ICT Support of Higher Education Institutions Participation in Innovation Networks

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Abstract. This research addresses the issues of information and communications technologies (ICT) support of participation of Higher Education Institutions (HEIs) in innovation networks by indicating some strategies and approaches for ICT infrastructure management. The study is based on the idea, that the management of the formation and transfer of intellectual resources becomes the key task of HEIs in the framework of their new role in development. Based on research results the main directions of ICT-innovations application for the creation of educational programs based on unified scientific-educational and innovation processes with application of interdisciplinary problem-oriented and project-oriented educational technologies were formulated. Moreover, this paper explores the effects of C-engineering approach application for multidisciplinary engineering analysis purposes in S2B-B2S (Science-to-Business – Business-to-Science) cooperation processes. The main issues and cases of ICT application in HEIs for technology transfer management thought the creation of smart environment of HEIs researches programs for business were considered.

Keywords: Digitalization, Technology Transfer, Cooperation, Digital Education, ICT Support, Innovations, C-engineering, Network

1 Introduction

Innovation networks are an effective mechanism for mutually beneficial interaction between research and development, start-ups and innovative business, interested in the practical implementation of their scientific and technological developments and projects both in their own territory and internationally.

This need is also caused by Industry 4.0 trends [1]. A typical feature of Industry 4.0 solutions is efficiency from interaction. Ability to interact with other participants of innovation system, to integrate into innovation networks or to adapt the new

conditions; openness to such interactions becomes important factors of the competitiveness of any product or business. For this reason, one of the key topics in the development of Industry 4.0 technologies is the theme of interoperability and communications standards. Support for a standard makes a product, service or system open to interactions for other participants.

High and increasing information and communications technologies (ICT) accessibility necessitates a rethinking of many processes. A wave of breakthrough innovations not only passes through technological markets, but also destroys many seemingly formed and predictable industries, including education and science in education. In this situation, higher education institutions (HEIs) should take responsibility for the formation of new technologies, both in terms of equipping the economy with qualified personnel and technological development of industries.

The innovative potential of HEIs is one of the most effective levers in state innovation policy and one of the most important factors for economic development. Therefore, at present, in all countries, the search for a new institutional form of organization of scientific and educational activities is actively carried out, designed to take on the main burden in personnel and scientific support for the demands of high-tech sectors of the economy. This, in turn, leads to the search for new approaches not only to change the paradigm of education, the introduction of experimental methods, forms and technologies of organizing integrated scientific and educational activities.

Thus, the organizational aspects of implementing of innovation networks principles through the creation of ICT infrastructure are an important task. The implementation of ICT is based not only on the operational approach for HEI management as a factor in modernizing the efficiency of internal communications, but also on trends in the knowledge economy and the post-industrial economy.

The reports devoted to Industry 4.0 (e.g. [1]) note that development strategies must be based on a completely new approach to production as a network conglomerate of major industrialists, experts, economists and academics. Therefore, the question arises about the development of tools for designing relevant networks that will form synergies of interaction. This approach is also suitable for open innovation context [2] and open innovation networks development [3].

This synergy of interaction can be created within the framework of ecosystems of innovation in relation to interacting groups of actors operating in a single environment and creating value that none of the companies could produce alone [4; 5]. From the point of [6], the innovation ecosystem consists of partners, on whom your success depends in the creation of innovation. And they include both those who are directly involved in the innovations creation and those who are not directly involved in creating the product, but are needed for its successful launch (for example, a network of special gas stations for electric vehicles that you want to produce). Therefore, when developing an innovation strategy, it is necessary to identify all the interdependencies and partnerships that are necessary for success, as well as the ways to create these partnerships. This idea can be successfully applied for HEIs which are innovation agents with development goals.

In view of above, we can note that the existing innovation infrastructure lacks such innovation network communication component [7; 8], which would provide not just

access to supporting information for innovation activity, but would help innovation actors to enter into network contact with each other, as well as to receive the necessary information directly from the subjects of innovation and give feedback in business – education system. Therefore, the development of a model of ICT support for HEIs based on the network mechanism is a relevant scientific and practical task. The purpose of this study is to develop a communication model of the university's innovation infrastructure in order to improve the efficiency of the innovation ICT infrastructure through increasing the efficiency of information transfer and network communication interactions with the business sector.

