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Specification of Requirements and Success Factors for Corporate e-Learning User Interface Requirements and Solutions in Corporate e-Learning

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► **To cite this version:**

Milos Kravcik, Lora Aroyo, Stefano Ceri, Alexandra Cristea, Paul de Bra, et al.. Specification of Requirements and Success Factors for Corporate e-Learning User Interface Requirements and Solutions in Corporate e-Learning. 2004. hal-00591535

HAL Id: hal-00591535

<https://hal.science/hal-00591535>

Submitted on 10 May 2011

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Network of Excellence Professional Learning

PROLEARN

European Sixth Framework Project

Deliverable	1.6 & 1.4
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Specification of Requirements and Success Factors for Corporate e-Learning

User Interface Requirements and Solutions in Corporate e-Learning

<i>Editor</i>	<i>Milos Kravcik</i>
<i>Work Package</i>	<i>1</i>
<i>Status</i>	<i>Document</i>
<i>Date</i>	<i>July 12, 2004</i>

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Document Control

Title: **Specification of Requirements and Success Factors for Corporate e-Learning**
User Interface Requirements and Solutions in Corporate e-Learning

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1 Introduction

To make the workplace education of their staff members more efficient, companies search for new training methods. Realization of corporate training by e-learning should save costs (e.g. reduction in travel expenses), streamline business processes (e.g. putting relevant materials online), as well as bring new approaches to learning and training. The new training methods should help the end user to perform better, to speed the time to performance, and to learn the relevant knowledge or skill.

In the PROLEARN project, key issues involve advanced production, deployment, and exchange of professional learning resources and the use of these learning resources for professional training in smaller and larger companies. The key areas include the use of personalized learning and interactive media resources, with learning resources connected to real-world settings and reusable in different contexts. 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, as well as virtual collaborative learning communities.

One of the objectives in the PROLEARN project is development of a portal enabling access to distributed learning repositories. The intended learners are employees of SME's and larger companies that need corporate e-learning and professional training. The corporate learners need personalized adaptive learning systems to satisfy their learning needs in an individualized way. In these settings often happens that a great amount of information needs to be delivered to the learners within a very limited time.

The purpose of this deliverable is to specify the state of the art and the requirements in corporate e-learning and professional training in SME's and larger companies, with regard to personalized adaptive learning. As user interface requirements are closely related to user requirements as well as functional and non-functional system requirements, we decided to integrate the originally planned two deliverables into one:

- Deliverable 1.6: Specification of requirements and success factors for corporate e-learning
- Deliverable 1.4: User interface requirements and solutions in corporate e-learning

In the following, we first list critical success factors as well as learning theories and instructional design models for corporate e-learning. Then we define basic user roles that should be distinguished in corporate e-learning. For each role, we provide user scenarios, specify use cases, and generate user, system, and user interface requirements. Finally we generalize the requirements related to adaptivity and user modelling. A brief evaluation of adopted methodologies is also included. The appendix contains additional scenarios for professional learning.

2 Critical Success Factors for Corporate e-Learning

Enterprises need e-learning. Increasing global competition, rapid technological advances, demographic changes, and the emergence of a service- and knowledge-based economy force organizations to train and re-train their workforce in new ways. Sustaining competitiveness requires continual learning, an accelerating pace, staying economically feasible and being widely distributable. This is the formula for e-learning (Harris, 2002). Companies that effectively deploy and utilize e-learning are likely to have competitive advantage. The Internet redefines e-learning not only in terms of better delivery, but also more current dynamic educational content, more personalized, relevant learning experiences and more collaboration with experts and peers. The main obstacles to e-learning, such as bandwidth, content availability, technology standards and service integration, are addressed by practitioners as well as researchers. Efforts are also directed at determining the factors that create effective e-learning environments. This includes establishing a basic framework of Web-based learning that covers eight dimensions (Khan, 2002), including pedagogy, technology, interface design, evaluation, management, resource support, ethical considerations and institutional support. Furthermore, there is a clear trend of creating so-called “enterprise training management solutions” that offer a full suite of products and services ranging from initial skill-gap analysis, course development, assessment and delivery, to course registration, tracking and hosting (Urdu & Weggen, 2000).

Put briefly, the success or failure of corporate technology-enabled training is determined by a tripartite force - organizational, pedagogical and technological. Subsequently, we present a list of 10 Critical Success Factors (CSF) subsuming under each of the three componential forces. These lists are derived from the relevant literature (see References), which reports results from several large-scale surveys, benchmarking studies, and research efforts.

2.1 Organizational Factors

Paradoxically, the organizational context is both the enabler and the constraining force for e-learning programs (McPherson, 2002). To maximize its enabling effects and transcending its constraints, the following organizational CSF's are identified:

1. Clarifying precisely the mission, vision, values and strategic focus of the project, and aligning the project's specific goals with organizational goals
2. Undertaking a number of planning activities at the early stage of the project, including a needs assessment; a requirements analysis; user research; a feasibility study; a communication plan for marketing; a business case for cost benefit analyses; a measurement plan detailing performance measures
3. Conducting appropriate performance analyses to develop the connection between business needs and learning solutions
4. Tuning up corporate culture to e-learning and increasing all stakeholders' openness to change by encouraging them to recognize the vision that current technology can optimize learning, knowledge and performance
5. Engaging a high-level champion into the project, who is normally a top executive willing to provide input into strategy, and securing sponsorship from the senior management
6. Maintaining high visibility of the project within the organization
7. Insuring the structure and accountability of the project implementation team
8. Establishing partnership with the IT department that has rich experience in implementing enterprise-wide software
9. Documenting proposed metrics, including reduced head count; increased revenue; reduce training time and costs; improved employee retention and satisfaction; enhanced customer satisfaction; improved organizational performance, etc
10. Measuring performance from the outset of the project and demonstrating the value of the projects in both qualitative and quantitative terms (Kirkpatrick, 1994) to top executives on a regular basis

2.2 Pedagogical Factors

Content is recognized as the cornerstone of an e-learning program. However, it is also well acknowledged that producing quality content is very challenging. It is necessary to address not only *what*

content is, but also *how* content is used to yield *which* expected outcomes. As pedagogical requirements are relatively complex, CSF's are accordingly multifarious, ranging from design issues to costs management issues.

1. Developing quality content based on sound instructional design methodologies, which are in turn informed by learning theories (see Section 3), and reaching critical mass on a variety of topics ranging from specific professional knowledge to general soft skills
2. Taking advantage of the full range of tools to create a dynamic online classroom with powerful interactive features (e.g., streaming media, simulations, peer and expert learning communities); interactive learning programs lead to higher user retention, motivation and completion rates
3. Adopting blended learning approaches; as learning moves closer to the job, blended instruction addresses the need for a generally greater variety of events and experiences
4. Rendering curriculum design and development unique and customized, using "just in time", "just enough", and "just for me" as a guide
5. Placing the responsibility for learning in employees' hands, competency management accelerates the use of e-learning; accreditation opportunities provide further motivation to engage in e-learning
6. Including (pre- and post-training) mentoring or tutoring services (real-time and time-delayed mode) in e-learning packaged courses; ensuring instructor's responsiveness and relevance of feedback that are essential for sustaining learners' motivation
7. Addressing regional and cultural issues and adapting content and practices to deal with them; combining the impact of standard enterprise-wide activities with flexible and quick local innovations and efforts
8. Using a clear set of guidelines based on content, audience, resource availability and strategic factors to decide what elements of content development to outsource and what to handle internally or via partnerships
9. Adopting well-entrenched strategies for managing the high cost of content include syndication of content, participation in content-sharing consortia and working with development houses that are willing to share or resell their knowledge assets
10. Controlling costs and speeding up the rollout of critical knowledge through the use of templates and learning objects, which allow for reuse of content in various courses

2.3 Technological Factors

Enabling technologies have attracted most of the research attention and efforts in the realm of e-learning. It is generally agreed that the true power of the Web lies in its ability to create collaborative learning communities that introduce anywhere, anytime human interaction. Well-thought-out exploitation of the technologies in this direction is the determinant of the success of corporate training:

1. Ensuring system integrity, including system stability and availability, straightforward access portal, and technical support responsiveness
2. Maintaining usability of user interface, including intuitive navigation, creative user of graphics, lesson start/resume ability, and low intimidation factor
3. Rendering broadband connectivity to enable live video events and rapid large file transfers
4. Rendering wireless connectivity to enable mobile and ubiquitous learning
5. Providing a wide availability of inexpensive software tools and hardware (e.g., webcams, headsets, scanners) to support learner interaction
6. Selecting appropriate learning management systems based on well-thought-out criteria
7. Adhering to instructional management systems standards to increase reusability of online content
8. Designing new authoring tools that allow teaching practitioners to easily modify materials selected from a repository of learning objects and sequence these materials
9. Ensuring appropriate, efficient and educationally-sound use of enabling technologies through careful planning, resourcing and support
10. Enhancing interoperability by supporting the move to defined, open standards and creating flexible, adaptive, and integrated learning systems (i.e. one-stop-shopping):
 - authoring tools need to operate across different platforms and communicate with other tools used to build learning systems
 - content and courseware must be reusable, interoperable, and easily manageable at different levels of complexity throughout the online instructional environment

- enterprise learning systems have to accommodate numerous and varied learner requirements, needs and objectives
- corporate customers are able to easily track content created by multiple content providers through one training management system and search vast local or distributed catalogs of content to identify learning objects on a particular topic

In summary, an effective e-learning strategy must be more than the technology itself or the content it carries. It must also focus on critical success factors that include *building a learning culture, engaging true leadership support, deploying a nurturing business model and sustaining the change throughout the organization*. People who are highly skilled and capable of executing effectively must pursue it. Moreover, it must engender the view that sees learning in the context of the intellectual capital of the firm and the enabling of higher individual and organizational performance (Rosenberg, 2000).

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3 Learning Theories and Instructional Design Models

3.1 Learning Theories

Learning theories inform Instructional Design (ID), which is increasingly recognized as a, or even the most, critical success factor of e-learning in both corporate and academic environments (Section 2). Loosely defined, ID is a system or process of organizing learning resources to ensure learners achieve established learning outcomes, cf. (Berger & Kam, 1996) comprehensive definition. ID is based on theoretical and practical research in the areas of cognition, educational psychology and problem solving. Five learning theories are identified to be highly applicable to online ID (Patsula, 1999). The main concepts of each of these theories and their implications to the design of e-learning systems are summarized in Table 1.

Table 1: Five Learning Theories Relevant to Online Instructional Design

Learning Theories	Basic Concepts	Implications to online ID
Gagne's (1985) Conditions of Learning Theory	A hierarchy of intellectual skills organized according to complexity that can be used to identify prerequisites necessary to facilitate learning at each level. Instruction can be made more efficient by following a sequence of nine instructional events, including reception, expectancy, retrieval, selective perception, semantic encoding, responding, reinforcement, assessment, and generalization	<ul style="list-style-type: none"> - Instructional designers should anticipate and accommodate alternate learning styles by systematically varying teaching and assessment methods to reach every student - Learners are enabled to criss-cross intellectual landscape of the content domain from multiple perspectives
Bruner's (1996) Constructivist Theory	Learning is an active process in which learners construct new ideas based upon their current knowledge. Instruction can be made more efficient by providing a careful sequencing of materials to allow learners to build upon what they already know and go beyond the information they have been given to discover the key principles by themselves	<ul style="list-style-type: none"> - Attract, sustain and focus learners' attention with use of various display arrangements - Improve retention by sequencing screens and presenting related materials together - Provide instructional cues to avoid information vertigo
Bandura's (1977) Social Learning Theory	Emphasis is put on the importance of observing and modeling the behaviors and attitudes of others. Instruction can be made more efficient by modeling desired behaviors of functional value (i.e., mentoring, apprenticeship) to learners and by providing situations which allow learners to use or practice that behavior to improve retention	<ul style="list-style-type: none"> - Teach learners how to model cognitive processes as well as behaviors using real-world (authentic) problem - Provide similar examples and comparisons to aid perception and recall - Use 'show me' (help) buttons - Use examples as a method for modeling problem solving - Use repetition with variety
Carroll's (1998) Minimalist Theory	Course designers are advised to minimize instructional materials that obstruct learning and focus on the design of learner-directed activities. Instruction can be made more efficient when the amount of reading is minimized and learners are allowed to fill in the gaps themselves	<ul style="list-style-type: none"> - Keep important information at the top of the page - Keep frames simple and be consistent in design of text, graphics and sound to limit cognitive load - Keep pages uncluttered by extracting unnecessary elements - Filter out excess information - Structure materials as topical modules

Vygotsky's (1978) Theory of Social Cognitive Development	Social interaction plays a fundamental role in the development of cognition. Instruction can be made more efficient when learners engage in activities within a supportive environment and receive guidance mediated by appropriate tools (e.g. online tutor) whose role is to help learners complete a task near the upper end of their zone of proximal development and then to systematically withdraw this support	<ul style="list-style-type: none"> - Simplify navigation - Create effective menus - Include indexes, table of contents, and search capabilities - Clearly identify content with appropriate headings and titles - Place most important information on the top left
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3.2 Instructional Design Models

While learning theories are essentially frameworks for understanding learning processes and predicting learning outcomes, ID models are more prescriptive in specifying procedures to realize conceptual ideas. However, the difference between the two is subtle. Here we list several ID models that are commonly adopted for technology-enabled learning:

ADDIE refers to Analyze, Design, Develop, Implement, and Evaluate.
(http://distance-ed.fullerton.edu/pages/faculty_staff/online_guide/guide24.htm)

Algo-Heuristic suggests that all cognitive activities can be analyzed into operations of an algorithmic, semi-algorithmic, heuristic, or semi-heuristic in nature. It specifies that learners ought to be taught not only knowledge but the algorithms and heuristics of experts as well.
(<http://tip.psychology.org/landa.html>)

Dick & Carey Model prescribes a methodology for designing instruction based on a reductionist model of breaking instruction down into smaller components.
(<http://www.soe.ecu.edu/ltdi/colaric/KB/DickCarey.html>)

Rapid Prototyping involves learners and subject matter experts interacting with prototypes and instructional designers in a continuous review/revision cycle.
(<http://www-personal.umich.edu/~jmargeru/prototyping>)

Empathic Instructional Design prescribes 5-step process, namely Observe, Capture Data, Reflect and Analyze, Brainstorm for Solutions, and Develop Prototypes.
(<http://www.elearningpost.com/features/archives/001003.asp>)

Learning Orientations Model is based on the whole-person learning model, putting emphasis on emotions, intentions and social factors as a dominant influence how individuals learn differently.
(http://ifets.ieee.org/periodical/vol_1_2001/martinez.pdf)

In sum, learning theories and ID models play an indispensable role in e-learning. Pedagogy must drive the choice of instructional technology, not the other way round. ID is to serve the learning needs and success of learners through effective presentation of content and fostering of interaction. Several compelling concerns about e-learning such as drop out rates, learner resistance, and poor performance can be addressed through a structured design process. The resulting benefits - reduced design costs, consistency, transparency, quality control, and standardization - make organizational decision to invest in ID easier (Siemens, 2002). Nonetheless, there exist different models for instructional design, which are more than presented above. Selection of an appropriate model is contingent on the characteristics of the organization where the training takes place and of the learners who are beneficiaries of the training. Hence, it is necessary to systematically carry out a needs assessment, a requirements analysis and user research under the close collaboration of an interdisciplinary team. Furthermore, the growing trend to blended learning recognizes the use of enabling technology in the instructional process as one that augments rather than replaces face-to-face delivery. Moreover, continually changing demographic profiles for consumers of e-learning imply the need to adopt a user-centred design process (ISO 13407) for development projects (Eklund, Kay & Lynch, 2003).

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4 User Roles and General Requirements

We have identified five basic user roles relevant for corporate e-learning:

- *Learner* – the person who consumes a learning service
- *Instructor* – the person who ensures effective teaching in online environments
- *Training Manager* – the person that represents the company's interests and strategy
- *Author* – the creator of learning resources
- *System Administrator* – the person responsible for the system maintenance

We describe these roles and their tasks in the next special sections together with scenarios and requirements related to each of these roles, taking into account the following issues:

- *User scenarios* – global stories that give a big picture; they are descriptions of concrete users' activities, and tell how the system is used in a domain
- *Use cases* – relatively abstract single episodes that give detail aspects
- *User requirements* – describe how the system should work and look like from the user's point of view
- *System requirements* – both functional and non-functional demands expressed in a technical language
- *User interface requirements* – specify which types of information should be visualized for the user and how

However, before we proceed with investigations of the individual roles, we first briefly mention general user and system requirements that should be considered, especially when implementing adaptivity and user modelling. Investigation of these issues in more detail will follow in the next deliverables.

4.1 General User Requirements

Personalized and adaptive functionalities provided by the system rely on knowledge about the user, such as knowledge and interests, goals, background and experience, preferences (Brusilovsky, 1996). Existing systems typically adapt to the learner but adaptation to other roles can be considered as well. Generally, a priori knowledge about users is not available. The emphasis in knowledge acquisition must lie on the implicit (i.e. unobtrusive) acquisition of user attributes, e.g. from user feedback, usage data, models of similar users, and inferences. The explicit acquisition of user information before runtime should be restricted to a brief initial interview (Carroll, 2000). The adaptation to relevant user attributes is required to be relatively quick (Carroll, 1995):

- the provision of personalized information and services should already be possible during the user's first session
- in subsequent sessions, the system should be able to cater to a user's changing interests and preferences

Special attention should be given to the shared control of the adaptivity between the user and the system – the user finds initiative and support for adaptations but remains in control about the process and results.

4.2 General System Requirements

In general, to provide personalization and adaptation the system has to store, update and delete explicitly provided information, implicitly acquired assumptions, and selected demographic data (e.g., users' age, gender, and continent of origin) by carrying out the following central tasks for several users at the same time (Kobsa, 2001):

- acquire, infer and provide access to knowledge about the user
- learn the relevant attributes (such as knowledge or experience) of users based on their usage of the application
- predict characteristics of individual users based on those of similar users, and on assumptions about homogeneous user subgroups - *stereotypes* (Rich, 1989)
- infer additional attribute-values using domain knowledge

Thereby, different acquisition techniques for user modeling should complement each other, and synergistic effects between methods should be exploited. For instance, predicting user characteristics based on similarities between user profiles should be able to take information explicitly provided by users into account, as well as information that was implicitly acquired by inference methods. Implying that the lifetime of individual learner models must extend beyond a single learning session, the support of long-term learner modeling is required. To supply authorized applications with current information about the learner, easy access to the learner modeling system should be possible from different applications, and different software and hardware platforms.

4.2.1 User Interaction Requirements

As a prerequisite, personalized systems must be able to watch the user behaviour and make generalizations and predictions about the user based on their observations. These systems evaluate the interaction of users with the system, their navigation in the information space and their interaction with the learning material and other users to adapt the functionality, the information presentation, and the interaction style to the current user needs. The evaluation includes the history of the usage process in order to establish a continuous user profile that allows inferring elements to be adapted – long-term perspective reflecting the context of use. The evaluation also includes the momentary situation in which the adaptation is performed – short-term perspective reflecting the situation for the moment.

4.2.2 Openness and Standards

The user modeling system must be open with respect to

- new or evolving learner modeling requirements and their implications for the acquisition and representation of learner models, for learning methods, and for inferences on the basis of learner models
- external data sources about learners that may become available in the future
- tools for learner model analysis (e.g., visualization tools, data mining tools) and associated interface standards
- upwards compatibility between existing and future prototypes

The user modeling system should comply as much as possible with existing and emerging standards and de facto standards (e.g., from organizations like ISO and IETF).

4.2.3 Communication and Cooperation Facilities

To support cooperative learning as well as asynchronous collaboration and communication among users the following facilities should be provided:

- *Annotations*: Users can create private and public annotations related to the whole course or to a particular learning object and edit them later on.
- *Discussions*: Users can start threaded discussions and contribute to the existing ones. A discussion can relate to the whole course or to a particular learning object.
- *Shared Workspace*: Users can use the space for cooperation and sharing purposes.

4.3 Additional Requirements

4.3.1 Personal data protection

Personalized adaptive learning systems typically involve learner profiles with sensitive personal information and activities that might breach learner's privacy, such as tracking, profiling or collaborative filtering. Therefore, it is crucial that those systems adequately protect the learner's identity and her data and are compliant with EU data protection directives, e.g. EU Directives 95/46/EC or 2002/58/EC, security standards and best practices.

4.3.2 Minimization of data storage and processing

The system should be compliant with the “minimal disclosure of personal data” principle. Only the data that is necessary for service provision should be collected and processed.

4.3.3 Support of multiple virtual identities

In personalized systems a learner should be able to select and use different virtual identities when presented against other educational services and applications. An identity manager under the control of the learner should manage virtual identities. Applied virtual identity must be managed and displayed to a user in a user-friendly way. Managing identity should follow some predefined schemes, such as default privacy rules or identity protection, also defined on the company level.

4.3.4 Personal data collection and user control of information

The user should have control over the sort of information on her is held by the system. A convenient GUI should facilitate the control and editing of user information and access rights to it. Flexible resolution of cases when a conflict of user interests and corporate policies arises is needed. The user must also be informed at the moment of collection (transfer) of her personal data to other systems or services.

4.3.5 User control vs. automation

Special attention will be given to the shared control of the adaptivity between the user and the system: the user finds initiative and support for adaptations but remains in control about the process and results. Users should be able to control the degree to which automated assistance is provided. They should have the option to override automation.

4.3.6 Personal data management

An efficient mechanism for storage and management of personal information should be established, in order to help users keep track of their personal data. User-friendly and flexible methods for configuring the user preferences should be developed. Users should be able to manage their personal data (e.g. interface & service preferences, identification information, performance, skills etc) in a fast, robust and easy manner. The system has to care for the consistency, security, and privacy of the user model contents. The responsiveness, robustness, and the access management facilities it provides (quality of service of the user modeling system) is very important. It is also important to specify which personal data can be presented to other user (e.g. the instructor) and which have to be kept private. Generally, the threshold can be configurable, taking into account the local requirements and needs.

