than 10% of the projects conduct research on the topic.

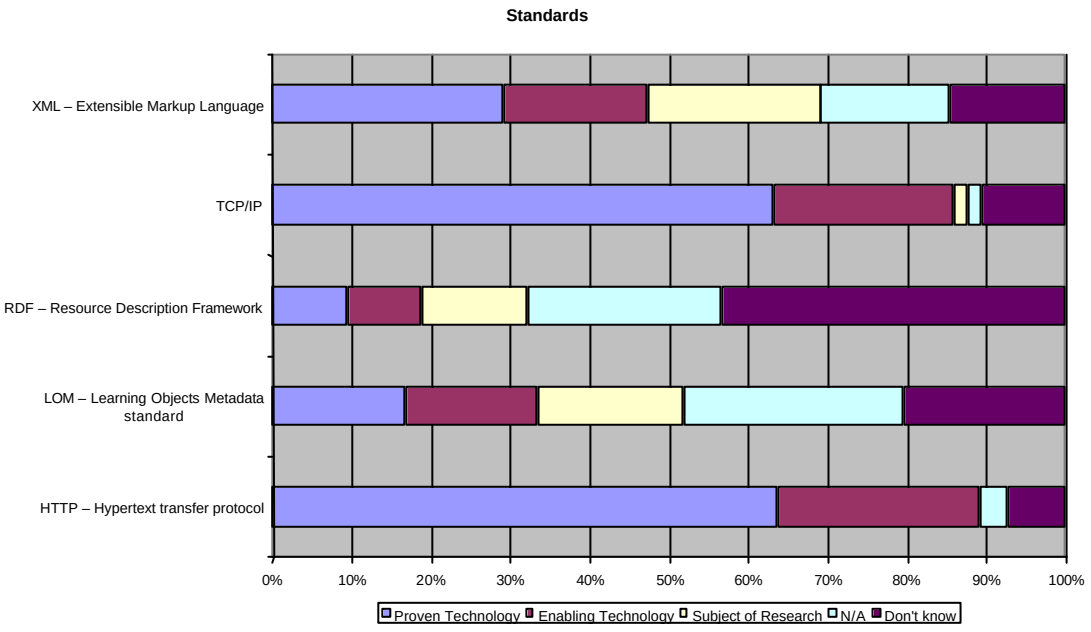

Figure 14 Results for the Standards domain

8.4.2 Specifications

The results in the specifications domain show that the specifications in the learning technology area are as well-known as the LOM metadata standard. On average about 40% of the project coordinators indicated not knowing if the specifications was applicable for their project or not knowing the specification at all.

A small number of projects indicated that they consider one or more of the specifications as proven technology. It is clear however that specifications, by nature of their frequent changes, are mainly enabling or subject of research. Even the specifications that have been around for a number of years aren't generally considered proven technology yet.

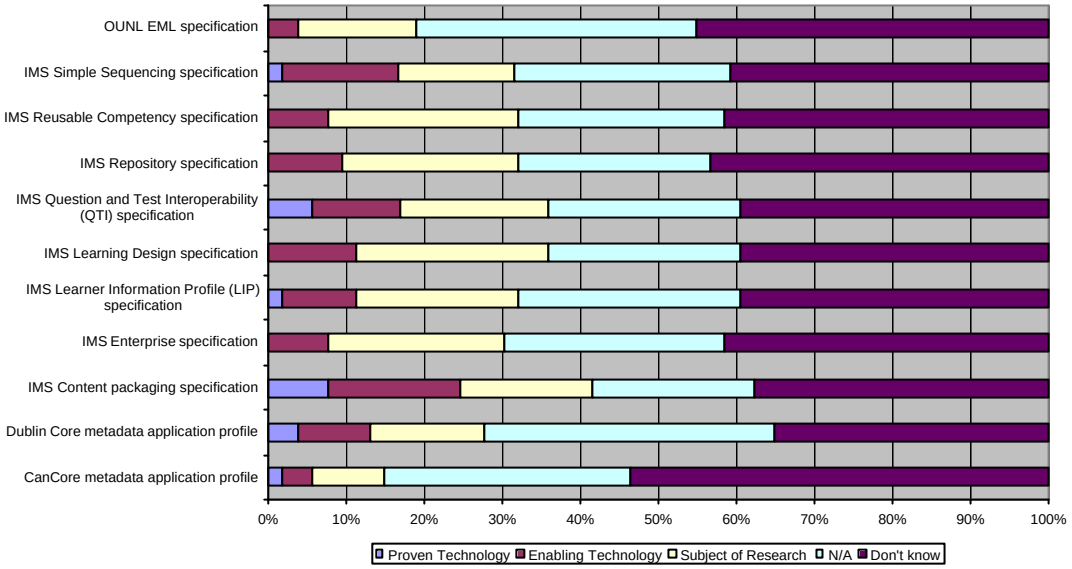

Figure 15 Results for the specifications domain

8.4.3 Reference Models

When comparing the results for ADL SCORM with the results in the Specifications domain, SCORM can be considered a bit better known. Still it is hardly considered as proven technology, but combined with the existing effort in research there is little need for concern.

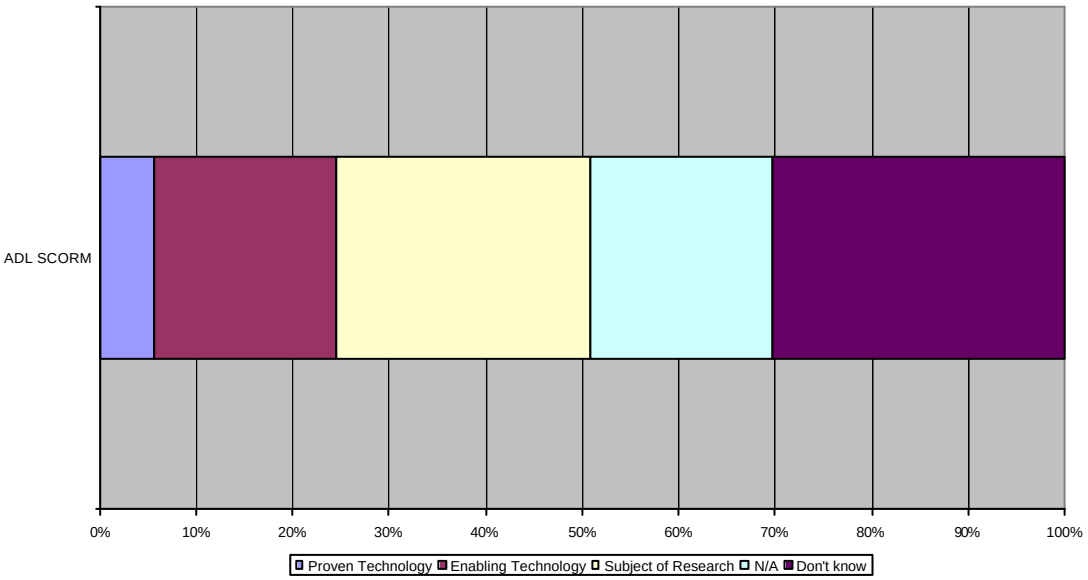

Figure 16 Results for the Reference Models domain

8.4.4 Networks

The results for the networks domain show a mixed image. There are two technologies labelled as being very stable (proven): World Wide Web and Microsoft Windows.

Promising is that 75% of the projects knew whether or not the Semantic Web was relevant for their project. Compared to the fact that more than 40 percent of the project coordinators did not know about the relevancy of xDSL for their project shows that the Semantic Web is relatively well known.

Main research topics in this domain are: XDSL, VPN, Semantic Web and broadband connections. Though way behind Windows in the proven technology section, Linux plays a role in more than half the projects reviewed. Netware from Novell seems to have been reduced to a niche player.

E-Commerce still is considered much more a proven technology than m-Commerce, despite all hype surrounding the use of mobile phones for mobile payment.

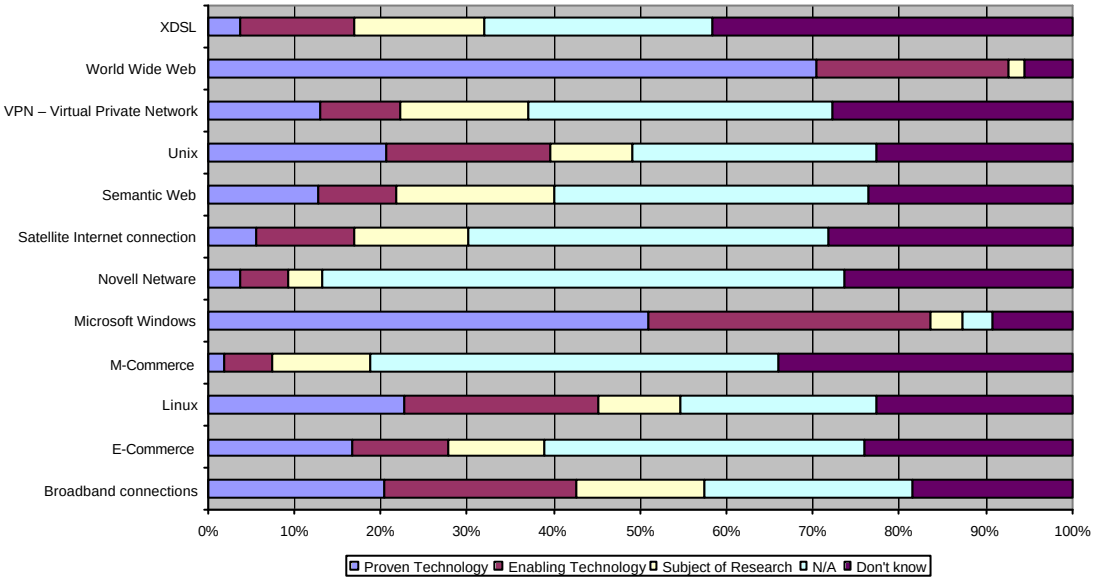

Figure 17 Results for the Networks domain

8.4.5 Wireless networks

Reassuring is that wardriving isn't considered proven technology by any of the project coordinators. That almost half of them can't indicate if the topic is relevant or not for their project is less reassuring though. Also interesting is the amount of research still conducted on WAP, even though many consider that technology obsolete with the introduction of GPRS and I-mode.

Comparing the answers for WiFi and 802.11x shows that there must have been an error filling out those two questions. WiFi is a consortium of manufactures of 802.11b appliances. It enabled appliances from different vendors using the 802.11b standard to communicate with each other much better than before. The fact that less project coordinators consider WiFi proved technology than they do for 802.11b is interesting considering the above relation between the two.

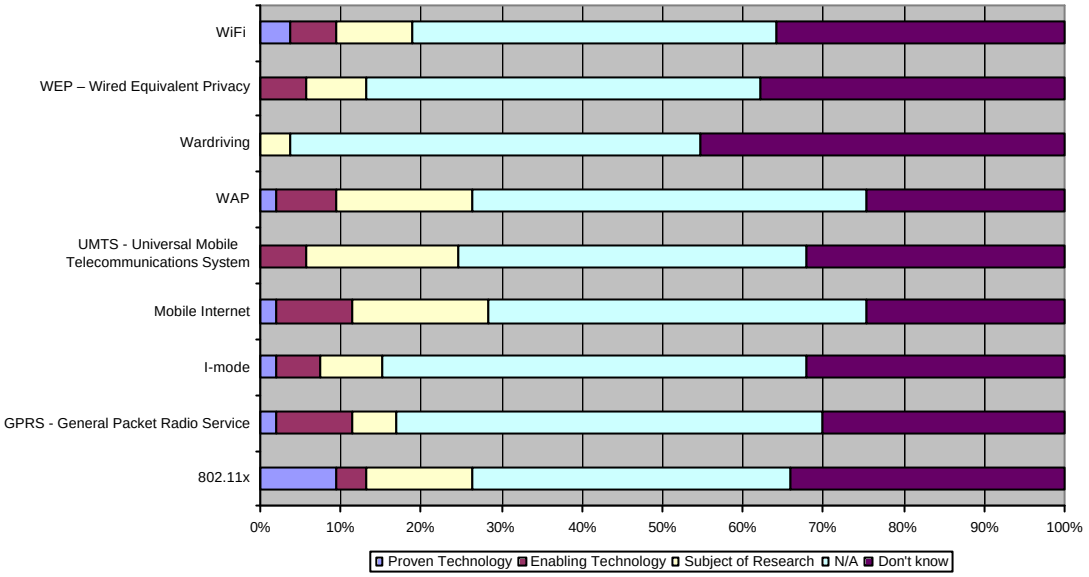

Figure 18 Results for the Wireless Networks domain

8.4.6 Communication

The platform for Privacy Preferences Project still has some work to do, because 40 percent of the project coordinators didn't know what role it can play for their project. None of them considers it proven technology. Videoconferencing can be considered a stable, yet developing, technology. The same can be said for Peer-to-Peer communication. For the reviewed projects, instant messaging doesn't play the big role it does for students and young Internet users. It would be interesting to see if that changes within the next couple of years. With IM growing into an important method of communication for our future generation of workforce it is bound to claim a more important role in the near future.

