

Migration from Commercial to in-House Developed Learning Management Systems

Lejla A. Bexheti, Visar S. Shehu, Adrian A. Besimi

Abstract—The Learning Management Systems present learning environment which offers a collection of e-learning tools in a package that allows a common interface and information sharing among the tools. South East European University initial experience in LMS was with the usage of the commercial LMS-ANGEL. After a three year experience on ANGEL usage because of expenses that were very high it was decided to develop our own software. As part of the research project team for the in-house design and development of the new LMS, we primarily had to select the features that would cover our needs and also comply with the actual trends in the area of software development, and then design and develop the system. In this paper we present the process of LMS in-house development for South East European University, its architecture, conception and strengths with a special accent on the process of migration and integration with other enterprise applications.

Keywords—e-learning tools, LMS, migration, user feedback.

I. INTRODUCTION

EVEN though we cannot say that Learning Management Systems (LMS) are the latest innovative educational technology, still currently they are one of the most invasive technologies in higher education. Therefore many educational technologists are exploring these systems from various aspects.

South East European University (SEEU) started with the usage of LMS in autumn 2006, with the implementation of ANGEL Learning. Although there is usually an adjustment period for most students and professors, as they learn the rhythm and patterns of online communication, the interest for using ANGEL has grown from year to year. As it is shown in Fig.1, till now there were added around 1100 courses in ANGEL, and the last number of users was 7700.

The entrances of ANGEL, transformed completely the SEEU course management system in terms of teaching and learning, developing rich situations for collaborative knowledge construction, and information seeking and sharing.

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Being aware of the benefits of the usage of an LCMS and facing the expenses that were very high we decided to develop our own software.

The opportunity of Open Source LCMS was also considered, but because of number of e-systems like: e-roster, e-grading etc. that were implemented in our university during this time, it was decided to design and develop our own system which would solve the LCMS issue but at the same time would offer a solid background for integrating all e-systems.

As part of the research project team, which aims to develop software for Learning Content Management System at SEEU University, primarily had to be decided which features would satisfy our needs and also comply with the actual trends in this area of software development. While analyzing and choosing the essential features of the software, we studied and analyzed several surveys about the usage of ANGEL, as well as compared research papers that assess and/or, compare different LMSs or simply indicate the main aspects when developing an LMS. Next, we designed a LCMS for our university, where we implemented the experience from the research done.

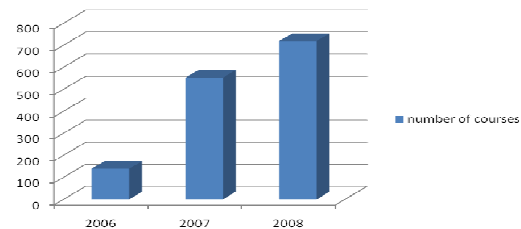


Fig.1. Number of courses taught using ANGEL in the past years.

II. THE DATA FROM ANGEL EXPERIENCE

The reports about the usage of ANGEL, generated from the system itself, as well as the result of the surveys showed that although ANGEL was very well accepted from the teaching staff and students at SEEU, its usage was mainly focused in some specific tools.

The survey results showed that the teaching staff and the students mostly have used lesson and communication tools (Tab.I).

Other ANGEL tools are mainly used from the teaching staff of the faculty of Computer Sciences and the overall usage of these tools is very low. While asked about the usage of quizzes

and other evaluation tools the staff didn't show high interest (Tab.II).

