

ABSTRACT

of the dissertation work submitted for the degree of Doctor of Philosophy (PhD) in the specialty 6D070300 - Information Systems (by industry)

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DISTRIBUTED INFORMATION SYSTEM FOR TRANSFER OF KNOWLEDGE OF UNIVERSITIES

The relevance of the topic of the dissertation research.

Within the market-oriented concept framework of innovation university, it is necessary to improve the education system, which involves the development of professional skills, in accordance with the demands of the global economy. For a qualitative training of a specialist who is ready to work in a dynamically changing economic environment, it is necessary to provide the graduate with not only knowledge, but also a set of competences. This requires changes in the training of specialists.

Transformations in direction, goals, content and results of education, are focused on “free development of man”, on creative initiative, independence, competitiveness, mobility of future specialists. Knowledge-based education is replaced by a competency-based education that provides a more complete personal and socially integrated educational result.

Instead of knowledge-based education, a competence-oriented education is coming, which provides a more complete personal and socially integrated educational result. Many papers have been devoted to the issues of methodology for the development of educational programs on the basis of a modular-competence approach. At the same time, the implementation of the mechanism for accounting the needs of the labor market, and the comparability of educational programs with national and international requirements for preparation of specialists in the development of educational programs are not fully reflected. In this paper, an attempt is made to formalize this mechanism using the ontological approach and the hierarchy analysis method.

In the Republic of Kazakhstan there have been cardinal changes in the model of functioning of higher education institutions. These changes are conditioned by the Development Strategy of the Republic of Kazakhstan until 2050 and the concept of the Bologna Process, in accordance with which the centers of "education, science, creativity and knowledge transfer" are assigned to higher educational institutions. The Republic of Kazakhstan supports the concept of a market-oriented innovation university, adopted by leading world countries, based on the knowledge triangle (education-science-innovation) aimed at large-scale investment in human resources, development of professional skills and scientific research, support for modernization of the education system to meet their needs of the global economy, based on knowledge. For the implementation of innovative

activities, a system of its organization is needed, which has been called the knowledge transfer system.

The problems of developing and implementing knowledge management systems at the lower infrastructural level remain relevant and critical for the expansion of the range of knowledge transfer participants. One of the approaches to solving this problem is the development of a distributed information system for the transfer of knowledge of higher education institutions, providing access to distributed knowledge bases of educational programs and scientific research through a semantic portal and programming interfaces.

Analysis of foreign and domestic scientific research in recent years has shown that an important technological infrastructure of the knowledge economy is the distributed knowledge base.

The mechanism of taking into account the needs of the labor market, which is the basis for the concept of the educational program, should update the requirements for the types of professional activity, flexibly respond to changing conditions of the external environment, promote the further development of the educational program, increasing its quality and relevance in the market of educational services. The thesis presents the implementation of the mechanism for recording the needs of the labor market, using the modular-competence and ontological approaches.

The modular-competence approach is used to implement the mechanism of correlating educational programs with the requirements of professional competences, which will allow to overcome the discrepancy between the requirements for the quality of education between the state, society and the employer.

Now universities are given the opportunity to independently create the content of educational programs, but the formation of educational programs does not take into account the labor market requirements and comparability with foreign programs.

An approach is proposed in the field of information and communication technologies. Projects of professional standards will allow to formulate national requirements of professional competencies for the professional qualification of ICT personnel. To comply with the international requirements of professional competencies, the European Framework of ICT Competencies (e-CF) and the European Certification System for EUCIP ICT specialists are used.

To compare the competencies of the educational program with professional requirements, it is necessary to carry out an examination of the educational programs of the university to compare educational programs with national and international training requirements for ICT specialists. To solve this problem, an information model of the distributed knowledge base of the university should be constructed

Evaluation of the correspondence of educational programs to professional requirements makes it possible to offer recommendations for the formation of modular educational programs, which will greatly facilitate this educational

process.

The approach for the correspondence of educational programs with professional requirements will allow students to build an individual educational trajectory, aimed at obtaining concrete results necessary for performing labor functions, in which student is interested. It will allow the university to respond flexibly to changing conditions of the external environment and develop educational programs, increasing their quality and relevance in the market of educational services.