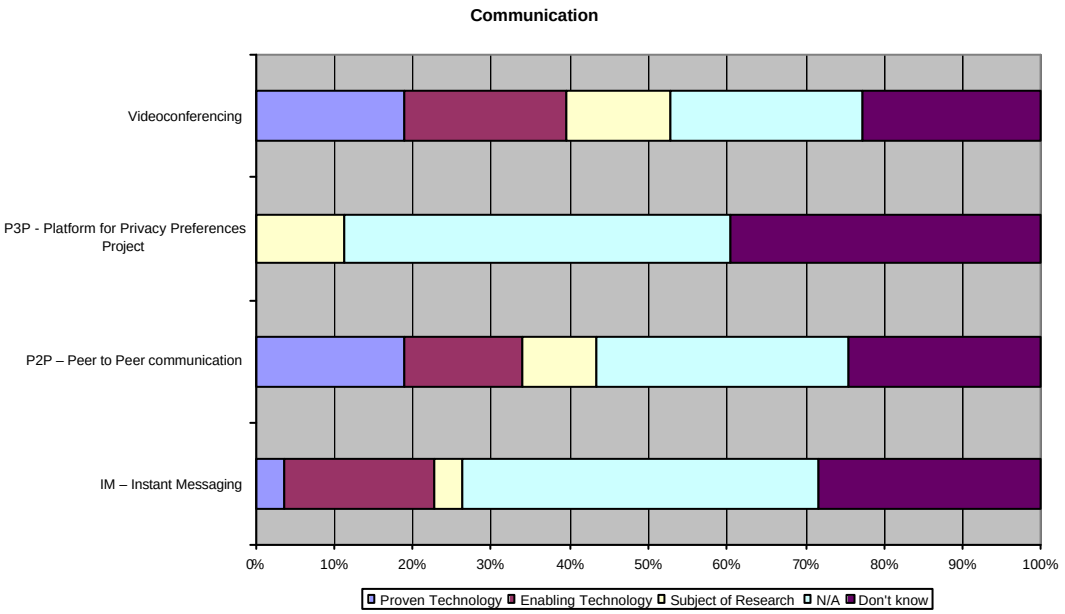

Figure 19 Results for the Communication domain

8.4.7 XML

Important to remember when looking at the results for this domain, that it actually doesn't say anything about the importance of XML itself, but about a couple of specific applications and topics related to XML. That is because for example the specifications, standards and reference models all have a XML binding for their information model. That is because for example the specifications, standards and reference models all have a XML binding for their information model. Since that wasn't explicitly mentioned in the questionnaires there is no data for that part of the use of XML.

The results show that some of the technologies used for Webservices like WSDL, UDDI and SOAP are less well known than the umbrella topic (Webservices) itself. The amount of "Proven Technology" responses for this complex and young domain is promising. Java has a solid basis in the projects while newcomer .NET is surprisingly well known considering the final release has been less than one year ago and the platform that integrates the technology (Windows 2003) is even younger. How much influence the Microsoft marketing power has had on this is not clear.

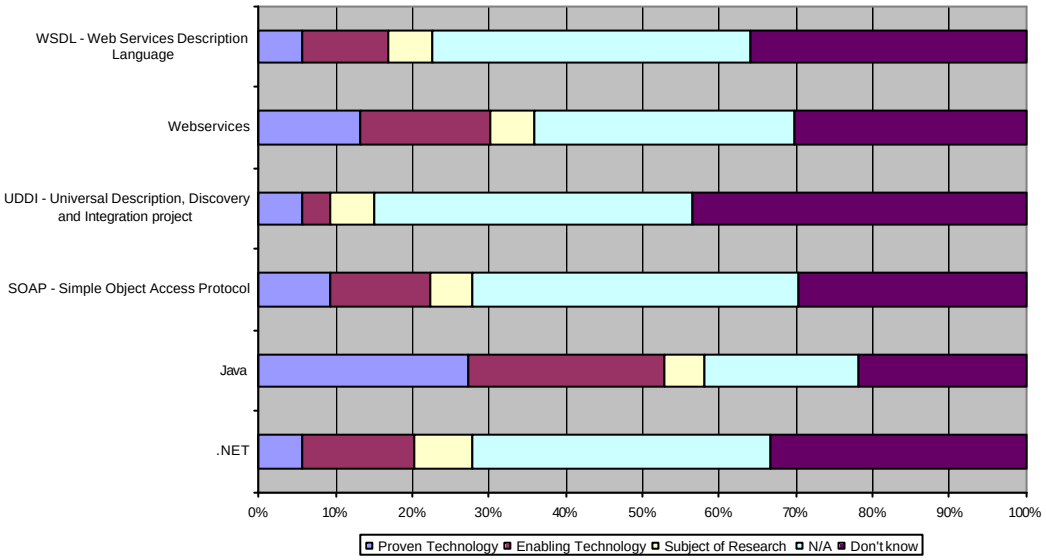

Figure 20 Results for the XML domain

8.4.8 Devices

In the devices domain, the personal computer is the prominent proven technology. This was like expected. Remember that the "Don't know" answer should just be interpreted as not knowing anything about the technology, but also as not knowing for sure what role the technology played in the project or an occasional blank answer for a technology. The hybrid of mobile phone and PDA, the O2 XDA is an unknown technology for almost half of the project coordinators. It is expected that this specific hybrid won't be around for long, but that wireless and mobile functionality will become integral part of what people will consider to be a Personal Digital Assistant (PDA).

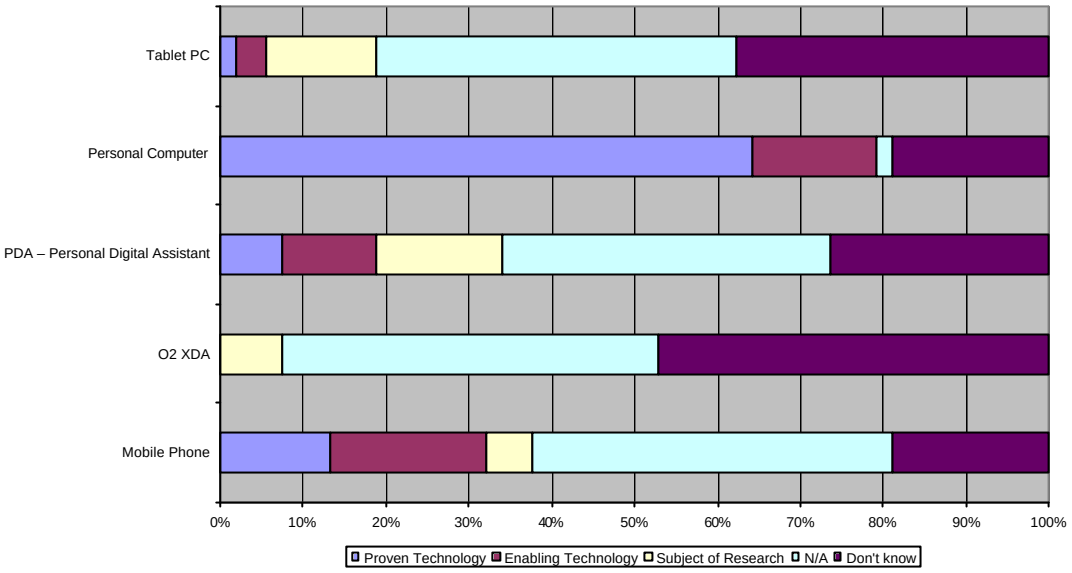

Figure 21 Results for the Devices domain

8.4.9 API

The three API's that were mentioned in the questionnaire are fairly unknown to the project coordinators. Only a few projects conduct research in this domain or think the API is either proven or enabling for the project. Because the use of API's could considerably lower the cost of application development, more effort should be put into the development of APIs.

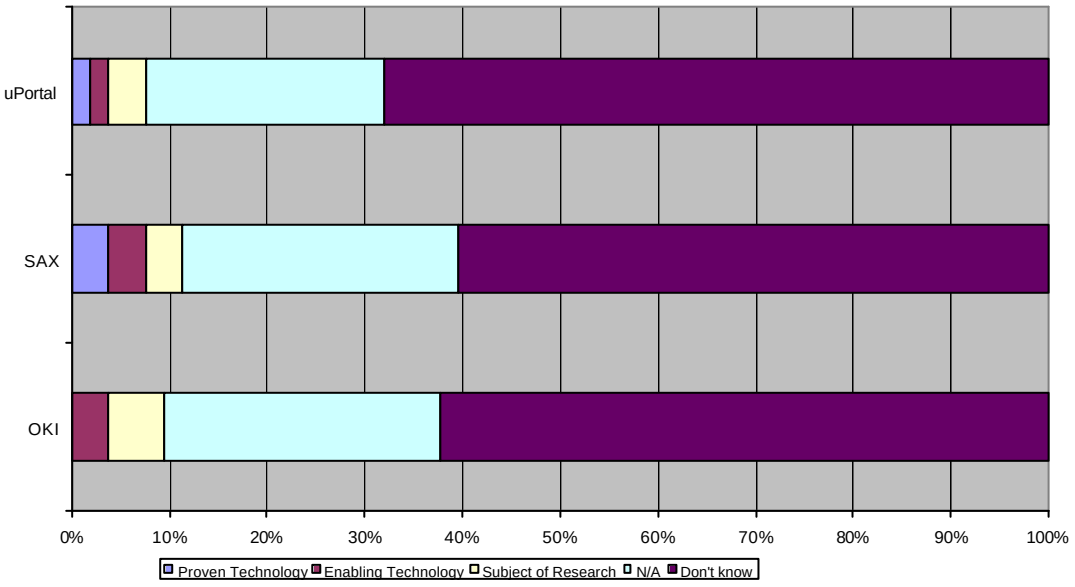

Figure 22 Results for the API domain

8.4.10 Storage

The results for the storage domain show a mixed picture. Best known are the relational databases. XML databases could be a competitor of the future.

Least used or researched are the Storage Area Network and Network Attached Storage. That in itself isn't strange because they both are specialized technologies not suitable for every project or situation. The attention for CMS and LCMS is promising since those two are topics on the functional use side of storage. What would a SAN or NAS be useful for, without systems requiring access to their data?

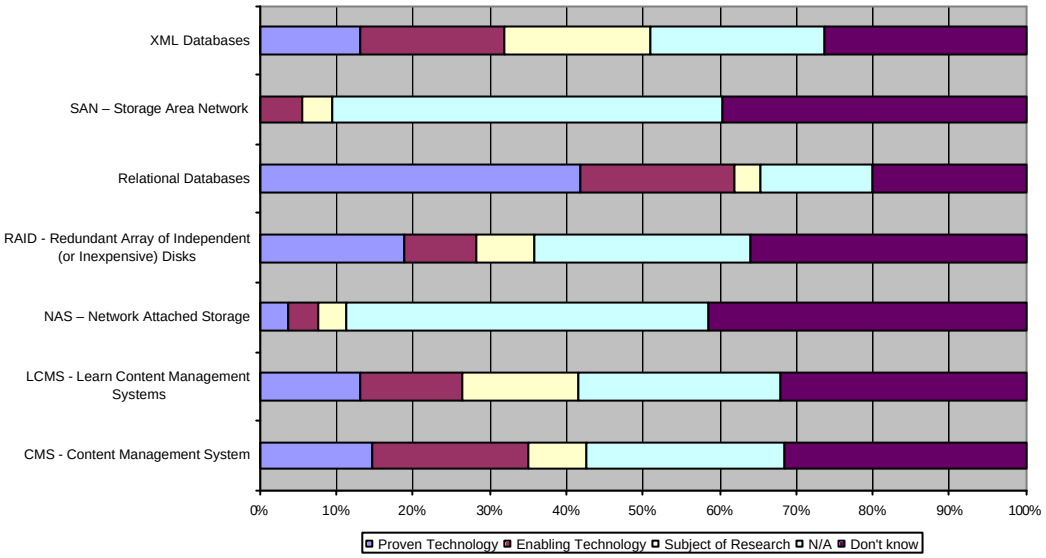

Figure 23 Results for the Storage domain

8.4.11 Middleware

Like API's, the Middleware domain is a niche area of technology. Unclear from the results of the questionnaire is whether or not that means that there is too little research in this domain. Looking at the importance of being able to connect different systems from different vendors and the lack of interoperability specifications and standards at this moment, there is a gap.