TABLE I

THE USAGE OF LESSON AND COMMUNICATION TOOLS AMONG TEACHING STAFF AND STUDENTS

Lesson tools	Always	Frequently	Sometimes	Rarely	Never
staff	45.00%	38.33%	11.67%	0.00%	5.00%
students	38.22%	37.11%	19.78%	3.33%	0.89%
Communication tools	Always	Frequently	Sometimes	Rarely	Never
staff	40.00%	23.33%	20.00%	6.67%	10.00%
students	22.00%	28.89%	30.44%	14.44%	4.22%

TABLE II

THE USAGE OF TESTING AND EVALUATION TOOLS AMONG THE TEACHING STAFF AND STUDENTS

Testing tools	Always	Frequently	Sometimes	Rarely	Never
staff	8.33%	16.67%	33.33%	13.33%	28.33%
Evaluation tools	Always	Frequently	Sometimes	Rarely	Never
staff	8.33%	18.33%	38.33%	25.00%	10.00%

Based on this data as well as other reports generated from the survey, the initial modules of the new system were defined [1]. The system should provide the possibility for uploading materials, submitting homework's, e-mail communication, discussion forms, announcement and calendar. It is important to note, that the system development was realized using modular approach. This means that one could add or remove other modules to the system as needed without any impact on the initial system.

III. LMS CONCEPTUAL DESIGN AND ARCHITECTURE

A. Conceptual Design

An overview of principal components of the application modular architecture is given in Fig.1. The implementation is split into different parts [2]:

- LCMS.Common –used for defining application entities (ex. Users, Courses, Resources etc.);
- LCMS.Operational –used from application for mail operations;
- LCMS.BusinessLogic –is responsible for all actions that are going on behind the scene;
- LCMS.DataTier – is used from LCMS's BusinessLogic for extracting and storing data;

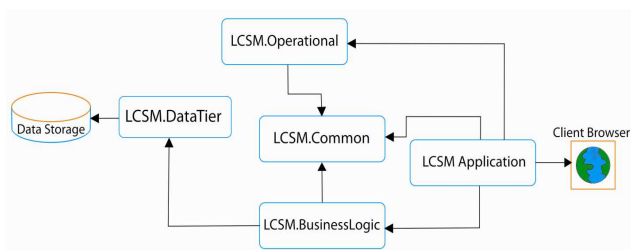


Fig. 1 LCMS's conceptual design

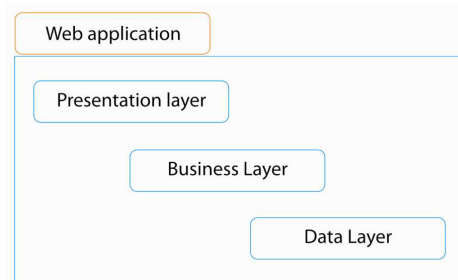


Fig. 2 The LCMS's architecture

B. LCMS's architecture

In this section is described the architecture of the application. Today's most web-based applications use three-tier client/server model [3]. This approach clearly divides the presentation layer from content and data storage. This kind of system decomposition enables us develop large-scale software systems and reduce overall development time [4].

Using this approach, the application's architecture would be like in the following diagram. To present system's architecture, components diagrams are used. The following diagram is composed of three sub-systems: Web Presentation subsystem, Business Logic subsystem, and MySQL database as data storage.

IV. SOFTWARE MIGRATION

A. Project Planning

The project for design and development of the new LMS was scheduled in 4 phases, as listed below:

- Phase_I - winter semester 2007/2008. Studying and testing the existing LMSs, exploring their opportunities and functionality from SEEU perspective.
- Phase_II - summer semester 2007/2008). Design of the LMS according to the research results and SEEU requirements
- Phase_III - winter semester 2008/2009. Development of the LMS modules and integrating them in one functional unit.
- Phase_IV- summer semester 2008/2009. Implementation and evaluation at SEEU.

After a successful realization of the first three phases, the last phase would be to deploy the system and evaluate it while being used in real time.

During the last phase a six month pilot project was started, where a chosen group of courses would use the new system. As a backup strategy, those courses would also be able to transfer to the old system, in case this new LMS would not function.

