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## PROLEARN: Technology Enhanced Learning and Knowledge Distribution for the Corporate World

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**Abstract:** *E-Learning is increasingly influencing university and workplace education in Europe. The EU/IST FP6 Network of Excellence PROLEARN is focussing on these issues, advancing the state of the art in this area. Some of PROLEARNs key issues are the production, deployment, exchange and brokerage of learning resources as well as their usage for professional training in SMEs and larger companies. Furthermore, the project addresses the needs of companies from the learning as well as from the business perspective, e.g. including appropriate business process reference models for the introduction of e-learning systems and scenarios, embedding them into the complete IT environment of an enterprises an the respective working environments of an employee. In this paper we will focus on the issues of metadata for learning resources, its use in brokerage systems and the relation to respective business processes in enterprises, thus basically relating issues of knowledge management to technology enhanced learning in commercial scenarios.*

**Keywords:** technology enhanced learning, business models, knowledge management.

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### Introduction

Companies recognise the knowledge of their employees as an increasingly valuable asset. The employees' knowledge significantly contributes to the companies' ability to react on requirements of fast changes markets, customer needs and successful business processes. As such, companies need to manage the knowledge of their employees. Maintaining the knowledge means to evaluate the employees' tacit and explicit knowledge as well as fostering and provision of this knowledge within the company with suitable tools. Managing knowledge in companies includes this maintenance process and, furthermore, the development of additional knowledge. Obviously, the process of

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acquiring new knowledge for companies is based on the developments plans of these companies and thus needs to be reflected within the respective business processes.

When companies intend to acquire knowledge by educating their employees, suitable methods are based on technology enhanced learning (TEL). First of all, companies will formulate respective learning goals, which will then be fulfilled by the employees. Based on the formulated learning goals, suitable tools will be chosen to facilitate the learning process. These tools need to incorporate the principles of knowledge management tools, and at the same time, will rely on the advances of technology enhanced learning. From the technological perspective, the combination of knowledge management and technology enhanced learning tools leads to the combination of knowledge management systems (KMS) with learning management systems (LMS) including content management systems, user administration and tracking systems, communication management and business process integration.

In other words, integrating knowledge work and learning is the key to support human resource management and company profile development. PROLEARN<sup>1</sup>, the Network of Excellence in Professional Learning addresses the need for specialized business models and processes to integrate life-long learning into the work process and to build a viable infrastructure of E-Learning technology, service and content providers in Europe.

Facilitating innovative technology enhanced learning scenarios successfully in a variety of environments is a major PROLEARN goal. New kinds of interactive media and videoconferencing environments as well as simulations and hands-on experiences in the context of online and virtual laboratories promise to make learning more effective. Techniques to personalise content, which rely on user and group profiles will individualize the learning experience. PROLEARN researchers also work on advanced distributed and peer-to-peer learning infrastructures which support sharing and exchanging learning materials without centralized servers or administration. Standardized descriptions of interfaces and learning resources are a prerequisite for such infrastructures and enable the simplified and automated access to appropriate learning.

In this article, we will describe how personalisation and adaptation will need to evolve in coordination with the development of learning management and brokerage systems as well as knowledge management systems in the context of PROLEARN. Interoperability among systems will be achieved by relying on the respective standards, while business processes and models will enable a seamless integration into the corporate world.

### **Technology enhanced learning for professional education**

Supporting technology to combine the advantages of knowledge management and eLearning in companies requires the combination of knowledge management systems with learning management systems, also taking into account the respective business processes and the requirements of human resource management systems.

Therefore, we focus PROLEARN on the application of technology enhanced learning in corporate education. In order to make E-Learning successful and applicable in a variety of application scenarios, we have to integrate extensive interactive experiences,

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<sup>1</sup> <http://www.prolearn-project.org>

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including the usage of interactive media and videoconferences, simulations and hands-on experiences in the context of online and virtual laboratories. Great potential for advanced eLearning environments have techniques to personalize learner experiences based on user and group profiles, taking the actual needs of specific learners into account. Brokerage systems can significantly help to share and exchange learning materials, in the form of advanced learning objects, including (new) pedagogical models as they emerge. Using standardized descriptions of learning objects and interfaces, LMS are able to connect and to facilitate simplified access to learning resources in a distributed environment. At the same time these environments can support and integrate knowledge work and learning, supporting human resource management and company profile development. Special business models and processes are needed to integrate life-long learning into the work process and to build a viable infrastructure of eLearning technology, service and content providers in Europe.

All these factors represent issues to be solved, we will focus on the issues of learning management and brokerage systems that implement personalisation and adaptation and which take business processes into account. Metadata plays a key role in the combination of various LMS and KMS, as it allows for the simplified integration of information into these systems. Metadata will be used to describe learning resources, information assets, user profiles, business profiles, etc. By relying on standardized metadata, the provision of the right information at the right time for the systems will become an (semi)automatic task. It usually is semiautomatic because in the general case heterogeneous ontologies are used to describe the content while only the description is captured in schemas. Therefore, combining schemas that use the same metadata standards but different ontologies are usually solved relying on human interaction.

### **Personalized Adaptive Learning in LMS and Brokerage Systems**

Respecting the focus of the paper, we describe the various research issues here, grouping them according to the structure of the work packages of PROLEARN. Each area gives a brief introduction into the subject and continues with an explanation of the various key research issues. Starting with the area of brokerage systems and learning management, we outline the recent issues of LMS. Proceeding to the area of personalized adaptive learning we reflect on personalisation and adaptation issues. The area of metadata standards argues about the standardization issues of eLearning in general. The following chapter will deal with the area of business processes, models and markets that will introduce the corporate view on eLearning.