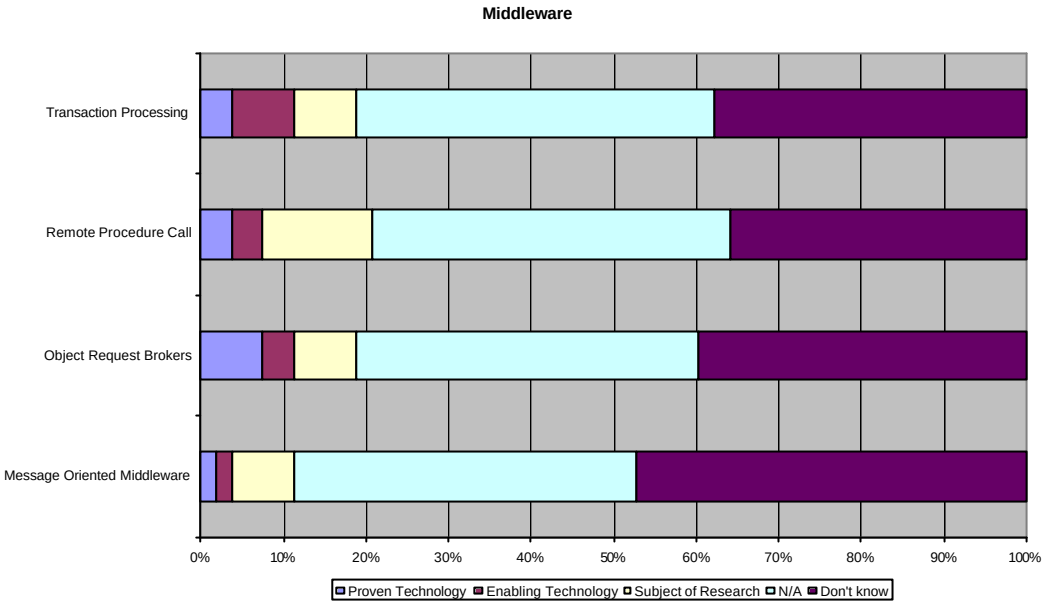

Figure 24 Results for the Middleware domain

8.4.12 Summary of the results

If we aggregate the responses per topic into the defined domains we can see that there are no domains were none of the topics are considered proven technology. But that the amount differs a lot. The amount of "Don't know" responses for the API domain is considerable higher than for the other domains. Important to remember is that it doesn't mean the reviewed projects just didn't need API's, because then they would have selected "Not applicable", but that the project coordinators didn't know enough about API's to determine whether or not it would be applicable for them. The large amount of "don't know" responses for some domains (i.e. API, Middleware, Reference Models) shows that there is a big lack of knowledge about the possible significance of the technologies within that domain for the research projects. Better dissemination of existing research, knowledge and application possibilities in these domains should help to get a clearer picture for the true importance of these technologies."

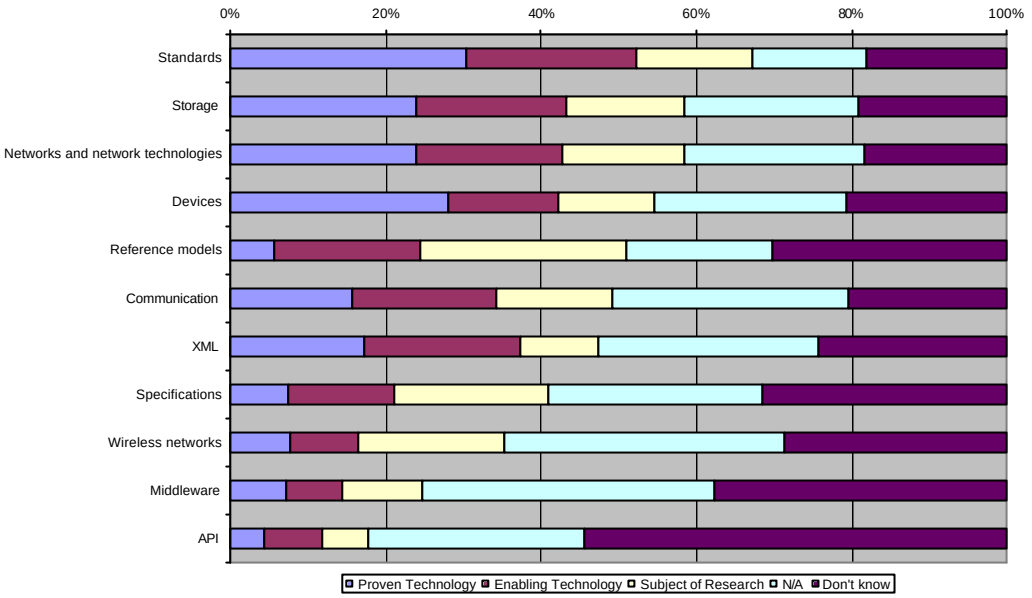

Figure 25 Results per domain

For the Middleware domain, a gap between expected needed research and current conducted research has been determined. For the other domains, a continued effort on research is needed, but overall the questionnaire identified no other significant gaps.

If we look at the number of projects that does research on a per topic basis, we see a lot of specifications and XML related topics in the top ten.

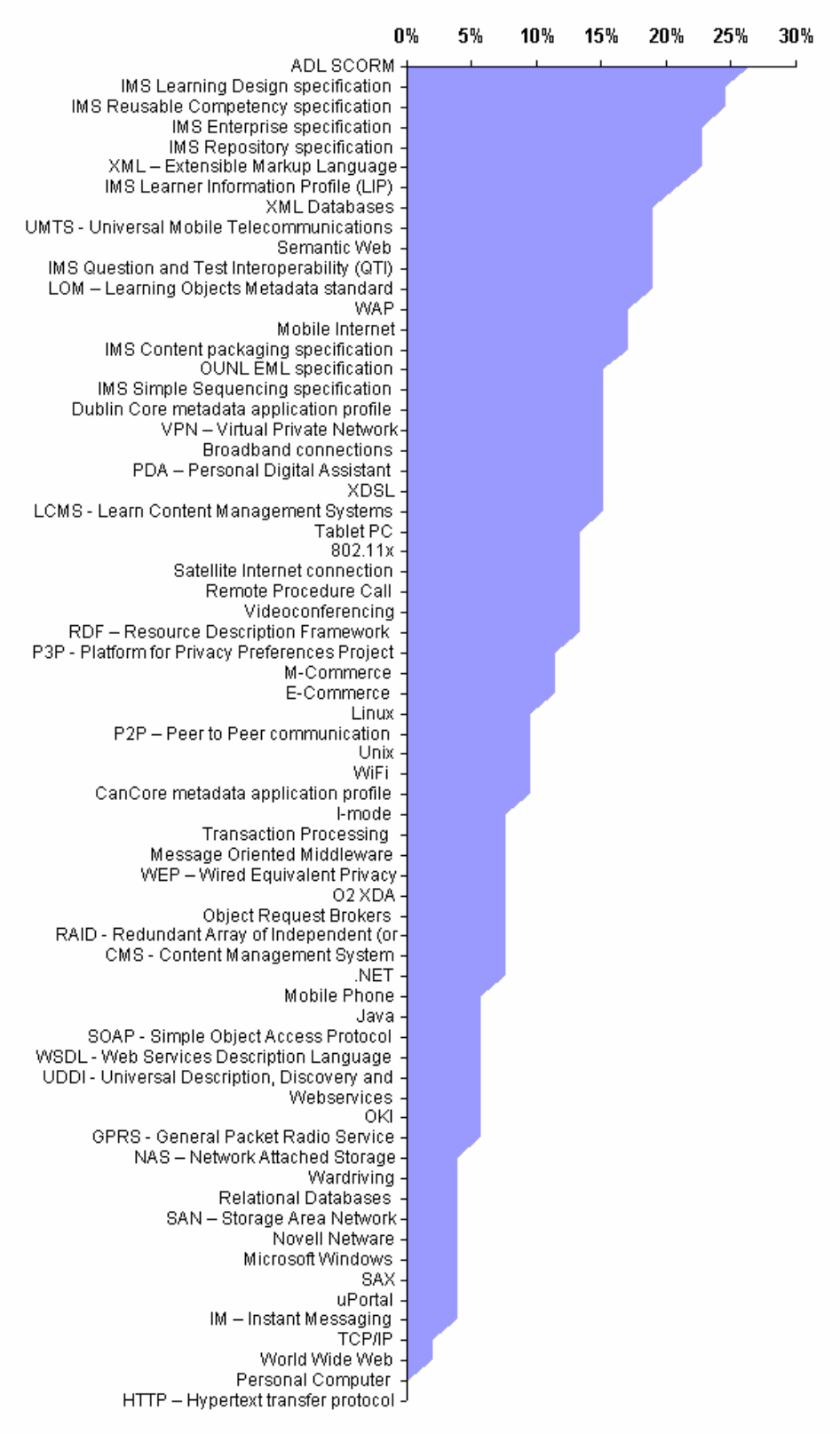

Figure 26 Research per topic

9 Conclusions from the Reports

In these reports we have presented the results of a research evaluation an assessment study and have complemented this with the categorization of the projects according to their objectives. From the statistical analysis of the collected data stems that content creation, learning-models and management are gaining a broad research interest in the eLearning Community.

Methodological approach data analysis revealed that asynchronous collaborative learning is currently the dominant learning method, since a variety of mature tools exists nowadays and a lot of studies have proven the effectiveness of this method. In fact, the modern instructional models advocate that a "mix and match" of learning methods can lead to more effective learning. This trend is followed by the R&D community. On the other hand the collected data identify that some particular learning methods, like argumentation tools, virtual reality and active worlds, have not been explored yet within the framework of European and National eLearning projects.

The results of enabling technology services analysis comply with the findings of the 1st scan analysis showing that the primary effort in most projects is allocated to the investigation of applications in the categories LMS and LCMS. In national projects, self-developed tools are identified as a substantial tool in the majority of the cases, whereas in European projects many self-developed applications classified as supporting tools. This might reinforce the assumption that the focus of European projects is not the development of applications itself, but rather the integration of tools in a single environment, complemented by self-developed supporting tools whenever necessary.

From the enabling infrastructure analysis the acceptance of the standards from the eLearning Community and the significant research activities in the topic of wireless networks imply an ambient access approach. XML and specifications related topics are among the most popular research trends. On the contrary API's are quite unknown topic, while they are a very useful tool to reduce costs in the implementation of an interoperable system. Future steps in the research community may incorporate topics like APIs and Middleware in order to solve interoperability issues that emerge from the integration of diverse systems.

10 Overview of the European situation as compared to North America

eLearning can be defined as instructional content or learning experiences delivered or enabled by electronic technology. The technology enabled learning is designed to increase workers' knowledge and skills and to be more productive, locate high-quality work, advance in their careers, and have a positive impact on the success of their employers, their families and their communities. eLearning has the potential to revolutionize the basic tenets of learning by making it individual- rather than institution-based, eliminating clock-hour measures in favor of performance and outcome measures, and emphasizing customized learning solutions over generic, one-size-fits-all instruction. [8]

eLearning is a product of the knowledge based economy and as such focus has to be put on the adult, working learner. The points following give a brief outline on how Europe and America are dealing with the transition of implementing eLearning methods and what the issues and considerations are: [9]

- Innovation vs. automation: witnessing the issues of effectiveness over efficiency
- Technology is widely used in adult learning and beyond any traditional social policy arena.
- There is a movement from "education and training" to "knowledge management"
- Methods for sorting, retrieving, and re-using data and information through the application of "object-oriented" methods are advancing.
- The Internet and multimedia is widely used in eLearning.
- Technologies and organizations are merging to create multi-faceted and multimedia delivery channels for content that enables learning.
- The wireless age and use of broadband cable are helping individuals and institutions and will provide access to information at home, at work, at school – anywhere and anytime.
- Teachers and technology experts are working together to create a set of methods and standards that will enable easy re-use, recombination and transfer of content between individuals, institutions and countries.

Where eLearning is now?

There has been an accelerating boom in eLearning in Europe and Asia, where interest is high and the necessary IT infrastructure is established or evolving quickly. Analysts are placing Europe a year behind the United States in adopting eLearning technologies, but opinions vary. Asia is further behind, but no one can dispute the ability of Asia to quickly rebound its economy to enter into the e-business arena and eLearning very quickly and gain ground. [10]

Europe

European countries are adopting eLearning at different speeds with the United Kingdom and Scandinavian countries being the early adopters and Germany following in a more conservative side.