4.3.7 High-level policies

In order to exploit dynamic adaptation of user environment, high-level rules and policies can be defined so that the services and content provided are personalized according to the current context values, aiming at making users' lives easier. Rules might be generated automatically or manually. For example, a user can explicitly determine how the system should react. On the other hand, there could be automatic generation of rules based on the statistically observed learner behavior.

4.3.8 Policy and rule templates

Policies and rules are generally complicated and difficult to specify by non-technical people, people who are not competent enough or those who do not want to be bothered by details, such as privacy preferences formulation. Standard policies and rules are needed for typical situations to help users formulate their requirements in an easy and consistent way. Studies show that policy development is also easier when initiated by real-time releases, i.e. users might initially be asked what to do when the data is about to be released to create new rules.

4.4 References

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5 Learner

A *learner* is a person who consumes a learning service. This section contains a description of the learner requirements as formulated in this stage of the project. The requirements have been derived from the scenarios that have been developed and discussed in the work package. As the Learner requirements represent only one of five roles, these requirements are integrated and combined with the requirements from the other four roles. We do however follow the general template structure to facilitate the combination of the material. The section takes a concrete view at the problem of curriculum or study program recommendation from the perspective of the company learner.

5.1 Learner Scenario: E-advisor

We outline the different issues involved in the learner context, before addressing the specific scenario of E-advisor (see Appendix), for curriculum/study program recommendation in corporate setting, and the associated requirements. The main trigger for this scenario is on the one hand the need for a good (personalized) curriculum/career advice on user's demand and in overall the need for a tailor-based education. This leads to the more specific *goals* identified for the e-advisor scenario, such as:

- transparent and synchronized use of distributed learning resources (LR)
- quick and relevant recommendation for curriculum/program
- offer an optimised learning process (e.g. time, effort, result)

Subsequently the *main tasks* performed within this scenario are related to:

- Web-based learning (both individual or group work)
- Exchanging and sharing of LR
- Changing and monitoring preferences
- Requesting and providing explicit advise/recommendations

We have identified three main *actors* in this scenario:

- *learner/student*, which can be either a company employee in a training, or an unemployed individual searching (following) a qualification program; another example of this role is given by a just graduated high school student, looking for a suitable career advice or for an appropriate additional qualification curriculum (or separate courses) in order to build additional skills and gather knowledge
- *educational institution*, realized either by a typical academia institution, such as an university, college or high school, or in a corporate setting by the training department of a company or by a specialized consultancy company
- *instructor/coach*, carried out by traditional teachers at high school level, in specialized (professional) schools, or at an university; a trainer or a professional with specialized skills can also realize the instructor actor

In order to handle in a more general way and to make the links between the different actors more explicit and more concrete, three roles have been identified:

- role of a *consumer* of learning resource(s)
- role of a *owner* of learning resource(s)
- role of a *producer* of learning resource(s)

This way can define at a general level the characteristics of the learner and his/her dependencies on the instructors and the curriculum recommender. Note that the there roles can alternate within the various realizations of this scenario, i.e. the learner can be a consumer of LR but he/she can also be an owner of the same or another LR. Often the roles of the owner and the producer are overlapping and realized by the same individual or institution.

5.1.1 Curriculum / Study Program Recommendation

From the above given issues involved in the learner context, the scenario of an E-advisor takes a concrete view at the problem of curriculum or study program recommendation from the perspective of the company learner. Such a learner can be in different stages of his/her career, and thus also with slightly different needs. We include several possibilities for the situation of the learner:

- a high school student with no idea about his/her future in terms of studies or career
- a young professional that wants to find the best educational/business continuation after the prior education
- a more experienced professional who turns into a new area and wants to strengthen his/her expertise in the area

There are three main interaction streams described in the following sections.

5.1.1.1 Consulting an e-advisor application

The component that supports the interaction with the learner regarding the composition of the curriculum or study program can be seen to provide services for the following aspects:

- match learner profile with the available solutions and offerings
- identify the topics of interest
- propose suitable courses or career options
- adapt learner selection in a program (adjusting the selection after the recommendations)

5.1.1.2 Using a course application

The component that supports the actual following of a course or part of a program provides service such as:

- adaptation of course level, topics, tasks, etc.
- adaptation to learner preferences
 - length of the study/program
 - topics to follow
 - place to study
- e-advisor collaborates with various applications to collect and share data about the learner to update recommendations
- e-advisor simultaneously recommends other or new courses, conferences, lectures, etc, which fit the current learner

5.1.1.3 Consulting / changing user preferences

The maintenance and access to the user preferences and user model data is an essential component with services for the learner to be in charge of the data that the learning applications use:

- specify how and what to share between institutions (learning material providers) and applications
- see how the applications keep track of learner knowledge and course status
- see and verify the current status and application assumptions about the learner, and possibly change them

5.2 Learner Use Cases

Title: <i>Search for Learning Resources</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Learner, System</i></p> <p>Task: <i>Searching for learning resources satisfying learner learning goal.</i></p> <p>Input: <i>Learners' learning goals</i></p> <p>Actions: <i>Learner logs into the system and try to fill in his learning goal in a form of a query for learning resources. He can submit the query to his application and get results back. He is able to refine his query if results or query are inappropriate.</i></p> <p>Output: <i>Learning resources satisfying learner goals</i></p>
<p>System support:</p> <ul style="list-style-type: none"> • <i>Means for specification of learner goal</i> • <i>Constructing system query out of the typed learning goals</i> • <i>Means for refining learner goal</i> • <i>Browsing search results</i>

Title: <i>Ask for Advice or Recommendation</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Learner, Advisor, System</i></p> <p>Task: <i>Ask for recommendation.</i></p> <p>Input: <i>Request for advice</i></p> <p>Actions: <i>Learner is able to ask an expert for advice by specifying his needs. He is able to ask for automatic recommendation of learning resources.</i></p> <p>Output: <i>Advice or recommendation</i></p>
<p>System support:</p> <ul style="list-style-type: none"> • <i>Computing the recommendation</i> • <i>Match learner profile with the available solutions and offerings</i> • <i>Identify the topics of interest</i> • <i>Propose suitable courses or career options</i> • <i>Adapt learner selection in a program (adjusting the selection after the recommendations)</i> • <i>Communicating a need for advice to an expert</i> • <i>Providing advice received for an expert</i>

Title: <i>Access Learning Resource</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Learner, System</i></p> <p>Task: <i>Access selected learning resources.</i></p> <p>Input: <i>Selected learning resource</i></p> <p>Actions: <i>Within a company that provides learning resources to other institutions or individual users, a training manager might specify a learning resource offer and use conditions. The training manager takes a resource that has been prepared by an author and offers it by specifying metadata such as price of the learning resource, access rights and use conditions.</i></p> <p>Output: <i>Use conditions for the provided learning resource</i></p>
<p>System support:</p> <ul style="list-style-type: none"> • <i>Providing access to the learning resource</i>

Title: <i>Explore Learning Resource</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Learner, System</i></p> <p>Task: <i>Exploring a learning resource</i></p> <p>Input: <i>Learning Resource, Learner Profile (e.g. Goal, Preferences, Learning Performance)</i></p> <p>Actions: <i>Learner access a learning resource through a guidance application where his learner profile is utilized to provide more appropriate guidance through the learning resource..</i></p> <p>Output: <i>Increase of knowledge, competence</i></p>
<p>System support:</p> <ul style="list-style-type: none"> • <i>Adaptation of learning path to</i> <ul style="list-style-type: none"> ○ <i>the goals and training needs,</i> ○ <i>employees' skills, competencies and performances,</i> ○ <i>privacy preferences</i> ○ <i>learner preferences</i> <ul style="list-style-type: none"> ▪ <i>length of the study/program</i> ▪ <i>topics to follow</i> ▪ <i>place to study</i> • <i>Collaboration with various applications to collect and share data about the learner to update recommendations</i> • <i>Simultaneous recommendations of other or new courses, conferences, lectures, etc, which fit the current learner</i>

Title: <i>Explore Learner Profile</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Learner, System</i></p> <p>Task: <i>Exploring learner profile and making his self reflection.</i></p> <p>Input: <i>Learner</i></p> <p>Actions: <i>Learner explores his learner profile according to categories of information available in his profile.</i></p> <p>Output:</p>
<p>System support:</p> <ul style="list-style-type: none"> • <i>Showing categories of learner information</i> • <i>Navigation facilities according to the categories</i> • <i>Specify how and what to share between institutions (learning material providers) and applications</i> • <i>See how the applications keep track of learner knowledge and course status</i> • <i>See and verify the current status and application assumptions about the learner, and possibly change them</i>

Title: <i>Perform Learner Assessment</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Learner, System</i></p> <p>Task: <i>Performing learner assessment.</i></p> <p>Input: <i>Learner input provided in the assessment</i></p> <p>Actions: <i>Learner fills in an assessment test or questionnaire and system evaluates his answers according to an assessment methodology provided.</i></p> <p>Output: <i>Assessment results</i></p>
<p>System support:</p> <ul style="list-style-type: none"> • <i>Constructing learner assessment</i> • <i>Providing assessment guidance</i> • <i>Evaluating assessment results</i>

5.3 General Considerations

This section describes some considerations for personalized adaptive learning systems from learner point of view. They reflect the above use cases and scenarios collected in the project consortium (see Appendix) as well as research on Educational Adaptive Hypermedia [8,10], SWALE [9], AIMS [6], AHA! [11], and CHIME [7].

5.3.1 General Portal Facilities

As a consequence of the discussion on the above scenario, the following general portal facilities are recommended to be provided:

- Learning material environment
 - Information search & browse
 - Recommender (coaching facility)
 - Annotation facility
 - Information kiosk
- Course environment
 - Testing (pre-assessment, post-assessment, course assessment)
 - Learning units
- People search & browse
- Open Learner Profile
- Discussion forum
- Activity history

5.3.2 Personalization and Adaptation Considerations

In terms of the specific adaptation for the sake of personalization, the system needs to have specific facilities. In order to capture the scope of the adaptation, we have identified that the customization, personalization and adaptation is realized on the information/content, application/services, and on the user interface (providing different options for each user). The adaptation that is offered to the learners uses several learner aspects to base the adaptation on:

- knowledge about the system and the application
- knowledge about the subject and its area
- local and global goals
- interests
- background (i.e. profession, language, prospect, capabilities)
- navigation history

The adaptation system should support an intelligent management of learners, knowledge and information, and it should do so both for individual or group learners. The intelligent assistance that goes with this learner support includes feedback, awareness hints and guidelines as well as a reflection, which can be implemented using

- case-sensitive guidance
- orientation support
- system explanations

In order to support the user (learner) model the adaptation system has to allow support to *different type(s) of learner models* (and the facility to deal with differences in learner model types), providing this learner model as a *single shared learner model* or as an *external user modelling server* architecture. The learner profile or learner model itself includes aspects such as:

- interests
- knowledge
- current educational status
- residential constraints
- preferred study duration
- language

- medical status

5.4 Requirements

This section presents concrete user interface and functional requirements.

5.4.1 Data Requirements

Actor: Learner

Description: The requirements are derived from research performed on the Personal Learning Assistant [2] proposed for personalized search in an environment connected by the Edutella [4] infrastructure and the Personal Reader [1].

R1 Requirements issued by user interface for typing queries

Description: The requirements are derived from what the user will be faced on his search user interface.

R1.1 User types in a concept or a set of concepts as his user query

Description: The user is provided with several slots to type in topics he is interested in, or taxonomy is provided where he is able to select the topics from. The metadata of resources from repositories connected to the personalized portal should contain the subjects or it will be possible to derive those concepts.

R1.2 User types in a free text which might refer to the concepts, title or description of a resource

Description: The user is provided with fields where he can type in free text. The text is then matched to subject, title and description fields provided in the metadata about learning resources.

R1.3 User types in a type of a learning resource he is interested in

Description: The user is provided with fields where he can type in or select from taxonomy of learning resource types available in the connected repositories. The type should be provided in the metadata of the connected resources or it should be derivable from their metadata.

R1.4 User types in a teacher's (or provider's) name which authored/provides learning resources a user is interested in

Description: A user can type in or select from teachers or providers of learning resource in the connected repositories.

R2 Requirements derived from the user interface for query results

R2.1 Result user interface displays title of a resource

Description: The title of resource will be displayed to the user according to what is provided in the metadata of a learning resource.

R2.2 Result user interface displays description of a resource

Description: The description of a resource will be displayed to the user according to what is provided in the metadata of a learning resource.

R2.3 Result user interface displays concepts/competencies/subjects taught by a resource

Description: The competencies as educational objectives and concepts/subjects used in the learning resources will be displayed to user according to what is provided in the metadata of learning resource or according to what is derived from the metadata.

R2.4 Result user interface displays the URL from where the resource is available

Description: The URL of a resource will be displayed to the user according to what is provided in the metadata of a learning resource.

R2.5 Results are annotated by recommendation information

Description: The recommendation information for a resource will be displayed to the user according to what is derived from the metadata of a learning resource and the learner.

R3 Requirements derived from the employed personalization strategy**R3.1 Prerequisites of resources should be retrievable**

Description: The prerequisites are used to identify which resources/competencies/concepts have to be learned prior to accessing the resource

R3.2 Intended audience should be retrievable

Description: The author had in mind a specific audience when he authored a resource for. Those classes of learners will be used to restrict resources to the appropriate ones for current user.

R3.3 Taxonomy of subjects used to classify learning object should be available

Description: The taxonomy of subject/competencies is used to identify the expected outcome of a resource and to compute recommendation information. The metadata about resources available in connected repositories should contain such taxonomy or it should be derivable.

R3.4 Learner profile should contain concepts/subjects/competencies learner

Description: The system will be able to retrieve or import information about concepts / competencies / subjects learned by a learner in his previous learning experiences.

R3.5 Learner profile should contain resources visited

Description: The system will be able to retrieve or import information about previous learning experiences with learning resources.

R3.6 Learner profile should contain language preferences

Description: The system will be able to retrieve or import the preferred languages of a learner.

R3.7 Learning goal and learner role is maintained in his learner profile

Description: The system will be able to identify, retrieve or import information about learning goals (e.g., acquire new knowledge, refresh existing knowledge, deeper existing knowledge, and so on).

5.4.2 Functional Requirements

Actor: Learner

R4 User interaction

Description: User interaction functionality provides a search interface interacting with subject ontology to construct appropriate queries, as well as a user interface for refining user queries when they have been constructed using subjects which do not match entries in the particular subject ontology. The subject ontology service is able to provide similar entries to the ones typed in the search interface. Furthermore, the User Interaction Component visualizes the results of a query, as well as additional personalization and annotation hints. The user interaction component is able to follow the user interactions and to store it to his history.

R5 Query rewriting

Description: The query rewriting functionality

- extends a user query by additional restrictions, joins, and variables based on various profiles; this extension is performed based on heuristic rules/functions maintained by the query rewriting functionality
- adds additional constraints to user queries based on user preferences and language capabilities
- extends a user query based on previous learner performance maintained in learner profiles, if a query is constructed in the context of improving skills
- extends user query based on information the connected services need, which can be exposed as input part in DAML-S/OWL-S based service profile descriptions

R6 Recommendation

Description: The recommendation functionality provides annotations for learning resources in accordance with the information in a learner's profile. These annotations can refer to the educational state of a learning resource, the processing state of a learning resource, etc. The functionality holds heuristic rules for deriving recommendations based on learner profile information.

R7 Link generation

Description: The link generation functionality provides (personalized) semantic relations for a learning resource in accordance with the information in a learner's profile. These relations can show the context of a resource (e.g., a course in which this learning resource is included), or they can show other learning resources related to this resource (e.g., examples for this learning resource, alternative explanations, exercises). The link generation holds heuristic rules for creating semantic hypertext links. Some of the rules refer to information from the learner profile, in absence of learner profile information the service can at least provide some, not optimised, hypertext links.

R8 Ontology functions

Description: The ontology functionality holds one or several ontologies and can be asked to return a whole ontology, a part of it (e.g., a subgraph selected via some filter criterion), or can answer queries of the kind "give me all subconcepts of concept C", "which properties are defined for concept C", "who authored concept C", etc. Since ontologies will change over time, Ontology Services also have to accept update requests and inform other services of these updates.

R9 Mappings

Description: The mappings functionality holds mappings between ontologies (or schemas) to allow services not using the same ontologies to communicate with each other. Such a mapping can be asked, e.g., "to map a concept C from one ontology to a concept C' in another ontology", or "to map an instance I formulated in terms of one ontology to an instance I' formulated in terms of another ontology". Since ontologies change over time, mapping functionality also needs to understand requests for updating the mapping specifications.

R10 Access to the repository

Description: Access to the repository maintains a link to a metadata store. This might be a physical connection to a database or might be a group of peers with an address (identification) of sub-networks where query or manipulation commands will be submitted. We assume that the access to a repository uses queries formulated in the repository's query language. These queries are expressed using ontologies understood by the repository query functionality, so the calling side must provide the query in the correct language (possibly using additional mapping/query transformation), or the storage service provider must contact other services to get the appropriate format of a query.

R11 Sharing the learner profile

Description: To share learner profile between applications an API should be provided which supports following requirements. The requirements for API are based on the learner profile schema proposed in [3] and further documented in [5].

R11.1 Providing the capability to create a profile of a learner

Description: The API must provide the methodology to create a learner profile, i.e. a RDF graph with information about the learner, and to process each part of the profile. The API must include the means to browse and edit the complete data included in a profile, so that a system can easily be built which uses this profile definition or parts of it.

R11.2 Support of a learner definition

Description: The API must provide the methods and virtual structure to support the learner definition according to the Learner schema [2]. The learner fragment integrates other learner profile fragments.

R11.3 Support for a learner performance

Description: The API must provide the virtual structure and methods to support the creation and manipulation of learner performance, certificates and portfolios according to [2], which was created according to LTSC IEEE 1484.2 Learner Model WG Standard proposal for PAPI.

R11.4 Support for learner goals and preferences

Description: The API must provide the virtual structure and methods to support the creation and manipulation of learner goals and preferences according to [2], which was created according to IMS Learner Information Package Specification.

R11.5 Support for learning competencies

Description: The API must provide the virtual structure and methods to support them creation and manipulation of the competencies fragment defined according to the schema proposed in [2], which was created according to IMS reusable definition of competency and educational objective draft standard. The competencies references are used to articulate learner performance and educational objectives of a learner assessment.

R11.6 Support of concept schema definition

Description: The API must provide the virtual structure and methods to support of creation and manipulation of the concept fragment according to the schema suggested in [2]. The concept references are used to articulate learner performance.

R11.7 Support of learner identification

Description: The API must provide the virtual structure and methods to support the schema definition of the personal information and other extensions according to the schema proposed in [2].

R11.8 Functionality to read in and to write RDF files with the profile(s)

Description: The API should provide methods, which allow the import of a model, i.e. one or more learner profiles, from a RDF/XML file or database. Likewise, the API must have the capabilities to save the model to a file or database.

R11.9 Functionality which allows access to the profile(s) from multiple users/systems

Description: The API is meant to be a basis on which a learner self-assessment or self-reflection system can be built upon. Furthermore, there can be several systems that also want to access the profile data that are created and maintained using the API. Therefore, the API must provide capabilities to manage and access a model with the profiles of learners from multiple systems at the same time. The consistency of the model must be guaranteed.

R11.10 Full support of the QTI specification (full and light)

Description: The IMS Question & Test Interoperability specification must be included in the API, based upon the RDF definitions, which were created according to the schema specification in [2]. The API has to provide the methodology to create, browse and edit tests according to this specification. Both the full and the light version of the QTI specification have to be supported.

R11.11 Functionality to read in and to write RDF files with the test(s)

Description: Methods have to be included which allow the import of a QTI structure from a RDF/XML file or database. Likewise, the API must have the capabilities to save a QTI structured test to a file or database.

R11.12 Structure which allows easy use and which can be easily extended and adapted

Description: The whole API has to be structured in a way that allows easy use and easy adaptation and extension. The API must consist of two parts: a formal definition of its components, and of a default implementation that can be used or adapted according to the needs of the user.

R12 Exploring the learner profile

Description: This functionality is intended for learner self-reflection. Following requirements should be satisfied.

R12.1 System must allow the user to browse and edit a profile online

Description: The system must provide the user with the capability to log on to the browsing system via the internet, and then to browse and edit every aspect of the profile.

R12.2 System has to present the model of the learner in an understandable way

Description: The contents of the profile has to be presented to the user in an understandable and clear way, so that even the more complex structures of the profile can be comprehended by the average user.

R12.3 System has to be configurable

Description: The system has to be configurable concerning the data source (from a local file or a global model) and method of data storage.

R12.4 System architecture should consider changes and extensions

Description: The system should be built in a way that allows easy changes of the visual presentation and the data processing. Furthermore, it has to be possible to extend the system, so that possible extensions of the Learner Profile can be included.

R12.5 Self reflection component is required

Description: The active component of the system will be a system for a learner reflection. The system will support imports of an RDF file based on the QTI specification and which subsequently creates from this data a test, which the learner can answer. The reflection component must correctly evaluate the answers given by the user.

5.5 References

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6 Instructor

An *instructor* is a person who imparts knowledge and ensures effective teaching in online environments. This may be the only person directly communicating with the learner. This role can be considered as “a guide on the side” rather than “a sage on the stage”. Activities carried out by instructors include:

- Providing guidance to learners
- Providing recommendations to learners
- Assessment of learners’ work
- Answering learners’ questions
- Monitoring discussion
- Promoting discussions

This section describes scenarios and requirements related to the instructor role in corporate e-learning.

