DOI 10.15826/rjcst.2021.2.005 УДК 69.05

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ISSUES OF INVENTION IN THE CONSTRUCTION SECTOR IN CONDITIONS OF ITS DIGITALIZATION

Abstract. The article considers the possibility of creating a digital environment of engineering creativity for organizing training for students of construction universities based on cloud technologies, which is an urgent task in the context of the implementation of the State program "Digital Economy of the Russian Federation". The purpose of the study is to develop theoretical grounds for creating a cloud digital environment of engineering creativity (DEEC) for interaction between participants in the creative process in construction universities. The practical value of the study lies in the possibility of applying the proposed solution when implementing distance learning for students of civil engineering universities.

Keywords: cloud technologies; construction university; cloud digital engineering environment; invention, patenting.

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ВОПРОСЫ ИЗОБРЕТАТЕЛЬСТВА В СТРОИТЕЛЬНОЙ СФЕРЕ В УСЛОВИЯХ ЕЕ ЦИФРОВИЗАЦИИ

Аннотация. В статье рассмотрена возможность создания цифровой среды инженерного творчества для организации обучения студентов строительных вузов на базе облачных технологий, что является актуальной задачей в условиях реализации государственной программы «Цифровая экономика Российской Федерации». Цель исследования – разработать теоретические основания для создания облачной цифровой среды инженерного творчества (ЦСИТ) для взаимодействия участников творческого процесса в строительных вузах. Практическая ценность исследования заключается в возможности применения предложенного решения при реализации дистанционного обучения студентов строительных вузов.

Ключевые слова: облачные технологии; строительный вуз; облачная цифровая среда инженерного творчества; изобретательство, патентование.

1. Introduction

According to the Decree of the Government of the Russian Federation of July 28, 2017 No. 1632-r of the state program "Digital Economy of the Russian Federation," it is planned to create the necessary conditions for the development of the digital economy, in which the leading factor in production is digital data [1].

In economics, digitalization is understood as the process of transition of an enterprise or an entire economic industry to new models of business processes, management and production methods based on information technologies [2].

The digitalization of construction should be considered as the management of economic activities and resources in construction, including a digitized (digitized,

suitable for recording on electronic media) system for the production and sale of construction products, which, in turn, provides for the digitization of external relationships (cooperation chains) and internal business processes in each construction company [3].

The construction sector is one of the key sectors for the development of the world economy. It accounts for 6% of world GDP. Digitalization plays a significant role in the development of the construction industry, as the opportunities it offers help to change and optimize the construction business. However, the current state of the construction sector in Russia indicates that its development is not proceeding at an intensive pace, which does not allow the industry to adequately and quickly change in the face of rapid changes in society, politics and business.

The implementation of this state program requires the improvement of the construction industry, as well as the education system, within which future bachelors, masters and specialists for the construction sector are trained. In the process of university training, graduates of construction institutes should have professional competence that allows them to solve production and scientific problems using engineering methods, as well as protect its results with appropriate patents.

Digitalization of the construction industry requires the development of an appropriate infrastructure environment that provides the conditions for the formation of professional competence in the field of engineering creativity.

The topic relevance of the article is determined by the insufficient development of theoretical grounds for creating a digital environment of engineering creativity when teaching students at construction universities. In addition, the topic relevance of the article increases due to the need to ensure reliable information security of individual and group inventive activities of environmental subjects, as well as its protection from borrowing (theft) during the period of drawing up the application and passing its examination, before receiving the relevant security document.

The purpose of the article is to develop on the basis of cloud technologies theoretical grounds for creating a digital environment of engineering creativity (DEEC) to form the necessary professional competence among students in the field of invention in the construction sector.

2. Literary review

A graduate of a construction university with professional competence in the field of engineering creativity must:

- *to know* the main methods of invention, the regulatory framework of the construction industry, general information about intellectual property and its patenting; requirements and recommendations for drawing up a patent application;
- *to be able* to use information templates to independently compile a patent application;
- *to have practical experience* in the application for patents for invention and useful model.

One of the tasks to achieve the goal of the article is to analyze studies on the use of cloud technologies in education.