This demand is leading European universities to try to accommodate businesses which are in need of highly skilled people with multidisciplinary skills and knowledge in technology, graphics, semiotics, education, sociology, psychology, business development, and project

management for designing and developing technology supported-learning. But for example in France the state is the one with the responsibility of education and initial vocational and professional training and the private sector has little or no involvement. The idea is that education and training should be for developing citizens with political, social, cultural, and economic knowledge and skills.

Continuing with technology supported learning which, is learning supported by technology i.e. an electronic tool for designing, delivering and managing learning, Europe is divided. The terms TSL and ICT (Information & Communication Technologies) are interconnected and where TSL is used it equals the highest usage for ICT skills. The controversy lies in the different ways countries are implementing TSL, countries like Germany are witnessing some of the most advanced TSL applications and others are lagging behind. This is an issue to be resolved in order for the European countries to reach a common standard. Furthermore, the skills that are emerging as important are soft skills, communication, people management, and personal development.

Concluding the European part, one can see a strong emphasis put on knowledge, skills needed to be taught and information technology changing the access to knowledge, the process of learning, and the delivery of education. It is a common fact that technology's intersection with learning is not a simple trend of old approaches being replaced by new, but that new hybrid forms of learning and delivering content are emerging, with many combinations of traditional classes and teaching combined with technology-based methods for finding content and learning. [11]

North America

American lives are changing in many ways by the new global economy. It has been realized that a number of new and different jobs now require increased proficiency with technology and other demanding job skills. The employees of the future will require a constantly changing set of skills, with technology skills at the forefront. Such rapid advancements in technology will require a workforce committed to lifelong learning and the foundation for that. Taking this into account, in 2000, the American Society for Training and Development (ASTD) and the National Governors Association (NGA) convened the Commission on Technology and Adult Learning. Its mission: *to define and encourage a technology-enabled learning environment that will result in an engaged citizenry and a skilled workforce for the digital economy.*

This Commission on Technology and Adult Learning depicts a future where eLearning is a continuous process of inquiry and improvement developing together with business and the society. With eLearning, the learner has convenient, just-in-time access to needed knowledge and information, with small content objects assembled and delivered according to the learner's specific needs. There is also a continued rise of an eLearning market based on common technical standards, "open design" and the widespread sharing of information across states and sectors about successful and innovative approaches. The government, as stated above, and businesses and education are joined in an effort to shape America's eLearning future.

Trends in North America

As mentored above the states and the postsecondary education institutions are engaged in facilitating new eLearning delivery systems, expanding capacity, upgrading infrastructure and instructor skills, promoting access, and shaping the regulatory environment.

Learning is focusing on the needs and interests of the individual learners and is integrated into virtually all aspects of the individual's work and life. This means that the control of the learning process shifts from the institution to the individual, who assumes greater responsibility for developing their skills and knowledge. The emphasis is on the individual and furthermore

technology that supports eLearning makes it possible to customize and personalize content and delivery to match individuals' learning styles, experience and skills.

Furthermore, cross-state and cross-sector partnerships assure investment and attention in, promoting new learning strategies, they exchange successful practices in order to promote best practice and in doing so they accelerate the speed of the needed changes. Information about successful and innovative eLearning practices is widely shared and informs the development and implementation of new programs and policies. This is one difference to Europe that can be stated, due to America's common ideas, strategies and government, ideas are being developed and implemented much faster than in Europe where the individual countries are testing the grounds individually. The eLearning situation in America is thus embedded in a system of practices and policies designed to broaden individual opportunity and increase economic competitiveness. Below are points on some of the current state actions: [12]

- The states invest in upgrading the skills of educators to employ new eLearning technologies, which are more effective.
- The states promote access to eLearning through infrastructure investments and financial incentives.
- The states build the virtual highways for eLearning.
- Some states provide incentives for businesses and individuals to participate in eLearning.
- The states assure the *quality* of eLearning content, programs, and learner achievement.
- Some states use competency-based credentials as a new currency of learning that recognizes prior experience.
- Some states form skill standards boards in order to promote performance based and assessment-based learning.
- The states explore many forms of *governance* issues as they bring eLearning activities into a coherent system.
- The states explore ways of ensuring privacy, security, and intellectual property rights in eLearning environments.

In conclusion America has gained ground compared to Europe and this due to common cooperation between the states and businesses. One advantage America has over Europe is the language, Europe is divided between 11 main languages thus, any content should be developed accordingly while America surpasses all language barriers and can concentrate on the development of eLearning applications. Below are some of the main points being currently undertaken in America.

- Delivery systems for eLearning, through virtual university and college models, and are establishing digital library models to support e-learners' search for information.
- Conventional courses online.
- Networked Colleges. Networked colleges offer a central online access point for learners otherwise registered at individual colleges and universities of an existing state system.
- Aligned systems. Aligned systems go one step further than networked colleges because they may involve many more participating institutions that are not necessarily from the same system or state.
- Independent virtual universities. Independent virtual universities have a separate corporate entity or umbrella for the participating individual colleges and universities.

Characteristics of eLearning in both continents

What is evident in both continents is the realization of what is needed in the eLearning front and their effort to accommodate these demands, which are: [13, 14]

- The learner is moving away from stand-alone courses and is now demanding integrated eLearning solutions with value added services like needs assessment, online mentoring, performance support etc
- Using brokering platforms are now more evident as the web enables the delivery of information, performance support, knowledge bases and record keeping
- Content is becoming more and more important thus, many companies are cooperating with producers, vendors and portals, and this ensures high quality.
- Consulting services – more and more companies cooperated and consult organizations on how to make the most of the new media options and how to implement the solutions most effectively
- Delivery of off-the-shelf content to linking content to organizational competencies. Which tries to answer to the question of how to move from a course-delivery model to matching learning and information-support objects to career competencies and performance-management systems?

Possible challenges

As mentioned above Europe's main challenge is the language barrier that call for native-language content development for local companies unwilling to adopt English. Another issue, which involves privacy law, is how countries can exchange information on an international level. Europe has strong labor laws that can interfere with sharing employee skills data across borders. American developed LMS systems in Germany have had to disable learner-skills tracking functions to conform to German laws. Furthermore, the European Union have privacy regulations that could hinder implementation of LMS systems. [10]

Future Recommendations

What has been identified as the most important characteristic of eLearning and what countries should focus upon are access to information, quality of content and in the delivery systems, assessment capabilities and certification opportunities. The most important focus though will be on knowledge, skills and training. The new learner is a "consumer" of knowledge available worldwide, anytime and anywhere.

This is depicted in the table below showing the changes in the information access and what the emphasis is on: i.e. from mega content containers to information objects, from keywords to metadata in order to facilitate easy transmission and reuse of content. [9]

Today	Tomorrow
Mega Content Containers	Information Objects
Keywords	Metadata
Static Content	Dynamic Content
Proprietary Authored	Standard Based Interoperability
Power Publishers	Self-Publishing

In the next diagram the role of the learner and the changes anticipated are depicted and this confirms with observers and studies saying that there is a need for corporate IT skills business skills, collaboration tools knowledge. [15]

Conventional roles and skills	Future roles and skills
Design and develop	Develop and purchase
Develop individual brain power	Manage organizational brain power
Develop content knowledge	Develop individual learning power, establish associations, find relevant materials, and make meaning
Deliver or coordinate classes	Focus on organizational readiness and management of knowledge resources
Develop and produce events and products	Create and nurture place-bound and online environments that continuously support and develop people
Coordinate short-term events and interactions	Broker systems to be used before and after classes
Deliver from content inventory	Perform analysis to customize and tailor content
Share skills and knowledge	Manage knowledge resources
Focus on employees as learners	Develop programs for managers and students as learners
Measure "butts in seats" and Web hits	Measure contribution to strategic goals
Reactive problem solving	Proactive problem solving

The future employees are more in control of what they learn and the emphasis lies in their development and their integration in the decision making process when learning is concerned.

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12 Appendix A: Methodology

The approach for the entire process of the collection, cataloguing and analysis phase is depicted in the following diagram:

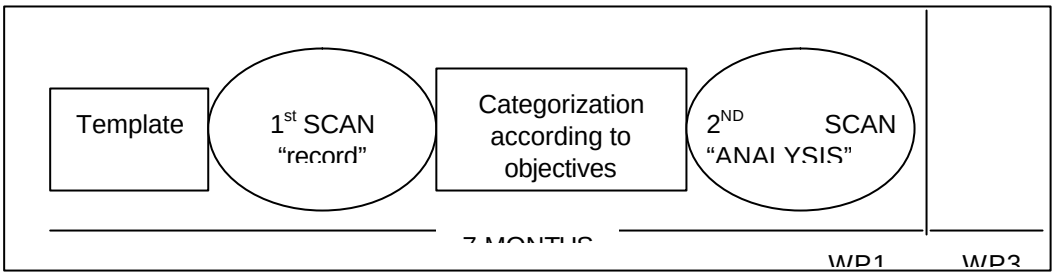

Figure 1: Actions diagram

A template was designed and used to facilitate the collection of data[4]. The fields contained in the data collection template include:

- Abstract of the project
- Objectives
- Expected results
- Contact details
- Budget information
- Duration (starting date – ending date)
- Source of funding

During the 1st scan analysis a quick recording and basic categorization of the recent and ongoing R&D projects in Europe, using the above-mentioned template, was performed. From this procedure stemmed the population of a web-interfaced database. Using this database we have completed a draft statistical analysis of the results.

From the collected projects an indicative subset was selected to perform the second scan analysis. This analysis focused in the collection of more in-depth data and their assessment based on predefined evaluation criteria.

Each one of the three SIGs focused on its assigned sector i.e. methodological approach, technology services and infrastructure and created a respective questionnaire. The compilation of the questionnaires was based on the list of nuggets already produced in the process, with respect to each SIG field of interest. The majority of the identified nuggets were elaborated into the questionnaires. In some fields of interest nuggets were further extended into the questionnaires in order to describe a particular technology in a more detailed fashion.

During the interviewing process, each selected project was contacted and asked to complete all three SIG questionnaires. The completed questionnaires were reviewed by their respective SIG resulting to the creation of three assessment reports. These reports were compiled into a final report and incorporated with minor changes into this deliverable (figure 2 depicts the described process).

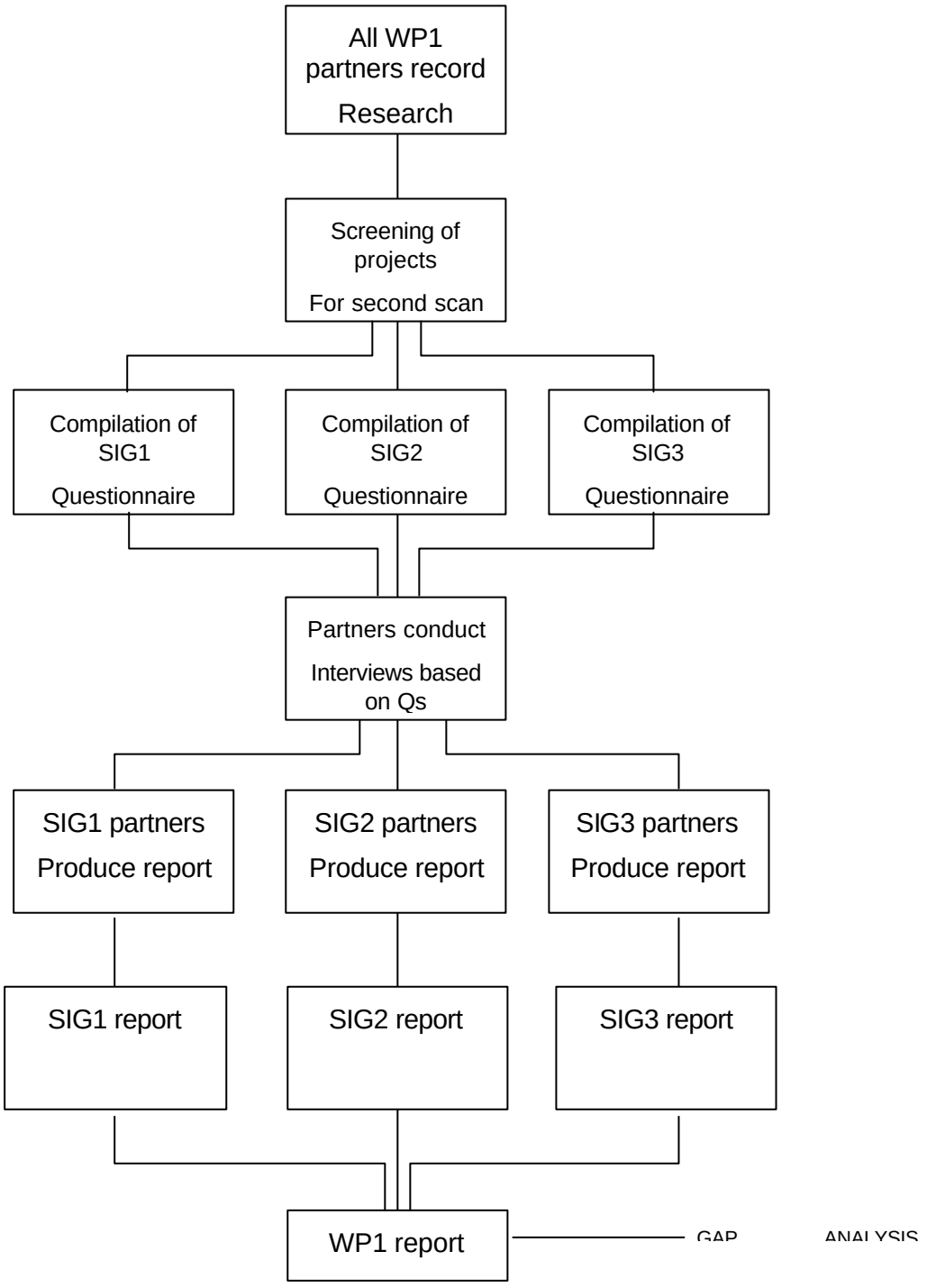

Figure 2: Workflow chart used to produce the WP1 report

[4] See appendix B of the current document

13 Appendix B: Review of External Reports

13.1 L-Change – Yearly Report 2001/2002

The L-Change project's main aim is to create an observatory system able to support IST Key Action III projects and other interested parties in the analysis of the changes implied by new technologies on education, training and lifelong learning. In order to realize its targets the L-change project conducts:

- Prospective studies on future scenarios for learning systems
- Systematic literature and press review on IST in Education and Training
- Systematic field research on industry in this market

We present here some brief conclusions from their recent yearly report were they have deduced some interesting results regarding our common area of interests. As they state the research on ICT for learning is growing but tendentially diverging. Despite a significant rise, research on eLearning still lacks inter- and multi-disciplinary convergence. Pedagogical, organizational, economic, technological and cultural aspects are treated independently and with low synergy in the research area, bringing a substantial divergence of results, and little progress in the overall context of eLearning. Research efforts are currently focused mainly on 'Knowledge Management' and 'Virtual learning environments/mobile learning and broadband'. A minor emphasis is devoted to the 'Training of teachers and trainers' and to 'Media usage and literacy', and research on 'Economics and Management of eLearning' and on Digital gaps is covered to a minimal extent. Until a synergy is not created among researchers in these different areas, little improvements will be possible in the quality of eLearning.

From their conclusions we have extracted their comments on the gap between research and practice. They stress that the lack of contextualisation link between theory and practice is currently a feature of research. Learning providers (teachers and trainers) have performed much of the in practice evaluation done until now. The raising academic interest within the field, combined with an interest in the potential market from the private sector gives a strong possibility of bringing many of the stakeholders into play simultaneously. The research needed within this area is not solely basic research, but also research closely related to actual needs. There is an already existing and growing demand for relating theory and practice and integrating ICT for practical learning purposes.

13.2 Prometeus5 – eLearning in European Enterprises

To generate a quite bright overview of the actual eLearning projects a survey was initiated and conducted sampling a large number of projects from various countries and multiple research intensions and methods resulting in interesting conclusions. Based upon the defined set of 7 criteria the research study was undertaken according to the set-up guideline resulting to a level of identifiable research area initiatives. Though we have to point out that the findings of this state of the art survey have to be treated with some kind of attention due to the complexity and diversity of the project aims and investigations.

It appears that most project have adopted evaluating and implementing eLearning applied on private sector enterprises and multiple industries profiling. Thus the technological nature of the intended project should enhance the chances that eLearning practices will be further investigated, deployed and implemented under the influence of new emerging key business drivers such as:

- Business opportunities/threats created by rapidly changing marketplace and need for quick assimilation of knowledge about new products and services.
- Time constraints to ensure compliance with new directives.
- Requirements to provide proof of training and competence.
- Cost efficiency
- Need for minimal disruption
- Need to ensure same quality learning available to widely dispersed workforce in different regions and countries.
- Return on substantial IT investment usually by fast roll-out.

Besides that a large number of project take under consideration the whole range from learner and learning theories and their application both to the eLearning research and to the enterprise adoption leading such adoption to benefits like:

- Capacity to reinforce learning more easily via eLearning, thereby increasing retention of knowledge.
- Creation of Learning Communities not only leading to knowledge sharing but also social interactions, increased employee job satisfaction and therefore decreased turnover of staff.
- Change of work practices through collaborative learning.
- Importance of a highly skilled workforce to remain competitive in the knowledge economy

Capacity to satisfy the different learning styles of individual learners.

Based upon the stated objectives it appears that larger enterprise and industries address their needs focused on:

- Clear defined instructional design
- Simulations and on-going assessments to reinforce learning

[5] PROMETEUS (PROmoting Multimedia in Education and Training in EUropean Society) is the name the consortium of signatories adopted following the signature of an MoU, which aim was to enable key players identify key issues for further development of ICT based learning applications and services and the provision of multimedia access to education and training in Europe. http://www.prometeus.org

- Use of multi-media to facilitate engagement and enjoyment
- Variety of deployment possibilities
- Multi-lingual versions available.

To conclude, most of the benefits of the introducing and deployment of eLearning methods can be related back to drivers like:

- Time-to market of new products has to be forced.
- Quality of product knowledge has to be satisfied.
- Cost-effectiveness.
- Increasing Staff retention and motivation.
- Enabling training not possible by other means.

13.3 Prometeus – eLearning in Higher Education

This report intends to describe selected European case studies and to outline common trends arising from the use of information and communication technologies in higher education.

The Information Communication Technologies will act as a flywheel to achieve the following objectives:

1. Quality
2. Access
3. Opening up to a wider world

In the following paragraphs we present in brief some remarks from this study.

The role of ICT-based teaching in traditional Universities

ICT has caused the switch from distance learning to OPEN LEARNING and WEB LEARNING, which is flexible, interactive, and student - centred. ICT has had a dramatic impact on the activities, and all services provided within the framework of higher education (libraries, campus research, etc.)

Technology and Pedagogy

The survey recorded a strong resistance from teachers to use technology-based learning. There is a strong need for "culture change" within the framework of the "Traditional University" in order for eLearning to be empowered.

University Staff and technicians must strategically organize and plan all steps when choosing technological solutions for the implementation of eLearning projects and on line courses.

Online courses and Virtual laboratories:

The characteristics of on-line courses are unique and are giving new, completely unexpected pedagogical models. Multimedia tools are a key component in education and training

especially in Science and Engineering. Online education presents many advantages but students taking these courses need support and technical assistance.

Problems recorded: eLearning is an expensive solution.

Currently available online courses show a lack of pedagogical strategy.

Learning technologies serving traditional university missions

The development of technology-based learning is changing not only the surface but is also influencing in a deep way the teaching – learning reciprocal relation. Interactive learning tools (email, voice-mail, electronic blackboard, video conference systems) are serving the traditional university mission because they offer interactivity, something that augments quality in learning. Reassuring quality in education is proven to be a very important issue.

The concept and the usage of Virtual Campuses

In order for cooperation to exist between the Virtual Campuses of several Universities, there has to be common language and criteria. There is a need for the establishment of methodology and quality standards between all.

13.4 Proacte – Advanced Training Systems at Work

In October 2002 the Proacte[6] service published a paper on "Advanced Training Systems at Work" (visit http://www.proacte.com/). This paper presents the findings of a survey of the Advanced Training Systems projects supported by the European Union under the Education and Training Action Line of the Information Society Technologies Programme. The Key Points of this paper are presented below:

- Since 2000 Advanced Training Systems projects have been developing leading edge technology-enhanced solutions for learning in the workplace, bringing together the latest thinking in pedagogy and technology
- As these projects come to fruition they are bringing products to market and seeking potential end-users
- Projects have:
  - developed a range of state-of-the-art solutions for complex industrial scenarios
  - brought together innovative learning processes (e.g. collaborative and networked learning) and leading edge technologies (e.g. advanced simulations and immersive virtual reality)
  - developed products for specific sectors and occupations, whilst retaining the flexibility to be used in a wide variety of sectors, occupations and settings

[6] PROACTe is a service to communicate work funded by the European Union under the Education Area of the Information Society (IST) Programme.

- Skills and knowledge that can be developed through project outputs include industry-specific skills as well as more general team working, business management and environmental skills
- Key benefits include:
  - flexibility based on on-demand and just-in-time principle
  - the ability to learn skills in safe environments tolerant of mistakes
  - reduced time and costs
  - direct learner involvement through experiential learning processes
- Critical success factors include:
  - exploitation of the adaptability of emerging technologies
  - precise definition of requirements
  - creation of user-friendly applications
- Project outputs have a wide range of potential applications outside the specific fields for which they have been developed
- Connecting with potential end-users is becoming an important priority for projects

13.5 Proacte – Open Platforms and Tools for Personalised Learning

In November 2002 the Proacte service published a paper on "Open Platforms and Tools for Personalised Learning". In this paper they present the findings of a survey upon the Open Platforms and Tools for Personalised Learning projects supported by the European Union under the Education and Training Action Line of the Information Society Technologies Programme. The Key Points of this paper are presented below:

- Since 1999 Open Platforms and Tools for Personalised Learning projects have been developing leading edge systems to enable learning providers to implement and maintain integrated learning services based especially on re-usable learning objects
- As these projects come to fruition they are bringing products to market and seeking potential end-users
- Existing technologies are being brought together in creative ways to develop platforms and tools that are more comprehensive than their predecessors. Products are demonstrating faster processes and enhanced performances, offering a new and cutting-edge improved environment
- Key benefits include:
  - reduced times and costs
  - better recognition of the needs of users
  - enhanced interactivity with educators and learners
  - added value to existing learning methods
  - ease of use
- Critical success factors include:
  - ensuring products can be customised
  - flexibility, availability and affordability

  - knowledge of learning technology standards and of the activity of standardisation bodies
  - creation of strong collaboration
- The platforms developed are aimed specifically at the educational sector rather than business. Yet there are wider potential commercial applications for most products and the sectoral focus could be expanded. As the projects are characterised by high levels of flexibility and adaptability, further product developments can be tailored towards a different target audiences

Connecting with potential end-users is becoming an important priority for projects.

14 Appendix C: Template of the 1st scan analysis

14.1 Research Activities Collection Report

Filled-in by:

Status: Ongoing ☐ Completed ☐

Title of research activity:

Abstract: (200-300 words)

Objectives:

Expected Results:

Contact Details

Coordinator :

Address :

Email :

Phone :

Fax :

Partners (Name, country)

1.

2.

3.

URL: http://

Direction:	Application	☐
	Technology	☐
	Infrastructure	☐

Supported by:	EU	☐	Programme:	
	National	☐	Institution:	Country:
	Industry	☐	Name:	
	Other	☐	Please specify:	

Budget:			
Duration	Starting Date:		
	Ending Date:		
Type of Research:	Basic research - Pilot	☐	
	Pre-competitive research	☐	
	Standards	☐	

15 Appendix D: Questionnaire SIG One

Goal of questionnaire:
This questionnaire aims to capture the educational methodology followed by the researchers, educators, policy makers who will be called to answer it.

Methodology Questionnaire

Filled-in by (Name of partner/Company providing data):

Type of organisation (higher education institute, research centre, education industry, secondary/vocational school, training organisation):

Instructions on how to fill out the question list

Please fill out this questionnnaire to describe in detail the teaching, training, research and development activities that you have undertaken.

For each service there are a number of options you can select to indicate whether you have integrated it or not and to what extent:

1. high expertise in using it
2. experimental usage
3. subject of research
4. not applicable
5. don't know / never heard of it

Exploratory learning	
Direct instruction	**high expertise in using it**
Non directive teaching	**high expertise in using it**
Collaborative learning	
Via simple E-mailing lists	**high expertise in using it**
Via asynchronous Discussion forums	**high expertise in using it**
Via newsgroups	**high expertise in using it**
Via Chat rooms	**high expertise in using it**
Via Video conference	**high expertise in using it**
Via Voice conference	**high expertise in using it**
Via Shared white board	**high expertise in using it**
Via Application Sharing	**high expertise in using it**

Via argumentation tools	**high expertise in using it**
Via cooperative environments	**high expertise in using it**
Simulation based learning	
Role playing	**high expertise in using it**
Business Simulation Activities	**high expertise in using it**
Virtual Laboratories	**high expertise in using it**
Microworlds	**high expertise in using it**
Virtual Reality & Active Worlds	**high expertise in using it**
Drill and practice (a teaching method not assessment)	
Assessment	**high expertise in using it**
Self assessment quizzes	**high expertise in using it**
Adaptive and personalized quizzes	**high expertise in using it**
Open type assessment	**high expertise in using it**
Problem solving tasks	**high expertise in using it**
Self learning	
Via hypermedia stand alone tutorials	**high expertise in using it**
Via Intelligent Tutoring Systems	**high expertise in using it**
Case-based learning	**high expertise in using it**
Scientific inquiry	**high expertise in using it**

16 Appendix E: Questionnaire SIG Two

Goal of questionnaire:

This questionnaire aims at creating a concrete taxonomy of the applications and services found in current research.

