ONE APPROACH IN DISTANCE LEARNING INFORMATION SYSTEM DESIGNING

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Abstract—In this paper, the designing of business activities that take place within authorized platform of Distance Learning System – DLS, with the aim to improve the organization and achieve as better as possible teaching process in secondary education. Authorized DLS platform represents a dynamic interactive DLS Web application created in ASP.NET technology. Functional and information modelling was performed by application of IDEF method. Within DLS platform, there are multimedia e-learning resources, i.e. multimedia teaching units, which can be of different types: processing, determination or verification of knowledge. Performances of DLS application were analyzed and possibilities of further upgrade of DLS platform were considered.

Keywords—Business processes, Distance Learning System, E-learning resources.

I. INTRODUCTION

APPLICATION of multimedia creative solutions in development of DLS (Distance Learning System) represents innovative technology for knowledge placement in order to raise the education quality [1-6]. For the realization of DLS projects, development environment Microsoft Visual Studio was used. Functional Modelling of business processes of DLS platform was realized by application of **IDEF0** method, i. e. **CASE** (*Computer Aided Software Engineering*) tool **BPwin** (*Business Process for win*dows).

Project task includes the development of distance learning at teh level of processes, data models, user and web application by applying appropriate tools in the following manner:
1) *Development of the functional process model in BPwin programme;*
2) *Development of information process model in ERwin programme;*
3) *Development of applicative model in programme MS Access;*
4) *Development of Web application in ASP.NET technology.*

The first and fourth item of the project are the subjects of detailed consideration in this paper, while the second and third are mentioned as integral parts of entire project. Based on projected functional and information model, database of distance learning business process and Web site of appropriate information system. In final part of designing, possibilities of managing developed information system in real conditions are examined.

The aim of this paper is to apply modern methodologies on distance learning business process in order to develop information system and put such a system in operation.

The significance of the paper is in:
1) *Overall observation of the issues of database organization, which can serve as basis for the extension of requirements for the upgrade of such database type;*
2) *Availability of Distance Learning Information System (DLIS) on the site http://localhost/eucenje, realized at local computer of Technical School in Vrbovac. Distance Learning application, as a part of this information system, is fully realized on Web site www.webng.com/eucenje;*

In the first part of the paper, the process of DLIS modelling was developed. Functional modelling of the process was performed in BPwin programme by defining limits of the model, presented through context diagram. Afterwards, context diagram was divided in subactivities, which created conditions for formation of activity tree and decomposition diagrams.

The second part of the paper represents the upgrade of DLIS modelling and the architecture of Web application was also analyzed in it through the sequence of activities of accessing database through Web page.

Functioning of the realized distance learning system is explained through activities from: assigned learning resources, made learning resources and administrative application (the third part).

Within concluding remarks, the advantages and disadvantages of distance learning information system application are stressed and conclusions reached through systematic monitoring of system's operation in real conditions are presented.

II. FUNCTIONAL MODELLING OF DLIS

Analysis of information systems (IS) methodology implies defining of the term information system, its functions, as well as the position of information system in the environment where it acts. This methodology is of general character and it should be applicable to any type of the system. The system is defined as a set of objects (entities) and their mutual relations. Limits of the system

define a set of objects that are observed in that system. Objects of the system are often related with objects outside its borders. For that reason, it is required to determine the system's limits that isolate relevant system objects from its environment. Effect of the environment on the system is described through the entrance into the system, and effect of the system on environment through its outputs [4, 7].

Development of DLIS is based on IDEF0 standards for functional modelling and IDEF1X (eXtend) standards for information modelling. IDEF0 are the modelling techniques based on the combination of graphics and text, which are presented in an organized and systematized manner in order to increase the understanding and provide logics for potential changes or specified requests, i.e. in order to support the system analysis by levels [4], [7]. Functional modelling of ISUND was performed through context diagram, activity tree and decomposition diagrams.