To ensure the transfer of knowledge of universities between all participants - teachers, students and employers, it is necessary to create a single educational space, i.e. educational portal.

This approach will allow to overcome inconsistencies in the requirements for the quality of education between the state, society and the employer. That, in turn, will allow the university to respond flexibly to changing conditions of the external environment and develop educational programs, increasing their quality and relevance in the market of educational services.

Despite the fact that the concept of «knowledge management» appeared in the 90s of the last century, the problems of developing and implementing knowledge management systems at the lower infrastructure level remain relevant and critical for the expansion of the range of participants in the transfer of knowledge. One of the approaches to solving this problem is the development of a distributed information system for the transfer of knowledge of higher education institutions, providing access to distributed knowledge bases of educational programs and scientific research through a semantic portal and programming interfaces.

Knowledge is the most important resource of an organization. In this regard, organizations need to manage their knowledge. Based on this, the relevance and importance of knowledge management and the transfer of knowledge is emerging.

Research in this direction began in the 90s of the last century. A great contribution to the study of knowledge management was made by such scientists as T. Davenport, L. Prusak, I. Nonaka, H. Takeuchi, T. Stewart, B.Z. Milner, K. Weig., D. Bell, M. Demarest, P. Drucker, M. Polanyi and others.

Since 1998-2012, research on «knowledge management» has been carried out by: B.Z. Milner, Z.P. Rumyantseva, V.G. Smirnova, U. Bukovic, R. Williams, M.K. Rumizen, C. Janetto, E. Wheeler, N.M. Abdikeev, A.D. Kiselev, K.D. Eck, T.M. Koulopoulos, K. Frappalo, A.N. Kryshchafovich, V.A. Dresvyannikov, V.P. Baranchev, V.V. Labotsky and others. Since 2012: E.V. Kolesnikova, A.A. Negri, A.L. Gaponenko, T.M. Orlova, I.P. Malichenko, I.S. Annenkov, R.M. Nizhegorodtsev, O.N. Oleinik, M.N. Kutsenko, T.V. Sabetova, I.Yu. Fedulov and others.

Knowledge management based on the ontological approach is devoted by following works: A.F. Tuzovsky, S.V. Chirikov, V.Z. Yampolsky, V.B. Tarasov, A.V. Fedotova, I.T. Davydenko, A.Ya. Gladun, Yu.V. Rogushina, Yu.A. Kravchenko, V.V. Markov, P.O. Skobelev, V.V. Bova. A.M. Kashevnik, G.B.

Burdo, E.V. Vorobyeva, V.A. Pronina, K.V. Kryukov, V.V. Golenkov, N.A. Gulyakina, A.I. Subetto and others.

The problems of knowledge management were considered in the works of Kazakhstani scientists: G.M. Mutanov, M.N. Kalimoldaev, A.A. Sharipbaev, A.S. Omarbekova and others.

Research development of knowledge bases devoted to the works of scholars such as: T.A. Gavrilova, V.F. Khoroshevsky, A.V. Palagin, N.G. Petrenko, B.V. Dobrov, N.V. Lukashevich, V.A. Filatov, S.S. Shcherbak, A.A. Khairova, Yu.A. Zagorulko, B.V. Dobrov, V.V. Ivanov, A.F. Tuzovsky.

There is a fairly large number of different approaches that underlie the preparation of specialists. The latest new, included in the scientific revolution relatively recently, is the modular-competence approach. Competent approach is considered by Kazakh scientists A.E. Abylkasymova, M.Zh. Zhadrina, K.Zh. Aganina, N.M. Utebaeva, T.G. Balova, V.O. Mokerov, N.M. Temirbekov and others.

At present, attention to ontological knowledge bases has increased, since they differ in advantages over traditionally used relational databases. Kazakhstani scientists are engaged in building the portal on the basis of the ontological approach: B.M. Sadanova, S.K. Zhumagulova, G.S. Mukhasheva, M.K. Dakibaeva, R.R. Miftakhov et al.

The object of the research is the knowledge management processes of the university.