SIG2 focuses on eLearning specific tools and components that are used for application development. i.e. LMS tools, Authoring Tools, Delivery platforms.

Enabling Technology Services

Filled-in by (Name of partner/Company providing data):

Title of research activity:

Instructions on how to fill out the question list

Please fill out one question list for each project or research activity you want to describe in detail.

For each application/tool you have a number of options to indicate the role that this tool plays within the project or research activity:

6. substantial tool for the project
7. enabling tool for the project
8. subject of research
9. not applicable
10. don't know / never heard of this application

For tools that have been developed in the project please answer the following questions:

- Reason for development – what is the scope of the tool?
- Uniqueness - why is the tool unique - differences from existing tools?
- Development Cost.
- Readiness for marketing – exploitation plans.

index

Virtual Learning Environments

· ***Learning Management Systems***	☐
· ***Learning Content Management Systems***	☐

Add on Applications

Authoring Tools - Content Creation

· ***Multimedia Editors***	☐
· ***Web Editors***	☐
· ***Recording Tools***	☐
· ***Video Editing Tools***	☐
· ***Voice Recognition, Speech Synthesizers???***	☐

· ***Course Development Tools (knowledge Management)***	☐

Distance Interactive Learning - Delivery Tools

· ***Virtual Classrooms***	☐

Collaboration Software

· ***Web Conferencing Tools***	☐
· ***Video Conferencing Tools***	☐
· ***Collaborative Tools***	☐
· ***Special Communication Tools***	☐
· ***Simulation Tools***	☐
· ***Information & Exchange Systems***	☐
Learning Brokerage Platforms	☐
Knowledge Management Tools	☐
Assessment Tools	☐
ERP/HRIS Software	☐

Learning Management Systems		***Comments***
Ariadne Academic Consortium	*<select an option>*	
Blackboard 5 Blackboard Inc.	*<select an option>*	
Campus 2000 Online Ibis acam partner AG	*<select an option>*	
CLIX imc information multimedia communication AG	*<select an option>*	
DLS Distance Learning System ets. GmbH Verlag für didaktische Medien	*<select an option>*	
Docent Enterprise Docent Inc.	*<select an option>*	
Enterprise Learning Platform Sun Microsystems GmbH Educational Services	*<select an option>*	
Hyperwave eLearning Suite HyperwaveAG	*<select an option>*	
IBT Server eLearning suite Time4you GmbH communication & learning	*<select an option>*	

Learning Management Systems		*Comments*
iLearning Oracle Corporation	*<select an option>*	
ILIAS open source University of Cologne	*<select an option>*	
Interwise Interwise Inc.	*<select an option>*	
Lotus Learning Space Corporate offices International Business Mashines Corporation	*<select an option>*	
Saba Learning Enterprise Saba Software GmbH	*<select an option>*	
Sitos bit media eLearning solutions GmbH &Co KG	*<select an option>*	
Smartforce SkillSoft	*<select an option>*	
ToolBook II/Librarian Click2Learn Inc.	*<select an option>*	
TopClass 5 WBT-Systems	*<select an option>*	
WEbCT Campus Edition WebCT Inc.	*<select an option>*	
Other:	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Learning Content Management Systems		*Comments*
Aspen Click2Learn Inc.	*<select an option>*	
Centra Knowledge Center Centra	*<select an option>*	

Learning Content Management Systems		*Comments*
Docent Content Delivery System + gForce Docent Inc.	*<select an option>*	
JupiterSuite Avalatus	*<select an option>*	
Knowledge Planet Content Knowledge Planet	*<select an option>*	
learn eXact Interactive Labs	*<select an option>*	
Saba Content Saba Software GmbH	*<select an option>*	
TopClass WBT Systems	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** **Readiness for marketing :**		
General Comments		

Multimedia Editors		*Comments*
Blaze MediaConverter	*<select an option>*	
CheberSoft Autorun Creator	*<select an option>*	
CDH Media Wizard	*<select an option>*	
COM Sniffer	*<select an option>*	
DataMPX	*<select an option>*	
Lyred PRO	*<select an option>*	
Macromedia Flash	*<select an option>*	
Macromedia Authorware	*<select an option>*	
Macromedia Director	*<select an option>*	
VAMP Media Center	*<select an option>*	
Other	*<select an option>*	

Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		
General Comments		

Web Editors		***Comments***
Adobe Golive	*<select an option>*	
Macromedia Dreamweaver	*<select an option>*	
Microsoft Frontpage	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		
General Comments		

Recording Tools		***Comments***
RealPresenter	*<select an option>*	
Lecturnity imc informaton multimedia communication AG	*<select an option>*	
ScreenCorder	*<select an option>*	
ViewletBuilder	*<select an option>*	
WinCorder	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name):		

· **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Video Editing Tools		***Comments***
Adobe Premiere	*<select an option>*	
Cyberlink PowerDVD	*<select an option>*	
Dazzle DVD	*<select an option>*	
Video Explosion Deluxe	*<select an option>*	
Final Cat pro	*<select an option>*	
MedioSteamvNeoDVD Standard	*<select an option>*	
Video Dub	*<select an option>*	
Video Studio	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Voice Recognition, Speech Synthesizer Tools		***Comments***
CommCarePro (Speech synthesis) Informations Management	*<select an option>*	
Natural Language Understanding (Service	*<select an option>*	

developers, deploy apps) Unisys		
Nuance 6 (Developer tool) Nuance Technology	*<select an option>*	
TrueDialog (200,000 word vocabulary) Philips	*<select an option>*	
ViaVoice 1.0 for Mac IBM Voice Systems	*<select an option>*	
Visual Voice (Text-to-speech, voice recognition) Artisoft	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Course Development Tools		***Comments***
Artesia Repository	*<select an option>*	
Atomica Knowledge Management	*<select an option>*	
Inktomi Content Description System	*<select an option>*	
learn eXact Interactive Labs	*<select an option>*	
Lectora Trivantis	*<select an option>*	
OutStar's Evolution	*<select an option>*	
Sitos Content Creator	*<select an option>*	
XMetal for Course Creation	*<select an option>*	

Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		
General Comments		

Virtual Classrooms		***Comments***
centra Tetria Edutec (CH), Tetria Edusoft (D)	*<select an option>*	
eWebClassroom eWebUnivercity	*<select an option>*	
Interwise ECP Interwise Inc.	*<select an option>*	
LearnLinc Mentgery	*<select an option>*	
Teamwave Workplace	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Web Conferencing Tools		***Comments***
Placeware PlaceWare Inc.	*<select an option>*	
Other	*<select an option>*	

Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Video Conferencing		***Comments***
Centra	*<select an option>*	
Interwise	*<select an option>*	
NetMeeting Microsoft	*<select an option>*	
Polyspan Video Conference System	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Collaborative Tools		***Comments***
Centa One Collaboration Server	*<select an option>*	
Serf	*<select an option>*	

SiteScape	*<select an option>*	
Webboard ChatSpace	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Special Communication Tools		***Comments***
Chatspace Community Server	*<select an option>*	
Enterprise Communication Platform Interwise	*<select an option>*	
BSCW Frauenhofer Geselschaft	*<select an option>*	
WebEx	*<select an option>*	
AB Tutor Control	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Simulation Tools	***Comments***

Other :	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		
General Comments		

Information & Exchange Systems		***Comments***
Commsy	*<select an option>*	
UniOpen Hagen	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Learning Brokerage Platforms		***Comments***
Universal	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Knowledge Management Systems		***Comments***
eKnowledge Infrastructure HyperwaveAG	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		

General Comments

Assesment Tools		***Comments***
Crystal Reports crystal decisions	*<select an option>*	
Perception QuestionMark	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :** · **Development Cost :** · **Readiness for marketing :**		
General Comments		

ERP/HRIS Software		***Comments***
Enterprise Software Applications PeopleSoft	*<select an option>*	
Other	*<select an option>*	
Self Developed Tool (name): · **Reason for development:** · **Uniqueness :**		

· **Development Cost :** · **Readiness for marketing :**		
General Comments		

17 Appendix F: Questionnaire SIG Three

Infrastructure Questionnaire

Filled-in by (Name of partner/Company providing data):

Title of research activity:

Instructions on how to fill out the question list

Please fill out one question list for each project or research activity you want to describe in detail.

Make sure you enter the same title for the research activity as you did when you filled out the Research Activity Collection Reports so it is easier for us to match them afterwards.

For each technology you have a number of options to indicate the role that technology plays within the project or research activity:

11. considered proven technology
12. enabling technology for the project
13. subject of research
14. not applicable
15. don't know / never heard of the technology

Select the column indicating the role for each of the technologies for the project or research activity.

Standards	1	2	3	4	5
TCP/IP					
HTTP – Hypertext transfer protocol					
LOM – Learning Objects Metadata standard					
XML – Extensible Markup Language					
RDF – Resource Description Framework					

Specifications	1	2	3	4	5
IMS Content packaging specification					
IMS Simple Sequencing specification					
IMS Question and Test Interoperability (QTI) specification					
IMS Enterprise specification					
IMS Learner Information Profile (LIP) specification					
IMS Repository specification					
IMS Reusable Competency specification					
IMS Learning Design specification					
OUNL EML specification					

Specifications	1	2	3	4	5
Dublin Core metadata application profile					
CanCore metadata application profile					

Reference models	1	2	3	4	5
ADL SCORM					

Networks and network technologies	1	2	3	4	5
Novell Netware					
Microsoft Windows					
Linux					
Unix					
M-Commerce					
E-Commerce					
World Wide Web					
Semantic Web					
VPN – Virtual Private Network					
XDSL					
Broadband connections					
Satellite Internet connection					

Wireless networks	1	2	3	4	5
802.11x					
WiFi					
WEP – Wired Equivalent Privacy					
Wardriving					
Mobile Internet					
WAP					
I-mode					
UMTS - Universal Mobile Telecommunications System					
GPRS - General Packet Radio Service					

Communication	1	2	3	4	5
P2P – Peer to Peer communication					
Videoconferencing					

P3P - Platform for Privacy Preferences Project					
IM – Instant Messaging					

XML	1	2	3	4	5
Webservices					
UDDI - Universal Description, Discovery and Integration project					
WSDL - Web Services Description Language					
SOAP - Simple Object Access Protocol					
Java					
.NET					

Devices	1	2	3	4	5
Tablet PC					
O2 XDA					
PDA – Personal Digital Assistant					
Personal Computer					
Mobile Phone					

API	1	2	3	4	5
OKI					
uPortal					
SAX					

Storage	1	2	3	4	5
NAS – Network Attached Storage					
SAN – Storage Area Network					
RAID - Redundant Array of Independent (or Inexpensive) Disks					
Relational Databases					
XML Databases					
CMS - Content Management System					
LCMS - Learn Content Management Systems					

Middleware	1	2	3	4	5
Object Request Brokers					
Transaction Processing					

Remote Procedure Call					
Message Oriented Middleware					

18 Appendix G: Glossary

.NET

Microsoft .NET is a set of Microsoft software technologies for connecting your world of information, people, systems, and devices. It enables an unprecedented level of software integration through the use of XML Web services: small, discrete, building-block applications that connect to each other as well as to other, larger applications via the Internet.

source: http://www.microsoft.com/

802.11x

The IEEE 802.11 specifications are wireless standards that specify an "over-the-air" interface between a wireless client and a base station or access point, as well as among wireless clients. The 802.11 standards can be compared to the IEEE 802.3 standard for Ethernet for wired LANs. The IEEE 802.11 specifications address both the Physical (PHY) and Media Access Control (MAC) layers and are tailored to resolve compatibility issues between manufacturers of Wireless LAN equipment.

source: http://standards.ieee.org/wireless/overview.html#802.11

ADL SCORM

The Sharable Content Object Reference Model (SCORM) defines a Web-based learning "Content Aggregation Model" and "Run-Time Environment" for learning objects. The SCORM is a collection of specifications adapted from multiple sources to provide a comprehensive suite of eLearning capabilities that enable interoperability, accessibility and reusability of Web-based learning content. The work of the ADL Initiative to develop the SCORM is also a process to knit together disparate groups and interests. This reference model aims to coordinate emerging-technologies and commercial and/or public implementations.

source: http://www.adlnet.org/index.cfm?fuseaction=scormabt

CanCore metadata application profile

The CanCore Protocol will allow educators, researchers and students in Canada and around the world to more easily search and locate material from any online repository of educational objects. These educational or learning objects can be as simple as individual web pages, video clips, or interactive presentations, or as comprehensive as full lessons, courses or training programs.