6.1 User Scenario

Title: <i>Personalized tutoring on PROLEARN portal</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Instructor, learner, system</i></p> <p>Task: <i>Get overview of learners’ progress and provide recommendations, guidance, and assessment.</i></p> <p>Input: <i>Learner’s objective and progress</i></p> <p>Actions: <i>The instructor logs in on the PROLEARN portal. He can see updates in the learners’ progress, new delivered exercises and new discussion contributions.</i></p> <p><i>The instructor downloads a learner’s exercise (homework), prepares its assessment and uploads it. He checks the learner’s progress and recommends her suitable learning objects. The instructor checks discussion contributions and replies if needed.</i></p> <p><i>The learner receives the recommended resources and starts reading the overview. She realises that she has already read a similar paper from a different author and asks the instructor whether the two sources are equivalent. The instructor confirms the essential overlap but recommends studying chapter 3 that gives a complementary insight to the subject of interest. The learner realises that the materials are unsuitable for her level (e.g. too easy or too difficult) and asks the instructor for another recommendation. The instructor finds resources that are more appropriate and recommends them to the learner. To obtain new learning objects the instructor formulates a request and sends it to authors and the training manager. The instructor notifies authors about the pedagogical value of their learning objects according to his experience.</i></p> <p>Output: <i>Instructor’s feedback on learner’s progress (guidance, recommendations, assessment), instructor’s contributions in discussions, instructor’s feedback / request on learning resources – to author (training manager)</i></p>
<p>System support: <i>Providing overview of students’ progress (social, cognitive, and behavioral aspects), communication facilities</i></p>

6.2 Use Cases

Title: <i>Course assignment</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Manager or Instructor, System</i></p> <p>Task: <i>Assign a course to an instructor.</i></p> <p>Input: <i>Course, instructor, group of learners</i></p> <p>Actions: <i>The manager or the instructor chooses a course together with a group of learners and assigns them to the instructor.</i></p> <p>Output: <i>Notification of the instructor and the learners about the new arrangements</i></p>
<p>System support: <i>Course assignment facility</i></p>

Title: <i>Learner enrollment for a course</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Manager or Instructor or Learner, System</i></p> <p>Task: <i>Register a learner for a course.</i></p> <p>Input: <i>Learner, course</i></p> <p>Actions: <i>The manager, the instructor, or the learner registers the learner for the course.</i></p> <p>Output: <i>Notification of the learner about the new arrangements</i></p>
<p>System support: <i>Learner enrollment facility</i></p>

Title: *Learner progress overview*

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors:*Instructor, System***Task:***Get an overview of the learner progress.***Input:***Learner, course***Actions:***The instructor can view the current progress of the learner as well as the personal data.***Output:***Visualization of the learner progress***System support:***Learner progress overview facility***Title:** *Recommendations and guidance for learner*

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors:*Instructor, System***Task:***Provide recommendations and guidance for the learner.***Input:***Learner progress in the course***Actions:***Based on the learner progress and preferences the instructor provides recommendations and guidance for the learner.***Output:***Recommended learning objects, learning path***System support:***Learning path generation and recommendation facility*

Title: Communication with learners

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors:

Instructor, System, Learners

Task:

Answer learners' questions and promote discussions.

Input:

Learners' questions, progress, and preferences

Actions:

The instructor monitors learners' discussions, answers their questions (both public and private) and promotes new discussions

Output:

Instructor's answers to learners' questions

System support:

Discussion forum, communication facility

Title: Exercise management

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors:

Learner, Instructor, System

Task:

Assessment of learners' exercises

Input:

Exercise(s)

Actions:

Learners deliver their exercises. Instructors download them, evaluate them and upload the assessments back to the system. Instructors get an overview of the current state of the exercises for all the learners.

Output:

Assessments of the exercises

System support:

Exercise assessment and overview facility.

6.3 User Requirements

This section describes the functionality that needs to be provided from the user point of view.

6.3.1 Guidance

The instructor can compose new learning objects and generate learning paths based on available learning objects. Instructor's role will be close to the author's role when it comes to definitions of learning paths. There can be several types of learning contextual paths:

- Initially created by authors
- Proposed by instructors
- Defined or used by learners in individual study
- Generated automatically according to existing ones and statistical analysis (popularity, indexing)

6.3.2 Class Management

Course Management Systems (e.g. Kravcik & Specht 2004) usually provide a tutoring module for class management and performance monitoring. Each instructor gets access to a course book and the course contents. He also gets an overview of the subscribed students together with their personal data (including contact information) and the current progress in the course. He can register new students and invite or subscribe other instructors to the course. Furthermore, the tutoring module allows the instructors to highlight learning objects and define them as hot topics. This will be emphasized with the instructors' comments in the learner interface. Based on the questionnaires defined by authors, instructors get feedback on the materials and statistics of the student involved in the course enrolment. Instructors can also use the course communication spaces to contribute to discussions, and add annotations.

6.3.3 Practice

In some domains (e.g. design), teaching passes through daily practice and long revision processes. Protocol analysis studies of students' revision activities have demonstrated that these activities consist principally in the construction of reasons that have lead to solutions (design rational). Thus, these are principal objectives of teaching in this area. For instance, ALE (Kravcik & Specht 2004) enables to control the homework workflow by means of the learning element *Exercise*. This learning element can be created by the author and consists of:

- Task(s) and a file (if needed) - created by the author
- Homework files - submitted by students
- Assessment files - submitted by instructors

The homework workflow process consists of the following steps:

1. The author creates an Exercise, specifies the task(s) and possibly uploads a file to be elaborated by the students as their homework.
2. The student downloads the homework file (if available), elaborates it or prepares a new file according to the task(s) and delivers the homework.
3. Instructors have an overview of all the homework submitted and their assessments. The instructor downloads available homework exercises delivered by students. Then the instructor can work off-line to assess the homework. The instructor uploads assessments, assigns the note for each exercise individually and emphasizes the works of particular didactic interest to demonstrate typical errors, good examples, exemplar solutions, interesting case studies, etc. Instructors can also assign one or more concepts to an individual homework.
4. The student receives the assessment and the note. Each student can see just his or her own homework and its assessment. Assessments of homework marked as special are available to all

students. In the concept viewer a list of related homework assessments is displayed according to the assignment done by the instructor.

6.4 System Requirements

Here we describe relevant features and facilities that the system should provide for the instructor.

6.4.1 Learner Progress Overview

The instructor needs to know the learner and her progress to be able to guide her and recommend her learning materials. The section *User Interface Requirements* contains more details on this issue.

6.4.2 Recommendation Tools

The instructor can recommend or emphasize the learning objects with a particular didactic interest to the learner. Specific exercise solutions and their assessments can be recommended to illustrate particular topics.

6.4.3 Learning Object Composition and Path Generation Tools

The instructor can compose a specific (volatile) learning object for a particular learner or a group of learners to address a certain learning objective. Similarly, the instructor can create a linear learning path.

6.4.4 Exercise Management

To improve the control over the homework workflow the system should provide suitable delivery and assessment facilities. Instructors can emphasize the objects of particular didactic interest to demonstrate typical errors, good examples, exemplar solutions, interesting case studies, etc.

6.5 User Interface Requirements

Instructors need understanding of their students. The system should provide them help to gain understanding of cognitive and social processes in classes. A good tutoring practice requires monitoring the learners' progress with course material and testing the acquired knowledge and skills on a regular basis.

6.5.1 Information Visualization

Very little has been done to facilitate distance teachers, especially to help them understand what is happening at the students' side (e.g. the material the student has read, the level of mastery achieved by a student on a specific domain topic, the frequency and effectiveness of the participation in discussions, etc.). One of the biggest problems with the data provided by commercial learning environments is that it is in a numerical tabular format, often incomprehensible, with a poor logical organization, and difficult to follow (Mazza 2003). Information visualization exploits graphical representations to render a vast amount of abstract data to help people comprehend and interpret the data. Visualization is a powerful tool in three major tasks:

- Exploration – searching for relationships, trends, and interesting phenomena
- Confirmation – validating or refuting hypothesis
- Presentation – conveying information to others

Suitable pictorial representations of data can help the instructors to form mental models of individual students as well as mental models of groups of students. Based on these models, the instructors can provide instruction that is more effective. Using graphical representations of student tracking data, instructors can identify tendencies in their classes, or quickly discover individuals that need special

attention. An empirical study (Mazza & Dimitrova 2003) has identified the needs of distance learning instructors and recommendations how to help teachers gain a better understanding of cognitive, social and behavioural aspects about individual students in on-line distance teaching. Note that the study considered general distance learning situation, so there might be some specific requirements related to corporate learning.

6.5.1.1 Social Aspects

These may be various kinds of interactions between course users. The study recommends provision of:

- quantitative visualization about discussions
- appropriate visualization of the data about the participation in group work

6.5.1.2 Cognitive Aspects

This includes the students' course performance. It is recommended to give a suitable external representation of:

- the overall performance in the course
- the level of knowledge achieved by each student for each domain concept of the course
- students having difficulties with a concept (comparison of a student with the whole class)

6.5.1.3 Behavioural Aspects

This identifies specific features of students' behaviour. The following data should be visualized:

- the students' access to the course
- the reading of course material
- the performing of evaluation proofs
- the participation in discussion
- the students' progressing with the schedule of the course

6.5.1.4 System

CourseVis (Mazza & Dimitrova 2004) is a visualization tool that obtains tracking data from a content management system (CMS), transforms the data into a form convenient for processing, and generates graphical representations for course instructors to examine social, cognitive, and behavioral aspects of students. Data from a CMS is extracted and converted into an XML format. Then *OpenDX*, an open source package for visualization of analytical and scientific data, graphically renders it.

6.6 References

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7 Training Manager

This section describes the use cases and requirements related to the training manager role. The *training Manager* is the person that represents the company's interests and strategy. Training management (or learning life cycle management) within a company refers to all business processes related to the identification of training needs, selection and planning of training measures, as well as training outcome evaluation. The training manager is responsible for efficient and effective training of the employees. This role is usually found in the literature under different names, for example as the learning manager role. Training management within a company can be also seen as a sub-discipline of human resource management. Therefore, training managers are sometimes referred to as human resource managers or human resource developers. In smaller companies, this role is frequently covered by one of the general managers. As training managers are responsible for the whole company, line managers, project managers or group managers usually take some of their tasks on lower levels, in the departments or project groups. Group managers for example oversee specific subject areas and are responsible for the knowledge evolution in those fields. For the sake of simplicity, we will assume in this document that there is only one role, i.e. training manager, which covers all training management activities within the company.

7.1 Use Cases

Title: <i>Knowledge analysis</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Training Manager, System</i></p> <p>Task: <i>Analyzing existing knowledge within a company</i></p> <p>Input: <i>Learners' performance</i></p> <p>Actions: <i>Training Manager logs into the system and assesses the knowledge of corporate users from the entire company or from particular departments. The assessment is based on learners' competencies, past achievements, skills, etc. The manager can also compare existing knowledge with the knowledge needed for a project or other specific tasks to see what kind of training is needed to complete the work.</i></p> <p>Output: <i>Level of knowledge within a company or department</i></p>
<p>System support: <i>Analysis of corporate users' knowledge</i></p>

Title: <i>Definition of goals and training needs</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Training Manager, System</i></p> <p>Task: <i>Define goals and training needs</i></p> <p>Input: <i>Company's strategic goals</i></p> <p>Actions: <i>Based on company's strategic goals, a training manager defines the training goals and training needs. These are defined on different levels: on a company level, on a department level, or on individual level of employees.</i></p> <p>Output: <i>Defined goals in the company's, departments' and learners' profiles</i></p>
<p>System support: <i>Specification of goals and training needs</i></p>

Title: <i>Provision of learning resources</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Training Manager, System.</i></p> <p>Task: <i>Provide learning resource and define an offer with use conditions.</i></p> <p>Input: <i>Learning resource, use conditions</i></p> <p>Actions: <i>Within a company that provides learning resources to other institutions or individual users, a training manager might specify a learning resource offer and use conditions. The training manager takes a resource that has been prepared by an author and offers it by specifying metadata such as price of the learning resource, access rights and use conditions.</i></p> <p>Output: <i>Use conditions for the provided learning resource</i></p>
<p>System support: <i>Specification of learning resource metadata related to the use conditions</i></p>

Title: <i>Searching of learning resources</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Training Manager, System</i></p> <p>Task: <i>Find suitable learning resources for an employee or a group of employees.</i></p> <p>Input: <i>Goals, performances, learners</i></p> <p>Actions: <i>Training Manager is looking for a learning resource that contributes most to the goals and training needs, and best covers skill gaps of a learner or group of learners as a whole.</i></p> <p>Output: <i>List of suitable learning resources with their metadata (e.g. terms of use, cost)</i></p>
<p>System support: <i>Adaptation of the search query and search results to</i></p> <ul style="list-style-type: none"> • <i>the goals and training needs</i> • <i>employees' skills, competencies and performances</i> • <i>privacy preferences</i> • <i>training manager's preferences for results presentation</i>

Title: <i>Searching of learning resource providers</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Training Manager, System</i></p> <p>Task: <i>Find suitable learning resource providers.</i></p> <p>Input: <i>Goals, performances, learners</i></p> <p>Actions: <i>Training Manager is looking for learning resource providers that are able to create or provide the most appropriate learning resources taking into account the goals, training needs, competencies, and skill gaps. Providers' assessment is done by using assessment and reputation services.</i></p> <p>Output: <i>List of suitable learning resource providers</i></p>
<p>System support: <i>Adaptation of the search query and search results to</i></p> <ul style="list-style-type: none"> • <i>the goals and training needs</i> • <i>employees' skills, competencies and performances</i> • <i>learning resource providers' reputation information</i> • <i>privacy preferences</i> • <i>training manager's preferences for results presentation</i>

Title: <i>Booking of learning resources</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Training Manager, System</i></p> <p>Task: <i>Book a learning resource for a learner or group of learners.</i></p> <p>Input: <i>Learning resource offer, learner or group of learners</i></p> <p>Actions: <i>After appropriate learning resource has been found through the PROLEARN portal, a training manager checks whether its offer and use terms are acceptable, and books it for a corporate learner or group of learners. During the booking procedure only non-sensitive information (defined by company's privacy policy) is disclosed to the learning resource provider. Data for access to the learning resource is distributed to the learners.</i></p> <p>Output: <i>Access information for the learners</i></p>
<p>System support:</p> <ul style="list-style-type: none"> • <i>Validation of the offer and use terms against company's policy (e.g. department budget plan)</i> • <i>Matching of the provider's privacy policy against company's policy</i>

Title: <i>Approval of learning resource booking</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Training Manager, Learner, System</i></p> <p>Task: <i>Training Manager has to approve all bookings of learning resources that meet certain conditions.</i></p> <p>Input: <i>Learning resource offer, learner</i></p> <p>Actions: <i>A learner finds through the PROLEARN portal an interesting learning resource and tries to book it. As the price of the learning resource is more than 1000 EUR, the system asks the training manager for approval before continuing with the booking procedure.</i></p> <p>Output: <i>Booking of a learning resource is allowed or denied</i></p>
<p>System support:</p> <ul style="list-style-type: none"> • <i>Checking of the learning resource offer terms against company's policy</i> • <i>Notification of the training manager</i>

Title: <i>Collection of expectations</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Training Manager, Learner, System</i></p> <p>Task: <i>Collect learner's expectations before learning resource consumption.</i></p> <p>Input: <i>Learner, questionnaires</i></p> <p>Actions: <i>Training Manager with support of the systems collects learner's expectations of the booked learning resource. Expectations are used later for evaluation of the training outcome.</i></p> <p>Output: <i>Learner's expectations</i></p>
<p>System support: <i>Collection of learner's expectations</i></p>

Title: <i>Transfer and outcome analysis</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Training Manager, Learner, System</i></p> <p>Task: <i>Transfer and outcome analysis</i></p> <p>Input: <i>Questionnaires, performance results</i></p> <p>Actions: <i>Training Manager measures whether training measure had a positive impact on achieving company goals.</i></p> <p>Output: <i>Evaluation results of the training measure, degree of knowledge transfer into a working process</i></p>
<p>System support: <i>Evaluation</i></p>

7.2 Requirements

This section describes requirements for personalized adaptive learning systems that relate to the training manager role. The requirements are sorted according to their place in the training life cycle management. Adaptation is realized on the services, e.g. query service, and on the user interface, and is based on the goals, training needs, skills, competencies, achievements, performance, learning resource (LR) metadata, service providers' reputation information, and user preferences such as language preferences, privacy preferences or preferences for results presentation.

7.2.1 Knowledge analysis

Before the training needs within a company can be identified, a training manager must be able to assess the knowledge, competencies, skills, achievements, etc. of corporate users. The assessment can be done on institutional or group level. The manager can also compare existing knowledge with the knowledge needed for a project or other specific tasks to see what kind of training is needed to complete the work. This information is necessary for the goals and training measures definition that are used for selection of the most appropriate content and learning activities. To support this requirement the learner model of the system must support specification of learner knowledge, competencies, skills, and achievements. Group or institution model must also support specification of goals and training needs.

7.2.2 Management of goals and training needs

Training manager must be able to define training goals and training needs on different levels: on a company level, on a department level, and on individual level of each employee. The goals can be selected from pre-defined taxonomies. To support these requirements the learner model, group model or institution model of the system must support specification of the goals and training needs.

7.2.3 Provision of learning resources

After an author creates a learning resource, the resource can be provided to other institutions. LR provision can be done by the author or by the training manager. Provision of the learning resource includes definition of LR metadata and specification of an offer (price and use conditions). The system should help the training manager to define the metadata by adapting the provision procedure to the company's provision policy (e.g. which use conditions, such as price, intellectual property rights or user groups access rights apply for different types of learning resources). The rules must be supported by the company model.

7.2.4 Searching of learning resources

Training manager must be able to search for learning resources that contribute most to the goals and training needs of individual learners or group of learners, and best cover their skill gaps. When preparing a query the system must take into account the goals, training needs and performance of the individuals or group members, privacy preferences for disclosure of sensitive personal data, and other user preferences, such as language. The returned results are ranked according to the relevance, LR provider's reputation information and other information such as the price. The user interface for presentation of the results is adapted to the training manager's preferences.

7.2.5 Searching of learning resource providers

When no relevant search results are given or when the training manager has special needs, she can search for learning resource providers instead of learning resources. As in R3.1.4 the query must be prepared according to the goals, training needs and performance of the individuals or group members, privacy preferences for disclosure of personal data, and other preferences, such as language. The returned results are ranked according to the relevance, LR provider's reputation information and other

information such as the price. The user interface for presentation of the results is adapted to the training manager's preferences.

7.2.6 Booking of learning resources

The training manager should be allowed to book learning resources for individual learners or groups of learners. The system should validate the offer and use conditions against the company's budgeting policy, and adapt the booking procedure (e.g. data disclosure) to the company's privacy policy. The system should support specification of those policies in the company model.

7.2.7 Approval of booking

In certain cases, for example when the price of a learning resource is beyond a certain limit, the training manager might have to approve the booking of the learning resource. The system must therefore adapt the booking procedure to the company's booking rules. The company model must also support specification of the booking rules.

7.2.8 Evaluation, transfer and outcome analysis

Training manager should be able to collect from learners their expectations of the booked learning resource before the consumption takes place. Expectations are used later for evaluation of the training outcome. During the evaluation procedure, the training manager should be able to overview learner's performance. The training manager should also be supported by the system to measure the effect of the training on achieving the goals. Evaluation results as well as the transfer and outcome analysis results are used by the system to offer more appropriate training activities or for revision of the training needs.

8 Author

This section contains a description of the Author requirements as formulated at this stage of the project. The *Author* persona referred to here creates adaptive learning material fit for delivery on some adaptive learning environment, via the PROLEARN portal. The Learner envisaged here by the Author is the corporate learner. The requirements have been derived from the scenarios that have been developed and discussed during the work package WP01 meetings. As the Author represents only one of five User roles, the Author requirements are dependent on, and feed back into, the requirements of the other four roles. The most important issue in the Author Requirements is to incorporate all the necessary elements that permit the Learner role to function as specified in the Learner Scenario. This section presents:

- Generic Author scenario as extracted from the many different Author scenarios (see Appendix 1)
- Author Use cases, as more abstract single episodes focussing on a detailed aspect
- Translation of these into different Requirements

8.1 Author Scenario

Next to describing the Author scenario in more details, we can characterize it in short via some principal features that we have selected for PROLEARN within the work package WP01 for defining the Author scenario (similar to the other scenarios) are:

- *Trigger* – the actual reason for authoring adaptive learning resources (for instance, instead of authoring ‘simple’ non-adaptive learning resources)
- *Goal* – what can be achieved by authoring and authoring scenarios
- *Actors* – the user roles (directly or indirectly) involved in the actions of the Author
- *Tasks* – the main tasks that are performed by the User Author
- *System support* – how should the system perform to make the Author’s tasks feasible

We have found two main possible *Triggers* in authoring adaptive learning resources:

- In the first place, the need of adaptive courseware due to some (significant) variations in the parameters of the learner or of the environment; this is due to the fact that if learners are similar in needs and goals, no adaptation would be necessary, and a one-size-fits-all approach would be suitable
- Another possible trigger is just the testing of the need or appropriateness of adaptive courseware

The ultimate *Goals* of any type of authoring of learning resources is to support, improve and trigger learning. Therefore, the ultimate goals of the Author Scenario will be the same as the ones on the Learner Scenario, except for it doesn’t reflect the goals of one singular learner, but those of a whole group of Target Learners. On a more limited perspective, the goal of the Author Scenario is the *Creation of Adaptive Learning Resources*, whilst supporting *Synchronization*, *Maintenance* and *Usage* in Adaptive Learning Resources Creation.