Participants of this pilot project were mostly Computer Science instructors and students as well as members of the LMS development team. They were encouraged to use the system extensively and report any problem they might

encounter or suggest new features. A noteworthy fact was that these participants did not receive any formal training; the aim of this experiment was to realize the adaptability curve of the system. [5]

The target group for this experiment consisted of less than 5% of the entire university population. However, the feedback gathered from them was tremendous and very insightful. The development team set up a feedback system based on Uservoice (Fig. 1), which proved to be a very efficient communication channel between LMS users and the development team. [6]

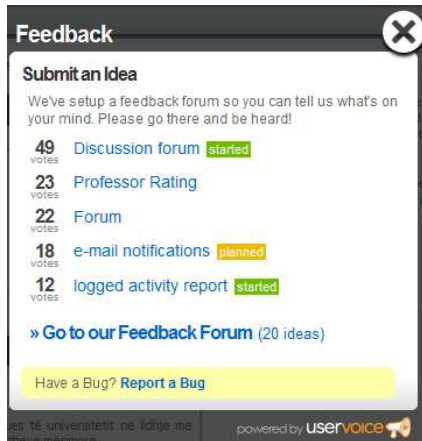


Fig. 3 UserVoice feedback modal dialog

Most of the concerns related to user interface issues such as navigation, lack of consistency with the old system and performance / efficiency issues. Users also used the opportunity to propose new features and recommendations which mostly had to do with individual system usage.

All the suggestions were gathered and sorted by priority. Many of them were scheduled to be developed during the future phases of the system, while others were left out due to lack of time and resources.

A usability study using heuristic evaluation was also executed during the pilot phase. The heuristic evaluation implemented Nielsen's model. This study helped the researchers to identify and fix any user interface / usability problem with the system.

B. New feature acceptance

During the early phases of the project, the research team performed a requirement analysis which consisted of surveys, interviews, system usage analysis etc. It was decided that besides implementing core features from the old system, the new LMS had to introduce its own modules. Among these new modules were the blogging tool, custom site creation and direct communication channel with the development team.

The blogging tool encouraged teaching staff and students to publish daily thoughts, communicate their work with the world or any other content they felt was necessary.

Students and instructors also had the opportunity to create their own custom sites. This way they could create groups of

common interest areas where they could collaborate on projects, assignments or just have a common place where they could communicate and share ideas. These sites would be created upon user request.

All these features were welcomed and accepted by users immediately after the system was launched. There was a growing interest into using custom sites and creating blogs. Instructors and users also took full advantage of the new feedback system, by submitting numerous requests and bug reports. Many bugs and security vulnerabilities were identified and handled on time due to these reports.

The pilot project also helped identify the acceptance level of the new features. Unfortunately reports from this experiment as well as after the full scale launch of the system showed that these new features were mostly used by Computer Science teachers and students. It was realized that teachers and students from other departments would have to be trained and informed about the benefit of using those features.

C. Large scale deployment

The six month pilot project proved to be successful among the chosen sample of users. After this phase the true test for the system would be a large scale deployment for all courses taught during the spring term in SEEU.

The system had the possibility to fetch data from the Online Scheduling System in SEEU, and create courses automatically. A total of 1186 courses with a total of 3837 users were created either using this automatic process, or manually upon request from users. During the first month of usage more than 3600 files were uploaded on the system, 80 discussion forums were opened, and more than 800 emails were sent.

The development team kept track of user activity both using system logs and by using Google analytics. These reports showed that the system had a constant increase in the number of visits, with a total of 4509 visits during the last week of March, and 2481 unique visitors. Most of the traffic (66.98%) was caused by directly accessing the site while the rest from referring sites (27.59%) which was mostly the main SEEU web page (www.seeu.edu.mk). A small amount of visits was credited to search engines such as Google.com or Live.com.

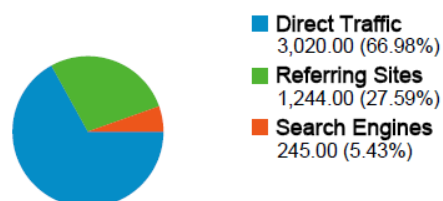


Fig. 4 Google Analytics report

The new LMS was designed to scale appropriately regardless of the demand. Its architecture consisted of a separate database, application and file server, all of which supported with appropriate backup systems. Even though the increase of demand was sudden, the system did not suffer from any major performance hit.

