Internet Based E learning service provisioning platform
Papić, M., Pustišek, M., Zebec, L., Bešter, J.
Faculty of Electrical Engineering, University of Ljubljana, Slovenia
marko.papic@ltfe.org

I ABSTRACT
Successful e-learning implementations, as well as an extensive evaluation of existing commercially available products led to systematic development and implementation of our own e-learning service provisioning system. The basic idea was to design and implement, flexible and easy to use Learning Management and Learning Content Management System (LMS, LCMS).
System supports any Internet based content. Content developers are not limited to design content with any predefined tools, yet they can adapt the content to the needs of learners within the system. System enables flexible, but very simple to use learning management procedure that completely mirrors existing traditional learning process to the hyper space. It supports e-learning provisioning and is completely Internet based.
The paper outlines systematic e-learning introduction approach and reviews necessary components of e-learning. The system that supports complete e-learning implementations is presented and commented upon.

II INTRODUCTION
Introduction of e-learning into any business or academic environment facilitates studying activities as well as management and administration process. E-learning assists in extension and deepening of student’s access to information, increased flexibility of study delivery and integration of student's learning experiences and knowledge. Aspects of e-learning initiation that are not directly correlated with the studying activities are also important. Students save time and money that would otherwise be spent on travelling and accommodation expenses. Faculties with enrolment limitations due to lack of space (lecture rooms, laboratories, ...) can increase the number of enrolled students.

Because all learning materials are in electronic format, their upgrade, maintenance and distribution can be substantially simplified. This is significant in the natural and technical science studying fields where knowledge is modernized and upgraded all the time. Simplified distribution means the increase of use of the same learning materials in different faculties and studying programs. Systematic e-learning introduction also enables better time efficiency in the engagement of the pedagogues.

Internet based education in any target organization should reflect existing traditional learning environment. The process of setting up of e-learning requires inclusion of necessary components that will be described in the following chapter of the paper. When selecting appropriate e-learning platform one should have in mind that majority of activities is usually done over Internet technology, therefore the learning infrastructure should be entirely Internet based.

III NECESSARY E-LEARNING PREREQUISITES
E-learning should reflect actual education process in academic environment and enhance educational possibilities in innovative way from the viewpoint of the course access, contents and level, in order to meet diversified needs of target groups. The only way to accomplish this is to support the following e-learning components:

• **E-learning content** commonly presented in html format, enriched by multimedia that is supported by Internet as well as real time audio or video streaming clips. Java applets are usually used to explain experiments.

• **Management of the learning process** consists of managing students, learning staff, learning content, different learning tools and dissemination of learner's statistical data as well as progress tracking.

• **Collaboration between learners** can be accomplished by forming of groups of learners, giving them common assignments and enabling them to have guided or non-guided discussions among themselves.

• **Pedagogical support** is achieved through tutor - learners communications via advanced communications channels. These can be asynchronous: e - mail, discussions and notice boards, or synchronous: chats or audio & videoconferences.

• **Assessing knowledge** in e-learning is not only about getting feedback on the learners activities and gained knowledge, but also about acquiring complete picture of the quality of e-learning. The most common model to achieve this is through multi-level evaluation. This way we evaluate reaction of the learners, track learners progress and get the results of e-learning.

E-learning set-up and LSP
E-learning initial costs for smaller and medium sized target environments are very high. Purchasing of expensive unnecessary e-learning infrastructure can damage long-term effect of e-learning implementation.

![E-learning set-up](image-url)
Internet represents main technology that is used in e-learning. In order for Internet Service Providers (ISP) to provide e-learning service to the users, they need to set-up e-learning infrastructure. It consists of software necessary to support all e-learning components that were described in the previous chapter of the paper. As Learning Service Providers (LSP) they provide the learning infrastructure to corporate, academic and other environments. LSP enable target environment to concentrate only on learning aspects such as defining learning objectives, developing learning material, pedagogical study support, etc. Technology aspect of e-learning is left to the LSP.

**E-learning key players**

![E-learning players](image)

One of the most important steps in e-learning implementation is the development of electronic course content, adapted to the requirements of ICT based delivery to the learners. Smaller and medium sized target environments are not able to cope with the exertion of time and finances that pursue development process. Content providers as the new key players emerge to fill in the gap.