The main *Actors* involved in the Author Scenario are, as already emerging from the Triggers and Goals described above:

- The Author him/herself (Domain Specialist, Trainer or University, College or School Professor)
- Company or Educational Institution (e.g. Training company, University, College, High School), represented in our role distribution by the Manager (and to a lesser degree, by the Administrator or even the Tutor)
- Target Learner (e.g. company employee)

The main *task* that the Author has to perform is *Adaptive Learning Resources Creation*. The fact that PROLEARN is managing resources via a common portal leads to the possibility and even necessity of *Collaborative* Adaptive Learning Resources Creation or *Reuse*. As the target product has to be adaptive, the tasks of the author divide into a number of sub-tasks that can be performed by the same or different persons, as follows:

- Creating or Reusing Material for Adaptive Educational Hypermedia

- **Creating or Reusing Behaviour for Adaptive Educational Hypermedia**

The first sub-task specifies the creation or reuse of the actual material to be taught, its granularity, and the meta-data describing its various purposes and contexts of use (such as LOM or extensions) [1]. The second sub-task specifies the creation or reuse of adaptive strategies that describe the use of the actual material, according to its meta-data, in different contexts or according to different (educational, pedagogic) goals [2]. Please note that collaboration and reuse does not have to only be at the level of the static data (such as in LOM exchange), but can also be at the level of dynamics, or strategy description (such as in LOM usage pattern exchange). Below we look into more details of the Author Scenario from the two points of view outlined above. The actual authoring can be a subset of the activities outlined in sub-sections 2.1, 2.2. Moreover, the same author can perform activities attributed to any of these points of view; the delimitation helps towards separation of concerns and in defining reuse elements and appropriate meta-data tagging.

8.1.1 LOM Creator: Creating or Reusing Material for Adaptive Educational Hypermedia

The main character is the author, a domain specialist in a specific area that creates course material or puts together already existing material for an adaptive presentation. He is asked to do this job by an institute offering educational services or a corporation wishing to train their employees on his specialty topic. He is creating this material to connect it to a portal, such as the PROLEARN portal, or via an adaptive web service offered via the PROLEARN portal, or separately on his machine. For dealing with the emerging restrictions and specifications, he needs some help (in the form of prior training, or (frame-based) authoring system with help facility, etc.). Moreover, some other constraints can be taken into consideration:

- The institute or corporation would like to offer adaptive courseware according to some parameters of the learner, or of the environment.
- The author does not know much about adaptation or its power, but knows his subject domain well.
- He is used to a linear, hierarchical course creation, given a target educational goal, a target audience and a time frame. The author therefore has to be informed about these parameters. If there are several target goals, audiences and time frames, as happens in adaptive educational setting, the author has to be informed about all the possible combinations required from him.
- The author would like to be able to create his material as much as possible in the same way as he is used to. He might assume, for instance, that the material will be presented in the same order as he is structuring it, unless he is informed otherwise (again, via training, or via a helpful authoring system).

This might mean that if the order has to be able to be changed later, the author must be informed about this possibility. For instance, he might be asked to create the pieces of courseware as independent as possible, and explicitly mark some dependencies. He does not have to specify the adaptive behaviour of the courseware pieces, but must be helped to create them in such a way that these pieces can be meaningfully used in adaptive courseware presentation. This means that the institute or corporation should inform the author what type of material is necessary for the parameters of the learner or environment envisioned. For instance, if there has to be a whole backup course for visually challenged learners, the author has to be informed to create a second version of each courseware piece targeted at visually challenged learners. If this only has to happen for part of the material, the author has to be informed which part has to be doubled this way.

Finally, the author might be collaborating with other authors on his task. The system has to be able to support this feature, by allowing at least access to the group of collaborating authors to the (parts of the) courseware they are specialists in and responsible of. The author must be able to specify if the course will still be modified or is finished.

8.1.2 Strategy Creator: Creating or Reusing Behaviour for Adaptive Educational Hypermedia

The main character is the author, an educational specialist that has a lot of knowledge and understanding about pedagogy and educational strategies, but does not necessarily understand the domain on which

his knowledge is going to be applied on. He is asked to do this job by an institute offering educational services or a corporation wishing to train their employees on one or more specialty topics in an adaptive way. He is creating this adaptive behaviour for material that will be or is already connected to a portal, such as the PROLEARN portal, or to an adaptive web service offered via the PROLEARN portal, or offline by himself. For dealing with the emerging restrictions and specifications, he needs some help – e.g. in the form of prior training or (frame-based) authoring system with help facility.

This author has to be able to transform a teaching strategy in terms of meta-data needed and rules. It means that his specifications give the definition space for the author creating content. This also means that he might need support or training to achieve the expertise needed for transforming educational ideas into machine-readable information. The author has to tag the created behaviour descriptions with natural language descriptions that are understandable for the content author.

Finally, the author might be collaborating with other authors on his task, although to a lesser degree than the content author. The system has to be able to support this feature, by allowing at least access to the group of collaborating authors to the (parts of the) courseware behaviour they are specialists in and responsible of. The author must be able to specify if the course behavior will still be modified or is finished.

8.2 Author Use Cases

Title: <i>Search for Authoring Assignments</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actors: <i>Author, System (PROLEARN portal), (indirectly: corporations, other authors)</i>
Task: <i>Try and find an appropriate authoring task corresponding to the author's expertise (also possible: timeframe and preferences).</i>
Input: <i>Expertise, timeframe, preferences</i>
Actions: <i>The author logs in and performs a query about the desired authoring task (input). He can refine the query.</i>
Output: <i>The outstanding authoring tasks corresponding to the author's input are listed</i>
System support: <i>The system has a log-in facility for authors. The system stores data on the existent authoring tasks from corporation, as well as meta-data on it (such as expiry date). The system allows registered authors queries on this data.</i>

Title: <i>Bid for Authoring Assignments</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Author, System (PROLEARN portal), (indirectly: corporations, other authors)</i></p> <p>Task: <i>Author offers his/her services for the Authoring tasks s/he is interested in.</i></p> <p>Input: <i>Selected Authoring task, also: Expertise, timeframe, preferences</i></p> <p>Actions: <i>The author selects a specific authoring task from a list offered by the system and adds his input on it.</i></p> <p>Output: <i>The bid is registered, together with the extra information on the author, in order for the corporation to see existing offers.</i></p>
<p>System support: <i>The system allows selection of authoring tasks and registers this action in the form of Author task, Author identification and Author input.</i></p>

Title: <i>Export course material</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: <i>Author, System (PROLEARN portal)</i></p> <p>Task: <i>The author has finished a course that s/he wants to publish via the PROLEARN portal.</i></p> <p>Input: <i>Course with appropriate meta-data</i></p> <p>Actions: <i>The author accesses the PROLEARN portal and selects the course export facility. The course is uploaded and verified for consistency with PROLEARN format and completeness. The author specifies the beneficiary/beneficiaries of this course.</i></p> <p>Output: <i>The author receives a notification that the course is successfully uploaded, or information on what data is missing or what is wrong with the formats. If the upload is successful, the course is stored on the portal with the appropriate metadata (author identification, creation time, beneficiary). The beneficiary is informed.</i></p>
<p>System support: <i>The portal has to provide an uploading and verification facility, as well as the notification/ reporting facility. The system has to manage access rights.</i></p>

Title: Update course material

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors:

Author, System (PROLEARN portal)

Task:

The author wants to modify or extend a course s/he has uploaded, or a course to which s/he has modification rights.

Input:

New data for the course; information about material/data to be deleted.

Actions:

The author accesses the PROLEARN portal and selects the course to be modified. The author uploads the new material or selects material to be deleted.

Output:

The course is updated accordingly on the server. The author receives a notification, as well as the beneficiary.

System support:

The system has to provide support for selection of the course to be modified, as well as the material to be deleted or added. The system has to manage access rights and handle notifications.

Title: Search for related course material

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors:

Author, System (PROLEARN portal)

Task:

The author wants to create a new course without re-writing everything from scratch. He wants to reuse existing material that is available (according to his/her access rights).

Input:

Query on topic, keywords.

Also: Author profile (expertise, timeframe, preferences, and access rights).

Actions:

The author accesses the PROLEARN portal and queries the system about the material s/he's looking for. The author can refine the query. The author accesses the retrieved information for reuse (by copying it into the used authoring system, or by pointing to it via references).

Output:

The portal provides a list of related courses, and more specifically, related topics within those courses.

System support:

The system should be able to support queries on the existing stored material, or to forward queries to repositories outside, considering the given access rights. The system should be able to visualize the retrieved information, and to provide access to it. The system should support copying the information or pointing to it.

Title: Export course behaviour

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors:

Author, System (PROLEARN portal)

Task:

The author has finished a course behaviour description (strategy) that s/he wants to publish via the PROLEARN portal.

Input:

Strategy with appropriate meta-data

Actions:

The author accesses the PROLEARN portal and selects the strategy export facility. The strategy is uploaded and verified for consistency with PROLEARN format and completeness. The author specifies the beneficiary/beneficiaries of this strategy.

Output:

The author receives a notification that the strategy is successfully uploaded, or information on what data is missing or what is wrong with the formats. If the upload is successful, the strategy is stored on the portal with the appropriate metadata (author identification, creation time, beneficiary). The beneficiary is informed.

System support:

The portal has to provide an uploading and verification facility, as well as the notification/ reporting facility. The system has to manage access rights.

Title: Update course behaviour

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors:

Author, System (PROLEARN portal)

Task:

The author wants to modify or extend a course behaviour description (strategy) s/he has uploaded, or one to which s/he has modification rights.

Input:

New data for the strategy; information about material/data to be deleted.

Actions:

The author accesses the PROLEARN portal and selects the strategy to be modified. The author uploads the new material or selects material to be deleted.

Output:

The strategy is updated accordingly on the server. The author receives a notification, as well as the beneficiary.

System support:

The system has to provide support for selection of the strategy to be modified, as well as the material to be deleted or added. The system has to manage access rights and handle notifications.

Title: <i>Search for appropriate course dynamics/ behaviour</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: Author, System (PROLEARN portal)</p> <p>Task: The author wants to create a new course behaviour description (strategy) (for a given course or not) without re-writing everything from scratch. He wants to reuse existing material that is available (according to his/her access rights).</p> <p>Input: Query on educational goal, adaptive strategy type, name, keywords. Also: Author profile (expertise, timeframe, preferences, and access rights).</p> <p>Actions: The author accesses the PROLEARN portal and queries the system about the strategy s/he's looking for. The author can refine the query. The author accesses the retrieved information for reuse (by copying it into the used authoring system, or by pointing to it via references).</p> <p>Output: The portal provides a list of related strategies and provides access to them according to the access rights.</p>
<p>System support: The system should be able to support queries on the existing strategies, or to forward queries to repositories outside, considering the given access rights. The system should be able to visualize the retrieved information, and to provide access to it. The system should support copying the information or pointing to it.</p>

8.3 General Portal Requirements

As a consequence of the discussion on the above scenario some general PROLEARN portal requirements and issues were identified. The PROLEARN portal is supposed to integrate various applications, among others, also various authoring tools. The portal itself will not provide authoring as such, but will be used for the connection and exchange of information between these various tools, including connections between different authoring and learning environments, in an “write once, use many” approach [3]. For this purpose, its functionality will be that of a wrapper over these tools. The resulting requirements are listed below, grouped on major categories.

R1 Authoring Environment Wrapper

Description: The PROLEARN portal has to provide a wrapper around the existing authoring applications that provides some extra functionality, especially with respect to export of material to the portal and collaboration.

R1.1 Information search and browse

Description: The author has to be able to search via the PROLEARN portal for:

- Material created by other authors
- Adaptive behaviour specifications created by other authors

R1.2 Recommender and help

Description: The PROLEARN portal should be able to recommend to an author:

- Tool recommender: what authoring tool to use, or a list of tools
- Compatibility recommender: what tools are directly compatible with the end-delivery system, what authoring tools are known to be compatible
- Design method recommender: what design method to use, in order for the information to be exportable

R1.3 Information kiosk

Description: The PROLEARN portal should provide easy access to other relevant information for the authoring process, the given topic, the goals envisaged, the collaborating colleagues.

R2 Environment Information Exchange

Description: The PROLEARN portal description should provide:

- Intermediate portal format for exchange between authoring environments, or authoring environments and learning environments
- State notification mechanism, for notifying what information is exchanged in which particular state (especially finished/ work in progress)

R3 Author

Description: The PROLEARN portal should record information on:

- Author profile
- Activity history

This information should be available to inspection by the Author, as well as other authorized users.

R4 People

R4.1 People search and browse

Description: The PROLEARN portal should provide functionality for the author to find:

- Authors working on similar topics
- Authors working on related topics

R4.2 Interaction support

Description: The PROLEARN portal should provide:

- Discussion forum for authors, to exchange information about their authoring
- Bidding forum for author tasks (to connect providers and consumers)

8.4 Authoring Environment Interfacing Requirements

As the goal is to be able to integrate as many as possible different types of authoring systems, there are no direct requirements about the systems' internal processing. However, in order to interface efficiently with the portal, other authoring systems and other learning systems for collaboration or (re)use of finished courses, the authoring systems have to provide information in the exchange format specified by the portal.

R5.1 Data Type

Description: The exported material should be of a type allowed by the portal or web service (only if portal is used).

R5.2 Data Format

Description: The format / description / metadata / meta-tagging of this material should correspond to the one allowed by this portal / web service or by the target portal (in the case the material is created offline initially).

R5.3 Data Granularity

Description: The granularity of the material should be of the size allowed/ recommended by the (target) portal / web service.

R5.4 Behaviour (Strategy) Type

Description: The exported behaviour should be of a type allowed by the portal or web service (only if portal is used).

R5.5 Behaviour (Strategy) Format

Description: The format/ description/ metadata/ meta-tagging/ description language of this behaviour should correspond to the one allowed by this portal/ web service (or to the one allowed by the target portal).

8.5 Portal User Interface Requirements

At this stage, the user interface requirements are not definitive, as they should reflect the combination and consolidation of all requirements for all roles identified. However, beside the obvious and general requirements that hold for any user interface, the following requirements/ guidelines can be identified.

R6.1 Interface Functionality

Description: The PROLEARN portal user interface for authoring should provide easy user access to all the functionality specified in the General portal requirements.

R6.2 Visualization

Description: The PROLEARN portal should provide appropriate visualization tools and mechanisms for making the decision and search process easier.

8.6 Authoring Environment Requirements

An authoring application connected to the PROLEARN portal that creates adaptive learning material has to be able to fulfil some general requirements, besides the interfacing to the portal. The following requirements are based on [4][5][6][7][8] and are slightly adjusted for the PROLEARN objectives based on [1]. They should be seen as orientation rather than as restrictions.

8.6.1 Functional Requirements

R7 Manipulation of learning objects

Actor: Learning object designer

R7.1 Insertion of learning objects and their associated metadata

Description: The learning objects (LO) designer will insert LO content and its metadata according to the structure defined in the application data schema. Content insertion is tackled according to navigation mechanisms defined within the application hypertext. The management of relationships among LOs is also supported.

R7.2 Deletion of LO and associated metadata

Description: The application provides a function for deleting LOs and their metadata. The application also ensures that relations between LOs are not violated when a request for deletion is issued. The consistency should be ensured according to constraints put on the LOs database.

R7.3 Modification of LO and associated metadata

Description: The LO designer will be able to modify inserted LOs, their metadata and relations to other LOs. The LOs modification will be supported by navigation utilities designed for the modification.

R7.4 Export of LO metadata

Description: A LO manipulation tool will provide an export of metadata in particular format suitable for applications for sharing and exchanging LOs.

R8 Learning objects classification

Actor: Learning object designer / domain specialist

R8.1 Insertion of LO categories

Description: The LO designer will be able to insert a category into a taxonomy for LOs. A graphical interface for presenting such taxonomy will allow the designer to keep an overview over existing entries (e.g. through hierarchical indexes).

R8.2 Deletion of LO categories

Description: The LO designer will be able to delete a category in taxonomy. The system will ensure consistency by checking referencing and referenced entries from the taxonomy being deleted.

R8.3 Modification of LO categories

Description: The LO designer will be able to modify the existing categories. The system will ensure consistency of taxonomy especially when modifying relations between taxonomy entries.

R8.4 Import of existing taxonomies

Description: LO designer should benefit from existing taxonomies (e.g. <http://www.acm.org/class/1998>). The system will allow him to import existing taxonomies from particular format.

R8.5 Export of modified taxonomies

Description: LO designer will be able to export modified taxonomy to particular format needed in tools for sharing taxonomies, LOs and metadata. Such a format might be a classification category of LOM and its XML or RDF bindings.

R8.6 LO assignment to LO categories

Description: LO designer will be able to assign LOs to several categories. A graphical tool will help him to keep overview of already assigned categories.

R8.7 LO removal from LO categories

Description: LO designer will be able to remove LOs from a category.

R9 Learning path definition

Actor: Path designer / educational specialist

R9.1 LO Selection

Description: A SME (small and medium enterprise) author will be able to select learning objects needed for a particular learning path according to several conditions based on metadata schema provided.

R9.2 Adaptation Rules Specification

Description: A SME author will be able to associate accessibility rules for learning objects within the learning path to provide adaptation based on a learner profile.

8.6.2 Architectural Requirements

A *template-based* approach can be adopted: each page of the application publishing dynamic content is mapped to a page template, which includes the static mark-up of the page, plus server-side scripting instructions. In particular, a Model-View-Controller (MVC) architectural pattern [6] can be adopted for separating and insulating better the three essential functions of an interactive application: the business logic (the *Model*), the interface presented to the user (the *View*), and the control of the interaction triggered by users' actions (the *Controller*). Client side extensions need to be provided for managing client-side adaptation. The client side adaptation provides a possibility to maintain the user profile on the client side to reflect privacy requirements and is able to better shape context and environment of a user.

R10 Business Logic

The business logic of the application (page computation and operation execution) must be separated into the Model, which incorporates the business logic action that update the state of the application and produce a result (the page) to be communicated to the user through the presentation layer).

R11 User interface

The user interface presented to a user is separated into the View. The change in the Model triggers the most appropriate View, which builds the presentation of the response. Such a presentation typically embodies interaction objects, whereby the user may pose a new request and reactivate the computation process. In the Web context, the original MVC is adapted to take into account the peculiarity of HTTP as a client-server protocol.

R12 Control

The control of the interaction triggered by user actions is separated into the Controller. In the MVC architecture, the computation is activated by a user's request for some content or service. The Controller intercepts the request and decides which action should be performed for servicing it. The Controller dispatches the request, in the form of a request for action, to the suitable component of the Model.

8.6.3 Design Methods Requirements

R13 Designing hypertext for LO management and fruition

Actor: Web designer

Description: Web Designers use a conceptual model, for specifying the design of the vertical (data organization and hypertext composition) at a high-level of abstraction, independently from implementation details. In the following, WebML (Web Modeling Language) will be used as the reference conceptual model. More detailed descriptions of the WebML method can be found in [6][7].

R13.1 Data Modelling

Description: Through this activity, the Web designer produces a *data schema* representing the organization of contents to be published in the application hypertext. Well-known notations for data modelling are used, such as the E-R model, or UML class diagrams. The application data schema specifies the main information entities, corresponding both to LOs contents and metadata, as well as any other data to be dynamically displayed in the application hypertext. It also specifies relationships holding between LOs, such as generalization/specialization, prerequisite and part/whole relations.

R13.2 Composition Modelling

Description: Once the data schema is in place, the designer proceeds with composition modelling, for defining the way data must be published within the hypertext pages. In particular, composition modelling specifies the composition of atomic content units (*units* for short) within pages. In a concrete setting, e.g., an HTML implementation of a WebML application, pages are then mapped to suitable constructs in the delivery language, e.g. to HTML pages. While performing composition modelling, the designer can make use of some WebML primitives, as reported in the following:

- **Data unit.** It can be used to publish a single object of a given entity. More than one data unit can be defined for the same entity, to offer alternative points of view (e.g., a short text or a long text, a textual or a multimedia version of the instance, etc.). The definition of a data unit requires the specification of:
 - 1) A *source entity*, i.e. the entity providing the content to the unit
 - 2) A *selector*, i.e., a predicate identifying a unique object to be displayed by the data unit
- **Multi-Data unit.** It can be used to present multiple objects of an information entity together, repeating the presentation of several, identical data units. The definition of a multi-data unit requires the specification of:
 - 1) A *source entity*, i.e. the entity providing the content to the unit
 - 2) A *selector*, i.e., a predicate identifying the objects to be displayed by the multi-data unit
- **Index unit.** It presents multiple objects of an information entities as a list, by denoting each object as an entry in the list. The definition of an index unit requires the specification of:
 - 1) A *source entity*, i.e. the entity providing the content to the unit
 - 2) A *selector*, i.e., a predicate identifying the objects to be displayed by the multi-data unit
- **Scroller unit.** It provides commands to scroll through the objects in a container, e.g., all the instances of an entity or all the objects associated to another object via a relationship. A scroller unit is always used in conjunction with a data unit or a multi-data unit, which represent the currently visualized elements of the container. The definition of a scroller unit requires the specification of:
 - 1) A *source entity*, i.e. the entity providing the content to the unit
 - 2) A *selector*, i.e. a predicate identifying the objects scrolled by the unit
 - 3) A *block factor*, i.e. the number of objects that are scrolled together
- **Entry Unit.** It provides a form for data-entry, and is used for gathering input typically employed for performing searches or supplying parameters to operations like content updates, login, and external services. The definition of an entry unit requires the specification of the set of *fields* for inputting values.
- **Pages.** The granularity of units may be too fine for the composition requirements of an application, which normally demands that the information contained in several units be delivered together. A *page* is the abstraction of a self-contained region of the screen, which is treated as an independent interface block (e.g., it is delivered to the user independently and in one shot). Pages may be internally organized into several units, grouped together to accomplish a well-defined communication purpose. Pages can be characterized by the following properties:

- *Home Page*: this property denotes the hypertext Home Page. Only one page can be marked as Home Page.
- *Landmark Page*: it denotes that the page is reachable from any other page in the hypertext.

R13.3 Navigation modelling

Neither pages nor units exist in isolation, because real-world hypertexts are made of connected pages, which contain several interrelated pieces of content and commands permitting the user to interact with the application. To express these features, pages and units can be linked, to specify the allowed navigation paths between pages, the selections offered to the user, and the effect of the user's interaction on the content of the units displayed in the page. Navigation modelling therefore deals with the specification of the links between units and pages, and of the properties of such links. The central notions of navigation modeling are the concepts of *link*, *link parameters*, and *parametric selectors*:

- A *link* is an oriented connection between two units or pages.
- A *link parameter* is the specification of a piece of information, which is transported from the source to the destination of the link.
- A *parametric selector* is a unit selector whose predicates contain a reference to a link parameter.