Context diagram is the highest level of abstraction that is translated into lower abstraction level by decomposition diagrams. Generalized review of context diagram of the activities of distance learning system with accompanying elements of input, output, controls and mechanisms is shown in Fig. 1.
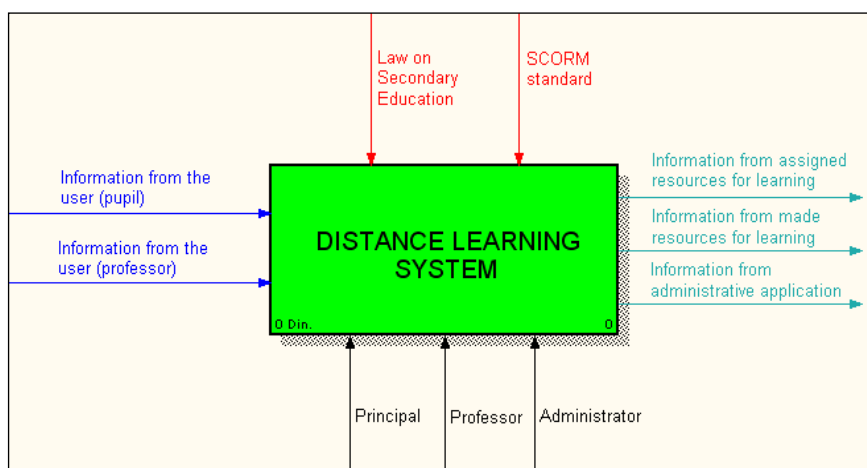

Fig. 1. Context diagram A0 – DISTANCE LEARNING SYSTEM

Input group of information on context diagram consists of:
1) *Information from the user – pupil (logging of pupils on DLS platform, requirements and needs of pupils);*
2) *Information from the user – professor (logging of professors on DLS platform, requirements and needs of professors).*

Output group of information consists of:
1) *Information from assigned learning resources represent the list of all assigned tasks through which logged pupil is informed about the details of all assigned homework;*
2) *Information from made learning resources is a list of accomplished tasks through which logged pupil is informed about the details of all homework he has done;*
3) *Information from administrative application includes personal data of students and professors, as well as statistical data on all assigned and done tasks.*

Controls are:
1) *Law on Secondary Education;*
2) *SCORM (Sharable Content Object Reference Model) standard. By applying some of e-learning standards (such as SCORM standard) on DLS platform and e-learning resources set on platform, realized distance learning system becomes SCORM compatible. Thus we provide different DLS platforms, which support the same learning standards, to freely exchange data, i. e. e-learning resources [8].*

Mechanisms in system's operation refer to principal and administrator. Principal is responsible for overall operation of institution for education and upbringing, and thus the regularity of all information within DLS system. Administrator is responsible for the input of new data, update of the existing and erasing of unnecessary data. In one word, administrator is responsible for functioning of entire DLS system.

Decomposition diagram. By defining decomposition diagram, activities of distance learning process are identified: Activities from assigned learning resources (1), Activities from made resources for learning (2) and Activities from administrative application (3) (Fig. 2). By developing decomposition diagram, vertical and horizontal connections between the activities of the same level are established. Decomposition of activities from administrative application into subactivities is shown in Fig. 3.
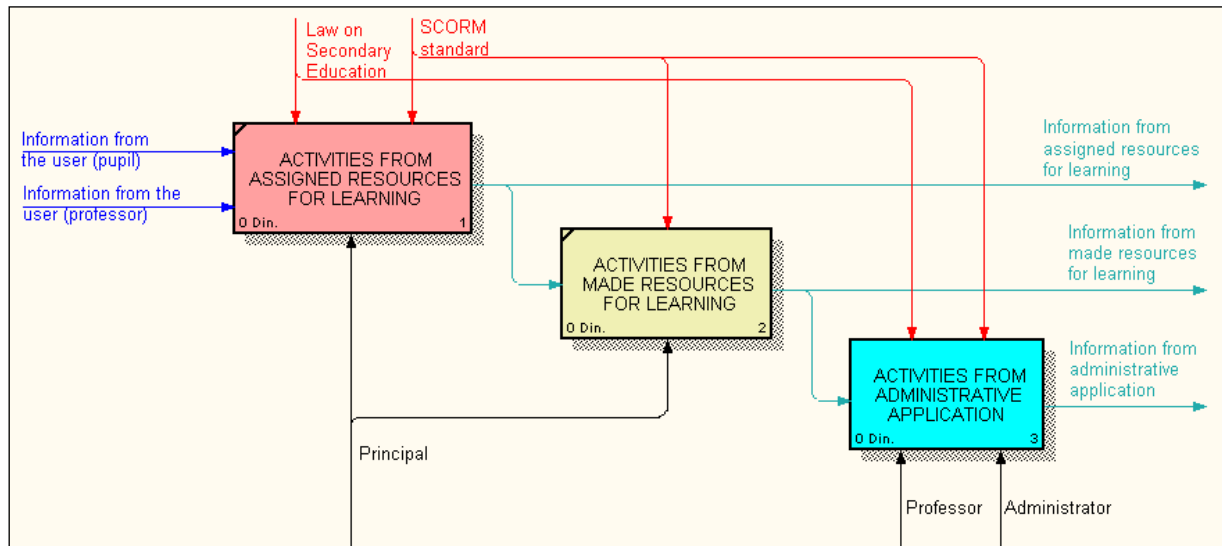