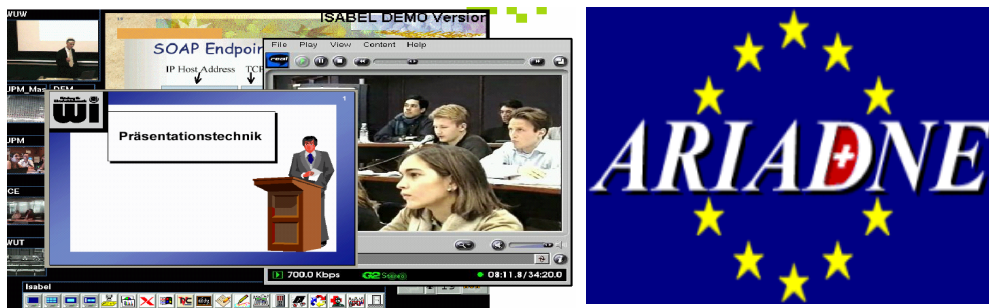
#### *Brokerage Systems and Learning Management*

Today's technology-enhanced learning landscape is characterized by a huge number of heterogeneous content and service repositories (commonly referred to as learning resources) (Guth et al 2001) (Jerman Blazic 2000) (Eberhart et al. 2000). Users either need to switch between many different systems, or they simply stick with one (meaning strong restrictions). The existence of brokers or marketplaces which integrate the existing repositories, thus creating completely new services, would be extremely beneficial for the knowledge society as a whole (Cooper et al. 2002), but especially for (small and medium) enterprise whose success relies on a workforce educated to the best-possible standards.

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To support the creation of such brokers, infrastructures are needed which support access to generic and reusable learning resources, and at the same time support the process of organizing the development of generic materials and services for a given company in such a way as to meet its specific requirements in an efficient way, minimizing the efforts required by learning resource providers. Research needs to be expanded in this area onwards from the technological (by creating new system interfaces for learning repositories and services) (Kraemer & Sprenger 2001), socio-economical (by showing ways to remove legal and organizational obstacles for common usage), and pedagogical frontiers (by creating guidelines for learning service creation and selection) (Rudestam & Schoenholtz-Ried 2002).

**Figure 1: ARIADNE, EducaNext and ISABEL**



A particular emphasis needs to be put on the design, creation and deployment of electronic brokers/marketplaces for learning resources and the management of learning processes within corporations. We need to work on concept-based access mechanism to learning resource repositories and their interoperability, as well as on integrated global learning resource repositories, where the user is capable of accessing learning resources at the various levels of specification, and which support the actual delivery of learning resources, adjusted to the needs and profiles of specific organizations.

### *Key Research Issues*

*How can repositories be made interoperable, how can we support open content?*  
Learning repositories have to be interoperable at the process level, open repositories capable of announcing and delivering learning resources to different kinds of end users and into different learning scenarios. Content production still is one of the main bottlenecks for the progress of Information Society, and we believe that open collaborative content production over the Internet can play the same role that "open software" has played in software production, given the right infrastructures and communities. However, a lively exchange of knowledge requires new distribution models securing the interests of providers (e.g. reputation, ownership, commercial prosperity) while being attractive for consumers. It is crucial to identify critical hindering and success factors for such knowledge exchange communities, as well as for supporting the creation and proliferation of learner communities and networks.

*How can the management of learning processes be organized in a flexible manner?*  
Learning, just like other human activities, cannot and will not be confined within rigidly defined boundaries such as course systems or learning repositories. A learning

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environment has to support trust building and rich forms of communication within and between all forms of knowledge workers, including teachers and learners.

### *Personalized Adaptive Learning*

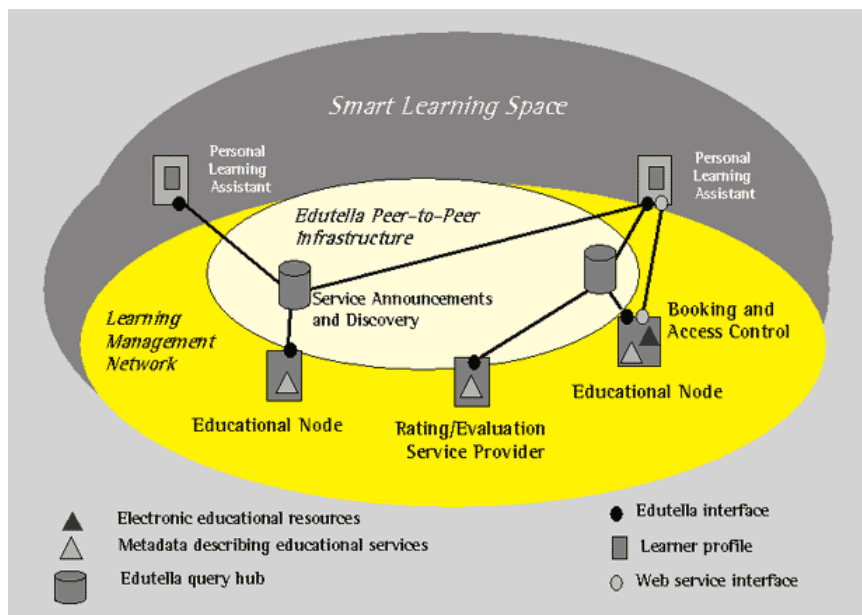
Personalized learning focuses on improving the efficiency and cost-effectiveness of learning, for individuals and organizations, independent of time, place and pace, through the development of open systems and services in support of ubiquitous, experiential and contextualized learning and virtual collaborative learning communities. An important issue to realize the potential of personalized and adaptive learning is to integrate the variety of perspectives on personalized and adaptive learning: Psychological Backgrounds, Diagnostics, Models of Competence, Personality, Knowledge, Social Psychology; Cognitive Science, Models of Cognition, Linguistic Approaches, Artificial Intelligence, Computer Science Approaches, User Modelling, User Tracking, Profiling, Machine Learning Methods, Business Applications of Personalization Tools, Human Resource Management, Employee Self Services, Business Processes underlying Personalization. This integration can build on a sound body of work in these areas, including (Naeve 2001) (Allert & Richter 2002) (Weber & Brusilovsky 2001) (DiNitto et al. 2003) (Matera et al. 2003) (Senicar et al. 2003) (Vrabic & Simon 2001) (Geoffroy et al. 2002) (Wiley 2001) (Furstenberg et al. 2001) (Adelsberger et al. 2001) (Dolog et al. 2003), (Hochgerner et al. 1994) and (Cooper et al. 2000).