The Canadian Core Protocol has been developed by national and provincial educators and technology developers, including project participants of Portal for Online Objects for Learning (POOL) and Broadband Enabled Lifelong Learning Environment (BELLE). Coordination and development work was led by the Electonic Text Centre at the University of New Brunswick and assisted by the Campus Alberta Repository of Educational Objects (CAREO). Funding and support has been provided by Industry Canada/CANARIE, Alberta Learning, Netera Alliance, TeleCampus.edu, and the Electronic Text Centre at the University of New Brunswick.

The national protocol has been under intensive development since November 2000. It is compatible with existing metadata standards to allow seamless searches of

educational object repositories located in Canada and around the world, such as the US-based MERLOT project (Multimedia Educational Resources for Learning and Online Teaching).

source: http://www.cancore.ca

Dublin Core metadata application profile

The Dublin Core Metadata Initiative is an open forum engaged in the development of interoperable online metadata standards that support a broad range of purposes and business models. DCMI's activities include consensus-driven working groups, global workshops, conferences, standards liaison, and educational efforts to promote widespread acceptance of metadata standards and practices.

DCMI traces its roots to Chicago at the 2nd International World Wide Web Conference, October 1994. Yuri Rubinsky of SoftQuad (who chaired panels regarding the future of HTML and Web authoring tools) along with Stuart Weibel and Eric Miller of OCLC (who were presenting papers about scholarly publishing on the Web and leading discussions on the delivery of Web-based library services) had a hallway conversation with Joe Hardin, Director of the National Center for Supercomputing Applications which led to a discussion on semantics and the Web.

Their initial brainstorming lead to NCSA and OCLC holding a joint workshop to discuss metadata semantics in Dublin, Ohio, March 1995. At this event, called simply the "OCLC/NCSA Metadata Workshop", more than 50 people discussed how a core set of semantics for Web-based resources would be extremely useful for categorizing the Web for easier search and retrieval. They dubbed the result "Dublin Core metadata" based on the location of the workshop. Since that time there have been a total of eight workshops held in England, Australia, Finland, Germany, Canada and the United States.

source: http://dublincore.org/

GPRS - General Packet Radio Service

The General Packet Radio Service (GPRS) is a new nonvoice value added service that allows information to be sent and received across a mobile telephone network. It supplements today's Circuit Switched Data and Short Message Service. GPRS is NOT related to GPS (the Global Positioning System), a similar acronym that is often used in mobile contexts. GPRS has several unique features which can be summarized as:

Theoretical maximum speeds of up to 171.2 kilobits per second (kbps) are achievable with GPRS using all eight timeslots at the same time. This is about three times as fast as the data transmission speeds possible over today's fixed telecommunications networks and ten times as fast as current Circuit Switched Data services on GSM networks. By allowing information to be transmitted more quickly, immediately and efficiently across the mobile network, GPRS may well be a relatively less costly mobile data service compared to SMS and Circuit Switched Data.GPRS facilitates instant connections whereby information can be sent or received immediately as the need arises, subject to radio coverage. No dial-up modem connection is necessary. This is why GPRS users are sometimes referred to be as being "always connected". Immediacy is one of the advantages of GPRS (and SMS) when compared to Circuit Switched Data. High immediacy is a very important feature for time critical applications such as remote credit card authorization where it would be unacceptable to keep the customer waiting for even thirty extra seconds.

source: http://www.gsmworld.com/technology/gprs/intro.shtml

IM - Instant Messaging

Instant messaging allows you to maintain a list of people that you wish to interact with. You can send messages to any of the people in your list, often called a buddy list or contact list, as long as that person is online. Sending a message opens up a small window where you and your friend can type in messages that both of you can see.

Most of the popular instant-messaging programs provide a variety of features:

* Instant messages - Send notes back and forth with a friend who is online

* Chat - Create your own custom chat room with friends or co-workers

* Web links - Share links to your favorite Web sites

* Images - Look at an image stored on your friend's computer

* Sounds - Play sounds for your friends

* Files - Share files by sending them directly to your friends

* Talk - Use the Internet instead of a phone to actually talk with friends

* Streaming content - Real-time or near-real-time stock quotes and news

source: http://www.howstuffworks.com/instant-messaging.htm

IMS Content packaging specification

The IMS Content Packaging Specification provides the functionality to describe and package learning materials, such as an individual course or a collection of courses, into interoperable, distributable packages. Content Packaging addresses the description, structure, and location of online learning materials and the definition of some particular content types.

The Content Packaging Specification is aimed primarily at content producers, learning management system vendors, computing platform vendors, and learning service providers. Learning materials described and packaged using the IMS Content Packaging XML format should be interoperable with any tool that supports the Specification. Content creators can develop and distribute material knowing that it can be delivered on any compliant system, thereby protecting their investment in rich content development.

source: http://www.imsproject.org/content/packaging/index.cfm

IMS Enterprise specification

The IMS Enterprise Information Model describes data structures that are used to provide interoperability of Internet-based Instructional Management systems with other Enterprise systems used to support the operations of an organization.

The objective of the IMS Enterprise Information Model is to define a standardized set of structures that can be used to exchange data between different systems. These structures provide the basis for standardized data bindings that allow software developers and implementers to create Instructional Management processes that interoperate across systems developed independently by various software developers. The major classes of Enterprise applications supported by this model are Training

Administration, Student Administration, Library Management, and Human Resource systems.

Note: The scope of the IMS Enterprise specification is focused on defining interoperability between systems residing within the same enterprise or organization. The documents comprising the IMS Enterprise specification are not targeted at solving the issues of data integrity, communication, overall security, and others that are inherent when investigating cross-enterprise data exchange

source: http://www.imsproject.org/enterprise/index.cfm

IMS Learner Information Profile (LIP) specification

Learner Information is a collection of information about a Learner (individual or group learners) or a Producer of learning content (creators, providers or vendors). The IMS Learner Information Package (IMS LIP) specification addresses the interoperability of internet-based Learner Information systems with other systems that support the Internet learning environment. The intent of the specification is to define a set of packages that can be used to import data into and extract data from an IMS compliant Learner Information server. A Learner Information server may exchange data with Learner Delivery systems or with other Learner Information servers. It is the responsibility of the Learner Information server to allow the owner of the learner information to define what part of the learner information can be shared with other systems. The core structures of the IMS LIP are based upon: accessibilities; activities; affiliations; competencies; goals; identifications; interests; qualifications, certifications and licences; relationship; security keys; and transcripts.

Version 1.0 of the IMS Learner Information Package Specification was released to the public in March 2001.

source: http://www.imsproject.org/profiles/index.cfm

IMS Learning Design specification

The IMS Learning Design specification supports the use of a wide range of pedagogies in online learning. Rather than attempting to capture the specifics of many pedagogies, it does this by providing a generic and flexible language. This language is designed to enable many different pedagogies to be expressed. The approach has the advantage over alternatives in that only one set of learning design and runtime tools then need to be implemented in order to support the desired wide rage of pedagogies. The language was originally developed at the Open University of the Netherlands (OUNL), after extensive examination and comparison of a wide range of pedagogical approaches and their associated learning activities, and several iterations of the developing language to obtain a good balance between generality and pedagogic expressiveness.

Version 1 Public Draft was approved by the IMS Technical Board in October 2002

source: http://www.imsproject.org/learningdesign/index.cfm

IMS Question and Test Interoperability (QTI) specification

The IMS Question & Test Interoperability Specification provides proposed standard XML language for describing questions and tests. The specification has been produced to allow the interoperability of content within assessment systems. This will be useful for publishers, certification authorities, teachers, trainers, publishers and

creators of assessments, and the software vendors whose tools they use. Authoring tools, and publishers, may publish XML and this data can be imported into other authoring tools and delivery systems.

Version 1.2 was approved by the IMS Technical Board in February 2002.

source: http://www.imsproject.org/question/index.cfm

IMS Repository specification

The IMS Digital Repositories v1.0 Public Draft specification, released August 2002, purpose is to provide recommendations for the interoperation of the most common repository functions. These recommendations should be implementable across services to enable them to present a common interface.

On the broadest level, this specification defines digital repositories as being any collection of resources that are accessible via a network without prior knowledge of the structure of the collection. Repositories may hold actual assets or the meta-data that describe assets. The assets and their meta-data do not need to be held in the same repository.

This specification is intended to utilize schemas already defined elsewhere (e.g., IMS Meta-Data and Content Packaging), rather than attempt to introduce any new schema.

source: http://www.imsproject.org/digitalrepositories/index.cfm

Java

The JavaTM programming language is designed to meet the challenges of application development in the context of heterogeneous, network-wide distributed environments. Paramount among these challenges is secure delivery of applications that consume the minimum of system resources, can run on any hardware and software platform, and can be extended dynamically.

The Java programming language originated as part of a research project to develop advanced software for a wide variety of network devices and embedded systems. The goal was to develop a small, reliable, portable, distributed, real-time operating platform. When the project started, C++ was the language of choice. But over time the difficulties encountered with C++ grew to the point where the problems could best be addressed by creating an entirely new language platform. Design and architecture decisions drew from a variety of languages such as Eiffel, SmallTalk, Objective C, and Cedar/Mesa. The result is a language platform that has proven ideal for developing secure, distributed, network-based end-user applications in environments ranging from network-embedded devices to the World-Wide Web and the desktop.

source: http://java.sun.com/docs/white/langenv/

Linux

Pronounced lee-nucks. A freely-distributable open source implementation of UNIX that runs on a number of hardware platforms, including Intel and Motorola microprocessors. It was developed mainly by Linus Torvalds. Because it's free, and because it runs on many platforms, including PCs, Macintoshes and Amigas, Linux has become extremely popular over the last couple years.

Another popular, free version of UNIX that runs on Intel microprocessors is FreeBSD.

source: http://www.webopedia.com/TERM/L/Linux.html

Message Oriented Middleware

Message-oriented middleware (MOM) is a client/server infrastructure that increases the interoperability, portability, and flexibility of an application by allowing the application to be distributed over multiple heterogeneous platforms. It reduces the complexity of developing applications that span multiple operating systems and network protocols by insulating the application developer from the details of the various operating system and network interfaces- Application Programming Interfaces (APIs) that extend across diverse platforms and networks are typically provided by the MOM.

source: http://www.sei.cmu.edu/str/descriptions/momt.html

NAS - Network Attached Storage

NAS usually consists of one or more computers that act as file servers and are only used for hard disk storage. NAS file servers can be added to a corporate network or even be included in a SAN.

source: http://storage.ittoolbox.com/pub/storage_overview.htm

Novell Netware

Novell® NetWare® 6 is the Net services software solution that offers you secure non-stop access to core network resources. With NetWare 6 you can access files, printers, directories, e-mail and databases across all types of networks, storage platforms and client desktops. NetWare 6 leverages the Novell eDirectory, giving you a way to manage your network from virtually any Web-enabled, wireless device or traditional desktop computer. NetWare 6 also supports open, Internet standards and includes innovative, browser-based Net services.

source: http://www.novell.com/products/netware/quicklook.html

O2 XDA

The xda combines the benefits of a GPRS mobile phone with the power of a PDA complete with a full-colour touch screen. It has all the Microsoft Pocket PC tools like Word, Excel, Outlook. Explorer, Media Player build in.

source: http://www.o2.co.uk/productsservices/xda_services/

Object Request Brokers

An object request broker (ORB) is a middleware technology that manages communication and data exchange between objects. ORBs promote interoperability of distributed object systems because they enable users to build systems by piecing together objects- from different vendors- that communicate with each other via the ORB [Wade 94]. The implementation details of the ORB are generally not important to developers building distributed systems. The developers are only concerned with the object interface details. This form of information hiding enhances system maintainability since the object communication details are hidden from the developers and isolated in the ORB

source: http://www.sei.cmu.edu/str/descriptions/orb.html

OKI

The Open Knowledge Initiative is defining open architectural specifications to support the development of educational software.

Its architecture will provide a modular and extensible development platform for building both traditional and innovative educational applications while helping institutions leverage existing infrastructure.

OKI is designed for broad adoption in the university setting.

It aims to simplify the methods of assembly, delivery and access to educational technology resources, while creating a large collaborative community.

source: http://web.mit.edu/oki/

OUNL EML specification

The work carried out by the Open University of the Netherlands (OUNL) on educational modelling comes from an R&D project funded by the Dutch national government through their structural funds for universities. The R&D work on learning technologies is paid from these funds with the objective of innovating education through the use of ICT.