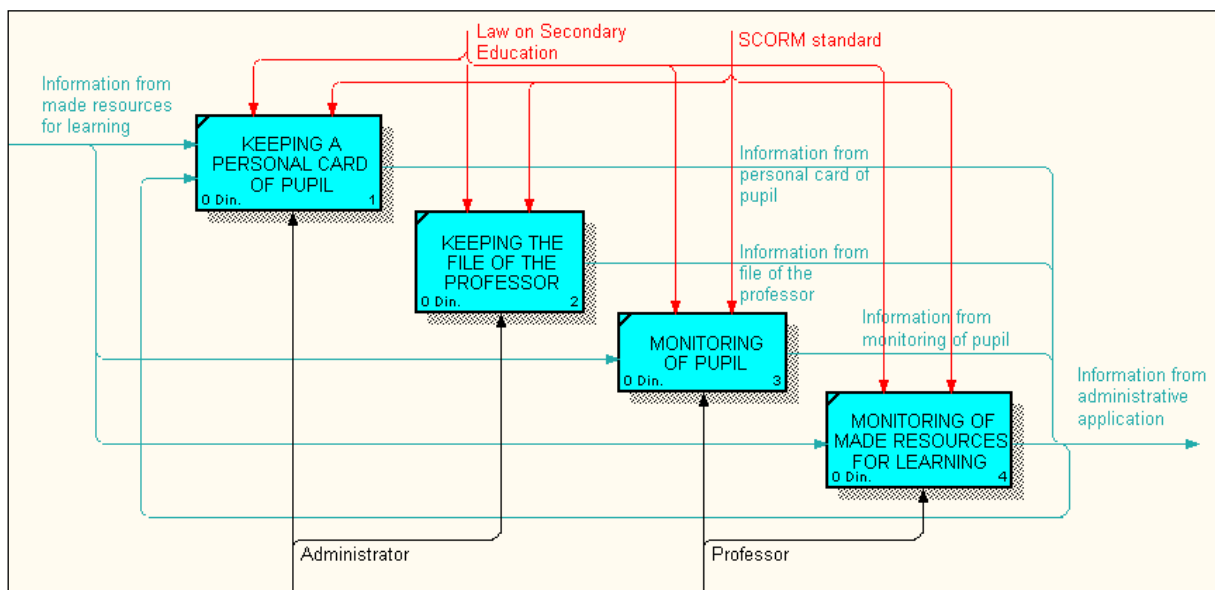Fig. 2. Decomposition diagram A0 - DISTANCE LEARNING SYSTEM

Fig. 3. Decomposition diagram A3 - ACTIVITIES FROM ADMINISTRATIVE APPLICATION
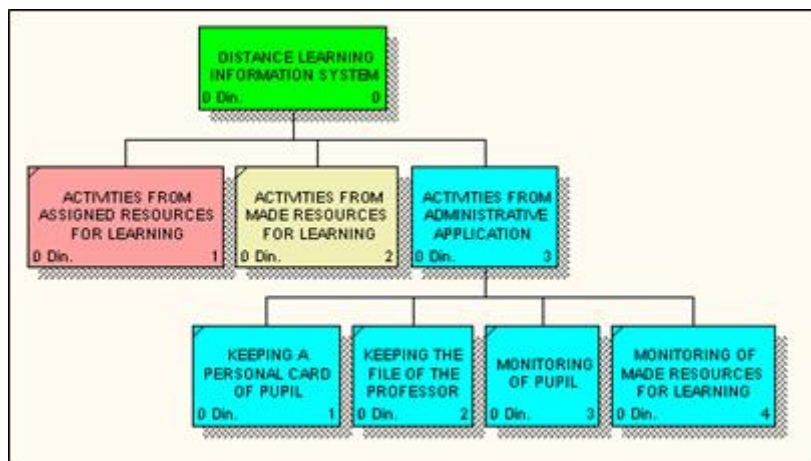
Fig. 4. Activity tree A0 – DISTANCE LEARNING SYSTEM