The subject of the research are models, methods and algorithms for knowledge management of the university.

Purpose of the research: the development of a distributed higher education institutions knowledge transfer information system, the functioning of which will contribute to increasing the competitiveness of universities by sharing knowledge between universities and employers in the development of educational programs focused on professional knowledge and competencies, demanded by the labor market.

In accordance with the chosen method of achieving the goal, the following **research objectives** are formulated:

- research of the world experience in the implementation of the technological (information) approach in knowledge management and the construction of distributed information systems for the transfer of knowledge of higher education institutions;
- development of the information model of the university's distributed knowledge base, including the ontology of the university's educational programs, the ontology of the professional competencies sought in the regional labor market and the ontology of the European ICT Competence Framework;
- creation of a method for the correspondence of educational programs with professional requirements;
- development of a method for identifying priority labor functions of the ICT educational program;

- the development of the architecture of a distributed information system for the transfer of knowledge of higher education institutions.

The scientific novelty of the dissertation research is determined by the fact that for the first time the architectural solution of the distributed information system of the knowledge transfer between universities was proposed, based on ontological models and logical methods of knowledge extraction.

The main scientific provisions that are put in defense of the thesis:

- information model of the university's distributed knowledge base, including the ontology of the university's educational programs, the ontology of the professional competencies sought in the regional labor market and the ontology of the European ICT Competence Framework;

- the method of the correspondence of educational programs to professional requirements using the module-competence approach;

- method for identifying priority labor functions of the ICT-educational program, based on the method of analyzing hierarchies;

- the architecture of a distributed information system for the transfer of knowledge of universities, providing ontological modeling of the knowledge base of educational programs of universities, examination of the educational program and assessment of its compliance with professional requirements.

Practical significance: is the applicability of the proposed information model of the distributed knowledge base of the university and its tools in educational organizations, authorized organizations of education and sciences of the Republic of Kazakhstan, enterprises and business structures.

An information model of the university's distributed knowledge base is being developed which will allow integrating the ontology of the university's educational programs and the professional competencies demanded on the regional labor market and the ontology of the European ICT Competence Framework for implementing the interaction of knowledge transfer participants.

As a result of the work on the basis of an information approach to knowledge management, a technological infrastructure will be created that will provide a targeted impact on the processes of creating, accumulating, using and transferring knowledge in order to increase competitiveness in the market of educational services, in the scientific, practical and innovative activities of universities.

Research methods are based on knowledge management, ontological engineering, hierarchy analysis method, and methods of service-oriented programming, descriptive logic and logical methods of extracting knowledge.

Approbation of the results of the dissertation research.

Materials of the thesis were reported to IX ISPC of students and young scientists «Science and Education - 2014» (Astana, Kazakhstan, April 2014); Optical Fibers and Their Applications 2015 (Lublin and Naleczow, Poland, September 22, 2015); ISPC «Innovations in science, education and production of Kazakhstan» (Almaty, Kazakhstan, November 17-18, 2016); ISPC «Potential of modern science» (Prague, Czech Republic, November 27, 2016); III International

scientific and technical conference of students, undergraduates and young scientists «Creativity of Young Innovative Development of Kazakhstan» (Ust-Kamenogorsk, Kazakhstan, April 12-13, 2017); ISPC «Modern Research - 2017» (Minsk, Belorussia, October 31, 2017); ISC «Actual problems of applied informatics in education, economics, state and municipal management: materials of the international scientific conference» (Barnaul, Russia, 2017).

Personal contribution of the author. Formulation of the problem, formalization of the research problems examined, search for methods and algorithms for their solution. The resulted scientific and practical results of research, analysis and formation of conclusions.

Publications on the topic of dissertational research.

On the topic of the thesis 14 scientific works were published: 1 in the international journal, included in the Scopus database; 7 in scientific journals recommended by the Committee in the field of education and science of the Ministry of Education and Science of the Republic of Kazakhstan; 6 in the proceedings of international conferences.

The structure and scope of the dissertational work. The thesis consists of an introduction, four chapters, conclusion, a bibliography (181 titles) and applications.