### *Key Research Issues*

*Pedagogical models and learning theories for corporate learning:* The focus here is on the development of new pedagogical models for e-Learning, mobile learning, learning on demand and for life long professional learning in general. Learning scenarios for different work processes and for learning/working situations will be considered in the PROLEARN Network, taking into account different roles that learners may perform. Communities building amongst the learners, collaborative learning as well as blended learning have proven to be adequate. Further research on learning theories and refinement of the constructivist learning model for the corporate learning environment will go on. The impact of e-Learning, mobile learning and learning on demand on society will be analysed and considered according to different target groups with specific needs. Beside technological ones also social and pedagogical approaches will be emphasized. Based on evaluation of work place performance needs pedagogical models and learning theories can then be proposed that are based on competence management, individual gap analysis and goal oriented learning to shorten acquisition of new skills.

*Standardized learning solutions and personalization:* Especially for reusability and technical integration aspects the interoperability of learning content is essential. The standardisation of learning content and content engineering processes today is the basis for personalized services of tomorrow. Standardized descriptions and the possibility to search learning object repositories therefore need to be extended and closely interrelated with methods for personalized learning support. PROLEARN partners will contribute to the development of standards by analysing user requirements and feeding them into the appropriate standards body as well as by contributing specifications to the standards organizations, as base documents for the development of consensus for finalized standards.

*Adaptive learning and assessment in open environments:* Open and distributed environments provide us with many learning resources that can be potentially shared and reused in different contexts, different learning situations, and by learners with different background. The learning resources should have appropriate interface for connecting them to different services. The learning services can be customized for particular learners by selecting appropriate resources and packaging them into final services. To enable such adaptive services we need models of static structure of learning services taking reusability into account, models of service behaviour taking learner model into account, mechanisms for adapting the learning services and resources to multi-modal interfaces, mechanisms for interpreting service behaviour by particular service provider or a learner peer, techniques and methods for adaptive configuration and packaging of learning resources within learning services. Semantic web technologies together with competence ontologies can help to design and implement adaptive and cooperative learning in a portable and platform independent way. Social recommendation techniques can help in exploiting similarities between learners to suggest potentially relevant learning objects that might not be found by explicit search.



**Figure 2: ELENA (Personalized) Smart Learning Space**

One of the key issues in a learning system is the assessment of the acquired knowledge. One of the activities will focus on the theoretical foundation of assessment, and the development of new assessment tools that can be used in open environments to construct exercise repositories. Assessment can be greatly improved by using personalization techniques to guarantee that the exercises posed are suited to the student. On the other hand, the development of open and reusable assessment tools will contribute to increase the modularity of the learning system, allow the comparison of the results obtained with different tutorial strategies, and contribute to the standardization of results obtained.

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*Learner modelling:* To provide personalized, adaptive learning, learner modelling tools must track learner's activity and interactions with the learning material, analyse the feedback, identify the needs or interests, and evaluate the psychological profile as well as the learning style. Modern context-adaptive systems employ generic and mobile user models to provide human centred and ubiquitous services. Learners can be modelled by various peers and learning service providers in a distributed network. The key research issues in this area are: interoperable learner model artefacts, techniques for describing such artefacts, methods for extracting relevant learner model parts for particular learning situations or services, techniques for exchanging and communicating such artefacts. Personalisation procedures benefit from learner models which enclose observations from different sources, for example observations of user interaction, learner self-reflection, or peer reflections. Diagnosis procedure methods for externalizing learner model artefacts, techniques for accessing, manipulating and processing learner model parts from different perspectives are important issues in this regard. Lerner models will also need to include situated learning in the context of work where learning is an integrated part of working (learning on demand). User competence profile will be taken into account, group modelling and pattern recognition in the user behaviour will be analysed.

*User interface:* The delivery of e-Learning content on different target devices and into different learning contexts is a highly challenging task. Corporate e-Learning scenarios give a rich and realistic chance to learn about the real added value of mobile services and situated learning tools. Based on pedagogical models of situated learning and cognition a wide application field can be defined to adapt the selection of learning tools and the customization of learning content to individuals. To allow the learner to take control of the personalization process in a responsible, flexible and empowering way we want to investigate the use of information visualization. Expert and expertise locators should support personalised discovery. Another promising technique to achieve adaptive behaviour human-machine interaction are didactic plans based on story boards. These story boards usually consist of scenes and scenes may be recursively divided into sub scenes. In this way, a space of paths is determined – the so-called story space. Another important aspect related to distributed and ubiquitous cooperative environments is the ability to deal with multi-device and multi-modal interfaces. In general, we envision the user to use a variety of devices to access an e-Learning infrastructure. Users have to be able to work and learn in sessions in which they seamlessly transit from one kind of device to another in different situations while interacting with the community.

