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Development of the effective system of cloud

technologies for the engineering education sector of the

Republic of Kazakhstan

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The paper shows the results of the study of possibility to develop effective cloud services for the sphere of engineering education in Kazakhstan at the present stage. Based on analysis of existing cloud-based solutions of the largest cloud providers, the cloud platform Windows Azure was chosen to host the educational cloud SaaS service. The designed version of the software architecture of the system has the following feature. The site core is located in the cloud hosting Windows Azure. CMS Drupal is installed using MS SQL database. Modules of the educational SaaS cloud service: "Teacher", "Student", "Data storage", "Online office", "Testing" are integrated on site into service with CMS Drupal. Module "Teacher" interacts with the module "Student" and with the module "Data Storage" via service (web site), developed on the base of Drupal. The process of data sharing in the "Data Storage" module is synchronized with Google Drive and functions via opening access to files and folders for all members or authorized users of the system. The site backup is stored in the cloud storage Dropbox. Taking into account the presented software architecture of cloud services and features of its main elements, the model of educational cloud service SaaS was developed. The architecture, basic modules, the principle of operation of the system and models were taken into account in the development of the algorithms complex for cloud service. For a software implementation of the tasks in the work we made an justified choice and gave a detailed description of the cloud platform and packages of system, tool and application software. Multifunctional module "Online Office" was developed, which works on Google Docs platform, performing functions of corporate instant messaging. The system start was done in the cloud, and the developed complex of educational services were tested at educational materials of engineering specialties, showing its performance and high efficiency.

Keywords: engineering education, cloud computing, cloud platforms, cloud services

Introduction

Development of efficient cloud services for the sector of engineering education in Kazakhstan is important not only against the background of the use of cloud computing in today's stage. In the opinion of authors Varachev (2012), T.V.Batur, F.A.Murzin, D.F.Semich (2014) it is due to the following factors: time savings, as there is no need for continuous monitoring of technical facilities and their condition, the lack of large investments, automated and scalable projects, which positively affects the work and further growth of the university, as well as data security and flexibility in the organization of educational process.

The main purpose of this work is to study the possibilities of developing an effective system of cloud-based solutions for the education sector of the Republic of Kazakhstan at the present stage. In accordance with the intended purpose of the work it is necessary to substantiate and develop a cloud-making system in the form of easily scalable, flexible, accessible and secure web-based applications.
Designed service must be suitable for practical use, and contain all the necessary services of such class.

1 Development of models and modules of the cloud solutions system for education sector of Kazakhstan

The proposed architecture of cloud services system for education sector in Kazakhstan is presented in Figure 1.

![Figure 1 Architecture of cloud services system for education sector in Kazakhstan](image)

Based on analysis of existing cloud-based solutions of the largest cloud providers, the cloud platform Windows Azure was chosen to host the educational cloud service SaaS (software as a service). The detailed description of main elements of the developed model of cloud service is presented in works by Utepbergenov, Naraliev, Baymuratov, Galiyeva (2015), Utepbergenov, Galiyeva (2015). The site core is located in the cloud hosting Windows Azure. CMS Drupal (Content management system Drupal) is installed using MS SQL database. Modules of the educational SaaS cloud service: "Teacher", "Student", "Data storage", "Online office", "Testing" are integrated on site into service with CMS Drupal. Module "Teacher" interacts with the module "Student" and with the module "Data Storage" via service (web site), developed on the base of CMS Drupal. The process of data sharing in the "Data Storage" module is synchronized with Google Drive cloud store (as well, it is possible to use other stores, for example, Dropbox or Yandex disc) and it functions via opening access to files and folders for all members or authorized users of the system. Administrator of the site core at Drupal periodically performs Backup to Dropbox via the module Backup Migrate.

2 Development of the model, functional structure of SaaS solutions and modules of cloud services system

In the light of the system architecture of cloud services for education sector in Kazakhstan (Figure 1) and the main features of its elements, the model of cloud service was developed.

Algorithm of the developed cloud service for education sector is based on the algorithms presented in the works by Safonov (2012), Fingar (2011) and the works of the authors of this report Utepbergenov, Baizyldayeva, Nurmagambetova (2014), Utepbergenov, Baizyldayeva, Iskakova (2014), Utepbergenov, Baizyldayeva, Uskenbaeva, Iskakova, Berkinbayeva, Nurmagambetova

The architecture, basic modules, the principle of operation of the system and models were taken into account in the development of the algorithms complex for cloud service. The information system SaaS based on the cloud technologies was developed as the main cloud service for education sector in Kazakhstan. The project is a set of measures and tools to create a cloud SaaS. The functional structure of SaaS system is shown in Figure 2.

![Figure 2 The functional structure of SaaS system](image)

Customer – an Educational Institution (University, education department of the region, oblast, etc.) interested in integrating of educational services or cloud solutions using cloud technology into their own information system. Customer acts as the initiator and the cloud-based solution formed in the design and development process is oriented on him.

Check list – a form containing non-formalized description of the required solutions. It is the main communication means at an early stage of the design.

Designer – a performer, fulfilling the following functions: processing the questionnaires completed by the customer, building a model based on data from the check list, discussing this model with the customer and creating a conceptual model, based on which the project is built.

Discussion - the process of discussing the model created by the designer based on data from the customer’s check list. The result of the discussion is a conceptual model of the designed system.