As reported in the following, links can be of different types.

- **Contextual links.** They connect two content units and carry some information (called context) from the source unit to the destination unit. Context is used to determine the actual object or set of objects to be shown in the destination unit.
- **Non-contextual links.** They connect pages, without transporting any contextual parameter. They just represent user navigation from one page to another one.
- **Transport links.** They are used only for parameter passing, and do not enable user navigation.
- **Automatic links.** They represent links that can be navigated in absence of user interaction, when the page that contains the source unit of the links is accessed.

R13.4 Content Management Modelling

It deals with the specification of operations for content management. WebML provides a number of built-in operations for:

- Object **creation**, **deletion** and **modification**, for managing instances of entity defined in the application data schema;
- Relationship **creation** and **deletion**, for managing instances of relationship defined between entities in the application data schema.

R14 Designing personalized navigation over LOs

Actor: Personalized curricula designer / strategy author

Description: Personalized curricula designer specifies guides over learning objects/web content independently from implementation details. The personalized curricula is created from the vertical specified by previous steps. In the following, The UML-Guide will be used as the reference conceptual model. More detailed descriptions of the UML-Guide method can be found in [1, 2].

R14.1 Designing user learning step/state

Description: Learning step usually refers to concepts of an application domain; thus, they can correspond to the above mentioned generic pages or page units, which enable the viewing of the information entities.

R14.1.1 designing simple step

Description: Curricula designer will be able to identify a simple learning step considered in a SME based on concepts or competencies exposed as learning objectives of that learning object.

R14.1.2 designing composite step

Description: Curricula designer will be able to group learning steps into higher level steps considered in a SME.

R14.2 Designing simultaneously presented objects

Description: Curricula designer will be able to design which learning steps will be presented simultaneously and will be provided with primitives for synchronization of those steps.

R14.3 Designing transitions between steps

Description: Curricula designer will be able to connect the learning step to a learning path at both levels: simple and also composite learning step. He will be able to assign events which will raise the transitions between learning states and will be able to constrain them with constraints which determine which links will appear to user and which not (*adaptive navigation*).

R14.4 Designing user actions

Description: Curricula designer will be able to assign additional actions to transitions and/or states for additional adaptation operations (*adaptive content presentation*), updates of learner profiles, and update of further learning sequence.

R14.5 Designing adaptive strategies

Description: Curricula designer will be able to create more complex sequences of adaptive behaviour appropriate for a specific learning style, instructional strategy or learner preference model. These should be able to be exported to the PROLEARN portal.

R14.6 Connecting personalized navigation model with generic one

Description: Curricula designer will be able to assign the learning steps to generic navigation units, competencies and concepts used in a customized e-learning application.

R14.7 Designing learner profile schema**R14.7.1 Designing classes of information to be maintained in learner profile**

Description: Curricula designer will be able to provide structures which will be used for storing learner data. Typical examples of learner data are competencies, concepts learned, certificate earned, learning goals, and so on.

R14.7.2 Designing relations between classes of information used to maintain information about a learner

Description: Curricula designer will be to connect those structures by relations. Typical example is a relation of a certificate to a competence acquired.

R15 Designing presentation profiles

Actor: Personalized curricula designer / strategy author / content author

Description: Personalized curricula designer should be able to select / design some alternative presentation formats for a specific course or for a general profile. These profiles should be used in the delivery platform together with the learner model in order to specify the best presentation format corresponding to a specific user.

8.6.4 Development Tools Requirements**R16 Code generator**

Description: The code generator should be based on a modular software architecture, where each aspect of the application logic is as isolated as possible. In particular, the presentation, business, and data extraction and manipulation logic should remain separated and be independently evolvable.

R17: Separation between code generation and presentation management

Description: The part of the presentation dealing with the graphical aspects of the pages (like the overall page layout, static texts and images, CSS styles, and so on) and client-side processing (like input validation) should be factored out of the code generation process, and editable by a non- technical graphic designer.

R18 Separation between code generation and data extraction

Description: The data extraction and manipulation queries should also be factored out of the code generation process and from the implementation code, so that the data expert should be able to override the system-generated queries, both in the design stage and after the application is deployment.

R19 Scalability of code generation

Description: The design and code generation process should scale to thousands of dynamic page templates and hundred of thousands database queries. In these contexts, applying presentation styles

and client- side logic to page templates manually is unfeasible, and these features should be applied automatically in a bulk manner.

R20 Performance of Web applications

Description: The generated code should perform and scale well, and comply with the requirements of Web caching architectures, especially those for caching dynamic page templates. In the remainder of this paper, we address each of these problems and the solution adopted in WebRatio; the design principles that will be discussed are indeed very general, as they apply to arbitrarily designed Web applications (including those which are manually coded) and to any Web development environment supporting a clear separation between data extraction, business logic, and presentation.

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9 System Administrator

This section contains a set of scenarios for the *system administrator* user. The scenarios are grouped in three groups:

- User management scenarios
- Platform management scenarios
- Content management scenarios

9.1 Scenarios and Use Cases

In each section there is a grand scenario followed by a use case diagram for the grand scenario and the individual scenarios.

Category	Grand Scenario	Scenarios
User Management	Grand Scenario for User Management Facility	<ul style="list-style-type: none"> • Creation of an corporate user account • Setting user rights • Creating Different Types of Users
Platform Management	Grand Scenario for Platform Management Facility	<ul style="list-style-type: none"> • Setting New Language for Graphical User Interface • Managing The Local Settings • Differentiating The Visibility of The Portal Using Themes • Differentiating the Portal Main Page • Log Management
Content Management	Grand Scenario for Content Management Facility	<ul style="list-style-type: none"> • Making the content invisible for all users or a set of users • Learning Modules Management • Defining Resource Types

9.1.1 User Management

Title: <i>Grand Scenario for User Management Facility</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actor/Role: Admin1 as the system administrator of PROLEARN Portal; Corporate1 as the corporate user, CorporateAdmin1 as the PROLEARN administrator of Corporate1, ContentCreator1 as a content creator user, ContentValidator1 as content validator user, Facilitator1 as facilitator user.</p> <p>Goal/Task: To create a new corporate user account, assigning a PROLEARN administrator to the corporate user, managing the users' permissions, creating users with different roles.</p> <p>Input/Resources: PROLEARN portal</p> <p>Actions: A new company, Corporate1, form Turkey is to be registered to PROLEARN portal. Admin1 logs-in to the portal using his username and password and clicks to "Create Corporate User" link under "User Management" menu. Admin1 assigns "TR_CORP01" as the ID to Corporate1 and enters some preliminary information about Corporate1 such as Name, Country, Activity Type, Legal Status and Industry. Admin1 enters "TBD" for the fields which are yet to be determined and also sets these fields "to be filled by corporate admin at first logon". Admin1 then assigns a termination date of 01.01.2006 for the account so making sure the account will be disabled in the first day of 2006.</p> <p>Admin1 then click to "Permissions" tab and check "Prevent this user to access any resource but the following" checkbox, unchecking the "Allow this user to access all resources but the following" checkbox and selects E-Business resources. This will allow Corporate1 to access only to E-Business resources on the platform. Admin1 authorizes CorporateAdmin1 to change permission settings on an individual basis.</p> <p>Admin1 then opens the individual users list to assign CorporateAdmin1 as a corporate admin to Corporate1. Admin1 realizes that CorporateAdmin1 is not in the list of individual users so clicks "Add Individual User" link. Admin1 enters "Corporate1Admin" as the ID for new user and enters her name, surname and e-mail address. System assigns a password for the new user and sends an e-mail to CorporateAdmin1. Now CorporateAdmin1 is in the list of individual users. Admin1 simply assigns CorporateAdmin1 as the corporate admin of Corporate1. System sends a new e-mail to CorporateAdmin1 informing her that she is the corporate admin of Corporate1.</p> <p>Admin1 then selects CorporateAdmin1 from the users menu and clicks "Permissions" button to see the current rights of CorporateAdmin1 on PROLEARN portal. As CorporateAdmin1 is the corporate administrator of Corporate1, Admin1 gives him the right to create individual users for Corporate1 and right to assign their user rights within the general rights of Corporate1. Admin1 then permits CorporateAdmin1 to modify the personalized front page for Corporate1, create learning sets, manage tasks and manage calendar.</p> <p>Admin1 clicks to "Create Individual User" link under "User Management" menu. Admin1 selects user type as Content Creator. Admin1 enters Name, Surname, e-mail address and Organization of ContentCreator1 and leaves other as TBD and marks these fields as to be filled by user at first login. A password for the new user is created by the system and an e-mail is sent to the new user again by the system.</p> <p>Admin1 then does the same operation to create a content validator user, ContentValidator1 and a facilitator user Facilitator1. The rights and options of the new users are set as default values for each user type and these rights can be modified anytime at the individual user level.</p> <p>Result: New corporate user account created, new individual users with different roles are created and user permissions are set at individual and corporate levels.</p>
System support: User Management Facility

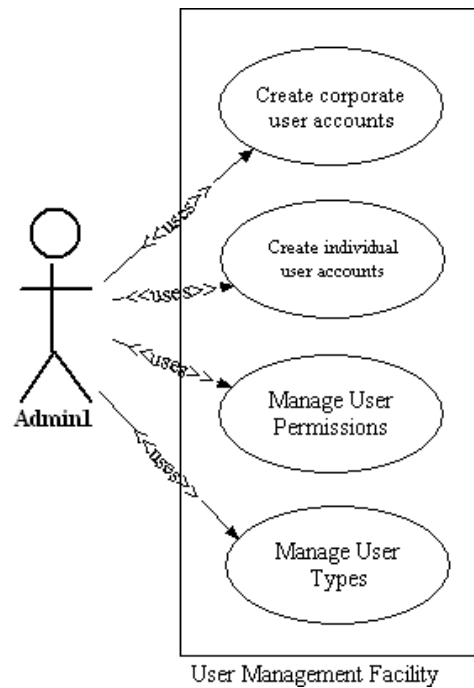


Figure 1. Use Case Diagram for User Management Facility

Title: <i>Creation of an corporate user account</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor/Role: <i>Admin1 as the system administrator of PROLEARN Portal; Corporate1 as the corporate user, CorporateAdmin1 as the PROLEARN administrator of Corporate1.</i>
Goal/Task: <i>To create a new corporate user account.</i>
Input/Resources: <i>PROLEARN portal;</i>
Actions: <i>A new company, Corporate1, form Turkey is to be registered to PROLEARN portal. Admin1 logs-in to the portal using his username and password and clicks to "Create Corporate User" link under "User Management" menu. Admin1 assigns "TR_CORP01" as the ID to Corporate1 and enters some preliminary information about Corporate1 such as Name, Country, Activity Type, Legal Status and Industry. Admin1 enters "TBD" for the fields which are yet to be determined and also sets these fields "to be filled by corporate admin at first logon". Admin1 then assigns a termination date of 01.01.2006 for the account so making sure the account will be disabled in the first day of 2006.</i>
<i>Admin1 then click to "Permissions" tab and check "Prevent this user to access any resource but the following" checkbox, unchecking the "Allow this user to access all resources but the following" checkbox and selects E-Business resources. This will allow Corporate1 to access only to E-Business resources on the platform. Admin1 authorizes CorporateAdmin1 to change permission settings on an individual basis.</i>
<i>Admin1 then opens the individual users list to assign CorporateAdmin1 as a corporate admin to Corporate1. Admin1 realizes that CorporateAdmin1 is not in the list of individual users so clicks "Add Individual User" link. Admin1 enters "Corporate1Admin" as the ID for new user and enters her name, surname and e-mail address. System assigns a password for the new user and sends an e-mail to CorporateAdmin1. Now CorporateAdmin1 is in the list of individual users. Admin1 simply assigns CorporateAdmin1 as the corporate admin of Corporate1. System sends a new e-mail to CorporateAdmin1 informing her that she is the corporate admin of Corporate1.</i>
Result: <i>New corporate user account created</i>
System support: <i>User Management Facility</i>

Title: Setting user rights
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actor/Role: Admin1 as the system administrator of PROLEARN Portal; Corporate1 as the corporate user, CorporateAdmin1 as the PROLEARN administrator of Corporate1</p> <p>Goal/Task: To configure user rights.</p> <p>Input/Resources: PROLEARN portal;</p> <p>Actions: Admin1 logs-in to the portal using his username and password and clicks to “Individual Users” link under “User Management” menu. Selects CorporateAdmin1 from the users menu and clicks “Permissions” button to see the current rights of CorporateAdmin1 on PROLEARN portal.</p> <p>As CorporateAdmin1 is the corporate administrator of Corporate1, Admin1 gives him the right to create individual users for Corporate1 and right to assign their user rights within the general rights of Corporate1.</p> <p>Admin1 then permits CorporateAdmin1 to modify the personalized front page for Corporate1, create learning sets, manage tasks and manage calendar.</p> <p>Result: User rights for CorporateAdmin1 are assigned.</p>
<p>System support: User Management Facility</p>

Title: Creating Different Types of Users
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actor/Role: Admin1 as the system administrator of PROLEARN Portal; ContentCreator1 as a content creator user, ContentValidator1 as content validator user, Facilitator1 as facilitator user</p> <p>Goal/Task: To create content creator, content validator and facilitator users.</p> <p>Input/Resources: PROLEARN portal;</p> <p>Actions: Admin1 logs-in to the portal using his username and password and clicks to “Create Individual User” link under “User Management” menu. Admin1 selects user type as Content Creator. Admin1 enters Name, Surname, e-mail address and Organization of ContentCreator1 and leaves other as TBD and marks these fields as to be filled by user at first login. A password for the new user is created by the system and an e-mail is sent to the new user again by the system.</p> <p>Admin1 then does the same operation to create a content validator user, ContentValidator1 and a facilitator user Facilitator1. The rights and options of the new users are set as default values for each user type and these rights can be modified anytime at the individual user level.</p> <p>Result: New user accounts created.</p>
<p>System support: User Management Facility</p>

9.1.2 Platform Management

Title: *Grand Scenario for Platform Management Facility*

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors/Roles: *Sa1 as the system administrator*

Task: *To set up different interface options and general portal management*

Input/Resources: *System administrator's configuration interfaces and different language strings database.*

Actions:

Sa1 logs in to the system with his/her own username and password and gain access to the configuration panel of the Pro Learn portal.

In the configuration panel, Sa1 can reach to various configuration interfaces. In these interfaces, Sa1 can manage multi-language settings, local – regional settings, configuration of portal themes, management of portal main page and configuration of logging settings.

In the language configuration panel, Sa1 sets up the default language in various levels such as the whole system, for a specific company site or for a specific course module and setting / modifying the language strings database. System administrator can add / remove language databases and also edit the strings in the specific language database.

Using the local settings page, Sa1 can manage local settings rules of the portal in many levels. The local settings rules set consists of number formats, currency formats, date – time displaying formats etc.

PROLEARN Portal users can change the visibility of their interfaces using different themes supplied by the system administration and personalize their own interfaces in terms of visualization. System administrator has an interface to define default themes for each module of the portal and also create new themes.

To manage the content published in the main page, system administrator uses the “main page configuration page” where he can add an introductory text, or define news or general announcements to be published on the main page in different formats.

System administrator is the only user who can manage the logging mechanism of the portal. Other users like teachers, site administrators or facilitators can obviously view parts of the logs saved by the system, but only system administrator can decide which functions of the portal is going to be logged and in which detail.

Results:

Sa1 changes the visual interface, regional settings and multiple language options using his/her management interfaces and also defines certain rules for logging mechanisms.

System support: *Management and configuration interfaces for each facility.*

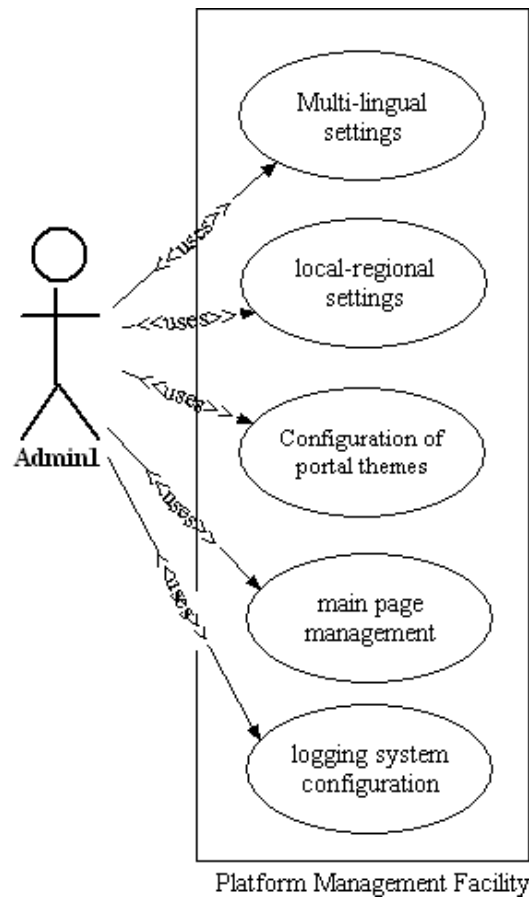


Figure 2. Use Case Diagram for Platform Management Facility

Title: *Setting New Language for Graphical User Interface*

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors/Roles: *Sa1 as the system administrator*

Task: *To set up different language options for the graphical user interfaces*

Input/Resources: *System administrator's configuration interfaces and different language strings database.*

Actions: *Sa1 logs in to the system with his/her own username and password and gain access to the configuration panel of the PROLEARN portal. Sa1 just browses to the language configuration option and sets up the default language in various levels such as the whole system, for a specific company site or for a specific course module.*

Second functionality in the language setting is setting / modifying the language strings database. System administrator can add / remove language databases and also edit the strings in the specific language database. For example sa1 logs in to the system and opens the language database configuration page. Selects the "Turkish" string database and a list of strings existing in the database is shown. Sa1 selects the variable used for "Student" word in the database and changes the Turkish string with "Ogrenci" and saves the database. After this operation, in the Turkish version of the portal, each "Student" word will be displayed as "Ogrenci"

Results: *Sa1 adds / edits the language availability of the portal and manages the language support of the portal using the language management option.*

System support: *A different string database should be available for each language supported on the portal.*

Title: *Managing The Local Settings*

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors/Roles: *Sa1 as the system administrator*

Task: *To manage all local settings of the portal.*

Input/Resources: *System administrator's configuration interfaces.*

Actions:

Sa1 logs in to the system with his/her own username and password and gain access to the configuration panel of the PROLEARN portal. Using the local settings page, Sa1 can manage local settings in many levels. Sa1 can either set a general local setting rules set for whole portal, or override different local settings rules set for different courses or course groups. The local settings rules set consists of number formats, currency formats, date – time displaying formats etc.

Results:

Sa1 effects the visibility of the data represented in the portal which are subject to regional differences.

System support: *Local setting rules set should be defined and regional data represented in the portal should be differentiated based on those rules.*

Title: *Differentiating The Visibility of The Portal Using Themes*

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors/Roles: *Sa1 as the system administrator*

Task: *To manage visibility options of the portal using the theme manager.*

Input/Resources: *System administrator's theme management configuration interfaces.*

Actions:

PROLEARN Portal users can change the visibility of their interfaces using different themes supplied by the system administration and personalize their own interfaces in terms of visualization. System administrator has an interface to define default themes for each module of the portal and also create new themes. A simple theme editor is available to create new themes. This editor shows different types of elements having different visual attributes which are subject to change and using this editor, sa1 changes the colour, shape or fonts of each element and saves/publishes the theme to users.

Results:

Sa1 produces many colour, shape and font options to users for personalizing their interfaces in terms of visual representations.

System support: *All interfaces subject to personalization should support the theme management (using Cascaded Style Sheets is an option)*

Title: <i>Differentiating the Portal Main Page</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actors/Roles: <i>Sa1 as the system administrator</i>
Task: <i>To differentiate the main page of the portal (with news, different texts, announcements etc.)</i>
Input/Resources: <i>System administrator's main page configuration interfaces.</i>
Actions: <i>System administrator is the only user who is responsible for the main page of the portal. To manage the content published in the main page, system administrator uses the "main page configuration page" where he can add an introductory text, or define news or general announcements to be published on the main page in different formats (they can flash or slide)</i>
Results: <i>System administrator differentiates the most important page of the portal using the main page configuration interface and supplies texts or generic announcements (or maybe banner ads)</i>
System support: <i>Main page should be also developed in a dynamic parametric manner to support the dynamic content availability.</i>

Title: <i>Log Management</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actors/Roles: <i>Sa1 as the system administrator</i>
Task: <i>To manage the whole logging functionality of the whole activities held over the portal.</i>
Input/Resources: <i>System administrator's logging configuration interfaces.</i>
Actions: <i>System administrator is the only user who can manage the logging mechanism of the portal. Other users like teachers, site administrators or facilitators can obviously view parts of the logs saved by the system, but only system administrator can decide which functions of the portal is going to be logged and in which detail.</i> <i>For example sa1 logs in to the logging configuration interface and views the list of all functions which are subject to logging in the system. Sa1 for example selects the "Forums" function and clicks on this function and sees detailed information of the logging options of the Forums. He / she deselect the option "Save all messages sent to the forums" and select the option "Only save the messages of the last one month" and save this configuration. After this configuration, the system does not keep logging the forum messages which are older than one month.</i>
Results: <i>System administrator manages all logging functionality and effects the data logged in the system</i>
System support: <i>All modules should support the logging and also bound to this logging settings mechanism.</i>

9.1.3 Content Management

Title: *Grand Scenario for Content Management Facility*

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actor/Role: *Admin1 as the system administrator of PROLEARN Portal;*

Goal/Task: *To hide some of the learning resources from a group of users, to define resource types and to assign modules to resource types.*

Input/Resources: *PROLEARN portal; Content1 as learning resource*

Actions:

Admin1 logs-in to the portal using his username and password and clicks to “Show/Hide Resources” link under “Content Management” menu. Admin1 focus on Content1 and selects to hide it from all users. Admin1 could also delete the content from PROLEARN portal but in case Content1 to be needed later, he decided only to hide it.