Formation and transformation of the conceptual model of HEI in the conditions of Industry 4.0 is proposed to be studied in such aspects: the place of the HEI in the educational structures and development institutes system; the identification of the specifics of the HEI's activities in the relationship education – science – practice in the era of Industry 4.0 and analysis of the value-semantic content of education. The research is based on the need to develop integrated vocational and education strategies that reveal the potential of new social role of academic institutions in modern conditions.

2 ICT Based HEIs R&D Strategies

According to the modern approach, to ensure the competitiveness of educational services, HEIs should implement appropriate quality assurance procedures, develop innovation management policies, standards of practice-oriented educational programs, form and implement a strategy for continually improving the quality of education through interaction with business and society (demand approach). At the same time, the management of innovations in modern HEI should include the digitization of the main directions of its innovation activity.

Digitalization and specialized ICT offer new platforms and applications to interact and integrate the processes of educational & research and innovation processes, as well as information technologies for variety of analytics. In addition, domestic and international R&D cooperation, which has become more effective through modern communication tools, is crucial for solving complex problems, crisis management, internal and international security, and much more. In general, innovative communications, collaboration tools and cloud services create completely new opportunities for coordinating efforts and overcoming future challenges. So according to the new role of HEIs, these capabilities are critical.

In this context, it can be accurately asserted that individual ICT solutions, modern network infrastructure and scalable cloud solutions will play a major role in HEIs R&D and technology transfer. ICT can be considered as a key for reengineering and streamlining of educational processes. In this way it will be crucial in future efforts to modernize of the higher education system, especially the technology transfer (including social). Thus, the digital transformation of the higher education system is important to maintain competitiveness in the era of globalization and Industry 4.0.

Therefore, a promising aspect is the analysis of modern ICT components that HEIs

need to participate in innovation networks in the formation of Industry 4.0. In order to achieve the goals of university development, it is necessary to analyze the peculiarities, problems and trends of the global knowledge generation environment in a post-industrial society, as well as the foreign experience of developing existing prototypes of ICT-based scientific and innovation networks in order to identify the possibilities for its adaptation to the conditions of the formation of the national innovation system.

Creation of information space and relevant communication tools to support S2B-B2S cooperation activities is one of the urgent tasks solved with the help of a specialized ICT platform. It is also important to note that the participants in the innovation network are geographically distant from each other organizations, including those located in different states. The ICT platform of innovation network S2B-B2S cooperation is one of the most important tools for the common work of the system's participants and should provide the following functions [9]:

- informational (databases of technological offers and requests profiles, interface for remote information management, website);
- communication (tools for organizing the tracking of expressions of interest and correspondence with customers, forum of participants of the system, tools for collaborative education projects);
- reference and training (library of methodical materials, program and regulatory documents, samples);
- monitoring of system (statistical reports on performance indicators).

3 C-technology as Approach for S2B-B2S Cooperation Networks

C-technology in high-tech industries and S2B-B2S cooperation is based on integrated product and process development, decision-making technologies and can be considered at three stages: the formation of specification of requirements, conceptual design and detailed design. At the first stage, the analysis of initial requirements and constraints is carried out, an assessment is made of the feasibility of finding a design solution, at the second – the selection of acceptable (in the context of subsequent integration) types of design decisions (concepts for implementing the domain model elements), at the third – the choice of technical solutions.

When using C-engineering in S2B-B2S cooperation digitization, there is a problem of information exchange between various project participants of innovation network from HEIs and business (students, researchers, customers, researchers, developers, manufacturers, operators, etc.). When transferring project data from one ICT component to another, it takes a lot of work and time to re-encode, which leads to numerous errors and loss of time. In addition, as the project becomes more complex, there is a sharp increase in the volume of technical documentation. Traditionally in the project firms there are considerable difficulties in finding the necessary information, making changes in the design and technology of manufacturing products.

There are many errors, the elimination of which takes a lot of time. As a result, the efficiency of the processes of development, production, operation, maintenance, and repair of complex high-tech products decreases sharply. There are difficulties in S2B-B2S cooperation both in the preparation and implementation of innovative projects.