OUNL research is academic and independent of any vendor or other commercial stakeholder. Besides work on Educational Modelling Language (EML), the OUNL's research and development activities in learning technologies include: competency based learning, new models of assessment (e.g. portfolio's), printing on demand, and others. The main outputs are: specifications, prototypes and publications.

Brief explanation on EML

To date no comprehensive notational system exists that allows one to codify units of study (e.g. courses, course components and study programmes), in an integral fashion. EML is the first system to achieve precisely this. EML describes not just the content of a unit of study (texts, tasks, tests, assignments) but also the roles, relations, interactions and activities of students and teachers. The major EML implementation is in XML (eXtensible Mark-up Language), an internationally accepted meta-language for the structured description of documents and data.

Various kinds of specifications with which educational content may be codified are under development. Examples are initiatives taken by IMS, IEEE-LTSC, Dublin Core and ADL-SCORM. EML does not make these initiatives superfluous, nor does it run contrary to their aims. If anything, it takes many of the ideas voiced by them one step further by developing an more comprehensive notational system.

EML allows to model a variety of pedagogies for education. One may use EML to model for instance a competence based pedagogy, problem based learning, performance support, self study packages or even traditional face-to-face teaching.

When using EML there is no need to worry about the delivery mode during content development. EML guarantees that investments in content will last for a long time; because of the uniformity of notation that EML brings, an instrument for comparative research on the effectiveness of educational structures emerges. Shortly, EML ensures the interoperability, re-usability, and compatibility of learning materials in the future.

source: http://eml.ou.nl/

P2P - Peer to Peer communication

peer-to-peer computing is the sharing of computer resources and services by direct exchange between systems. These resources and services include the exchange of information, processing cycles, cache storage, and disk storage for files. Peer-to-peer computing takes advantage of existing desktop computing power and networking connectivity, allowing economical clients to leverage their collective power to benefit the entire enterprise.

source: http://www.peer-to-peerwg.org/whatis/index.html

P3P - Platform for Privacy Preferences Project

The Platform for Privacy Preferences Project (P3P), developed by the World Wide Web Consortium, is emerging as an industry standard providing a simple, automated way for users to gain more control over the use of personal information on Web sites they visit. At its most basic level, P3P is a standardized set of multiple-choice questions, covering all the major aspects of a Web site's privacy policies. Taken together, they present a clear snapshot of how a site handles personal information about its users. P3P-enabled Web sites make this information available in a standard, machine-readable format. P3P enabled browsers can "read" this snapshot automatically and compare it to the consumer's own set of privacy preferences. P3P enhances user control by putting privacy policies where users can find them, in a form users can understand, and, most importantly, enables users to act on what they see.

source: http://www.w3.org/P3P/

RAID - Redundant Array of Independent (or Inexpensive) Disks

A category of disk drives that employ two or more drives in combination for fault tolerance and performance. RAID disk drives are used frequently on servers but aren't generally necessary for personal computers.

There are number of different RAID levels. The three most common are 0, 3, and 5:

Level 0: Provides data striping (spreading out blocks of each file across multiple disks) but no redundancy. This improves performance but does not deliver fault tolerance.

Level 1: Provides disk mirroring.

Level 3: Same as Level 0, but also reserves one dedicated disk for error correction data. It provides good performance and some level of fault tolerance.

Level 5: Provides data striping at the byte level and also stripe error correction information. This results in excellent performance and good fault tolerance.

source: http://inews.webopedia.com/TERM/R/RAID.html

RDF - Resource Description Framework

The Resource Description Framework (RDF) is a general-purpose language for

representing information in the World Wide Web. It is particularly intended for representing metadata about Web resources, such as the title, author, and modification date of a Web page, the copyright and syndication information about a Web document, the availability schedule for some shared resource, or the description of a Web user's preferences for information delivery. RDF provides a common framework for expressing this information in such a way that it can be exchanged between applications without loss of meaning. Since it is a common framework, application designers can leverage the availability of common RDF parsers and processing tools. Exchanging information between different applications means that the information may be made available to applications other than those for which it was originally created.

source: http://www.w3.org/TR/rdf-primer/

Remote Procedure Call

Remote Procedure Call (RPC) is a client/server infrastructure that increases the interoperability, portability, and flexibility of an application by allowing the application to be distributed over multiple heterogeneous platforms. It reduces the complexity of developing applications that span multiple operating systems and network protocols by insulating the application developer from the details of the various operating system and network interfaces--function calls are the programmer's interface when using RPC. The concept of RPC has been discussed in literature as far back as 1976, with full-scale implementations appearing in the late 1970s and early 1980s

source: http://www.sei.cmu.edu/str/descriptions/rpc.html

SAN - Storage Area Network

A SAN is a computer network that exists separately from the main corporate network. A SAN runs on storage-specific interfaces like Fibre Channel or a Small Computer System Interface (SCSI) that are designed to transfer data quickly between storage devices. A SAN is beneficial because it runs separately from the corporate network. Transferring data ties up bandwidth, which can dramatically slow down a corporate network.

source: http://storage.ittoolbox.com/pub/storage_overview.htm

SAX

Simple API for XML (SAX) is not a W3C Reccommendation. It is public domain software, created by members of the XML-DEV mailing list, led by David Megginson.

source: Professional XML 2nd Edition - Wrox

Semantic Web

The Semantic Web is the abstract representation of data on the World Wide Web, based on the RDF standards and other standards to be defined. It is being developed by the W3C, in collaboration with a large number of researchers and industrial partners.

"The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation." -- Tim Berners-Lee, James Hendler, Ora Lassila, The Semantic Web, Scientific American, May 200

source: http://www.w3.org/2001/sw/

SOAP - Simple Object Access Protocol

SOAP is a lightweight protocol for exchange of information in a decentralized, distributed environment. It is an XML based protocol that consists of three parts: an envelope that defines a framework for describing what is in a message and how to process it, a set of encoding rules for expressing instances of application-defined datatypes, and a convention for representing remote procedure calls and responses. SOAP can potentially be used in combination with a variety of other protocols; however, the only bindings defined in this document describe how to use SOAP in combination with HTTP and HTTP Extension Framework.

source: http://www.w3.org/TR/SOAP/

TCP/IP

Abbreviation for Transmission Control Protocol/Internet Protocol, the suite of communications protocols used to connect hosts on the Internet. TCP/IP uses several protocols, the two main ones being TCP and IP. TCP/IP is built into the UNIX operating system and is used by the Internet, making it the de facto standard for transmitting data over networks. Even network operating systems that have their own protocols, such as Netware, also support TCP/IP.

source: http://www.webopedia.com/TERM/T/TCP_IP.html

Transaction Processing

Transaction processing (TP) monitor technology provides the distributed client/server environment the capacity to efficiently and reliably develop, run, and manage transaction applications.

TP monitor technology controls transaction applications and performs business logic/rules computations and database updates. TP monitor technology emerged 25 years ago when Atlantic Power and Light created an online support environment to share concurrently applications services and information resources with the batch and time sharing operating systems environment. TP monitor technology is used in data management, network access, security systems, delivery order processing, airline reservations, and customer service. Use of TP monitor technology is a cost-effective alternative to upgrading database management systems or platform resources to provide this same functionality.

source: http://www.sei.cmu.edu/str/descriptions/tpmt.html

UDDI - Universal Description, Discovery and Integration project

The Universal Description, Discovery and Integration (UDDI) project is a sweeping industry initiative. The project creates a platform-independent, open framework for describing services, discovering businesses, and integrating business services using the Internet, as well as an operational registry that is available today.

UDDI is the first truly cross-industry effort driven by all major platform and software providers, as well as marketplace operators and e-business leaders. These technology and business pioneers are acting as the initial catalysts to quickly

develop UDDI and related technologies.

The UDDI project takes advantage of WorldWide Web Consortium (W3C) and Internet Engineering Task Force (IETF) standards such as Extensible Markup Language (XML), and HTTP and Domain Name System (DNS protocols. Additionally, cross platform programming features are addressed by adopting early versions of the proposed Simple Object Access Protocol (SOAP) known as XML Protocol messaging specifications found at the W3C Web site. The UDDI protocol is the building block that will enable businesses to quickly, easily and dynamically find and transact with one another using their preferred applications.

source: http://www.uddi.org/

UMTS - Universal Mobile Telecommunications System

Standing for "Universal Mobile Telecommunications System", UMTS represents an evolution in terms of services and data speeds from today's "second generation" mobile networks. As a key member of the "global family" of third generation (3G) mobile technologies identified by the ITU, UMTS is the natural evolutionary choice for operators of GSM networks, currently representing a customer base of more than 747 million end users in over 180 countries and representing over 70% of today's digital wireless market [source: GSM Association]

source: http://www.umts-forum.org/what_is_umts.html

VPN - Virtual Private Network

Short for virtual private network, a network that is constructed by using public wires to connect nodes. For example, there are a number of systems that enable you to create networks using the Internet as the medium for transporting data. These systems use encryption and other security mechanisms to ensure that only authorized users can access the network and that the data cannot be intercepted.

source: http://www.webopedia.com/TERM/V/VPN.html

Wardriving

WarDriving, a definition.

War (wôr) n.

1 open armed conflict between countries or between factions within the same country

2 any active hostility, contention, or struggle; conflict [the war against disease]

3 [Obs.] a battle

4 military operations as a profession or science

--n. of, used in, or resulting from war

Driv ing (dri'vin) adj.

1 transmitting force or motion

2 moving with force and violence [a driving rain]

3 vigorous; energetic [a driving jazz solo}

--n. the way one drives an automobile, etc.

War Driving (wôr dri'vin) v.

1 Driving around looking for unsecured wireless networks.

-term coined by Pete Shipley

Reference: Websters New World Dictionary Copyright:1988 by Simon and Schuster, Inc.

source: http://www.wardriving.com/

WEP - Wired Equivalent Privacy

Short for Wired Equivalent Privacy, a security protocol for wireless local area networks (WLANs) defined in the 802.11b standard. WEP is designed to provide the same level of security as that of a wired LAN. LANs are inherently more secure than WLANs because LANs are somewhat protected by the physicalities of their structure, having some or all part of the network inside a building that can be protected from unauthorized access. WLANs, which are over radio waves, do not have the same physical structure and therefore are more vulnerable to tampering. WEP aims to provide security by encrypting data over radio waves so that it is protected as it is transmitted from one end point to another. However, it has been found that WEP is not as secure as once believed. WEP is used at the two lowest layers of the OSI model - the data link and physical layers; it therefore does not offer end-to-end security.

source: http://www.webopedia.com/TERM/W/WEP.html

WiFi

"The Wi-Fi Alliance is a nonprofit international association formed in 1999 to certify interoperability of wireless Local Area Network products based on IEEE 802.11 specification. Currently the Wi-Fi Alliance has 195 member companies from around the world, and 505 products have received Wi-Fi certification since certification began in March of 2000. The goal of the Wi-Fi Alliance's members is to enhance the user experience through product interoperability."

source: http://www.wi-fi.org/

WSDL - Web Services Description Language

WSDL is an XML format for describing network services as a set of endpoints operating on messages containing either document-oriented or procedure-oriented information. The operations and messages are described abstractly, and then bound to a concrete network protocol and message format to define an endpoint. Related concrete endpoints are combined into abstract endpoints (services). WSDL is extensible to allow description of endpoints and their messages regardless of what message formats or network protocols are used to communicate, however, the only bindings described in this document describe how to use WSDL in conjunction with SOAP 1.1, HTTP GET/POST, and MIME.

source: http://www.w3.org/TR/wsdl

XDSL

Refers collectively to all types of digital subscriber lines, the two main categories being ADSL and SDSL. Two other types of xDSL technologies are High-data-rate DSL (HDSL) and Very high DSL (VDSL).

DSL technologies use sophisticated modulation schemes to pack data onto copper wires. They are sometimes referred to as last-mile technologies because they are used only for connections from a telephone switching station to a home or office, not between switching stations.

xDSL is similar to ISDN inasmuch as both operate over existing copper telephone lines (POTS) and both require the short runs to a central telephone office (usually less than 20,000 feet). However, xDSL offers much higher speeds - up to 32 Mbps for upstream traffic, and from 32 Kbps to over 1 Mbps for downstream traffic.

source: http://www.webopedia.com/TERM/x/xDSL.html

XML - Extensible Markup Language

Extensible Markup Language (XML) is a simple, very flexible text format derived from SGML (ISO 8879). Originally designed to meet the challenges of large-scale electronic publishing, XML is also playing an increasingly important role in the exchange of a wide variety of data on the Web and elsewhere.

source: http://www.w3.org/XML/