Admin1 clicks to “Define a resource type” link under “Content Management” menu. Admin1 then types “Seminar” to the name field of the new resource type. Admin1 then selects from the list of modules which are applicable for seminar such as “Presentation”, “Forum” and “Questionnaire”. These modules can be edited any time using the Learning Modules Management interfaces.

Admin1 clicks to “Module Management” link under “Content Management” menu. From the Resource Types list Admin1 focuses to “Course”. The available modules list for course type of resource appears with current available items such as “Assignment, Forum, Chat”. Admin1 selects “Quiz” from the list of all modules and adds this item to the list making the Quiz module also available for course type of resources.

Result: *A specific resource is hidden from users, a new resource type is defined and modules are assigned to a specific resource type*

System support:

Content Management Facility

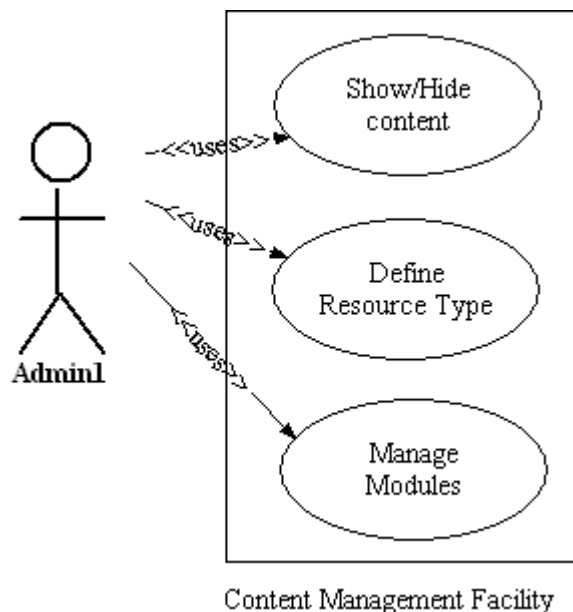


Figure 3. Use Case Diagram for Content Management Facility

Title: <i>Making the content invisible for all users or a set of users</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor/Role: <i>Admin1 as the system administrator of PROLEARN Portal;</i>
Goal/Task: <i>To hide some of the learning resources from a group of users.</i>
Input/Resources: <i>PROLEARN portal; Content1 as learning resource</i>
Actions: <i>Admin1 logs-in to the portal using his username and password and clicks to “Show/Hide Resources” link under “Content Management” menu. Admin1 focus on Content1 and selects to hide it from all users. Admin1 could also delete the content from PROLEARN portal but in case Content1 to be needed later he decided only to hide it.</i>
Result: <i>Resource is hidden from all users.</i>
System support: <i>Content Management Facility</i>

Title: <i>Learning Modules Management</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor/Role: <i>Admin1 as the system administrator of PROLEARN Portal;</i>
Goal/Task: <i>Assign a new learning module for a specific type of resource.</i>
Input/Resources: <i>PROLEARN portal;</i>
Actions: <i>Admin1 logs-in to the portal using his username and password and clicks to “Module Management” link under “Content Management” menu. From the Resource Types list Admin1 focuses to “Course”. The available modules list for course type of resource appears with current available items such as “Assignment, Forum, Chat”. Admin1 selects “Quiz” from the list of all modules and adds this item to the list making the Quiz module also available for course type of resources.</i>
Result: <i>Quiz module is made available for course type of resources.</i>
System support: <i>Content Management Facility</i>

Title: <i>Defining Resource Types</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor/Role: <i>Admin1 as the system administrator of PROLEARN Portal;</i>
Goal/Task: <i>Define a new resource type.</i>
Input/Resources: <i>PROLEARN portal;</i>
Actions: <i>Admin1 logs-in to the portal using his username and password and clicks to “Define a resource type” link under “Content Management” menu. Admin1 then types “Seminar” to the name field of the new resource type. Admin1 then selects from the list of modules which are applicable for seminar such as “Presentation”, “Forum” and “Questionnaire”. These modules can be edited any time using the Learning Modules Management interfaces.</i>
Result: <i>New resource type is introduced.</i>
System support: <i>Content Management Facility</i>

9.2 Functional Requirements

9.2.1 User Management Requirements

Managing corporate user accounts

Corporations should be defined to the portal as users. Each corporate user should have a unique ID. For a corporate user at least the following information should be stored:

- Organisation ID
- Organisation Name
- Country
- Activity Type (Industry, Research, Higher Education, etc.)
- Legal Status (Private, Public, Governmental, etc.)
- Industry (ICT, Chemicals, etc.)
- Number of Employees
- Address
- Phone
- Web Address
- PROLEARN Administrator (reference to individual users)
- Permissions on the portal

Managing individual user accounts

Individual users should be defined to the portal as users. Each individual user should have a unique ID. For an individual user at least the following information should be stored:

- User ID
- Name
- Surname
- Title
- Position in the organization
- Phone
- E-Mail
- Permissions on the portal

Managing user rights

For each corporate or individual user, very detailed permission settings should be done. The access permissions should be defined at resource level, resource type level and subject level. If there are no permission settings for an individual user, the settings for her organisation will be applied. So the other level approach is settings at organisation level and settings at an individual level. Some sample constraints are as follows:

- Subject Level
 - *CorporateA* can not access to resources but *Computer Engineering* resources
 - *CorporateB* can access to all resources but *Medicine* resources
 - *IndividualA* can not access to resources but *Management* resources
- Resource Type Level
 - *CorporateC* can access all resource types but *Map* resource type
 - *IndividualB* can not access to resources but *Book* resource type
- Resource Level
 - *CorporateD* can not access to *ArticleA*
 - *IndividualC* can access to *BookB*

Managing user types

Other than the corporate administrator and standard trainee type of users, special types of users such as content creator, content validator and facilitator user types should be introduced. User types apply to individual users. User type is not an attribute of the individual user but it is an attribute of a user together with a resource, a resource type or a subject. In other words an individual user may be a standard trainee for one subject whereas the same user may be a facilitator for another subject. Similarly an individual user may be a content creator of some resource type and a content validator for another resource type. The definitions of special user types are as follows:

- *Content Creator*: This type of users can upload resources to the portal with or without the approval of a content validator.
- *Content Validator*: For some of the resources to be available on the portal there will be the need of validation from this type of a user.
- *Facilitator*: for course type of learning, a facilitator will do management of a course.

The system administrator will do the assignment of user types to users and resources.

9.2.2 Platform Management Requirements

Multi lingual settings

- *Language Configuration Panel*, a sub-menu under the main configuraton panel, which includes links to language setting options
- Multiple-Language Strings Database for each language to support multi-language interfaces
- Configuration interfaces to support add-remove and update operations on the language strings databases

Local / Regional settings

- *Local-Regional Settings Panel* , a sub-menu under the main configuraton panel, which includes links to local settings options.
- Interfaces to support configuration of number formats, currency formats, datetime displaying formats within the portal.

Configuration of portal themes

- *Visual Configuration Page*, a sub-menu under the main configuraton panel, includes links to interface visibility settings.
- A theme editor to add, remove and update portal themes and supply portal users more theme options for personalization.

Main page management

- *Portal Main Page Configuration Page*, a sub-menu under the main configuration panel, which includes portal main page's configuration settings

Log management

- *Portal Log Settings Configuration Page*, a sub-menu under the main configuration panel, which includes portal's logging configuration settings

9.2.3 Content Management Requirements**Show/Hide Content**

- Some part or all of the content may be defined to be hidden for any purpose by the system administrator. Since deletion of the content will require reloading it in the case of needing it again such a facility will be useful.

Managing resource types

- The portal will support a variety of resource types such as articles, books, maps, etc. Each type of resources should be defined to the portal by the system administrator. The type of each resource will be defined by the content creator or the content validator users.

9.3 Non-Functional Requirements**9.3.1 Performance**

The performance of the clients in such web based software (considering system administrator as a privileged user who will access the system over the web just like other users of the system) mostly depends on the Internet connection speed of the server and the client. Therefore the Internet connection speed of the server should be appropriate regarding the number of expected simultaneous connections.

The hardware configuration of the server is another important issue which directly effects system performance. The hardware configuration of the server should also be appropriate regarding the expected load even in the near future.

Usually using different servers as the application server and the database server is a widely used architecture where the load of database issues and load of application issues are shared among two servers. This kind of architecture will positively affect the performance of overall system.

9.3.1 Security

Security leaks are major threads for web based applications. The system should be protected against all known security threads. Security issues are more critical for system administrator functions.

For a secure communication data cryptography solutions specific to web applications such as SSL, should be used. At the network level both the application server and the database server should be protected by a well configured firewall. Preventing direct access to the database server from the Internet is an effective measure for security.

At operating system level, a security configuration should be done and regularly in short periods security updates for the operating system should be installed. Servers should be protected against viruses with anti-virus software.

Using hardware solutions for data security like RAID will reduce the risk of data loss in a disk crash. Taking frequent backups of the data will also be necessary.

9.3.2 User Friendliness

User friendliness is also an important requirement even for the system administrator. Although the familiarity level of the system administrator on computer literacy and web based systems is expected to be high, the style and architecture of all functions should be consistent and clear. There should also be batch features for bulk operations. User friendliness is more important when it comes to the end users.

10 Evaluation of Adopted Methodologies

For the purpose of this deliverable WP1 partners have been required to follow a workflow model comprising two major tasks:

- generating user scenarios and use cases for each of the five main roles (i.e., Author, Learner, Instructor, Training Manager, and System Administrator)
- deriving different requirements from the obtained results

There exist various methodologies for fulfilling these two tasks. It is intriguing to identify which methodologies the partners have selected and how have they applied them. A small-scale questionnaire (see Appendix) has been developed to collect the information required, which can serve as references for the subsequent work of WP1. Six partners who have actively been involved in preparing the role descriptions are the respondents of the questionnaire.

10.1 Developing User Scenarios and Use Cases

First two questions deal with user scenarios and use cases. The responses are summarized in Table 1.

Table 1: Methodologies for developing user scenarios and use cases

Role	Personnel	Methodologies	Implementation
Author (1)	3 academics	<ul style="list-style-type: none"> ▪ Focus groups ▪ Transfer of experiences from other projects ▪ Literature review 	<ul style="list-style-type: none"> ▪ Reuse and restructure results of analyses of authoring systems performed for the Minerva project ADAPT
Learner (1)	3 researchers with expertise in: <ul style="list-style-type: none"> ▪ Adaptive Hypermedia ▪ Web-based Information Systems ▪ Learning Applications 	<ul style="list-style-type: none"> ▪ Field observations ▪ Transfer of experiences from other projects, including AIMS, AHA!, SWALE, Topia, CHIME ▪ Literature review 	<ul style="list-style-type: none"> ▪ Adapting current experience in user modelling from the related projects to corporate setting ▪ Tackling different issues related to user model such as attribute-clustering; interaction options; visualization, interoperability
Author (2) Learner (2)	6 researchers with expertise in: <ul style="list-style-type: none"> ▪ Adaptive Hypermedia ▪ P2P ▪ Web Engineering ▪ Software Engineering ▪ Semantic Web ▪ User Modelling 	<ul style="list-style-type: none"> ▪ Transfer of experiences from other projects, including Web Design projects, ELENA, and some other industrial projects ▪ Literature review ▪ Scenario analysis 	<ul style="list-style-type: none"> ▪ Scenario-based analysis: translating from high-level descriptions of scenarios to concrete requirements ▪ Using experiences from other projects to better shape requirements from scenarios
Instructor	4 researchers with expertise in: <ul style="list-style-type: none"> ▪ e-learning ▪ usability ▪ information visualization 	<ul style="list-style-type: none"> ▪ Field observations ▪ Transfer of experiences from the project WINDS ▪ Literature review 	<ul style="list-style-type: none"> ▪ Scenario-based analysis ▪ Using experience from other projects ▪ Consulting a list of related publications
Training Manager	3 researchers in technology-enhanced learning	<ul style="list-style-type: none"> ▪ Structured interviews ▪ Questionnaire surveys ▪ Transfer of experiences from the project ELENA 	<ul style="list-style-type: none"> ▪ Deriving the requirements from the interviews and surveys conducted in five European countries, involving 21 organizations

System Administrator	3 experts in software engineering with experiences in UML and requirements engineering and familiarity with various application software	<ul style="list-style-type: none"> ▪ Focus groups ▪ Field observations ▪ Transfer of experiences from other projects, including TrainSEE and MEDFORIST, which use e-learning platform <i>Virtual Campus</i> and <i>Moodle</i>, respectively 	<ul style="list-style-type: none"> ▪ Forming a focus group of graduate students to identify functional requirements for personalized learning in agent-based systems ▪ Conducting field observations about the use of a course content management system ▪ Reexamining the functionality of the two e-learning platforms
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Interestingly, transfer of experiences from other projects is the common approach adopted by all the six partners. Such experiences are regarded as valuable and useful. Besides, most partners have derived user scenarios and use cases from actual interactions with potential users through structured interviews and field observations, which are likely to generate contextualized and valid data.

10.2 Translating Requirements into User Interface Design

The third question deals with different aspects of this particular topic. The findings are summarized in Table 2. Note, however, that the related work was only at its preliminary stage at the time the questionnaire was being administered. Further investigation of this work will be conducted later.

Table 2: Translating requirements into user interface design

Role	Model/Framework	Usability Requirement	Difficulties
Author (1)	n/a – preliminary state	General usability requirements are to be adjusted to the basic as well as specific functional requirements	Selecting the best visualization technique for the specific functionality (expected)
Author (2)	<ul style="list-style-type: none"> ▪ Learner model standards ▪ Scenario-based requirements analysis ▪ Transfer of experiences from other projects ▪ Research reports and other relevant publications 	Relevance feedback: query refinement to satisfy user and recommendation based on the user profile	Not yet known
Learner	<ul style="list-style-type: none"> ▪ Guidelines for design ▪ Transfer of experiences from other projects ▪ Other sources of references 	Not yet specified	Not yet known
Instructor	<ul style="list-style-type: none"> ▪ ISO 9241 Standards ▪ IMS Learning Design Best Practice and Implementation Guide ▪ Transfer of experiences from WINDS 	Software evaluation using ISO 9241	<ul style="list-style-type: none"> ▪ Self-descriptiveness ▪ Conformity to user expectations ▪ Detectability
Training Manager	<ul style="list-style-type: none"> ▪ Transfer of experiences from other projects, including ELENA, UNIVERSAL and DAIDALOS 	Requirements about security and privacy	Not yet known

11 Conclusion

The objective of this deliverable was to identify main success factors for corporate e-learning as well as suitable learning theories and instructional design models. We have specified five basic roles of users in the area of professional e-learning. For each of these roles we have generated possible user scenarios to be able to describe specific use cases for them. Based on this we indicated user, system, and user interface requirements for corporate e-learning solutions.

In the next steps, we want to investigate the implications of these findings on corporate personalized adaptive learning systems. Based on the evaluation of current adaptive learning environments and user modelling approaches we intend to design and implement solutions supporting corporate e-learning. These will be presented at the PROLEARN portal for professional education providing transparent access to distributed learning resources.

Appendices

Appendix 1 User Scenarios

Title: <i>Personalized learning on PROLEARN portal</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors: Student, system</p> <p>Task: Get new knowledge/skill.</p> <p>Input: Learning need</p> <p>Actions: The student logs in on the PROLEARN portal. She can see references to her recently accessed materials, whether there is some new feedback from her tutors (e.g. new assessments of her delivered exercises) and replies to her discussion submissions.</p> <p>The student specifies her new learning objective as a text phrase. The system returns a list of learning resources ordered by relevancy according to her profile (including learning style). As the student is supposed to be intuitive and active the system provides first a theory (it can consist of several interrelated materials taking into account their relationships, e.g. prerequisite), then an exercise and finally a test. Based on the results new learning materials are offered if needed.</p> <p>While learning the student can use communication facilities – discussion forum, annotations (public and private). The coaching facility can recommend her suitable materials. She can also find other students with similar interests and objectives.</p> <p>Output: Knowledge/skill obtained.</p>
<p>System support: Providing suitable learning resources and facilities.</p>

Title: Authoring Adaptive Content

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors:*Author, system***Task:***Create new learning resources***Input:***Knowledge, raw materials***Actions:**

Mr. Presentation is a trainer that gives seminars for internal training in company XX. He wants to produce some learning content for presentation trainings he gives regularly in his company. The previous knowledge and the skills of the participants in his company differ highly. In some seminars participants have never heard anything about communication theory and have no background but have some skills on presenting. Even if the management tries to get homogenous groups for the training seminars with Mr. Presentation, the background knowledge and the experiences of the participants always differ. Partially Mr. Presentation has a lot of experience in organizing the group to exchange experiences and knowledge but sometimes he has to use a lot of time in the seminar for basic knowledge that is known to some participants, but of which others have never heard of before.

He plans to create some learning blocks (learning objects) which reflect the basic components for having the "Presenter's Starter Kit" for his seminars. He has prepared some video recordings, parts of scripts and excerpts of books and materials he uses, some PowerPoint slides and other materials.

He starts a learning object authoring environment and starts to create a structure and folders for the different blocks of his seminars. He creates pages inside the different folders to structure his content on the pages in the folders. As he does in his seminars for each block or module he gives some examples with video sequences and combines them with explanations, adds analyses of the video and gives references to other content found in books, scripts or online resources. He also adds book references for participants who are interested in further information. As he added this content to all modules he wants to define which blocks are dependent and build on others, so he defines prerequisite relations between the modules.

Finally to allow his participants to get recommendation if they should work on certain modules he adds an introduction questionnaire, which contains three to seven questions about each module to assess if a person already knows about the content of the module. After that he adds some interactive exercises in which the participants can find out with other participants if he can apply the skills from the different modules.

After finalizing his "Presenter's Starter Kit" he forwards the materials to the companies quality assurance. Before he can do that the system asks him to add some description about the target group, classify the content in the company's content catalogue.

Output:*Learning objects***System support:***Authoring tools*

Title: E-advisor: Career or curriculum recommender**Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)**

You are starter student with rather fuzzy idea of what to do or study further. You wish to find the best educational or business continuation after your high school. An e-advisor application tries to match your profile with the available academia or industrial solutions.

- You have a profile containing:
 - Interests (e.g. main interests, cross domain interests, etc.)
 - current educational status
 - residential constraints (e.g. preferred cities, max distance to travel per day, etc.)
 - preferred study duration
 - language (e.g. mother tongue, preferred study language, etc.)
 - medical status
 - etc.
- Identify the topics of interest for your education
- Identify which of the proposed by the e-advisor courses are of interest to you
- Readjust the proposed curriculum by the e-advisor (this is an adaptive process depending on the choices you put in your 'shopping basket' new adapted recommendations are generated)
- You start following the courses, but it appears not be very appropriate for some courses; you get further recommendations for change of course level, or topics, etc.
- During following the courses you change your preferences (or the program suggests to you new one depending on your current performance or change in the mean time interests) for:
 - how long you would like to study
 - what topics you would like to follow
 - where you would like to study
 - etc.
- In the middle of the studies a friend of yours wants to join, and you want to follow some courses together; there is adjustment of the recommendations depending on the profile of your friend
- While you follow the suggested curriculum, you follow courses given by various institutions, which can be allowed to share, or access specific parts of your profile in order to keep track of your knowledge and course status and in order to adapt and personalize their available curriculum; not every course needs to be adaptive, but the presentation of its content can be given to another application, which will do this in a personalized and adaptive way
- While you follow your curriculum the e-advisor can communicate with various other applications in order to collect or share data about you and thus provide best recommendation:
 - Your medical record (to check whether you are fit to travel for an interesting lecture; whether the place where the lecture would be is suitable for your allergy status, to schedule vegetarian lunch, etc.)
 - Your private schedule (for vacations, and other appointments in order to be schedule or identify good dates for exams, for appointments with teachers, for group meetings, etc.)
- While you follow your courses the e-advisor can constantly recommend to you new interesting courses, conferences, lectures, etc, which fit your profile and current interests, knowledge, etc.

Actors: Students (in a range from just finished high school, to regular university student, or company employee in training), Educational Institution (e.g. University, College, High School, Training companies, Consultant companies), Teacher (Professor or Trainer or Consultant)

Roles: Teacher – Owner of Learning Resources

Student – Consumer of Learning Resources

Educational Institution – Provider of Learning Resources

Tasks: Web-based learning; Web-based teaching; Monitoring; Recommending; Follow educational tasks; Exchange Learning Resources; Collaborative course building (giving); Group working

Goals: Synchronize Learning Resources creation, maintenance and usage; recommending the most relevant curriculum; taking various aspects in mind (not only educational); personalized education; personalized educational advise; optimizing the learning process

Trigger: The need for good career advise; the need for more tailor-based education

System support: Cataloguing of and access to Learning Resources; Enabling open-source knowledge exchange as well as commercial transactions; Tracking usage of Learning Resources

Title: *Creating or reusing material for Adaptive Educational Hypermedia*

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

This story looks at the different possible aspects of authoring of adaptive educational material in the sense of separation of concerns. The actual process of authoring can be a subset of the activities below.

The main character is the author X, a domain specialist in Y that creates course material or puts together already existing material for an adaptive presentation.

He is asked to do this job by an institute Z offering educational services or a corporation W wishing to train their employees on his specialty topic.

He is creating this material to connect it to a portal, such as the PROLEARN portal, or via an adaptive web service offered via the PROLEARN portal, or separately on his machine. This already sets some restrictions and specifications for the type of materials that he can create or reuse:

The material should be of a type allowed by the portal or web service. (only if portal is used)

The format/ description/ metadata/ meta-tagging of this material should correspond to the one allowed by this portal/ web service or by the target portal (in the case the material is created offline initially).

The granularity of the material should be of the size allowed/ recommended by the (target) portal / web service.

For dealing with these restrictions and specifications, he needs some help (in the form of prior training, or (frame-based) authoring system with help facility, etc.).

The institute or corporation would like to offer adaptive courseware according to some parameters of the learner, or of the environment.