Design Tools - application and tool software, techniques and principles used in the design process. The cloud design tools are indicated in the scheme as an example of the use of cloud technologies for the development of information systems.
The result of the design phase of the project is a conceptual model of information system - an abstract model that defines the structure of the simulated system, the properties of its components, and cause-effect relationships inherent to the system and are essential to achieve the objective of modeling - creation of efficient cloud service.

Approval of the draft model - a conceptual model, approved by the customer, subsequently implemented by developers.

Developer - Specialist implementing conceptual model of the project in practice. Also, the developer implements the technical support of the project. The computing and software resources of the cloud platform Windows Azure are mainly used in the process of development.

Development tools - tool, application and system software and other tools used in the process of building, testing, improvement and maintenance of the final product. Also, the software written by developers is used actively in development, these are templates, small programs, modules and software for testing.

Testing of SaaS solutions - testing of the finished project in the dedicated environment. The unaccounted features of the software are revealed in the process of testing and measures are taken to remedy any mistakes.

Turnkey SaaS solution - cloud service, suitable and used for its intended purpose, presenting implementation of the project conceptual model approved by the customer. The finished project is not the final design stage and can be modified due to changes in customer requirements to the product or changes in architecture of the cloud platform.

3 Generalized algorithm of the system operation

Information system SaaS includes several stages of creating a cloud service.

"Cloud" is a new business model for the providing and receiving of informational educational services. This model allows not only to reduce operational and capital costs, but it increases actually the effectiveness of innovative educational process.

Step 1: Start (Figure 2).

Step 2: The company wants to implement cloud services into its business model. It may be a document management system, special tools specific to the customer's area of work, but transferred to a cloud platform, cloud storage of data or any other plan for cloud use. Customer choses cloud technologies for implementation of his business processes and methods which should be used for the implementation of integration. In order to understand the customer, which may have a misconception about cloud technology, and to understand his needs, the customer fills in a check list which describes most clearly the result of the upcoming work. Further, the designers take the check list, analyze customer requirements and build an analytical model of the concept of information system, using all the available design tools, including the cloud. Besides, the dialogue with the customer is continuing during the design phase, and the customer takes an active part in the discussion, formulation and approval of the analytical model of the model concept. Also, during the development, the customer gets to understand working principles of cloud services and the vast possibilities of using SaaS cloud technologies.

Step 3. The result of the design phase is an analytical model of the concept of information system - an abstract model that defines the structure of the simulated system, the properties of its components, and cause-effect relationships inherent in the system and are essential to achieve the goal of modeling - creation of efficient cloud service. The analytical model of the concept must be approved by the customer in order to begin to implement it in practice.

Step 4: After the approval of the analytical model of the concept with the customer, the project moves to the development stage. At this stage, the developers begin to assemble the product, using intensively model design tools for cloud software as a service. Also, developers use their own tools and blanks / templates to accelerate the development of the project and to reduce routine work.
Step 5: Test of the created solution. Testing is performed in order to identify problems in implementation of the final version of the cloud services to the customer of educational services.

Step 6. Customer implements the designed system on the test machines, or in a particular segment of his computer system for review, conducts stress tests, identifies problems of integration and technical features of the work. After the test run of the system, the final adjustment of the elements is done, and minor faults and shortcomings are fixed.

Step 7. After successful end of tests, the solution is ready for implementation in the educational institutions. Further support of the solution is based on the agreement with the customer, and may include the further development of the solution, technical support and maintenance of the developed solutions, and so on.

Step 8. The end.

4 Start and testing of the service

The developed complex of educational services was run in the cloud and tested for research purposes. To start SaaS «EduCloudKz» service one should open the window of any browser (eg, Internet Explorer, Opera, Firefox, Chrome). In the address bar one should specify the URL - address http://educloudportal.azurewebsites.net.

After that, enter the username and password for the account in the section "Sign in". In this version of the site, there are 3 types of accounts: administrator, teacher, student.

Designed complex of educational services can be used for various educational specialties. As engineering specialties, namely IT specialty, were closer for the developers, so the test was performed on the learning materials of engineering specialties data.

Some screen forms of cloud services in test mode in Russian are presented in the following figures. Figure 3 is a page of “Student” account in the site.

![Image of EduCloudKz](image_url)

Figure 3 Page of “Student” account

Page «My profile» of the account «Teacher» is shown in Figure 4.
Figure 4 Page «My profile» of the account «Teacher»

Testing of the developed program has shown that the complex of educational cloud services «EduCloudKz» satisfies the basic needs of educational institutions of the Republic of Kazakhstan in the application of innovative cloud technology.

5 Conclusions
1. Based on analysis of existing cloud-based solutions of the largest cloud providers, the cloud platform Windows Azure was chosen to host the educational cloud service SaaS (software as a service).
2. Development of architecture, model and functional structure of an information system on the SaaS-based cloud was implemented.
3. A generalized algorithm is developed for implementation of the cloud service in the sector of education.
4. The developed complex of educational services was run in the cloud and tested, it indicates the possibility of developing an effective cloud service for engineering education in Kazakhstan using the latest available packages of systems, tools and application software. The developed effective educational complex of cloud services «EduCloudKz» satisfies the needs of educational institutions in the application of innovative cloud technology in the Republic of Kazakhstan.

References