*Privacy and data protection:* Important topics in this context are privacy threats of personalisation and technology enhanced learning in general, such as linkability of data, observability of data, identity disclosure, or data disclosure. PROLEARN partners will identify and evaluate privacy enhancing technologies, e.g. identity protectors, that should be integrated in learning solutions or that are missing in technology enhanced learning, and explore identity management in this area. Conflicts with personalization activities, such as activity tracking, also have to be dealt with. This includes dealing with the questions of how to protect users' data and which security technologies are the best choice to achieve data confidentiality and integrity, also from a user acceptance point of view.

*Evaluation of personalization and adaptation methods:* Evaluation and return on investment analysis are an important factor for the introduction of e-Learning solutions at the workplace. This includes the identification of enterprises requirements and of the

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main success factors for E-Learning in corporate environments. Other questions are to determine the real impact of technology-enhanced learning on individual and organizational levels, how to measure this impact, and how organizational issues and community culture influence the success of E-Learning in different environments.

### *Learning Objects, Metadata and Standards*

In recent years, research has focused on the notion of reusable multimedia content components, called "learning objects". The basic idea is that reuse of such components can lead to important savings in time and money, and enhance the quality of digital learning experiences: the end result is faster, cheaper and better learning. These developments are further amplified and accelerated by the standardization work on "Learning Object Metadata" or LOM, based on earlier work in ARIADNE and IMS, and integrated into the SCORM reference model, taking into account initiatives like the Semantic Web (Naeve et al. 2001) (Naeve et al. 2001) (Nejdl et al. 2002) (Nilsson 2001). As a consequence, learning objects are beginning to be applied in corporate contexts and support in commercial products is spreading (Nilsson et al. 2002). However, the transition process from more conventional approaches is not always gradual and easy (Simon & Quemada 2002). Moreover, many initiatives still take a rather narrow and traditional view of what learning objects are and how they can be put to use, often equating them with conventional documents.

As Europe has been at the forefront of many of the developments in this area, and as activities involve many of the leading organizations in the field (ARIADNE, EDUTELLA, UNIVERSAL, IMS...), some of which are deeply involved in global standardization, there is an excellent opportunity for truly relevant collaboration that can have a high impact on the state of research and practice.

### *Key Research Issues*

*Learning object taxonomy and component architecture:* In order to sharpen the very definition of learning objects, taxonomies are needed to identify different kinds of learning objects and their components, based on granularity, the level of specificity, etc. In order to realize the full potential of dynamic composition of learning object components, it is necessary to develop a flexible architecture that enables structuring of learning objects and their components: this work can start from IMS Content Packaging and Learning Design, the W3C SMIL standard, etc. and is closely related to the field of personalized adaptive learning interactions between learning objects and their components: One approach is based on component technologies (like JavaBeans). An alternative approach relies on web services that enable publishing of learning objects in UDDI registries, with the definition of their services through WSDL.

*Empirical analysis:* Empirical data about the actual use that is made of metadata, by different classes of end users will further our understanding of actual use cases. Useful approaches include log analysis of learning object repositories, usability studies of Learning Object (Metadata) tools, analysis of the actual content of learning object repositories (kind of learning objects, actual metadata, actual amount of reuse, actual annotations by users, etc.).

*Design for and authoring by reuse, automatic metadata:* Deep questions remain about the "glue" to be put between learning object components, automatic decomposition of conventional learning objects, design methodologies for reuse and the instantiation of

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reusable generic objects in objects that are more specific to a particular learning context. We also need to investigate how metadata can be generated (semi-) automatically, based on information about the author, the content itself, the context of use, related learning objects, etc. In this context, automatic transformation of MPEG-7 or Dublin Core metadata into LOM is highly relevant, as well as the use of application profiles such as CANCORE.

*Semantic interoperability:* In order to support the evolution towards semantic-based knowledge systems, we need to complement the technical interoperability with “semantic interoperability”. This includes making available information about the data elements and value spaces adopted by the components in the global infrastructure, in a way that can be processed by software agents and other Semantic Web-enabled applications. It also includes examining how to make the relations between different data elements and value spaces available to such applications, thereby enabling semantic extension and refinement of vocabularies. In this context, ontology based approaches will also be considered.

### **Integrating TEL into the business world**

Until today, the idea behind learning technologies has not yet brought the economical success that had been expected. In a time of cyclical downturns and decreasing IT-budgets the eLearning market suffers through a critical phase. The provider market remains static – the demand for eLearning refuses to gather momentum. Offers for individual eLearning users making use of new technological possibilities are too expensive thus neglect the necessary critical mass for a break-through. For professional users (enterprises) eLearning is first and foremost an IT-investment, calling for the justification of the purchase price and the ‘total value of opportunity’.

The prognoses about further market development and growth forecasts for eLearning are based on estimations and draw upon the argument of cost reduction. In general, all studies confirm the rough trend of a growing market for eLearning products and services until 2006 despite the ongoing conspicuous market consolidation. Overall, the results of current studies can be summarized into the following market trends that will be tackled by PROLEARN:

- Cost reduction and added value are the most promising marketing arguments for technology enhanced learning.
- Quality is promoted to be the most critical competitive trend. The usage of eLearning standards with respect to a description of metadata, learner profiles, and course structures will be needed in order to guarantee safety for the user’s investments and the sustainability of strategic decisions, e.g. the provision of a certain learning system.
- Users require individual eLearning products. In the early days of the eLearning market mostly large enterprises with large budgets and a great need for post-graduate and professional training were purchasing general non-personalized eLearning products. In order to extend target groups eLearning vendors have to address the requirements of potential customers in greater detail.
- Easy-to-use authoring tools facilitate the development of eLearning content and lead to an expansion of potential eLearning producers.

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- Customers of technology enhanced learning demand widespread recognition of their successful participation (certificates etc.).
- Customers of technology enhanced learning demand individualization and personalization of learning material to their specific needs and learning behaviour.

### **Economical approaches and common understanding of TEL**

Developing market awareness for and successfully deploying technology enhanced learning requires a common understanding of the requirements of providers and user groups, especially focussing on the specific business models and processes. Users are professional education portals, institutional education networks (Bohl et al 2002), consultants for organizational development and strategy definition, integrated e-services for technology enhanced learning, etc.

As a major objective, PROLEARN will provide a sound analysis of market trends based on a realistic assessment of the current situation, and forecasts, for all actors involved in the market. We are analyzing the market at a geographical level, according to the maturity of each market and to its cultural environment, subsequently aggregating it at the European level, where it will be compared with data from external markets such as North America. The analysis involves PROLEARNs associated participants, many of them being providers for TEL solutions on the European market.

The growing range of eLearning products and services leads to a complex and fragmented market. In contrast, existing and potential consumers as well as suppliers demand a transparent and structured market (Dohmen and Lutz 2003). Developing market awareness for the benefits of technology enhanced learning and making its deployment successful requires a common understanding of the different usage scenarios and the specific requirements of different providers and user groups. Key issues to analyze will be existing business approaches, strategy definitions and cost-benefit analysis of eLearning providers such as HEI, professional vendors, corporate universities, and education networks as well as corporate users.

### *Business models for providing and using TEL solutions*

Over the last few years progress in the field of eLearning has focused mainly on the areas of technical infrastructure and pedagogical innovation. As the demand for access to eLearning-services is growing rapidly - for the corporate worker as well as for the individual citizen - it is increasingly important that sustainable models emerge for market players, such as service-providers, users (companies and individual learners at home), policy makers and market regulators (Beinhauer 2002). Extending research with the focus on economic feasibility, commercial relevance, usability and educational benefits, is a key success factor to enhance the competitiveness of the European eLearning industry and European society as a whole (Brücher and Endl 2002). PROLEARN recognizes and addresses the shift in applying technology enhanced learning by providing reference business models for technology enhanced learning providers, both traditional learning providers as well as new entrants, such as corporate universities. For example, using TEL in higher education institutions changes

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- from a bottom-up, project-based orientation of media development, driven by individual research interests, to a process of organizational reform and institutional planning and professional support initiated and supported top-down;
- from technology-driven initiatives to the use of technology based on comprehensive pedagogical concepts.

PROLEARN will present a comprehensive and convincing taxonomy of business models and determine the best practices for business development in the field, in strong cooperation with our associated participants from the field of providers, e.g. im-c AG, Campus of Europe, eCharlemagne etc. PROLEARN will disseminate the results in order to support the forming of a harmonious market development with profitable companies, and to help avoiding the economical mistakes and fallacies made by start-up companies during the e-business wave.



**Figure 3: PROLEARN portal for TEL business solutions**

## *Helping the European TEL Market emerge*

As outlined above, technology enhanced learning is a multidisciplinary field in which independent factors have an important influence on its success and acceptance. Advanced technological possibilities, especially mobile and broadband learning solutions will change today's corporate learning scenarios in a sustainable way within the next years. The provision of eLearning services will grow substantially to satisfy the growing demand of different user groups. In order to support the (re)formation of a highly successful European eLearning market, PROLEARN will provide

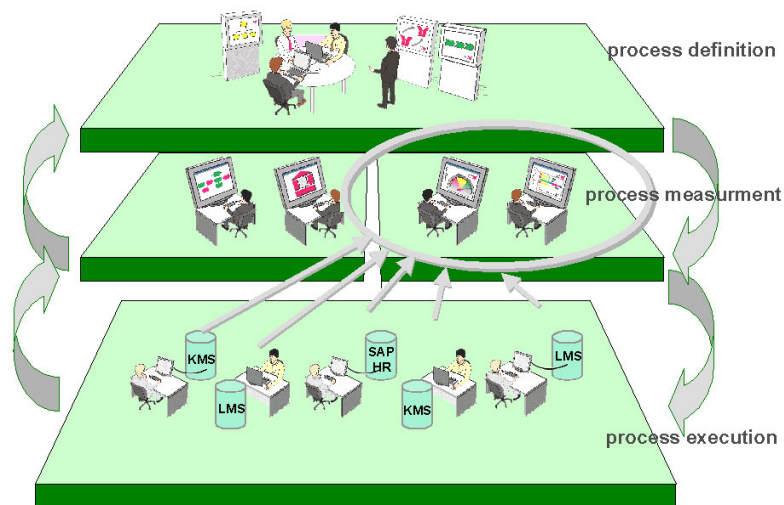
- *Expertise and recommendations for political stakeholders:* Political stakeholders in Europe will be provided with clear recommendations and measuring tools, aiming at the development of the global European technology enhanced market. PROLEARN is involved in international

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cooperation and participates in the existing Transatlantic, EuroChina and EuroIndia initiatives. PROLEARN offers its expertise to local authorities, national governments and provide the tools to measure the socio-economic benefits of an increasingly dynamic and competitive TEL industry on European society.