The author does not know much about adaptation or its power, but knows his subject domain well.

He is used to a linear, hierarchical course creation, given a target educational goal, a target audience and a time frame. The author therefore has to be informed about these parameters. If there are several target goals, audiences and time frames, as happens in adaptive educational setting, the author has to be informed about all the possible combinations required from him.

The author would like to be able to create his material as much as possible in the same way as he is used to. He might assume, for instance, that the material will be presented in the same order as he is structuring it, unless he is informed otherwise (again, via training, or via a helpful authoring system).

This might mean that if the order has to be able to be changed later, the author must be informed about this possibility. For instance, he might be asked to create the pieces of courseware as independent as possible, and explicitly mark some dependencies.

He does not have to specify the adaptive behavior of the courseware pieces, but must be helped to create them in such a way that these pieces can be meaningfully used in adaptive courseware presentation.

This means that the institute or corporation should inform the author what type of material is necessary for the parameters of the learner or environment envisioned. For instance, if there has to be a whole backup course for visually challenged learners, the author has to be informed to create a second version of each courseware piece targeted at visually challenged learners. If this only has to happen for part of the material, the author has to be informed which part has to be doubled this way.

Finally, the author might be collaborating with other authors on his task. The system has to be able to support this feature, by allowing at least access to the group of collaborating authors to the (parts of the) courseware they are specialists in and responsible of.

The author must be able to specify if the course will still be modified or is finished.

Actors: Author (Domain Specialist, Trainer or University, College or School Professor), Company or Educational Institution (e.g. Training company, University, College, High School), Target Learner (e.g. company employee who has to be trained, or student of university, K12 pupil, etc.)

Roles: Author – Creator or Retriever of Learning Resources

Company/ Institution – Accumulator and Manager of Learning Resources on Content Management System

Target Learner – potential end beneficiary of Learning Resources and Presentation

Tasks: (Collaborative) course creation;

Goals: Synchronize Learning Resources creation, maintenance and usage;

Trigger: Need of adaptive courseware due to some (significant) variations in the parameters of the learner or of the environment; Testing of need of adaptive courseware;

<p>System support: Facilitating creation of (labelled, structured) Learning Resources; Cataloguing of Learning Resources; Tracking creation of Learning Resources; Learning Resources version control; Authoring Support and Help facilities; Collaborative Authoring Support</p>
<p>Title: <i>Creating behavior for Adaptive Hypermedia</i></p>
<p>Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)</p> <p><i>This story looks at the different possible aspects of authoring of adaptive educational material in the sense of separation of concerns. The actual process of authoring can be a subset of the activities below.</i></p> <p>The main character is the author X, an educational specialist that has a lot of knowledge and understanding about pedagogy and educational strategies, but doesn't necessarily understand the domain on which his knowledge is going to be applied on.</p> <p>He is asked to do this job by an institute Z offering educational services or a corporation W wishing to train their employees on one or more specialty topics in an adaptive way.</p> <p>He is creating this adaptive behavior for material that will be or is already connected to a portal, such as the PROLEARN portal, or to an adaptive web service offered via the PROLEARN portal, or offline by himself. This already sets some restrictions and specifications for the type of adaptive behavior that he can create or reuse:</p> <p>The behavior should be of a type allowed by the portal or web service (only if portal is used). The format/ description/ metadata/ meta-tagging/ description language of this behavior should correspond to the one allowed by this portal/ web service (or to the one allowed by the target portal). For dealing with these restrictions and specifications, he needs some help (in the form of prior training, or (frame-based) authoring system with help facility, etc.).</p> <p>He has to be able to transform a teaching strategy in terms of meta-data needed and rules. This means that his specifications give the definition space for the author creating content. This also means that he might need support or training to achieve the expertise needed for transforming educational ideas into machine readable information.</p> <p>The author has to tag the created behavior descriptions with natural language descriptions that are understandable for the content author.</p> <p>Finally, the author might be collaborating with other authors on his task, although to a lesser degree than the content author. The system has to be able to support this feature, by allowing at least access to the group of collaborating authors to the (parts of the) courseware behavior they are specialists in and responsible of.</p> <p>The author must be able to specify if the course behavior will still be modified or is finished.</p>
<p>Actors: Author (Educational Specialist, Trainer or University, College or School Professor), Company or Educational Institution (e.g. Training company, University, College, High School), Target Learner (e.g. company employee who has to be trained, or student of university, K12 pupil, etc.)</p> <p>Roles: Author – Creator or Retriever of Behavior Specification Company/ Institution – Accumulator and Manager Behavior Specification on Content Management System Target Learner – potential end beneficiary of Learning Resources, Behavior Specification and Presentation</p> <p>Tasks: (Collaborative) course behavior creation;</p> <p>Goals: Synchronize Learning Resources behavior creation, maintenance and usage;</p> <p>Trigger: Need of adaptive courseware due to some (significant) variations in the parameters of the learner or of the environment; Testing of need of adaptive courseware;</p>
<p>System support: Facilitating creation of (labelled, structured) Behaviour Specification; Cataloguing of Behaviour Specification; Tracking Creation of Behaviour Specification; Behaviour Specification version control; Authoring Support and Help facilities; Collaborative Authoring Support</p>

Title: Brokerage of Learning Resources

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Professor G from University A plans to develop a new course on advanced technologies in telecommunications for the Masters of Electronic Engineering program. He has identified the topics that constitute the core of the academic content he plans to include in the new course. He uses the search function of the PROLEARN Portal and is able to locate several LRs related to the Internet technologies. He learns that the contributor of these LRs is from University B, where he was a visiting professor a couple of years ago. With the information associated with the LRs, including telephone and e-mail address of contributors, he calls Professor P, who has authored and provided the LRs. During the discussion, Professor P expresses his interest in collaborating with Professor G to write a new improved LR on software to support distant collaborative work and eventually to participate in the joint teaching of the class on Computer Supported Collaborative Work (CSCW) tools in telecommunications. Professor G and Professor P use the share function of the PROLEARN Portal to exchange the related knowledge and learning resources with each other.

Professor G and Professor P decide to teach jointly the course to their respective students within the Masters of Electronic Engineering program. They upload all LRs: 6 set of slides, 6 videos plus two cases studies and a few articles in PDF form on the PROLEARN Portal. They authenticate the identity of their students on the Portal so that they can access all the LRs. In addition to the self-directed educational materials, there are some instructor-led live educational activities. When Professor G presents his lecture face to face to the students at University A, the students at University B can follow the lecture live from distance. They use the multi-point video module of the Portal to link the two classes.

Professor P is contacted by Mr. L., CEO of an IT company to organize a seminar for 12 project leaders of his company with the view to improving their knowledge in advanced technologies in telecommunications. Professor P can reuse some of the educational material developed for the Masters course. With the given capability of the PROLEARN Portal, he defines the price for the LRs that are applied in this executive seminar. Later he receives the list confirming the booking of the LRs used in the seminar and also the payment of his teaching and royalties of LRs.

Actors: Two University Professors, Masters Students, CEO of an IT Company

Roles: The Professors – Providers and Consumers of Learning Resources

Masters Students – Consumers of Learning Resources (open source model)

CEO of an IT Company – Consumers of Learning Resources (commercial model)

Tasks: Exchange of Learning Resources, Computer-supported Collaborative Learning/Teaching

Goals: Enhancing the reuse of Learning Resources,

Enriching the exposure of learners to different sources of Learning Resources

Trigger: The need for developing a quality new course

Task Done: When the planned course with desired Learning Resources is launched

Input: Offers of Learning Resources in the Portal's Catalogue, Search Criteria

Output: Learning Resources retrieved are adapted and integrated into a course with coherent structure and content

Resources: Manpower to develop, input, retrieve and integrate digital Learning Resources

Tool: A powerful brokerage platform

Workflow: Login → Describe existing LR with metadata → Offer the LR (cataloguing) with terms and conditions → Search and Browse LR → Book LR → Access LR → Reuse LR

Application: PROLEARN Academy Training Programs

Business: A business model for commercial Learning Resources

System support: Cataloguing of and access to Learning Resources; Enabling open-source knowledge exchange as well as commercial transactions; Tracking usage of Learning Resources; Enabling community building of professionals (CSCL/W)

Title: Designing and customizing adaptive e-Learning applications

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors:

A Courseware Company (employing: Learning Object Designer, Curricula Designer, Web Designer) and several SMEs (employing: a manager for courseware acquisition, several employees desiring continuous education).

Input:

- A training need specification by the SME
- A demo or deployed installation of the complete vertical application, available at SME
- Vocabulary listings describing names and properties of LOs in the vertical application

Tasks: Inspection, Adaptation, Personalisation, Use of Courseware on the Web.

A courseware company develops and distributes a vertical application for e-learning, running on the company's server. The courseware company builds the vertical application according to a development method for web-based applications consisting of some phases (data design, navigation design, presentation design and generation of final application).

The generated vertical incorporates learning objects in the format of lessons, exercises, tests, definitions and examples for computer science, arranged according to the ACM categories (See <http://www.acm.org/class/1998/>), and learning paths with checkpoints for the learner. Thus, such a vertical has learning objects as content, and navigation mechanisms, such as guided tours or indexed accesses to pages based on broad categories, enabling a generic user to access such content through predefined navigation paths.

The vertical is used by Small-Medium Enterprises (SMEs) wishing to build personalized e-learning curricula, to be used by their employees for focused training activities. We assume that each SME has a clear instruction goal (for example, teaching its employees how to integrate Java programming into Oracle 9i). A vocabulary, listing all the learning objects available in the vertical clustered into subcategories, may be an easy-to-use interface for the SME designer.

The system supports the SME manager for courseware acquisition in the selection of the concepts to be covered in the learning paths, as well as the workflow driving the student in the learning process. We also assume that each SME has a clear view of its employees' competencies, and thus is able to constrain possibilities in the learning paths by adaptation rules based on such competencies. These rules enable adaptive content selection from the vertical and also enable to adaptively indicate, show, and hide links in the learning path, and adaptively customize their targets.

Once the set of LOs to be dedicated to each individual user or group of the SME has been selected, the system supports the employee in its individual and adaptive fruition of the material, which includes a personalised workflow with checkpoints and tests. Some information, designated as private and therefore kept at the SME premises, is managed on the client side of the application. Some other information, including the original LOs,, remains on the courseware server.

System support:

Title: <i>Extending knowledge with adaptive learning tools for search and browsing</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor: <i>Learner</i>
Input: <i>Learner Profile, Learning Resource Metadata, Learning Goal</i>
Output: <i>Recommended learning resources, Recommended links to related resources</i>
<p><i>A member of the company, who already has programming experience in some other programming languages, wants to know how specific programming concepts are realized in the Java programming language. For example, she wants to know how to implement concurrent programs in Java. This user will submit a query for learning resources on “concurrent programming” and “Java” using a personalized search service, which enriches the request with user profile information (like information about her knowledge in programming languages, her preferences for teaching language, style, etc.). The user retrieves from the network learning resources in her preferred language that teach “concurrent programming” in the Java programming language. Learning resources, which are targeted to experienced learners, are highlighted.</i></p> <p><i>Retrieved learning resources are enriched with pointers to other, related and relevant information. Links to relevant examples, different explanations, more detailed descriptions, etc., are provided. In addition, the context of a learning resource, for example in a course, can be provided for user.</i></p>
System support:

Title: <i>Alice and the Personal Reader</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor: <i>Learner</i>
Input: <i>Learner Profile, Course Metadata, Learning Resource Metadata</i>
Output: <i>Local Context, Global Context, Recommended links</i>
<p><i>Alice is interested in learning Java programming. Alice is currently learning about variables in Java by accessing some learning resource in an online tutorial. During her studies she realizes that she needs some clarifications on naming variables. The Personal Reader shows where detailed information on variables can be found in this online tutorial, and also points out recommended references for deeper understanding. For ensuring that Alice understands the use of variables, the Personal Reader provides several quizzes. When practicing, Alice does some of the recommended exercises. For the chosen exercises, the Personal Reader provides Alice with appropriate links to the Java API, and some already solved exercises. A further source of information are the JAVA FAQ references pointed out to Alice by the Personal Reader.</i></p>
System support:

Title: Content adaptation
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<i>Laura is an ambitious student of economy, preparing for her final exam. As she thinks that her knowledge in macroeconomy is not yet good enough, she looks at the PROLEARN portal for appropriate lecture that would fill her knowledge gaps. She registers for an excellent live lecture and starts following it on her personal computer. After an hour, Laura remembers that she has an appointment at the University and needs to catch the bus. As the lecture is very interesting, she decides to follow it on the bus with her mobile PDA. The lecture is adapted to lower quality device and redirected to her mobile device. Laura can continue following the lecture while driving to the University.</i>
System support:

Title: Multilinguality
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<i>Francisco is a regular user of the PROLEARN portal. As he is not very fluent in foreign languages, he prefers that everything, for example user interface, learning resource descriptions, or user notifications, is presented in Spanish. In case information is not available in Spanish, the portal invokes a translation service. Other parameters of the portal view are also adapted to his context, for example relevant news, size of letters, or colours.</i>
System support: <i>Adaptation of the user's view of the portal according to his preferences and context</i>

Title: Personal data protection
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<i>Bob has a meeting in Munich next week. His learning assistant tries to find appropriate seminars organized in Munich the days after the meeting. As Bob is aware of potential privacy problems he does not want to disclose sensitive personal data during querying of appropriate learning resources. His assistant therefore adapts the queries to suit Bob's privacy preferences before they are sent to the network. During registration for the selected seminar The seminar organiser would appreciate if Bob sent personal information, such as his e-mail address, phone number, age and interests. Since Bob had some unpleasant experiences in the past with learning service providers that disclosed his information to advertising organisations, his assistant is instructed that those information should not be exchanged.</i>
System support: <i>Selective disclosure of personal data according to user preferences and service provider's privacy statements</i>

Title: <i>Problem Driven Personalized Self Learning</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor/Role: <i>Employee1 as student; Manager1 as director of Employee1</i>
Goal/Task: <i>To find resources on a specific technical topic</i>
Input/Resources: <i>PROLEARN portal</i>
Actions: <i>Employee1 is responsible to complete a task that is assigned to her by Manager1. This task requires Employee1 to have knowledge on Transaction Processing in MS SQL Server. As Employee1 proceeds with the task the problem arises due to the lack of knowledge on Transaction Processing in MS SQL Server which drives the learning need.</i> <i>Employee1 logs in to the PROLEARN portal with her username and password and reaches her personalized front-page. Without even checking her personal messages and calendar she directly types "Transactions MS SQL" to the search box -where she placed to the up-right of her front-page during configuration- and clicks search button. System returns no results but returns a set of recommendations about the keywords. Employee1 clicks "Transaction Processing in SQL" which is the first recommendation.</i> <i>As the result of the search, system lists the resources related to the keywords ordered by the relevance value of the article to the keywords, highlighting the ones which are previously accessed by Employee1.</i> Results: <i>Resource found.</i>
System support: <i>Personalized front-page support Advanced querying support</i>

Title: <i>User permissions support with authority approval mechanism</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor/Role: <i>Employee1 as student; Manager2 as responsible of PROLEARN portal in the company</i>
Goal/Task: <i>To gain access to a resource on the portal</i>
Input/Resources: <i>PROLEARN portal; Article2 as resource on the platform</i>
Actions: <i>When Employee1 tries to open the Article2 on the list, she gets the message "You do not have access to this resource". Employee1 then states that she wants to have access to that resource which needs the approval of Manager2 that is responsible of PROLEARN portal in the company. Employee1 also reaches Manager2 by phone to accelerate the process.</i> <i>Some time later Employee receives an e-mail message saying that she has now rights to access to Article2. She clicks the hyperlink in the message body opening Article2.</i> Result: <i>Employee1 gained access to Article2</i>
System support: <i>User permissions support with authority approval mechanism</i>

Title: <i>Configuration of Personal GUI Settings</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor/Role: <i>Employee1 as student</i>
Goal/Task: <i>To configure personal user interfaces.</i>
Input/Resources: <i>PROLEARN portal</i>
Actions: <i>The first time Employee1 enters the portal she is forwarded to make the initial configuration of her personalized front-page. Employee1 selects to see texts larger on the interface and selects her favourite colour blue as the colour of elements such as bars, buttons, frames, etc.</i> <i>Then Employee1 states her area of interests out of all subjects which is in the scope of PROLEARN portal. She also states that she wants to be informed by e-mail about the new articles and other content on her areas of interest. She selects the option that she wants to receive HTML based e-mails.</i> <i>Then Employee1 selects the items to be displayed on her personalized front page such as her task list, her calendar, search facility, etc.</i> <i>Finally she submits the settings by clicking the SAVE button. Employee1 gets the message saying that the changes are saved and Employee1 can make changes any time by clicking "Edit My Personal Front-Page" link on her front-page anytime.</i>
Result: <i>Personalized front-page settings configured.</i>
System support:

Title: <i>Dynamic Resource-Keyword Relevance</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor/Role: <i>Employee1 as student</i>
Goal/Task: <i>To set the most appropriate relevance value for resources</i>
Input/Resources: <i>PROLEARN portal; Article1 as resource on the platform</i>
Actions: <i>Employee1 performs a search on the PROLEARN portal using the keywords: "Transactions MS SQL"</i> <i>Employee1 opens Article1 and see that the information she is looking for does not exist in that resource. As she closes Article1 she replies to the "Is this article relevant to the keywords you have typed?(Not at all, Not much relevant, Relevant, Very relevant)" message as "Not at all" so making the system to decrease the relevance value of Article1 to the keywords and to configure itself not to show Article1 to Employee1 for the same keywords.</i>
Result: <i>A new resource-keyword relevance value</i>
System support: <i>Dynamic resource-keyword relevance support</i>

Title: Content Personalization by Intelligent Agents
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actor/Role: <i>Employee1 as student; Agent1 as interface agent of Employee1; Manager2 as responsible of PROLEARN portal in the company</i></p> <p>Goal/Task: <i>To personalize learning content.</i></p> <p>Input/Resources: <i>PROLEARN portal</i></p> <p>Actions: <i>Agent1, the interface agent of Employee1, compiles the raw data related to Employee1's participation logs, test scores (including successful topics and unsuccessful topics), areas of interest, and objectives of training and prepares a set of e-learning content such as readings, presentations, case studies, assignments. Agent1 sends this learning set information to Employee1 and Manager2.</i></p> <p><i>Agent1 also places the tasks related to this learning set to the personal calendar of Employee1.</i></p> <p>Result: <i>A learning set is created and assigned to student.</i></p>
<p>System support: <i>Content Creator Agent support</i> <i>Personal Calendar support</i></p>

Title: Configuration of Personal Learning Content According to Personal Training Needs
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actor/Role: <i>Employee1 as student; Manager2 as responsible of PROLEARN portal in the company</i></p> <p>Goal/Task: <i>To prepare a personal learning content.</i></p> <p>Input/Resources: <i>PROLEARN portal</i></p> <p>Actions: <i>Employee1 receives an e-mail message informing her about a link on her personalized front-page to a questionnaire. Employee follows the link on the e-mail message and fills the questionnaire.</i></p> <p><i>As a result of the questionnaire a learning set is created which is basically a list of training activities linked to the content available on the PROLEARN portal. The proposed schedule of the activities is also integrated to Employee1's personal calendar.</i></p> <p><i>Employee1 decides to modify the set and change the duration of Activity1 from 2 days to 4 days and adds one more reading to the syllabus. The change is directly reflected to the current syllabus.</i></p> <p><i>Employee1 then decides to discard Activity2. This kind of change needs the approval of Manager2. As soon as Manager2 see the change request of Employee1, he approves the change and the new set becomes valid for Employee1.</i></p> <p>Result: <i>Fine-tuned learning set for Employee1's personal training needs.</i></p>
<p>System support:</p>

Title: <i>Secure Resource Sharing</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actors/Roles: <i>Tutor, Students</i>
Goals/Tasks: <i>Share and communicate local resources over the e-learning platform.</i>
Input/Resources: <i>Local files supplied by the student</i>
Actions: <i>The training aims to teach presentation techniques using presentation slides on computer (e.g. PowerPoint slides) and includes advanced methods of preparing impressive presentations. The e-learning platform includes an interactive demonstration facility to teach students the methods of preparing presentations and also wrong/right examples of presentations for specific business domains. The course includes an exercise facility where students prepare presentations locally and submit their presentations to the platform. This requires platform to have file upload/download facilities for both student and instructor interfaces. Student prepares the presentation file, uploads it to the platform, and the file uploaded information appears on the instructors' interface. Instructor downloads the file and grades the assignment.</i>
Results: <i>Students and tutors share and communicate their local files and enables their resources to be accessible over the platform.</i>
System support: <i>File upload / download facility</i>

Title: <i>Resource Recommendation</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor/Role: <i>Employee1, Employee2, Employee3 as students</i>
Goal/Task: <i>To recommend a resource to colleagues</i>
Input/Resources: <i>PROLEARN portal; Article2 as resources on the platform</i>
Actions: <i>Employee1 reads Article2. She also wants to inform Employee2 and Employee3, who work on the same task with Employee1, about Article2.</i>
<i>Employee1 selects the names of Employee2 and Employee3 from the list just on top of the article where as default only the list of users from the same company appear.</i>
Result: <i>Employee2 and Employee3 informed about the resource</i>
System support: <i>Resource recommendation support</i>

Title: <i>Easy HTML Uploading Facility</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actor: Actor1</p> <p>Goal: Uploading HTML material with multimedia content all at once</p> <p>Input: HTML and media files..</p> <p>Result: A full and zero-problem display of HTML files</p> <p>Actor1 is a student enrolled in a particular class. She has an HTML file with many images and a audio file embedded to it. She would like to upload it to the platform. After creating the document, she compresses them to a zip file in the directory structure according the HTML file she created.</p> <p>After uploading the zip file, the system automatically unzips it keeping the directory structure so that all the references to the media and other types of files are kept. This allows all-at-once uploading of multi-file content without trying to upload each single material one by one.</p>
System support: <i>Uploading facility, unzipping facility at server side</i>

Title: <i>Scheduled Peer-to-Peer Communication for Heavy Multimedia</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actor/Role: Employee1 as student; Agent1 as interface agent of Employee1</p> <p>Goal/Task: To download a multimedia material on a scheduled time.</p> <p>Input/Resources: PROLEARN portal</p> <p>Actions: Employee1 starts navigating through the learning content and comes across to a video material which will take some time to download and see. She clicks the link "schedule to download" and sets a time to download the material peer-to-peer.</p> <p>When Employee1 comes to her office the other day, she continues with her training thanking her interface agent, Agent1 which started the download on time.</p> <p>Result: Material downloaded</p>
System support: <i>Peer-to Peer communication support</i>

Title: Bonus System for Course Forums

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actor: Actor1, Actor2

Goal: Getting help for unsolved problems.