**IV DESCRIPTION OF THE E-LEARNING SYSTEM**

There were several reasons that led us to develop and implement our own e-learning system. Commercially available e-learning systems can be divided into two groups. The first one consists of the systems that support required e-learning prerequisites and can be functionally verified. These systems tend to be too complex to use and too expensive to purchase, especially for the smaller and medium size target environments. The second group consists of systems that support e-learning components only partially and can not be adapted to the specific needs of target environments. However, main reasons for the implementation of the e-learning system reside in the constraints and challenges that emerged from our practical implementations of e-learning.

**Basic features of the system**

The name, given to the e-learning system, discussed in this article, is E-CHO. System enables multilingual user interfaces, as well as course catalogue creation. Different roles of users were determined in order to define the level of access rights to the system. The authentication and authorization rules disable unauthorized proceeding among different roles within the e-learning system.

The system enables access to course content for the learners, creation of personalized courses. Pedagogical and administrative support during e-learning is also supported. Tracking of learners progress as well as different statistical reporting is an important feature of the system in order to provide the full learning experience.

Readers who are interested in the real e-learning environment, based on the E-CHO system can log on to the http://eizobrazevanje.mobitelovakademija.com web page, where the e-learning implementation for the Slovenian mobile operator can be experienced. The E-CHO e-learning system was implemented at the national telecom operator in Slovenia and at the biggest Slovenian bank for the internal employee training. Currently, there are more than 6000 users learning via the E-CHO e-learning system.

**Understanding the e-learning system**

The e-learning system is an internet based application. As such it can be integrated with any other internet or intranet application that would be potentially used for education purpose.

Education and training of employees, customers, students, etc. is often closely related to the business process of the target environment. The e-learning system is designed in a way that simplifies the integration with the existing information system of the target environment. It usually serves as the part of its information system.

Three main guidelines were set up during the functional specification of the e-learning system:

- the simplicity of use
- system independent course content creation
- personalization of the learning activities

Main features of the system are learning management (LMS – Learning Management System) and learning content management (LCMS – Learning Content Management System).

**Learning management system (LMS)**

The use of the LMS is almost inevitable, as soon as the e-learning consists of different groups of users and different knowledge requirements. For larger corporate or academic environments, flexible and easy to use LMS is necessary.

The system enables access to the learning content, joining of users into groups, administrative and pedagogical support of the learning process as well as acquisition and tracking of the learning progress data.

The following main entities of the system were defined:

- **users** (can have one or more different roles in the system)
- **courses** (complete series of content building blocks, pedagogically and technically suitable for e-learning delivery)
- **educations** (enable flexibility and simplicity of the learning management process)

The figure 3. (on the next page) presents entities of the system. We can presume that the system is installed at the LSP (not obligatory). The top entity is ‘Company (Organization)’. Several of them can use the system on the same server separately. ‘Companies (Organizations)’ create ‘Educations’, the core entity of the system. Each ‘Education’ consists of one or more ‘Courses’ and one or more ‘Groups’ of users.
All users access the e-learning system through specific user interfaces over the internet browser. Due to complexity of the e-learning, transparency and adaptation requirements, system distinguishes five types of users: learners (L), tutors (T), developers (D), managers(M) and system administrator. One can be registered in the system as the member of different types of users at the same time.

Managers work in the system is related to organization of the e-learning. In classical education or training activities, his work is done by the administrative workers in the student departments of the academic environments or human resources and training departments of the corporate environments.

Managers perform pedagogical support to education, tracks progress of the assigned learners and communicates with them.

Learning progress tracking in the system includes the survey of the already visited course building blocks (pages) by the learners (or groups of learners) and the survey of the time spent on the e-learning.

Communication mechanism within the system is implemented through forums within user interfaces.

Learning content management system (LCMS)

Content represents the most important component of e-learning, thus it has to be rich in multimedia, interactive and pedagogically appropriate. These conditions require system or platform independent content development. Content developers should use arbitrary tools for development, according to the needs of the content. They shouldn’t be limited with any compulsory content development tools by the e-learning system that is used for content delivery.

This approach to content development increases the portability of the content, as long as it is being developed in any of the standardized internet format.

The e-learning system discussed, enables importing of any internet based content. The content is usually represented as the series of HTML pages with belonging media building blocks.

The role of LCMS is to develop courses from the imported raw content. First the course building blocks have to be distinguished, sorted into series, then the levels of the building blocks have to be defined. This way the table of contents of the course is created, similarly to the table of contents of the textbook. Subsequently studying tools for the course have to be defined. There are several of them integrated within the system (e.g. user notes, dictionaries, calculator, adding favourite links, etc.), others can be added by integrating any existing internet applications, used for learning.