- *An open portal for TEL business solutions (see Figure 3):* Foundations of companies at the interface between research and development (R&D) and economy are expected to have strong effects on the development of geographical regions. PROLEARN provides an open portal to support the move from research results and prototypes into market ready solutions. It holds information about research results and prototypes and is accessible to any European organization or individual that/ who is interested in the collaborative development of excellent eLearning products and services with the right business models, expertise and budget to enter the market and stay competitive. The portal is envisaged to support close co-operations between European research and industry organizations and investors. It will be integrated into the technical and organizational infrastructure of the PROLEARN Virtual Competence Centre mentioned above.

**Figure 4: Process Performance Management Framework of PROLEARN**



### *Business Process Engineering and Management*

As the technical roadblocks for technology enhanced learning are removed and as it is getting affordable for companies (even SME), the efficiency of business processes in corporate training are of great interest. Therefore, business process reference models that aim at optimizing organizational and financial matters of learning processes themselves as well as normal business processes that are affected by corporate training will be of

interest. Formalized models for processes like corporate learning strategy definition, requirements analysis, integration processes, booking and charging processes, definition of learning scenarios and knowledge transfer will help to reduce costs for the introduction and execution of technology enhanced learning scenarios and tools. Those processes will continuously be affected by further market developments, for example supply chain and customer focused learning as well as the fusion of eLearning and knowledge management. The participants in the work package Business models, Processes & Markets, e.g. DFKI Germany, HUT Finland and HEC France have a strong background on business process modelling and management which will help to carry out the joint research of partners. Associated participants are involved by acting as test beds and advisors for a continued improvement and validation of the reference models.

Costs and benefit of business processes are subject to massive observations in times of economical constrictions. This applies also to the introduction and execution of technology enhanced learning scenarios, because they represent an IT-investment on the one hand, but are also accountable for manifold changes within the affected business processes. So-called training process performance management will help to secure the effectiveness and efficiency of professional training. It aims at the support of the planning and controlling of training processes in order to optimize and reduce the involved costs by identifying unnecessary cost drivers (see figure Figure 4). Based on the reference process models, the development of streamlined general processes and tools to measure the effectiveness will increase the efficiency and ensure the necessary economical success.

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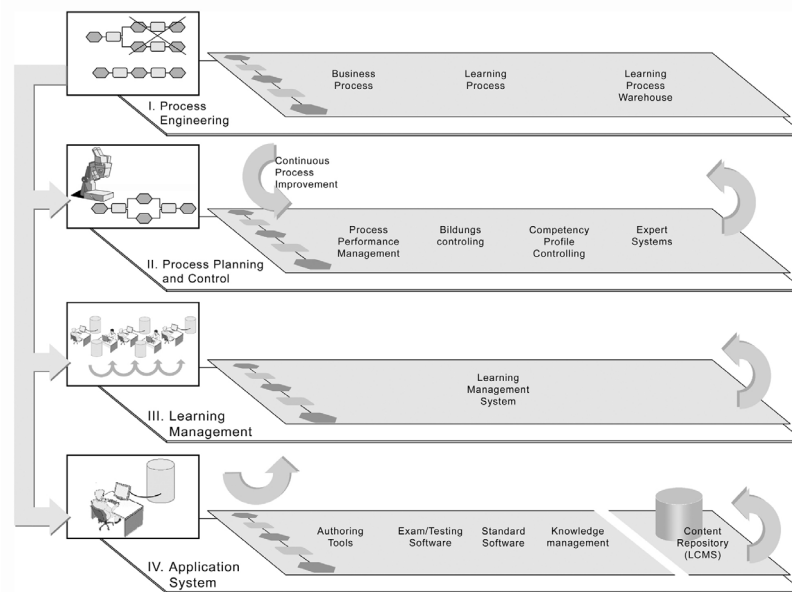
### **Framework for eLearning Systems and Architectures**

Human Resource Management departments increasingly focus on topics like planning, analysing, controlling, and assessing knowledge of employees. Existing knowledge management systems and eLearning systems / software applications generally focus on the administration and management of documents and on the retrieval of information that is stored in these documents taking into account user stereotypes. However, because knowledge is tied to persons and their working environment, a concept for the documentation, management and evaluation of employees' knowledge in enterprises by using so-called *competency profiles* (e.g. in the context of annual evaluations of results) is necessary to manage the companies implicit knowledge. In due course the integration of competency profiles into existing *Learning Management Systems* (LMS) and HRMS is of utmost importance. Leading LMS vendors like Germany's *I-MC Inc.* are already developing components to manage and capture the employees competencies and are working on their integration into LMS.

Today, achieving interoperability between *Learning Content Management Systems* (LCMS), *learning management systems* and *human resource management systems* (HRMS) is a big challenge. There are several standards for user profiles, unfortunately different ones to be used in HRMS and in LMS. As a result manual mediation is still

necessary for the interoperability of such systems, requiring manual mediation of user profiles, learning resources and courses, thus increasing effort and costs. Recent developments show that standard software components like HRMS increasingly rely on the definition of business process models in order to control the workflow that is managed by them (e.g. within the new *Netweaver* architecture of *SAP Inc.*). The standards for process models used by such systems have to be considered as well when establishing interoperability among HRM, LM and LMC systems.

One goal within the research area of PROLEARNs work package ‘Business Models, Processes and Markets’ deals with the conception, implementation and run-time of eLearning system infrastructures in enterprises. The special focus is on affected business processes within an organization. The work focuses on the development of a holistic framework for the methodology-supported implementation of an eLearning system infrastructure into an already existing IT environment. Main issues are the discovery and restructuring of affected business processes and the effective controlling of respective learning and business processes. The work will base on the ARIS concept of Scheer (Scheer 2001; Scheer 2002), especially the ARIS House of Business Engineering (HOBE) as a framework for business processes management in enterprises.