In conclusion students and instructors successfully migrated from the old system to the new one. It was also encouraging to find out that the system was ready to support the quick increase in load, and perform without any major delay or downtime.

D. Migration tools

When migrating from an old information system to a new system, one must take extreme caution into data migration. While developing the new LMS, one of the major migration issues was import courses from ANGEL Learning. This operation was handled by system administrators using a custom tool developed for this purpose. The tool was designed to preprocess data, transform them and import them to the new system.

ANGEL Learning offered a tool to export data in a given format. All files were named using UID's (Unique Identification Numbers) and referenced using supporting XML files. The tool used to import data onto the new system had to parse the XML files and remove all redundant information. After the data was preprocessed, it had to be transformed to conform to the new LMS information storage structure.

The tool was effective enough to transfer all old courses without losing any information. Data such as emails and discussion forum posts were not imported, since they would not be relevant for new courses.

It was set for future development to extend this tool to export and import courses using a SCORM standardized format. [7] This way the new LMS would be capable of communicating with other similar systems that are SCORM compliant.

E. Integration with other enterprise applications

Additional issue to mention here is the integration with existing systems inside the organization. In order to avoid duplicate data, the LMS database contains only the foreign keys that refer to the other databases primary keys that are managed by the organization.

When original data is required a proxy server queries the other databases within the organization and returns the result to the LMS server (Fig. 5) [8].

The provided solution with a proxy server does not require duplicate data in various databases and offers an easy way to integrate various applications inside the organization. On one hand, as seen on Fig. 5, the University Central Database is isolated from the existing network, allowing only certain servers to access these data directly. These are sensitive data that contain student records, such as grades, fees, contact information and similar. On the other hand, on the same server there is a scheduling database which handles all the scheduling for teachers and students.

To make the new LMS work perfectly a full integration with the existing data from these two databases is implemented, through the proxy server. The proxy server runs web services that execute queries and return results as data objects to the LMS.

This way, no student data are stored on the LMS database server, neither teacher data nor course data. Only references to University Central Database are saved and through the web services served by the proxy every data can be retrieved without the need of duplication.

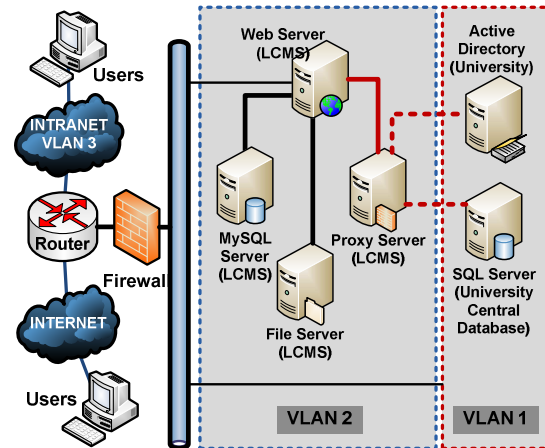


Fig. 5 bSimplified University network schema and infrastructure architecture for a LMS solution

This solution offers increased security as well, due to the Virtual LAN configurations. The physical network is divided into several VLANs (Virtual LANs) which separate networks from accessing the main database and domain servers. This schema prohibits any user, including the ones from the Intranet (VLAN 3) or Internet to access servers that contain sensitive data, like the University Central Database on VLAN 1.

Another integration is the Active Directory server (Fig. 5) which is managed by the University's IT Office, and this way the LMS Web Server has no need to store any user credentials or user data on its own server [8]. User's info, Roles and credentials are stored on the Active Directory Server and the reference is kept on the LMS database. Again, if additional data is required a proxy server provides them to the LMS system.

V. CONCLUSION

This paper included many aspects of the LMS development and its implementation. The system that has been developed and is being further on updated constantly is very complex. Therefore, it was very difficult to put in a single paper all the experiences gained during a two year period of this project. The running version of the release of the LMS: is <https://libri.seeu.edu.mk>, and there additional information regarding the technologies behind this system can be found.

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