Cloud technologies or cloud computing (cloud services) are networking technologies that are now fairly widespread. Cloud services are "substitutes" for desktop programs, that is, they often perform the same functions as programs on a computer, but they are created using network (Internet) technologies. For their work, the connection of the computer to the global Internet network and the Internet browser are mandatory. The entire functionality of the cloud service (program) operates on the servers of the cloud service provider, the user sees only the interface of the service used (appearance). That is, the user, in fact, uses his computer only as a point of access to services. All data is stored on servers on the global Internet.

Today, there are many different requirements for modern cloud systems. A number of Western researchers are studying this problem [4-7]. In the context of the topic of the article, the use of cloud technologies, as varieties of digital technologies, in the system of domestic education is of interest. This issue is considered in the works of Mironova L.I., Yazovtsev I.A. [8, 9]. In the article by Cheremisina E.N., Antipov O.E., Belova M.A. [10] we are talking about the fact that the use of cloud technologies in the training of students significantly reduces the costs of modernizing and maintaining the computer fleet of the university, and also makes it possible to fully equate the distance form of education to full-time. Sirotkin's A.Yu. study [11] confirms the great potential of cloud technologies for modernizing educational technologies due to their many advantages.

3. Method and results

Consider the theoretical aspects of cloud management. Work [9] details their options. In the case of organizing a cloud service for creating a digital environment of engineering creativity (DEEC), taking into account the specifics and a certain uniqueness of inventive activity, we consider it most appropriate for the university to manage the cloud, where students receive basic knowledge in the field of invention and patent science. In this case, we can talk about a complete monopoly in deciding on the development and management of the system. If it happens that new plug-in educational organizations will appear, then they will be only consumers of software resources, without the right to vote when making strategic decisions. At the same time, the entire technical side of the development and maintenance of DEEC falls on the shoulders of one, the main university.

Cloud-attached educational organizations will use exclusively ready-made authoring solutions, focusing all their attention on the operational interaction of users with DEEC resources. In this situation, it is possible that both the computing resources of the system and the access interface to the cloud system infrastructure will be available to users. In this case, developers will be able to create completely independent applications, as well as integrate into existing ones using available files and databases. With this form of cloud service management, options are possible when the main educational organization attracts third-party commercial organizations (for example, under outsourcing conditions) to maintain the operability of the technical components of the system.

In the light of current trends in the development of information services, when almost any computer work can be given to third-party organizations, many commercial companies use this principle of work. It significantly reduces the material and time costs of maintaining the company's information infrastructure. If the cloud is managed by one university, all users of the system become dependent on the main managing service. To protect the intellectual property of the participants in the system, a thorough contract must be created that distinguishes between the rights and obligations of the parties, and equally protects the intellectual property of all interested persons. Such a practice is carried out by such large representatives of the cloud services market as: Microsoft, Google, Amazon, IBM, Cisco, Red Hat, VMWare, Citrix, Oracle.

The advantages of the proposed cloud service management solution are:

- ease of administration and improvement (all decisions are made quickly, without bureaucratic approvals);
- closed architecture, which makes the process of destructive influence on the system extremely expensive and complex.

At the same time, two problems should be among the disadvantages of this solution:

- The closure of the cloud system and the impossibility of influencing its development, which provokes other universities to create their own similar systems;
- possible abuse of the position of the owners of the system.

In the information environment, the first problem is very relevant. Initially, information technologies developed according to a purely closed scheme (the source code of the programs and legal rights belonged exclusively to the developers). This situation gave rise to many examples of technological solutions that partially or completely repeat each other, since many companies were not satisfied with the available offers in the market, and there was no opportunity to influence the development.

As an alternative, the movement for open source software has been actively developing over the past twenty years (the right to change the source code by everyone is legally enshrined). The closeness of the cloud platform can give rise to many clones that repeat partially or fully the functionality of the offered cloud services due to the inability to influence the development and maintenance of the project from the outside, which will slow down the introduction of new innovative solutions and technologies. The issue of privacy of personal data on the Internet is extremely tough, since often the only guarantee of their safety is the "honest word" of the portal owners. Many cases of sales of databases with personal information of customers are known to various organizations that use them for their personal purposes, from promotions to illegal banking operations (some portals store their customers' passport data or bank card numbers). The desire to protect personal data (and the data of their customers) may force some educational organizations to create alternative cloud services that copy the functionality of the original "cloud" or not use the offered resources at all.

The methodological basis of the study is the theory of the information and educational environment Robert I.V. [13]. Based on the research results of the scientific school Robert I.V., by analogy with the information and educational environment, a *cloud digital environment of engineering creativity* (CDEEC) is proposed.

The digital environment of engineering creativity will be understood as a set of purposefully created conditions for interaction of participants in the process of engineering creativity with an interactive information resource and interacting with it as a subject of the creative process, responsible for the development and patenting of the results of engineering creativity in the field of construction based on cloud technologies.

The main components of the digital environment of engineering creativity include the following:

1. The main methods of invention in construction (in order of increasing complexity of their study) [14-18, 21-25]:

- brainstorming;
- morphological analysis;
- Synectic analysis;
- classical theory of solving inventive problems (TRIZ);
- functional and cost analysis;
- Modern TRIZ.

2. General algorithm for development of a new technical solution in construction [14, 17, 18]:

- analysis of the initial task;
- search for the optimal method of its solution;
- combination of methods for solution;
- synthesis of the obtained solutions;
- execution of the received technical solution.

3. Transformation of developed technical solution into patent application for invention (utility model) [14, 17, 19, 20, 26, 27]:

- name of invention (utility model);
- search of analogues and prototypes in patent bases (analysis of field and state of the art);
- formulation of the claims (utility model);
- method;
- device;
- a method and apparatus for implementing the same;
- isclosure of the invention (utility model);
- description of the graphic part;
- implementation of the invention (utility model):
- drawing up the graphic part of the application;
- preparation of annexes to the application;
- preparation of the abstract to the application;
- drawing up a patent application.

Each of the above components contains a set of interactive copyright templates that allow to greatly facilitate the work of the trainee, which contributes to the formation of a corresponding skill and increases the degree of assimilation of complex educational material.

For example, in addition to the general regulatory and methodological requirements for the structure and content of the formula in the patent application, the section "formulation of the claims (utility model)" contains copyright templates with possible keywords, as well as words with bindings or combinations thereof. The use of such templates does not limit the author's intention set forth in the claims (utility model), but will avoid some common errors of novice inventors: unity of terminology, incorrect form of verbs, description of the device in dynamics, etc.

The technological implementation of DEEC is possible on the basis of a cloud service, which will provide access to the necessary information for all participants in the creative process at any time. In addition, the cloud service provides remote interaction between participants in the creative process in real time. This feature avoids the use of irrelevant data and shortens the creative process. Information relevant to the creative process will be stored in the cloud.

Each of the main methods of invention in construction, described in clause 1, is implemented by an independent service. The general algorithm for developing a new technical solution, described in clause 2, can be presented in the form of an interactive module that allows you to get the desired solution. The transformation of the developed technical solution into an application for the grant of a patent for an invention (utility model), described in clause 3, can also be implemented by an independent service.

At the same time, the use of the cloud digital environment of engineering creativity (CDEEC) in the educational process will allow students to form *competence i*n the field of information security, including:

- *knowledge* about technologies for protecting the results of inventive activities and intellectual property from borrowing (theft);
- *skills* in structuring information related to invention and intellectual property to protect it from borrowing;
- *experience* in protecting specified information from borrowing using cloud technologies [13].

4. Conclusion

Based on the analysis of existing publications in the field of application of cloud technologies, the article shows that they have great potential for education, especially in the conditions of digitalization of the economy, in accordance with the state program "Digital Economy of the Russian Federation." The development and implementation in the educational process of the university of the proposed digital environment of engineering creativity will allow organizing convenient interaction between participants in the creative process. This protects against the loss of necessary information by storing data in the cloud. The practical value of the study lies in the possibility of using CDEEC in the implementation of distance education for students of construction universities.

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