Course developers can add standardized meta data about the course from which the course catalogue can be created.

Navigation and personalization of the e-learning is achieved by creating different suggested studying paths, adapted to the specific needs of learners or groups of learners. This way learners access and navigate through the course building blocks of their interest. The course content is manageable and personalized from the learners point of view.

The use of arbitrary content search mechanism on the server (e.g. QuestionMark Perception) can be added to the course, thus enabling pre tests, self assessment tests and post tests.

E-learning scenario

LMS features of the system enable implementation of the arbitrary training in any target environment. Only three entities that are familiar from classical education and training are used: education (educational programme), course and groups of learners (classes). The simplicity of this approach distinguishes the system from other existing e-learning platforms.

The following scenario of e-learning implementation in the corporate environment explains the entities and e-learning process in the system more thoroughly.

E-learning programmes in the target environment can be specified from the content and knowledge requirements point of view as:

- information presentation,
- acquiring basic skills or
- acquiring expert skills

Structure of the programme (e.g. structure of the content, the use of communication channels, studying tools, learning timeframe, etc) as well as e-learning content (one or more courses) have to be defined through the creation of different educations (educational programmes) in the system.

Joining of learners into different groups with common properties enables the specification of the level of interaction, pedagogical support and adaptability of the educational programme. Groups of learners have to be assigned to the already created educations.
Figure 4 (on the next page): Learners in all groups will be assigned to the “Business process introduction” education, that consists of Course 1 and Course 2 (e.g. “ISO 9001 standard in our company” and “Secure working conditions”). Learners in the group “Sales department” will be assigned to the “Marketing strategy” education. Learners from the groups “Customers” and “Sales department” will be assigned to the “XYZ product updates” education consisting of several courses.

Managers (administrative staff in the training department of the company) have to set up educations described above. Tutors role is to offer pedagogical support during training itself. Developers have to develop course content, create courses and personalize them to the needs of groups of learners.

System architecture
System is based on the widely used Microsoft technologies. System software consists of: operating system on the server (Microsoft Windows 2000 Professional), database server (Microsoft SQL 2000) and internet server (Microsoft IIS). Functionality of the system is implemented with three tier object architecture. Business logic layer is made up of two sub layers, therefore the term four tier architecture can be used.

Database layer is implemented with the MSSQL Server 2000 database. Stored procedures are used for data retrieval. Format of data retrieved to the business logic layer is XML. Chosen technology enables integration and synchronization of the e-learning system with existing information systems and LDAP directory services.

Business logic layer consists of COM+ (ActiveX) objects, arranged into classes. Classes are made up of number of methods. Layer provides for calls of stored procedures, accepts requests from the presentation layer and returns corresponding data. It is also used for business logic operations of the system, such as computing statistical data, learners progress tracking, etc. Layer is divided into two sub layers. The APL sub layer processes requests of the presentation layer and provides data to it. DB sub layer, on the other hand provides for communication with database layer (collecting and entering of data). DB sub layer simplifies the migration to different databases.

Business logic layer is implemented as two Dynamic Link Libraries (.dll) files, that have to be installed to the IIS WWW server. Presentation layer uses XML (XSL files) and ASP (Active Server Pages) technology that are both embedded in IIS server. ASP files are used for calling corresponding objects of the business logic. XSL files that define appearance of the user interfaces acquire data needed from the objects of the business logic that perform XML transformation. The use of technologies described above enables integration of any internet application (proprietary or non proprietary) that could be used in the education process.

Figure 5: E-learning system architecture
Four tier architecture described in this chapter was used in order to achieve better efficiency and scalability of the system.

The verification process of the e-learning system showed that it can process approximately 100 requests per second.

V CONCLUSION
The use of LMS and LCMS system is becoming a necessity for any target environment that is using the e-learning service professionally. However, the system itself represents only the foundation for successful e-learning implementation. Majority of activities related with e-learning introduction resides in various organizational and economical aspects. Chosen technology should not limit performers of the e-learning. It should enable target environments to focus only on pedagogical and content aspects of educational process. Important parameter is the price of the system used.

E-learning implementations are different in each case. Because of it’s open architecture and the possibility of integration of other applications, the E-CHO e-learning system developed in LTFE is applicable in most cases and this proved to be the big advantage. Cultural and other specifics of target environments were also considered during design of the system. Close cooperation with target environments, adaptation of the system to their needs also proves to be very important.

VI LITERATURE
[1] ICDE – International Council for Oper and Distance Education; [http://www.icde.org]