By developing context and decomposition diagrams, the conditions for the creation of **activity tree** is are obtained. On activity tree, there are vertical (hierarchical) connections between activities. Activity tree is defined by top-down method by which the complex activity, i.e. process is decomposed into several subordinate activities. In other words, starting complex activity is decomposed into a set of subordinate activities and subactivities whose structure is of tree type. Activity tree gives an insight into the depth of the development of connections between activities and subactivities (Fig. 4) [7]. As it can be seen from the Fig., the first two activities are primitive because they do not have subactivities. Activities from administrative application are decomposed into subactivities: Keeping a personal card of a pupil, Keeping the file of the professor, Monitoring of pupil and Monitoring of made resources for learning.

III. OPERATION MECHANISM OF APPLICATION

DLS platform, as a software solution that provides the implementation of distance learning process, contains a few important characteristics significant for the quality of this and any other application:

Optimized access to data (i.e. rational use of shared resources such as network and database itself);

Secure and fast access to database through stored procedures;

Reliable Web page load response in case of testing in different Web readers.

By connecting database and Web server of applications on set inquiry, we obtain the response that contains the data from the base formatted in accordance with the instructions. Those data are inserted on Web page and forwarded to Web client. Application server unites asp document (which can exist in database or out of it) with information stored in base and sends an asp document with inquiry results on Web server.

The following steps [5] show the database access operations sequence, by means of a Web station (Fig. 5).

1) *A Web guest starts the process by submitting his/her request concerning the database data to a Web server, activating a hyperlink by a mouse or clicking on the button "Submit";*

2) *The Web server (IIS) receives the request and on the basis of .asp extension starts the processor ASP script;*

3) *ASP script decodes the forwarded page by performing each code of a server script;*

4) *The server script code registers different ADO objects and uses the methods typical for these objects in order to get a direct access to data sources available on the server;*

5) *The application function – Open Database Connectivity (ODBC) – can be defined in the following way: in order to use MySQL or SQL program, it is necessary to conFig. the accessing application for operations with databases (a front end) so that this application can function as a database organizer. ODBC enables an alternative way of data access;*

6) *The data are forwarded to the database either directly from ADO or indirectly from ODBC, through a data forwarder;*

7) *The database data are built in ASP station and forwarded to a client in a reverse sequence. In other words, when a sender gets access to the data, he/she sends back the processing results to ASP script either directly (through ADO) or indirectly (through ODBC);*

8) *ASP script answers a Web guest sending him/her an adapted Web page [9-12].*

Distance learning information system is designed in three levels and it consists of integrated database, system for database management and applications: jobs from assigned learning resources, jobs from made learning resources and jobs from administrative application [5]. Mentioned applications function by processing data from appropriate file in database or data consolidated according to defined criterion from other files through DBMS system. For the purpose of aesthetic designing and efficient use of distance learning system database, main form through which modules of the base are called.

Work with database through main form includes the

access to the forms from main form, output from the forms and return to main form, input in report and return to main form, as well as output from main form, i.e. ending of the work with database. Main form simultaneously represents the content of the operation of entire information system and it is shown in home page of application – Web site (Fig. 6). Through command buttons, connections are formed with forms through