Input: An unsolved problem stated in a forum thread, and credits.

Result: Actor1 gains more attention to her problems

Actor1 is a student participating in a particular course in the platform. She occasionally visits course discussion forums to get and offer help.

When she enrolled to the class, the system has rewarded her 10 points to use in class forums. She has an unsolved problem about the class and she submits it to the forum. She attaches some of its point to encourage others to help her, as a list of most high-ranked participants is kept and publicly displayed.

Likewise, while gazing through the forum, she meets an unsolved problem thread worth 3 points from Actor2, she takes her time to solve it, submits it and it gets accepted by the original submitter. This makes her gain 3 points, where she uses it later to draw more attention to her problems. Three points are subtracted from Actor2's credits.

System support: Forum facility, point tracking facility, messaging facility

Title: Peer-to-Peer Communication of Learners

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actor: Actor1, Actor2

Goal: Sharing files and discussion in private with someone else.

Input: Text or computer files

Result: Participants share text and binary data in private without busying the platform server.

Actor1 and Actor2 is working together in a class project. They need to share conversation and computer files with each other in private. They download a P2P communication tool from the platform and use it to communicate with each other.

They choose to use the P2P client because it is much faster than sharing data on the platform server and they can each other more conveniently.

System support: P2P client

Title: <i>Forum with Notification Mechanism</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actor/Role: James(PROLEARN Portal User) Bob (PROLEARN Portal User)</p> <p>Goal/Task: to learn “how to connect MS SQL Server”</p> <p>Input Resources: Forum Message, Forum Thread, Forum</p> <p>Result: James has learned how to connect MS SQL Server</p> <p>James is a software developer and he has an account to the PROLEARN Portal. He has just entered to the system by using his username and password. He has just wanted to enter the communication facilities of the portal and seen forum facility. He has opened a thread on “connecting MS SQL Server with Java”. Under the forum thread he has just seen a checkbox which will be used to inform the owner of the thread when new messages are added to the system. He has also checked this checkbox.</p> <p>Bob is a member of the PROLEARN Portal and has just entered the system. He has entered the communication facility and then selected forum facility. He has seen the forum opened by James and answered it. System will automatically send an email and creates a notice for James to inform he has a new message in the forum thread opened by him.</p>
System support: Forum Facility, E-Mail sending Facility, notice Board facility

Title: <i>Tracing student participation</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors/Roles: Student, Teacher</p> <p>Task: Tracing and analyzing the student participation</p> <p>Input/Resources: Student participation information generated by the system</p> <p>Actions: Student is participating to the e-learning platform and taking various actions on the platform. Teacher is expected to view the actions taken by the student using teachers’ user interfaces. Goal is to make teacher aware of each student’s participation to the learning process.</p> <p>The system keeps track of every action that a student is taking (including all content viewing, and giving responses for interactive course environments and also date-time information of each action taken.). Teacher needs to know how much time the student spent to specific course content, so the logging mechanism has to keep track of the entry and exit times of the student to a specific content.</p> <p>Teacher also wants to know some statistics about the student participation, so in his/her interfaces, some statistical information like average/min/max course viewing times for a particular content should be supplied. For example teacher wants to view which part of the course is mostly viewed, which part is not interested by the students, so the teacher has the information about needs to review the course content.</p> <p>Results: Teacher has various reports about user participation and course attractiveness.</p>

System support: *Logging mechanism of students' actions and reporting and analyzing tools of instructors*

Title: Student Performance Monitoring by Intelligent Agents
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actor/Role: <i>Employee1 as student; Agent1 as interface agent of Employee1; Agent2 as interface agent of teacher; Manager2 as responsible of PROLEARN portal in the company</i></p> <p>Goal/Task: <i>To monitor students' performance</i></p> <p>Input/Resources: <i>PROLEARN portal; Test1 as a multiple choice test</i></p> <p>Actions: <i>An interface agent Agent1 keeps track of Employee1's learning performance by recording information whenever Employee1 accesses a learning resource. The information stored is regularly compiled and reported to teaching agent Agent2. Agent2 regularly prepares performance reports and automatically sends messages to Employee1 and the Manager2 who is responsible of PROLEARN portal in the company.</i></p> <p><i>Employee1 takes the test Test1 and answers all multiple choice questions. When she submits the answers she gets a detailed report on the screen and also by e-mail covering the total score, correct answers of all questions and her own answers. This information is also stored by Agent1 and sent to Agent2 for further compilations.</i></p> <p>Result: <i>Performance values are stored and compiled</i></p>
<p>System support: <i>Performance Tracker Agent Online testing support</i></p>

Title: Role Playing Exercises using Synchronous Virtual Communication
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
<p>Actors/Roles: <i>Sales representative as learner, tutor</i></p> <p>Goal/Task: <i>Supply a synchronous virtual communication platform for role playing exercises</i></p> <p>Input/Resources: <i>Tutor and learner conversations running on the virtual platform.</i></p> <p>Actions: <i>Sales representatives are to be trained in e-learning environment on "marketing techniques" topic. The learning process is based on role playing.</i> <i>The tutor acts as a client and sales representative is expected to convince the client. After role playing session is conducted, the session is discussed by the whole class. To achieve this process, all students and the tutor meet virtually in the e-learning platform at the same time period.</i> <i>The platform supports video and audio transferring.</i> <i>Tutor selects a student and sends a message to the student. Then tutor announces whole class that the session begins. The session includes continuous messaging of the tutor and the selected student respectively. Tutor decides to finish the session and starts a debate on the same virtual classroom (with chat facility). Whole classroom activity including the online debate is saved by the system automatically and made accessible by the students and the tutor.</i></p>
<p>System support: <i>Video conferencing support, online messaging and chat support</i></p>

Title: <i>Penalty based Assignment Submission Date Monitoring</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor/Role: <i>Ahmet (Student of Management Course), Mr. Baum (instructor of Management Course)</i>
Goal: <i>Uploading a homework to the portal</i>
Input Resources: <i>Assignment File , Answer File</i>
Result: <i>Ahmet has uploaded his homework, Ahmet's homework is graded by the instructor and system has automatically calculated his homework grade after applying penalty rule. Ahmet is a sales representative in a big textile company. His company has participated to an education given in the PROLEARN Portal on management. The instructor of that course is Mr. Baum. Mr Baum has uploaded an assignment for this course to the PROLEARN Portal for which the due date is assigned. He has also defined a late submission rule for that assignment as for each 1 day late submission of the assignment; the penalty was 10 percent loss of actual grade. Ahmet has entered to the portal by entering his username and password to the portal. After entering to the system, he has seen a notice on the notice board related to the homework that is uploaded by Mr. Baum. He has selected the courses from left menu and selected course on Management. The course information appears on the new page including a menu on which homework, communication, e-content, syllabus, calendar, announcement, etc... links are located. He has just selected the homework page and saw the homework uploaded by Mr. Baum. He had read the content of the homework and had seen that the due date is expired. He had just done his homework in the day and uploaded to the system</i> <i>Mr. Baum has entered to the PROLEARN Portal and saw a notice in the notice board in which system informs him related the newly uploaded homeworks. He has just selected the courses link from the left menu. On the new page the courses lectured by Mr. Baum was listed. He had just selected the course on management and menu related to that course has just appeared. The he had selected the homeworks link on which assigned homeworks were listed. He then clicks the sent homeworks link on which the student that had sent their homeworks is listed. He then reads the homework of Ahmet and gives as grade 80. System had automatically calculated the actual grade by applying the penalty rule. He has sent three day late his homework. The grade calculated by the system was 56 which is $80 - 80 * (\text{penalty}) / 100$.</i>
System support: <i>notice board facility, assignment facility, penalty control facility</i>

Title: <i>Case Study Development Practice for Trainers</i>
Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)
Actor/Role: <i>Employee1 as student; Company1 and Company2 as Industrial Partners of the PROLEARN portal</i>
Goal/Task: <i>To make a case study development exercise.</i>
Input/Resources: <i>PROLEARN portal</i>
Actions: <i>Activity3, which is an activity in Employee1's training syllabus, includes development of a case study. Employee1 first reads Article3 which is on developing case studies. Then Employee1 is asked to create a forum thread and design a questionnaire which will be filled by one of the industrial parties registered to the PROLEARN portal. Employee1 then selects two companies over PROLEARN portal. Company1 rejects to fill the questionnaire. Company2 fills the questionnaire and Employee1 is informed with the result. The forum thread is used for further discussions to finalize the case study.</i>
Result: <i>A case study developed together with an industrial partner.</i>
System support:

Title: Personalized learning on PROLEARN portal

Story: (Actor/Role & Goal/Task & Input/Resources & Actions & Result)

Actors: Learner, Author, Tutor, PROLEARN Portal, Global Search Engines.

Input:

Learner – search string

Author – object semantic descriptions (semantic language descriptions, including learning paths)

Tutor – object semantic descriptions (learning paths)

PROLEARN portal – interface enabling access to descriptive resources by the web crawlers

Tasks: PROLEARN Portal task – to help the learner to access learning objects and learning paths.

Actions:

A learner identifies his learning needs. The learner defines the outline of his interest in form of search string in the Portal's main search field.

Or: the learner does not know about the PROLEARN Portal and searches in one of the global search engines. One of the search results leads him to the PROLEARN Portal search window.

The learner presses "Search"-button.

The system accesses sets of objects available and based on the request and the available learning objects defines the objectives for the learner as a list. Objectives are put in a list with heading: "What is:" or "Relation between:". The lists have selectable boxes for either relation link search or simple selection.

Comment: The objectives can be generated based on sets of available assessment questions, quizzes etc. (The scenario means, that the authors should create assessment sets – sets of questions).

Comment: "What is" generates lists of objects. "Relation between" generates object pairs with relation descriptions.

After selection of the objectives by clicking the boxes, the learner clicks "Add to the collection". The objects are added to the right-hand window representing the collection. The learner can continue with next windows of corresponding search results (1, 2, 3, 4, 5...) and add more objectives of interest to the collection.

When the collection is ready, the learner presses a button "Learning paths" and the engine provides sets (pages) of corresponding learning objects with corresponding paths. The objects link to both the relevant objects to be accessed or semantic trees to other objects in available learning paths.

If the learner finds useful objects or paths, he selects them and is redirected towards payment/scheduling system or directly to the resource. If the object is not useful, the learner can continue by browsing the learning path tree, defining a new collection or a new general search.

Comment: If a resource is not located at the Portal, the procedure of resource usage does not have to be a part of the Portal's functionality. Only scheduling and payment are registered as a part of personalization.

Appendix 2 IMS Use Cases

The following use cases come from *IMS Learning Design Best Practice and Implementation Guide* published by IMS Global Learning Consortium, Inc. in January 2003:
http://www.imsglobal.org/learningdesign/ldv1p0/imslld_bestv1p0.html

Adapting Units of Learning to Learner Profile

Narrative: One model of learning has an instructor initiate the learning process by identifying desired outcomes for a particular learner. By pre-assessing that individual's prior knowledge and understanding the student's strengths and special needs, the instructor is able to identify relevant activities and pull them together into an individualized unit of learning, which is then delivered to the learner. This use case addresses how a software system could automate parts of this process, bringing value to both instructors and learners.

Primary Actors: Learner, Instructor

Stakeholders and Interests:

- Instructor - guidance of flexibly cast outcomes-based learning experiences.
- Learner (individual and/or group) - engagement in learning experiences suited to their capabilities.
- Organization- providing an efficient infrastructure that enables the capture, tracking, and sharing of units of learning.

Preconditions: The instructor and learner are logged onto the system.

Trigger: The instructor identifies a desired outcome for a student.

Scenario Steps:

1. Instructor matches learner and desired outcome(s) in the system.
2. System retrieves pre-assessment based on prerequisites for desired outcome and delivers pre-assessment to learner.
3. Learner takes pre-assessment and submits results to system.
4. System grades pre-assessment.
5. System uses Learner Information Package, pre-assessment results, and defined outcomes to retrieve relevant activities.
6. Peer evaluation is completed.
7. Units of learning are created.
8. System delivers Unit of Learning to the learner.
9. Learner completes unit of learning and submits results to the system.
10. System delivers post-assessment to the student.
11. Student completes post-assessment and submits results to system.
12. System grades post-assessment and delivers results to educator.

Extensions:

5a. Pre-assessment results show that student does not meet criteria for beginning activities matched to desired outcomes.

5a1. System notifies educator and displays pre-assessment result.

5a2. Educator identifies new desired outcome and returns to Scenario Step 1.

Provide Remedial Units of Learning

Narrative: One common instructional model at the tertiary level combines large, 1-hour, large-lecture class meetings taught by a professor with smaller, weekly sessions, run by teaching assistants, which focus on clarifying points of the lectures or facilitating completion of student homework. In an effort to optimize this model, pre-assessments are given to individual students in order to identify missing prerequisite knowledge and skills, followed by self-paced tutorials meant to address any deficiencies uncovered by the pre-assessment. These self-paced tutorials are assembled from existing materials, based on both their relevance in addressing the specific knowledge and skills identified, and their conformance to the individual student's learning needs. This use case addresses how a software system can effectively automate parts of this process.

Primary Actors: Learner

Stakeholders and Interests:

- Learner - receives instruction specific to deficits in required knowledge and skill, and relevant to individual learning needs.
- Instructor - enables participation of students capable of functioning well in large-lecture course.
- Organization - increases efficiency and effectiveness of introductory courses.

Preconditions:

1. The Learner has been registered with the system and has a learning profile.
2. The Learner has been registered for a qualifying course.

Trigger: The Learner attempts to log in to the qualifying course for the first time.

Main Success Scenario:

1. Learner logs into the System using an assigned id and password.
2. System recognizes the Learner, retrieves the correct profile, and offers the Learner a menu of options, based on access authorizations.
3. Learner makes a selection that corresponds to initiation of a qualifying course.
4. System notifies student that a pre-assessment is a course requirement and prompts the Learner for a decision whether or not to take the pre-assessment at this time.
5. Learner opts to take the pre-assessment.
6. System delivers the pre-assessment.
7. Learner takes the pre-assessment and submits the result to the system for grading.
8. Learner scores the pre-assessment, records the results, updates the learner's profile, and searches for learning activities that address those areas below criteria.
9. System assembles a unit of learning for course remediation, based on the deficiencies uncovered by the pre-assessment and activities aligned with the learner's profile. The unit of learning consists of a set of activity-structures whose sequence is based on the sequence of topics in the qualifying course. Each activity-structure contains a post-test used to verify effective completion of the activity-structure.
10. The Learner completes each activity-structure in order, takes the associated post-test, and submits the results to the system.
11. The System records the results, grades the post-test, and updates the learner's profile.

Extensions:

- 1a. System may not recognize the student id and/or password.
- 4a. Learner may opt to take the pre-assessment at another time.
- 9a. System may not locate any activity-structures that match the learner's deficits or learning profile.
- 10a. Learner may not complete an activity-structure in a single session.
- 10b. Learner may not take or complete the post-test.
- 11a. Learner may fall below criteria on the post-test.

Reduce Content in Learning Path Based upon Learner Profile

Narrative: Customers are asking for (demanding) the ability to solve business problems in less time. The time to take a traditional sequenced course over 3-5 working days is no longer possible for many. And at times the content may cover objectives the learner has completed in previous courses, a pre-assessment covering multiple content organizations or through on-the-job experience.

Primary Actor: System, Learner, (Instructor)

Stakeholders and Interests:

- Learner - reduces the time required to reach learning objectives, validating their prior knowledge either through a "test out" of content or accessing their learner profile.
- Business - trains customers in a shorter period and improve deployment of software and satisfaction levels.

Preconditions:

1. Authors have written assessment items and added meta-data mapping pre-requisite knowledge needed to skip over or point to necessary objects.

Trigger: Learner launches link to content on a particular domain of knowledge.

Main Success Scenario:

1. System provides pre-assessment option.
2. Learner chooses to assess previous knowledge from on-the-job experience.

3. System presents bank of QTI items.
4. Learner submits responses to individual questions, case studies, etc. in a sequential order.
5. Learner chooses to score results.
6. System provides feedback on entire pre-assessment results (displaying information on possible areas needing attention or remediation).
7. System maps individual QTI item results to prerequisite mastery needed within requested content domain.
8. System adapts learning track and offers alternate learning path based upon assessment results.
9. Learner chooses alternate path.

Extensions:

- 1a. Instructor looks to provide shortened course and teach just what needs to be taught (async activity).
 - 1a1. Instructor creates item bank covering multiple knowledge domains.
 - 1a2. Instructor sends link to pre-assessment to enrolled students.
 - 1a3. Student(s) take pre-assessment.
 - 1a4. System scores results and adds mastery scores to learner profile.
 - 1a5. Instructor creates new learning path for bulk of content and assigns pre-work to individual student(s).
- 8a. Learner has taken previous courses covering overlapping objectives (i.e., Windows 2000 Server has similar functionality repeated in Windows XP course content).
 - 8a1. System maps learner profile to current content and provides alternate learning path.

Adaptive Learning Delivery

Narrative: NETg wishes to be able to deliver content in an adaptive manner based on characteristics of the learner (for example, those found in NETg's Learner Profile project). There are many possible adaptive interventions that can be taken based on learner characteristics. For purposes of illustration, consider that learners with high inductive reasoning generally benefit from seeing concrete examples before conceptual material in a learning presentation, while learners with lower inductive reasoning generally benefit from seeing the conceptual material first, then the concrete examples. Alternatively, consider that learners with high social skills may benefit more from synchronous interaction with their peers, while those with lower social skills may benefit more from asynchronous interaction. These are merely two ways in which adaptive delivery might benefit a learner, and are presented as examples for the purpose of illustration, not as an exhaustive list.

Interoperability of such adaptive delivery would be enabled by a specification that identified the individual components of any given bit of content. Such a specification should clearly describe the educational role played by each piece of content, and how they relate to each other. Further, the specification should allow for the creation of rules embedded in the content that would allow content authors to describe how the presentation of the content should be adapted for the needs of the individual learner.

Primary Actor: Learning Delivery System

Scope: The system under discussion in this use case is the Learning Content.

Level: Summary

Stakeholders and Interests:

1. NETg: Enable the best possible learner experience from NETg content, in an interoperable manner.
2. Learner: Receive the highest quality educational experience from the learning content.
3. Learner's Organization: Provide on-the-job training with maximum results at minimum expense.
4. LMS Vendor: Deliver NETg content in a high fidelity manner at minimum expense.

Preconditions:

1. NETg and the LMS Vendor have a contractual relationship to deliver NETg content.
2. The Learner has an account (presumably through the Learner's Organization) with an instance of the LMS Vendor's system.
3. NETg content is loaded on the LMS Vendor's system.

Minimal Guarantees:

1. The content is delivered to the learner as presented in the descriptions packaged with the content (such as an IMS Manifest) without modification.

Success Guarantees:

1. The content is presented to the learner in the manner that will best serve that learner's needs as a learner, to the extent that said manner can be ascertained.

Trigger: Learner launches an instance of NETg Adaptive Learning content under a 3rd party LMS.

Main Success Scenario:

1. Learner logs in to a 3rd party LMS and launches an instance of NETg content.
2. LMS modifies the presentation of the content according to: the rules embedded in the content, its own presentation rules, and the known characteristics of the particular learner.
3. Learner logs off of the LMS, terminating the experience with the NETg content.

Extensions:

2e. It may be that the characteristics of the particular learner are unknown. In this case, the LMS should follow any rules that are learner independent, whether those rules are embedded in the content or local to the LMS.

2f. It may be that the rules embedded in the content contradict the rules that are local to the LMS. Proper behavior in this case is outside of the scope of this use case.

Appendix 3 Evaluation of Methodologies – Questionnaire

1. a) For which ROLE you have authored use scenarios and use cases?

- b) How many colleagues have been involved in authoring these scenarios and cases? What is their respective expertise?

2. a) Which METHODOLOGIES you have employed to derive the use scenarios and use cases? (Please mark 'X' where appropriate)

- Focus Groups
- Structured Interviews
- Questionnaire Surveys
- Field Observations
- Transfer of Experiences from Other Projects (Please specify: _____)
- Literature Review
- Others (Please specify: _____)

- b) Please explain HOW you have applied the methodologies: (e.g., Who have been involved in the related activities? How much time have the related activities required? Where have the observations taken place? Which literature has been referred to? Which difficulties have been experienced? etc.)

Answer for 1(b):

3. a) Which MODELS or FRAMEWORKS you have based on for translating **user requirements** into **user interface** requirements? (Please mark "X" where appropriate)

- Standards (Please specify:
(_____))

- Guidelines for Design (Please specify:
(_____))

- Transfer of Experiences from Other Projects (Please specify:
(_____))

Other Sources of References, e.g., books, experts, etc. (Please specify:

(_____)

None (Please elaborate your own model/framework:

(_____)

b) Have you referred to any **Usability** Requirements in your user interface requirements?

Yes: Please specify the references: _____

No: Please specify the reasons for not doing so: _____

c) What major DIFFICULTIES you have experienced when translating user requirements into user interface requirements? (e.g., Usefulness of the model/framework you employed, the resources required, etc.)

Answer for 3(c):
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4. What are your COMMENTS on the exercises involved in D1.4 and D1.6 and your IMPROVEMENT SUGGESTIONS?

Answer for 4:
