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MODELING OF THE INFORMATION-ANALYTICAL SYSTEM OF ACCOUNTING OF SCIENTIFIC WORKS OF UNIVERSITY EMPLOYEES

Abstract: The article describes development of an information system for storing the results of scientific work of the Taraz Regional University named after M. H. Dulaty. Today, such works are organized in a non-automated way. In addition, this leads to a number of anomalies, namely: errors in data entry, their duplication, complexity of preparing reports, difficulties in finding the necessary information because of the complexity of the information system. In order to solve such problems and to improve data quality it is necessary to create a research analytical information system that allow to reduce manual workload and use simple and convenient access system to stored information using various queries. The aspects of creating a research information system described in the article can be implemented in any higher educational institution of the Republic of Kazakhstan. In order to create an information system, a functional model was created using the Fusion Process Modeler 4.0 CASE-system. After the decomposition of the diagram, five functions were identified: "Accounting the research staff", "Research", "Accounting the publications", "Dissertation defense", "Reporting". Modern tools are used in the development of a system for analyzing and monitoring the research activities of TarRU: PHP scripting language, which is widely used for web applications, JavaScript, which is well known as a scripting language for interactivity on web pages in browsers, Microsoft SQL Server relational database management system.

Keywords: modeling, information system, research results, functional diagram.

Introduction

The scientific activity of the University is an integral part of the training process and is aimed at ensuring the integration of science and education, based on the development of scientific and educational process, competitive research and innovation as an important element of an effective and efficient national innovation system [1]. Indicators of scientific activity of the university determine its competitiveness in the market of educational services, being one of the main criteria in determining the ranking of universities as national and international organizations that carry out the accreditation of universities.Accounting and analysis of the results of research work of the teaching staff of the university is becoming

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increasingly important in the activities of the university. In the list of indicators for evaluating the effectiveness of the university, developed by the Ministry of Education and Science of the Republic of Kazakhstan, the direction of research is the largest.At the same time, the state is interested in getting results in this area due to the significant investment in science. In this regard, the importance of objective assessment of the results of scientific work of employees of scientific organizations is obvious. Such an assessment is currently not possible without special information systems aimed at collecting, storing and analyzing information. In general, Western countries use systems called Current Research Information Systems (CRIS) and Institutional Repositories (IR) to implement the issues under consideration.

The international association euroCRIS was established to develop a unified approach to evaluating the effectiveness of research institutions [2]. Consider the well-known systems of automation of management of the education system in higher education in Kazakhstan, including the accounting of research work. In Russia, much attention has recently been paid to the development of automated systems for accounting and inventory of the results of scientific, technical and intellectual activities of teachers and students of universities [3-9]. Systems of state accounting of the results of research, development and technological work, standard solutions for accounting of the results of intellectual activity for enterprises have been developed and implemented in various universities and research organizations [3,7,9]. They are systems that are often offered as a web application using different platforms.

For example, the "ISTINA" system was created on the django platform using the python language. In addition, the decision of the Institute of Systems Analysis was made to automate the process of accounting for the results of intellectual activity of the Russian Academy of Sciences system "ASU REED RAN" [9].The repository of Nazarbayev University, which is an institutional electronic archive for long-term storage, storage and long-term and reliable public access to the results of research and related intellectual products of the Nazarbayev University Academic Society, was launched in Kazakhstan in 2014 [10].Of course, the above-mentioned ready-made solutions can be purchased and used in TarRU.

However, they are expensive and very high in size. It is necessary to create such systems in accordance with the individual requirements of the university. It takes time to train employees to use the application. Also, they cannot be used as a subsystem of accounting and systematization of research activities, as their purpose is different. The publications, patents, research, etc. presented in this article. The introduction of an information-analytical system, which will allow to maintain a single register, will eliminate the above problems.Thus, the introduction of information-analytical system is based on the solution of a number of applied problems:

- automation of accounting for research activities;
- creation of a single electronic register of publications;
- convenient organization of the information entry procedure;
- regular monitoring of research activities;
- Accreditation of teaching staff on the criteria of research work;
- easy and convenient access to stored information through various search queries.

Many modern Kazakhstani educational institutions are now actively creating and using infrastructure that allows them to use the Internet not only as a means of communication, but also as one of the main tools to improve the quality of education and the exchange of information between users. That is, Internet applications that provide timely access to the necessary information and interact with corporate information systems are the solution to the effective management of the institution. Systems for accounting, analysis and monitoring of research and innovation activities of the university should be implemented in the same way.

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Processes of development of research work in higher education

Gathering information about the scientific activity of an individual (publications, intellectual property, grants, business contracts, participation in competitions, etc.) is a time-consuming task, even for a small department [11]. The department of research management at Taraz Regional University is the Department of Organization and Coordination of Research. After studying the work of this department, its structural scheme, shown in Figure 1, was developed.

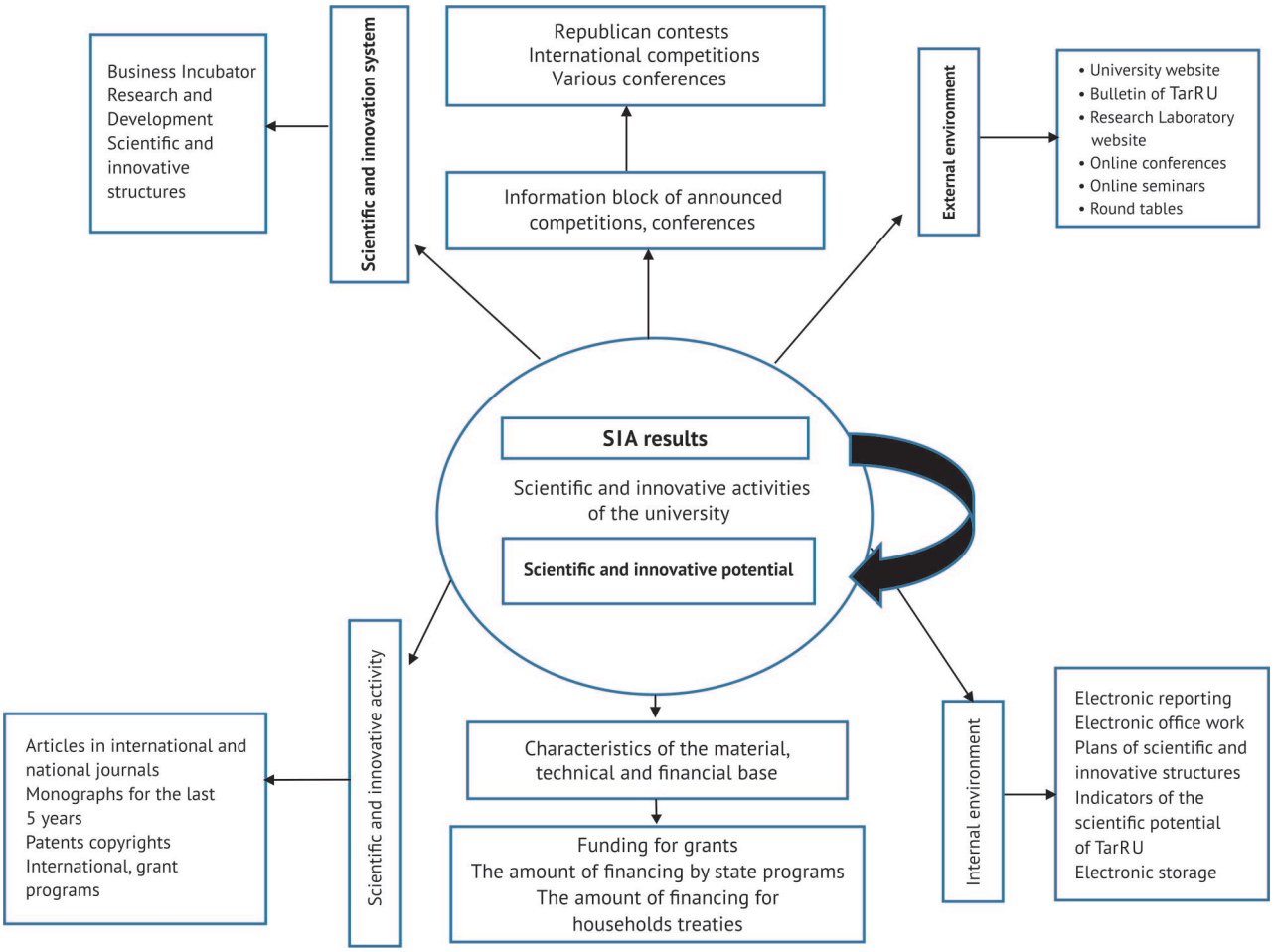

Fig. 1. The structure of the research department of TarRU

In order to effectively organize research activities within the university, aimed at achieving high results and their introduction into production, it is necessary to organize a system of information services implemented by the department "Organization and coordination of research work." Research work (SRW) is evaluated according to the following criteria:

- amount of funded research;
- the amount of grants for research;
- number of patents obtained;
- the number of published scientific articles and their printed pages, including journals with a non-zero impact factor;
- The number of scientific articles and monographs of the teaching staff (faculty);
- cooperation with republican and international organizations;
- doctoral students and undergraduates who defended their dissertations in a timely manner in individual plans;

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- Research reports;
- The number of students engaged in research, the effectiveness of student research.

The main contingent of system users are university employees in the following categories:

- Office of the Vice-Rector for Science;
- Research Department Management;
- Section “Organization and coordination of research work”;
- Faculties and departments.

Functional features of the system.

The developed system is designed to automate the accounting of research results, which means solving two main problems: the storage of information and the organization of access to it. Issues should be considered from the point of view of system users.The functionality of the system in relation to the categories of users is described below.

Employees of the department of science:

- input, review, processing of data on publications, patents;
- input, review, processing of data on research activities;
- input, viewing, processing of PPS data;
- input, review, processing of data on research projects;
- input, review, processing of data on dissertation councils;
- formation of reports;
- formation of reports on publications.

Library staff:

- editing by publications;
- confirmation of data on publications contributed by other users of the information system;
- view the list of authors;
- view the list of publications of a particular author.

Reporting staff:

- Formation and consideration of various reports on publications throughout the university;
- export reports from the system in the required format.

Heads of scientific departments:

- review the data on publications of the staff of its scientific department, send to the library for confirmation.

The peculiarity of the developed system is that it does not require the installation of special software on the computer. Can be used on any computer, laptop, tablet, mobile and other similar devices with an Internet connection and a web browser. A web browser interacts with a web server based on an HTTP or HTTPS connection. All software code and database (DB) of the system is located on the server computer, and the client part-sends requests to the server and displays its results. That is, the information system is implemented in an architecture called “thin client” or three-node server.

The database server interacts with the web server via TCP / IP protocols or a local socket.

The system is hosted on the university server and integrated with the official website of the university. The client part is implemented in the form of two modules: a module for entering data on the research activities of university staff engaged in research and a module available to employees of the research department and allow to review the data entered by each employee of the department, department or faculty.Based on the analysis of research activities of the university, a model of information flows of the research department’s interaction with other departments, both inside and outside the university, and a model of business processes for the organization of research activities in IDEF0 notation using BPWIN tools (Figure 2) .

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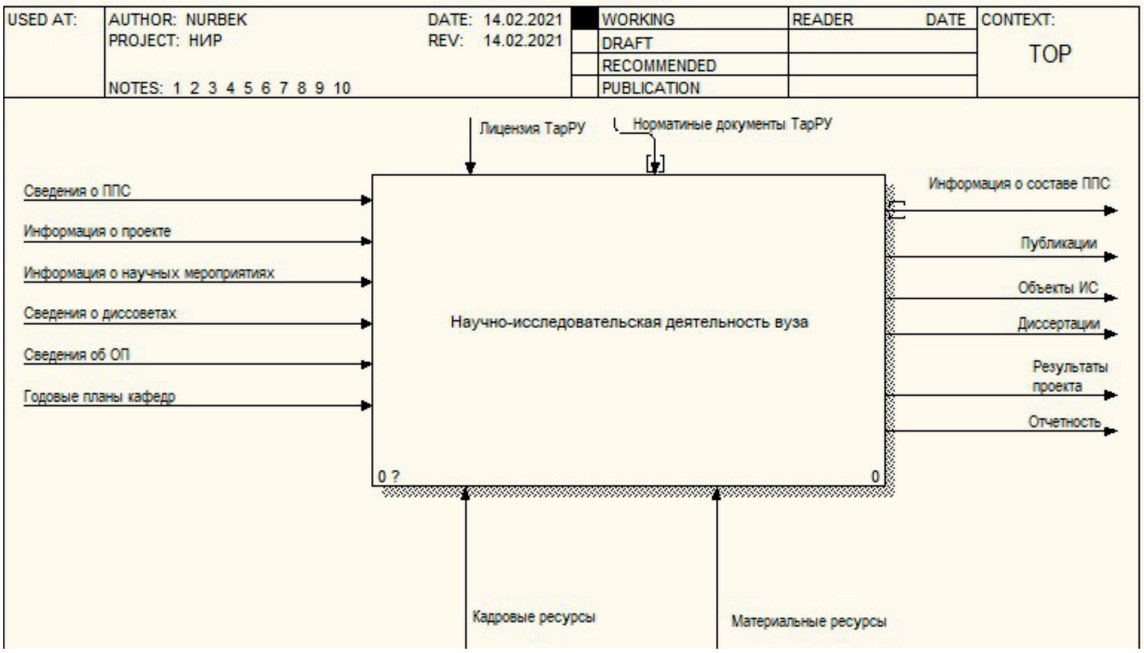

Fig. 2. Business process model for the organization of research activities in the IDEF0 notation.

The information system of accounting for research work of the university is formed mainly based on research work of the teaching staff of the department. Therefore, after considering in detail the direction of research activities of the department, a functional model was created using IDEF0 notations using the Fusion Process Modeler 4.0 CASE-functional modeling system. The context diagram of the scientific activity shown in Figure 3 describes the function of the module.