To solve this problem, we propose to consider the technologies of system information support and maintenance of the product life cycle in the S2B-B2S network integrated information environment, defined as a set of distributed databases containing information about products, production environment, resources and processes. This system should ensure the correctness, relevance, safety and availability of data to those subjects of production and economic activities involved in the product life cycle processes that need and be allowed.

For HEI, it is important that the process of creating specifications with information for software-controlled technological equipment, sufficient for the manufacture of a product, can be distributed in time and space among many project studios (student groups, labs, off.).

4 Conclusion

Creation of ICT support of network mechanisms will provide an opportunity to consolidate information resources of HEIs, innovation centers and integrate them into innovation networks. As a result, the communication model of innovation infrastructure will allow to coordinate, regulate and coordinate the activities of innovative labs, provide consumers with information about the market of scientific services, the market of innovative products and projects, technical problems of enterprises, provide authorities with all the information to record and monitor the results of scientific and innovative activities , to assess the innovation potential of the, to determine the priority directions of development of science and technology in HEI.

Based on research results the main directions of ICT-innovations application for the creation of educational programs based on unified scientific-educational and innovation processes with application of interdisciplinary problem-oriented and project-oriented educational technologies were formulated. Moreover, this paper explores the effects of C-engineering approach application for multidisciplinary engineering analysis purposes in S2B-B2S innovation network cooperation processes.

The results suggest that the creation of network mechanisms based on C-engineering will provide an opportunity to consolidate the information resources of HEIs, government agencies, specialized organizations and innovation business centers in modern innovation projects. The main issues and cases of ICT application in HEIs for technology transfer management thought the creation of smart environment of HEIs researches programs for business were considered. Empirically examining of these cases produced a more complete understanding of HEI ICT-based networked strategies. The application of ICT in HEI management will contribute to the emergence of new projects, increase the survival rate of existing R&D projects due to their expansion through practical testing and implementation, the formation of new partnerships, start-ups, an increase in the HEI achievements being implemented, the

use of existing intellectual, industrial and financial potential, close ties between the scientific community and business.

The given recommendations can be used by policy makers in R&D, managers of education and/or R&D organizations within the technology transfer strategies and innovation education technologies implementation projects to improve the interaction between HEIs and business within the innovation networks.

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References

1. Industry 4.0. Challenges and Solutions for the Digital Transformation and Use of Exponential Technologies. https://www2.deloitte.com/ch/en/pages/manufacturing /articles/manufacturing-study-industrv-4.html#, last accessed 2018/12/10.
2. West, J., Gallagher, S.: Challenges of open innovation: The paradox of firm investment in open-source software. R&D Management 36 (3), 319–331 (2006).
3. Secchi, E.: Open Innovation Networks and the Role of Intermediaries: An Agent-Based Simulation. In: Secchi D., Neumann M. (eds.) Agent-Based Simulation of Organizational Behavior. Springer, Cham (2016).
4. Durst, S., Poutanen, P.: Success factors of innovation ecosystems: Initial insights from a literature review. CO-CREATE 2013: The Boundary-Crossing Conference on Co-Design in Innovation, Aalto University, 27–38 (2013).
5. Rabelo, R. J., Bernus, P.: A Holistic Model of Building Innovation Ecosystems, IFAC-PapersOnLine 48 (3), 2250–2257 (2015). https://doi.org/10.1016/j.ifacol.2015.06.423
6. Adner, R.: Match your innovation strategy to your innovation ecosystem. Harvard Business Review 84 (2006).
7. Omelyanenko, V., Semenets-Orlova, I., Khomeriki, O., Lyasota, L., Medviedieva, Yu.: Technology transfer management culture (education-based approach). Problems and Perspectives in Management 16 (3), 454–463 (2018). https://doi.org/10.21511/ppm.16(3).2018.36
8. Prokopenko, O., Kudrina, O., Omelyanenko, V.: Analysis of ICT Application in Technology Transfer Management within Industry 4.0 Conditions (Education Based Approach). In ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer (ICTERI 2018): Proceedings of the 14th International Conference (Kyiv, Ukraine, May 14–17, 2018) Vol-2105, 258–273 (2018).
9. Development of the concept of creating a Eurasian technology transfer network, including the order of its formation https://www.rvc.ru/upload/iblock/06b/Innovation_ecosystem_analytical_report.pdf, last accessed 2018/12/11.