**Figure 5: Framework for the management of eLearning system environments (based on (Scheer 2002, p. 56-57).**

In order to establish the interoperability of LMS, KMS and HRMS an analysis will be conducted how business processes and learning processes can be modelled jointly, resulting in the definition of semi-formal reference models for the introduction and execution of eLearning processes in enterprises. These process models will be used for a holistic controlling of eLearning scenarios (training management). Research on training management has been targeting pedagogical issues rather than economical issues, e.g. neglecting to conduct analysis based on business processes. Defining standardised business process models will lead to process performance measurements and thus, an

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effective professional training management can be established in companies relying on standardized systems. In order to generate and document process models, thus creating different models for the execution and controlling of eLearning processes, modelling tools like the *ARIS Toolset*<sup>®</sup> can be integrated in LMS. On the basis of the developed framework, business process optimization and business process management within the field of electronic education and training in enterprises will be developed in order to achieve a continuous process controlling and improvement.

### **Conclusions**

European eLearning Research and Development has strongly influenced the advance of state of the art eLearning environments and innovative eLearning scenarios in the last years, and, through joint initiatives of European research and industry, will continue and increase eLearning potentials and benefits in the years to come. The PROLEARN Network of Excellence in Professional Learning, funded by the European Union in the context of the new 6th IST Framework Programme is focussing on a set of key issues, in a large concerted effort of more than 170 research institutions and companies working together in the PROLEARN Consortium and as PROLEARN Associated Partners. Interactivity in eLearning environments will strongly be supported by interactive media and hands-on experiences. Learning will become a personalized and an adaptive learning experience, and interweaved brokerage and learning management systems will provide learning objects and resources utilizing standard interfaces and metadata. Knowledge work management will support human resource development in companies and integrate learning into workplace scenarios, and innovative eLearning business models and networks will help identify and create new markets for European industry.

In order to establish the interoperability of LMS, KMS and HRMS we will provide semi-formal reference models for the introduction and execution of eLearning processes in enterprises. Using the process models for a holistic controlling of eLearning activities in companies, we enable businesses to make actively maintain and develop their profile. Integrating LMS, KMS and HRMS based on standards as well as interconnecting these in new eLearning business processes enables companies to simply and successfully operate on the continuously changing market as well as expand to new and future markets.

### **References and Notes**

- 1 Adelsberger, H. H. & Collis, B. & Pawlowski, J. M. (2001) (Eds.). *Handbook on Information Technologies for Education and Training*. Springer-Verlag, Heidelberg, Mai 2001.
- 2 Allert, H. & Richter, C. (2002). Re-Designing an Educational Setting - Trails of Competency in an Open Learning Repository. E-Learn 2002: World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education (E-Learn 2002). Oct. 15-19, 2002, Montreal, Canada.
- 3 Beinhauer, Malte: Perspectives for Universities in the Corporate e-Learning Market. In: Occasional Papers of CSHE, University of California, Berkeley, 2002.
- 4 Bohl, Oliver; Grohmann, Guido; Scheer, August-Wilhelm.; Winand, Udo: Virtuelle Bildungsnetzwerke: Struktur und Betreibermodelle am Beispiel WINFOLine, in: Engelen, Martin; Homann, Jens (Ed.): Virtuelle Organisation und Neue Medien 2002, (Eul) Lohmar, Cologne 2002, p. 41-68.