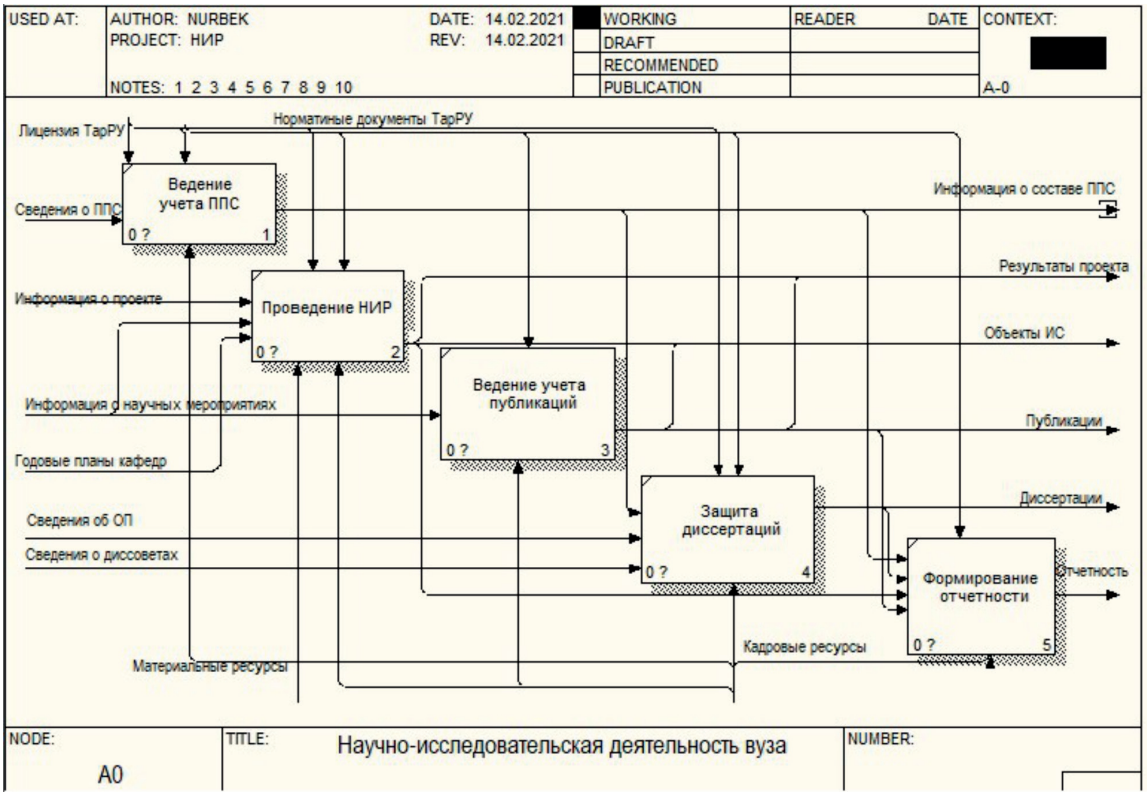

Fig. 3. Context diagram (decomposed level)

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Diagram of the main processes:

For further study of the scientific activity of the university, the context diagram was decomposed in terms of functionality. During the refinement of the diagram, five functions were identified:

- "Accounting of scientific personnel"
- "Research work"
- "Accounting for publications"
- "Dissertation defense"
- "Reporting".

Tools for creating information systems

The purpose of the work is to develop an application for the analysis and monitoring of research activities of TarRU. The following tools were used during the development:

- PHP (PHP: Hypertext Preprocessor) is a general-purpose scripting language that is widely used to develop web applications. Today, it is one of the leaders among the languages supported by the vast majority of hosting providers and the languages used to create dynamic websites.
- JavaScript (abbreviated JS) - Widely used in browsers as a scripting language for interactivity on web pages. Basic architectural features: dynamic types, automatic memory management, prototyping programming, functions created as first-class objects
- Microsoft SQL Server is a relational database management system (DBMS) developed by Microsoft. The main query language used is Transact-SQL. Used to work with databases from personal databases to large databases of the enterprise scale; competes with other DBMSs in this market segment.

Advantages of PHP:

- You do not need a special editor for programming in PHP - just a simple "notebook" or other similar text editor;
- It is easy to work with a database when creating a website in PHP, because this language is supported by many operating systems and DBMS.
- One of the most popular website building products in PHP is the Denver Gentleman Web Developer Kit.
- It is possible to use individual user scripts (engines) in PHP.

Advantages of MS SQL Server:

- SQL Server disk space scaling;
- SQL Server support for very large databases and the ability to process complex queries;
- dynamic self-administration by automating the execution of many daily administrative tasks;
- supports linguistic search, which allows you to create indexes of specific keywords or phrases for selected columns or tables;
- preparation of reports and data analysis using interactive analysis services (OLAP).

Conclusion

The analysis of the finished systems was carried out in order to create an information system for accounting and monitoring of research results in higher education. The analysis revealed that today in the programming market, along with universal systems, there are systems organized as a subsystem of information systems of a private university. The process of organization of research activities of TarRU was studied and analyzed. It was also decided to use a three-tier architecture, as it provides a high degree of flexibility and scalability, high security and high performance. Functional, info graphic models of information systems were

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created on its basis. In addition, it, in turn, became the basis for the creation of an information system database.

The processes of processing research work in the university were analyzed. Using the BPWIN modeling tool, a business process model was developed. After performing the decompositions, the functions of the system of accounting for the research work of the university staff were identified. All Fusion Data Modeler was used to create conceptual model of the information system. The technologies of system development were also analyzed and it was decided to use JavaScript, PHP and MS SQL Server database management system. The use of an intelligent method of data processing and a fuzzy search algorithm eliminates duplication of one element of research work for several co-authors. In the future, the developed system can include a subsystem that would search for and download scientific articles from well-known scientometric systems such as Google Academy, Web of Science, Scopus, etc. This will allow to exclude manual input of information from the available repositories.

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