which data are updated in appropriate tables and reports are presented [13]. Home page of the site is created in FrontPage, while the other pages are created by the object „Data Access Page" - DAP. It is the object that contains tools for drafting Web pages and transfer of data on the Internet. Unlike other objects in Access, pages can be used independently from Access because they can be opened by any Web reader [9].
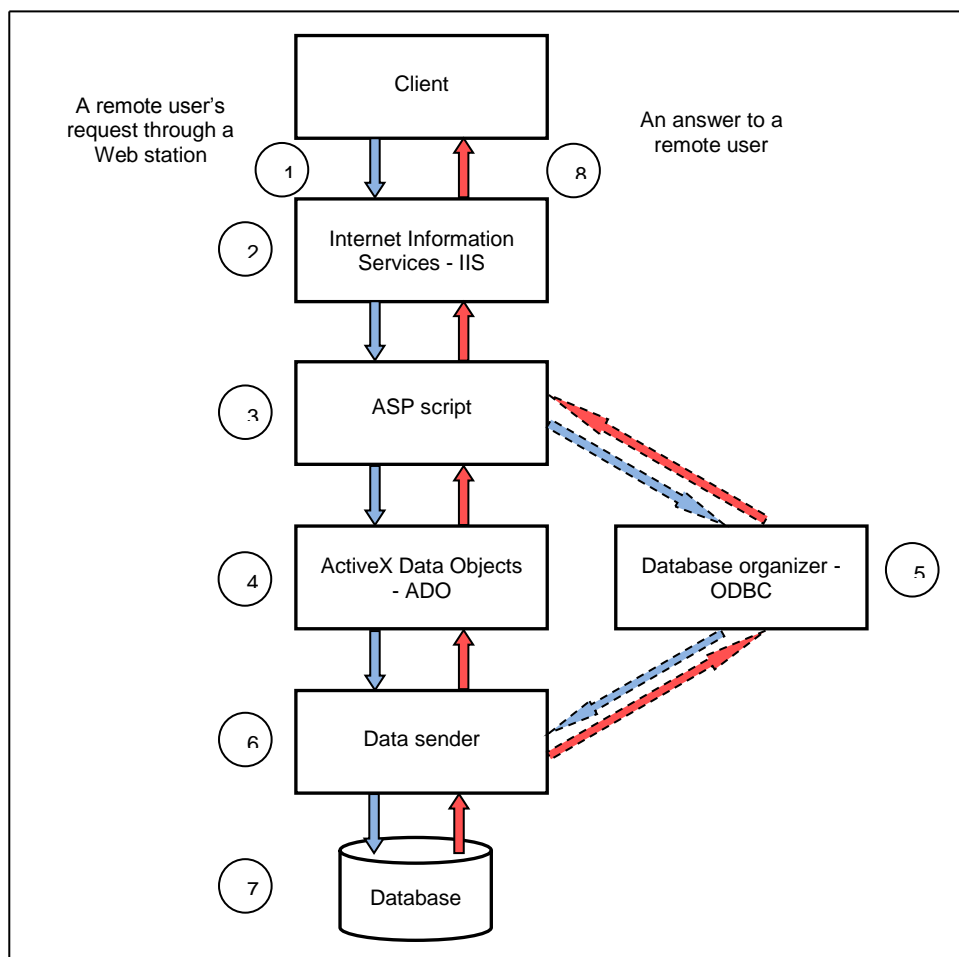

Fig. 5. An application architecture [5]

IV. FUNCTIONING OF THE REALIZED SYSTEM

Based on the above exposed functional model of distance learning system and operating mechanism of corresponding Web application, we can describe the functioning of the realized system. It is explained through the activities from the assigned resources for learning, activities from made resources for learning and activities from administrative application.

4.1. ACTIVITIES FROM ASSIGNED LEARNING RESOURCES

Business function *Activities from assigned learning resources* provides the logged pupil to review the content of the tasks that he needs to do for homework (Fig. 6). If the pupil has done all the tasks, appropriate message will be written for him, i.e. that there are no assigned tasks. This control practically represents the list of all the tasks

assigned to the pupil. Logged pupil gets notifications from the list regarding the details of all the tasks assigned to him, such as: subject from which the task is assigned, title of thematic unit and teaching unit of the assigned task, date when the task was assigned, date when the work was started and deadline for its completion, maximum score that successfully performed task can bring, name of the professor who assigned the task and type of the task (processing, determination or verification). In the end, the link is shown which initiates the task assigned and enables the pupil to have an insight into the task and to solve it.