- 5 Brücher, Heide; Endl, Rainer: Erweiterung von UML zur geschäftsregelerorientierten Prozessmodellierung. In: Becker, Jörg; Knackstedt, Ralf (Hrsg.): Wissensmanagement mit Referenzmodellen - Konzepte für die Anwendungssystem- und Organisationsgestaltung. Heidelberg : Physica, 2002, S. 145-161.
- 6 Cooper, M. & Scanlon, E. & Freaque, S. (2000). Remote Controlled Teaching Experiments, in Science and Engineering Subjects, Accessible over the World-Wide-Web: the PEARL project", in proceedings of to ED-Media Conference, Montreal, Canada, June 26 -July 1, 2000.
- 7 Cooper, M. & Colwell, C. & Amaral, T. (2002) Accessibility and usability in complex web based learning applications: lessons from the PEARL project. Proceedings of E-Learn 2002, Montreal, Canada.
- 8 Di Nitto, E. & Sassaroli, G. & Zuccalà, M. (2003). "Adaptation of Web Contents and Services to Terminals Capabilities: the @Terminals Approach", In Proceedings of First IEEE International Conference on Pervasive Computing and Communication (PerCom03), Fort Worth, USA, March 2003.
- 9 Dohmen, Dieter; Michel, Lutz P. (Hrsg.): Marktpotenziale und Geschäftsmodelle für eLearning-Angebote deutscher Hochschulen. Bielefeld : Bertelsmann, 2003.
- 10 Dolog, P., Gavrioloie, R., Nejd, W. & Brase, J. (2003). *Integrating Adaptive Hypermedia Techniques and Open RDF-based Environments*, Accepted for Publication at 12th International World Wide Web Conference (WWW2003), Budapest, Hungary, May 2003.
- 11 Eberhart, A. & Schiele, F. & Fischer, S. (2000). The Electronic Course Authoring and Management System at the International University, The 4th World Congress on Integrated Design and Process Technology (IDPT'99), published at IDPT'2000, Dallas, USA, Juni 2000.
- 12 Furstenberg, G. & Levet, S. & English, K. & Maillet, K (2001). "Giving a virtual Voice to the Silent Language of Culture", Language Learning and Technology Vol.5, No. 1, January 2001, pp. 55 – 102 (<http://llt.msu.edu/vol5num1/furstenberg/default.html> ).
- 13 Geoffroy, F. & Aimeur, E. & Gillet, D. (2002). "A Virtual Assistant for Web-Based Training In Engineering Education", The Intelligent Tutoring Systems Conference (ITS), Biarritz, France, June 5-8, 2002.
- 14 Guth, S. & Neumann, G. & Simon, B. (2001). UNIVERSAL - Design Spaces of Learning Media, in: Proceedings of the 34th Hawaii International Conference on System Sciences, Maui (USA), January, 2001.
- 15 Hochgerner, J. & Campbell, M. & Katsikide, S. (1994) (Hrsg.). Patterns of Social and Technological Change in Europe, Ashgate Publishing Group, Aldershot-Brookfield-Hong Kong 1994.
- 16 Jerman Blazic, Borka (2000). The usability aspects of an universal brokerage and delivery system for the Pan-European higher education. In: International Workshop on Advanced Learning Technologies, IWALT 2000 : advanced learning technology, design and development issues : 4-6 December 2000, Palmerston North, New Zealand : proceedings. Los Alamitos [etc.]: IEEE Computer Society, cop. 2000, pp. 184-185.
- 17 Kraemer, W. & Sprenger, P. (2001). Learning Service Providing, in: Kraemer, W.; Müller, M. (Hrsg.): Corporate Universities und E-Learning, (Gabler) Wiesbaden, 2001, S. 357-388.
- 18 Matera, M. & Maurino, A. & Ceri, S. & Fraternali, P. (2003). Model-driven Design of Collaborative Web Applications. Software Practice and Experience, June 2003.
- 19 Naeve, A. (2001). *The Knowledge Manifold - an educational architecture that Supports Inquiry-Based Customizable Forms of E-learning*, Proceedings of the 2nd European Web-based Learning Environments Conference (WBLE 2001), Lund, Sweden, Oct. 24-26, 2001, <http://kmr.nada.kth.se/papers/KnowledgeManifolds/KnowledgeManifold.pdf>.
- 20 Naeve, A., Nilsson, M. & Palmér, M. (2001). *The Conceptual Web - our research vision*, Proceedings of the first Semantic Web Working Symposium, Stanford, July 2001, [www.semanticweb.org/SWWS/program/position/soi-nilsson.pdf](http://www.semanticweb.org/SWWS/program/position/soi-nilsson.pdf)
- 21 Nejd, W., Wolf, B., Qu, C., Decker, S., Sintek, M., Naeve, A., Nilsson, M., Palmér, M., & Risch, T. (2002). *Edurella: A P2P Networking Infrastructure Based on RDF*, Proc. of the 11th

*PROLEARN: TEL and Knowledge Distribution for the Corporate World*

- World Wide Web Conference (WWW2002), Hawaii, May 7-11, 2002. <http://kmr.nada.kth.se/papers/SemanticWeb/p597-nejdl.pdf>.
- 22 Nilsson, M. & Palmér, M. & Naeve, A. (2002). *Semantic Web Meta-data for e-Learning - Some Architectural Guidelines*, Proceedings of the 11th World Wide Web Conference, Hawaii, May 7-11, 2002. <http://kmr.nada.kth.se/papers/SemanticWeb/p744-nilsson.pdf>.
  - 23 Nilsson, M. (2001). *IMS meta-data 1.2 RDF binding*, Appendix to the IMS 1.2 meta-data binding specification., 2001, [www.imsproject.org/rdf/index.html](http://www.imsproject.org/rdf/index.html), Electronic Commerce Integration MetaFramework, Final CWA - final version of the official CEN/ISSS project documentation, <http://www.cenorm.be/iss/Workshop/ec/Projects/Projects.htm>
  - 24 Rudestam, K. E. & Schoenholtz-Ried, J. (2002). *Handbook of Online Learning: Innovations in Higher Education and Corporate Training*, (Sage) Thousand Oaks, London, New Delhi, 2002.
  - 25 Scheer, A.-W. (2001): *ARIS - Modellierungsmethoden, Metamodelle, Anwendungen* (Springer) Berlin et al. 2001.
  - 26 Scheer, A.-W. (2002): *ARIS - vom Geschäftsprozeß zum Anwendungssystem*, (Springer), Berlin et al. 2002.
  - 27 Senicar, Vanja & Jerman Blazic, Borka & Klobucar, Tomaz (2003). *Privacy Enhancing Technologies - approaches and development*. Computer Standards and Interfaces, 2003.
  - 28 Simon, B. & Quemada, J. (2002). *A Critical Reflection of Metadata Standards based on Usage Scenarios*, in: *Proceedings der GMW Tagung 2002*, Basel (Switzerland), September, 2002.
  - 29 Vrabic, Gorazd & Simon, Bernd (2001). *Learning resource catalogue design of the UNIVERSAL brokerage platform*. Montgomerie Craig (ed.), Viteli Jarmo (ed.). *ED-MEDIA 2001 World Conference on Educational Multimedia, Hypermedia and Telecommunications*, Tampere, Finland; June 25-30, 2001. *Proceedings of ED-MEDIA 2001*. Norfolk: Association for the Advancement of Computing in Education (AACE), cop. 2001, pp. 1973-1978.
  - 30 Weber, G. & Brusilovsky, P. (2001) *ELM-ART: An adaptive versatile system for Web-based instruction*. *International Journal of Artificial Intelligence in Education* 12 (4), Special Issue on Adaptive and Intelligent Web-based Educational Systems, 351-384.
  - 31 Wiley, D.A. (2001). *Connecting learning objects to instructional design theory: a definition, a metaphor, and a taxonomy*. In Wiley, D.A. (Ed.), *The instructional use of learning objects*. Online Version: <http://reusability.org/read/>