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Information and Communications Technologies as a Factor in Railway Engineering Education Improvement and Promotion

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The article considers the role of information and communications technologies (ICT) in railway engineering education enhancement and promotion. The author has suggested a number of ways to improve the education of railway engineers.

Key words: engineering education, railway engineering education, a railway engineer, information and communications technology, ICT, education quality.

Currently, in information society, the economy of Russia needs improvements and positive investment climate. High technologies and knowledge-intensive industries, as well as a boost in the IT-sector, globally stipulate economy and intelligence development, and Russia is not an exception here. In this regard, the innovation economy greatly depends on professional staff preparation, therefore improvement and promotion of engineering education is one of the priorities of state education policy, for example, the President's program of continuing professional development for technical and engineering staff [8]. The importance of staff education improvement and continuing professional development in the information and communications technologies (ICT) sector is also contended in the Russian Federation state program "Information Society (2011–2020)" [1].

Being one of the structural sectors in Russian economy, transport industry, and railway transport, in particular, has a direct impact on the sustainable development of Russia's industrial potential. The role of higher education institutions in this process has been described before [3]. B.A. Levin has stated that the share of engineering staff in railway industry is more than in transport industry in general: future engineers make up 68.3% of all higher education students [2].

To improve and promote the railway engineering education, the international collaboration between transport engineering and technical universities is being currently strengthened. Petersburg State Transport University and its European partners have launched the project which aims to promote railway education and attract the talented youth to the transport industry. At the International scientific and practical conference "Standartization and Technical Regulation under New Conditions", held in Almaty, 2014, Rissian Railways, National Company "Kazakhstan Temir Zholy" and Belarusian Railways signed the Memorandum of engineering personnel preparation improvement for innovations and development of railway transport and mechanical engineering (October 28, 2014).

B.A. Levin in his works [2] has identified the aspects of engineering education (including engineering railway education) improvement in transport universities. The author has also determined the requirements to the quality of railway engineering education, which are stipulated by technical particularities of transportation as a system of interconnected technologies. These requirements include: [2, p. 109]:

1) continuing education, i.e. preparation of specialist able to adapt immediately to new technologies and develop these technologies through personal development;

2) development of digital and information technology competencies of future railway engineers.

The critical issue of today is the ability of the railway engineer to continue professional education and learn for life, as well as to apply ICT tools in professional activities. Modern information society needs railway engineers who possess not only profound knowledge of their profession, but also have developed ICT skills. In the 21st century ICT are one of the main elements of transport infrastructure, and railway infrastructure in particular, and is regarded as a tool of automatization and automated control of transportation.

Transport Strategy of the Russian Federation up to 2030 implies further automatization of Russian railways [9]. A new trend in railway enhancement is geoinformatics intensively developed by scientific and industrial testing center "Geoinformational and satellite-based technologies in railway transport". There are also scientific works and research considering the issue [4, 5]. The challenges and perspectives of railway automatization are discussed at the annual international science and technology conference "InfocTrans" and annual international symposium "Eltrans".

All the facts mentioned above prove the importance of ICT for railway transport and stipulate the application of ICT for enhancement and promotion of railway engineering education.

In the system of higher railway engineering education competency-based approach has been chosen and blended learning is widely used, which presumes combination of net technologies with the traditional ones.

The Federal State Educational Standards of Higher Professional Education determine the requirements which are impossible to be met through traditional teaching and learning methods. It stipulates the application of modern interactive educational technologies based on ICT, i.e. electronic learning (e-learning). Russian and international experience in this sphere (the works by A. Benedek, A. Bork, O.A. Kozlov, A.A. Kuznetsov, M.P. Lapchik, I.V. Robert, etc.) demonstrates that ICT, including e-learning, should be implemented in teaching all disciplines within the system of higher professional education.

Network educational technologies are supposed to change the educational process itself. E-learning not only ensures the high quality of education provided, but also makes lifelong learning possible, as well as increases the effectiveness of both teaching and learning. E-learning makes educational process interactive, which, in turn, ensures student's information mobility, develops individual educational path, and contributes to educational content updating [7].