4.2. ACTIVITIES FROM MADE RESOURCES FOR LEARNING

Business function Activities from made resources for learning enables logged user revision of tasks that he has already done. Accordingly, Web user control of *Activities*

from made resources for learning (Fig. 6), analogous to previously described function *Activities from assigned resources for learning,* informs logged pupil about the tasks he has done. If the student hasn't done a single task, a message will be written for him that he has no tasks that are completed. In other words, mentioned control of *Activities from made resources from learning* represents a list that provides information for logged user regarding the details of all the tasks he has done, such as: subject from which the task was done, title of thematic unit and teaching unit of the task done, date when the task was assigned, date when the pupil has done the task, maximum score that successfully performed task brings, name of the professor who assigned the task and type of the task (processing, determination or verification). In the end, there is a link that provides a review of the tasks completed previously, so that pupil can be reminded of them and analyze his success.
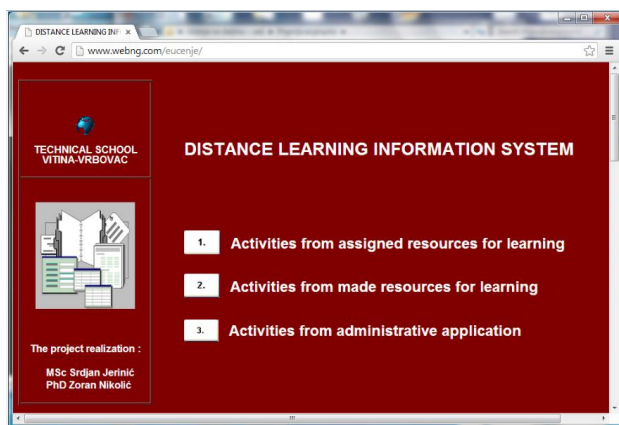

Fig. 6. Main form of Distance Learning Information System on homepage

4.3 ACTIVITIES FROM ADMINISTRATIVE APPLICATION

Based on the information from made learning resources, within the activities from administrative application, certain activities are predicted and they refer to: keeping personal card of pupil, keeping the file of the professor, monitoring of pupil and monitoring the made resources for learning. Keeping a personal card of pupil implies regular updating of pupil's personal card which contains all information and statistical data related to overall work of individual pupil based on which it is possible to assess the success of his work.

By keeping the file of the professor we define his duties and responsibilities, update his personal data and monitor progress in work.

Main document for monitoring pupil's work is parish register. It contains all personal data of the pupil that refer to enrolment (or expulsion), class, course, success for each school year and education and behaviour measures. In monitoring made learning resources, in case that resource type is knowledge verification, duty of the professor consists of the following: review and grading of made knowledge verifications, then distribution of grades, results and comments to pupils.

Management and organization of entire DLS platform system is carried out through administrative application and administrator is responsible for all entered updated and erased data. Specific duties of the subject teacher in e-learning within the presented DLS platform [3] consist of the following: creation and designing of multimedia learning resources, distribution of e-learning resources to pupils, tests creation, grading of the tests done, as well as distribution of grades, results and comments to pupils.

V. CONCLUSION

Possibilities of applying presented DLS platform are various. First of all, DLS platform enables raising education level and implementation of better teaching process that would facilitate learning for its users and make education process more interesting. Designed DLS platform can be used in implementation of classes through distance learning in all educational institutions at all levels of the Republic of Serbia. Content of e-resources for learning, set within DLS platform, will determine the nature of educational profile and education level of its users.

Directions of further studies of DLS application are aimed towards the introduction of new possibilities, such as application of Business Intelligence designing methodology that is supposed to translate the existing transaction DLS database into analytical database and enable OLAP (On-line Analytical Processing) and Data mining analyses [14]. In short, it is required to perform Data Warehousing. It is a specially designed analytical database in which the data are loaded from transaction base through the set of ETL programmes (Extraction-Transformation-Loading). After this, it is possible to implement OLAP data processing and discovery of „knowledge" in data (Data Mining). Results of Data mining analyses can be used in the process of making business decisions, which is the essence of the business intelligence concept.

Application is done by flexible interpreted ASP and VBScript language [15]. It is designed simply and it can be easily changed and adapted to new requirements of the users. Although the development of similar applications is in full swing, the conclusion that there should be more of them is inevitable. Therefore, this implementation represents a modest contribution to the increase of informatization level in education.

This information system in practice will probably show some flaws. Flaws observed and improvements that will be imposed by themselves through further functioning in real conditions will be a subject of work in the next developmental phase.

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