E-learning is based on electronic (digital) educational resources, mostly, network ones. Currently, there are many Internet educational resources for studying informatics and ICT, as well as engineering disciplines. As a result, the task to teach the student to use Internet educational resources for studying information and technical disciplines is among the primary goals of railway engineering education. The resources to be used are as follows:

1). Electronic library network, an ordered collection of various electronic documents along with the means of search and navigation. For example, the scientific library of graphics and image processing (http://library.graphicon.ru/catalog/), the electronic archive of the journal "Quantum" (http://kvant.mccme.ru).

Besides, there are digital library systems (DLS), for example, "University library online" (http://biblioclub.ru), DLS JURAIT (www.biblio-online.ru), DLS of Lan' Publishing house (http://e.lanbook.com).

2). Massive open online courses (MOOCs), which imply different methods for online education (writing tasks, video and audio resources, Internet-conferences, assisted by tutors and regular online seminars). MOOCs are based on online courses (webinars), for example, National Open University "INTUIT" (http://www.intuit.ru).

The Ministry of the Education and Science of the Russian Federation initiated the portal for open education. The national leading universities have developed

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National Platform for Open Education in Russia, which is operational since September 1, 2015. The aim of the platform is to develop national high quality open online courses available for all students and educational organizations. In 2015–2016 academic year 46 online courses will be launched (the information about the courses in represented on the website "Open Education", https://openedu.ru/).

The website has a subdivision "Engineering, technologies and technical sciences, 23.00.00. Machines and technologies for land transport", where one can find online courses for future railway engineers (https://openedu.ru/course/#group=40): "Mechanical Engineering", "Construction Materials Science", "Perspective Geometry and Engineering Drawing", "Performance of Construction Materials", "Fundamentals of Electronics and Electrical Engineering".

3). Online educational editions, which contain ordered materials for a particular science from, for example, the journal "Automatization and Control Engineering" (http://magazine.stankin.ru).

4). Distance education packages, which contain educational resources to support the educational process, including e-learning technologies, for example, "Discrete Mathematics: Algorithms" (http://rain.ifmo.ru/cat/), "Electrical Machinery" (http://elmech.mpei.ac.ru/em/).

Having considered the Federal State Educational Standards of higher railway engineering education [10, 11, 12], it is possible to identify the following aspects of ICT skills development. Students start with the discipline "Informatics", which belongs to the fundamentals of mathematics and natural sciences cycle (C.2). There is another discipline within the same cycle, namely, "Engineering Computer Graphics", which equips students with the tools of computer modeling and simulation.

The rest of information disciplines within cycle C.2 refer to the corresponding specialties and aimed at learning ICT and/or automated management information systems in a particular sector of railway transport. As a rule, the name of the discipline sounds as "Information technologies and systems in a certain sphere of specialty", for example, "Information technologies and test systems for electric rolling stock management" for the specialty 190300 "Rolling Stock", the profile "Electric Rolling Stock" [10].

Also, within mathematics and natural sciences cycle (C.2) and professional cycle (C.3) students study the disciplines which deal with computer engineering and mathematical modeling in engineering. As a rule, these disciplines make students use various software packages: spreadsheets and spreadsheet tables (for instance, Microsoft Excel, OpenOffice.org Calc), software tools for mathematical and technical calculations (for example, MathCAD). The analysis of professional cycle (C.3) content shows that the disciplines comprise the elements of IT-based management in railway transport, for instance, the discipline «The Theory of Automatic Control» taught for all railway specialties and profiles [10, 11, 12].

Since ICT play an important part in a railway engineer education, as well as in the promotion of engineering railway education, it is necessary to revise the entrance examination materials used by institutions of railway higher education and include the tasks on informatics. This will stimulate the pupils to take the discipline seriously when at school, which, in turn, will help to develop ICT-competencies of school graduates who plan to work in railway engineering.

Continuing development of ICT-competencies at the railway higher education institution should last over the whole period of studies. Any course work, practical training session report, graduation thesis should meet the requirement on ICT application not only for text revision but also for calculations, testing, etc. Moreover, within the system of railway engineering education particular attention should be paid to integration of ICT into educational process, since students should acquire the skill of efficient work with ICT, including different internet resources. The institutions of railway higher education should encourage this process by providing information and methodological support.

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