Peculiarity and functionality of the digital educational ecosystem for transport and logistics

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Abstract. The article presents the results and interpretation thereof of a study of the transport education transformation as a digital educational ecosystem in the context of the global digitalization processes, the strategy of the state, intellectual priorities for transport and logistics, the market demands. Certain potential innovative forms of modern education are suggested, namely the combined use of university educational resources and employer's materials and technical resources. They are studied on the example of the first Russian transport engineering higher education institution, Emperor Alexander I St. Petersburg State Transport University (PGUPS), where their ongoing implementations are called 'Innovative site for international educational programmes of proactive training of high-speed railway personnel', 'Network University'. Key words: digital transformation, digital educational ecosystem, network university, innovative platform, advanced training, transport, logistics.

1 Introduction

The main drivers of the change in the higher professional education are the processes of globalization, digital transformation of the economy, and even the COVID-19 pandemic which has not been so long-lived as the former two factors but joined them just three years ago.

Using digital technologies to build professional competencies in the graduates and fostering technological breakthrough requires the establishment of an innovative scientific and educational environment – digital educational ecosystem, taking into account industry intellectual priorities.

As a pilot project in the service of this goal, the 'Innovative site for international educational programmes of proactive training of high-speed railway personnel' programme was launched in Alexander I St. Petersburg State Transport University (PGUPS) in 2020. The aims of this programme are to advance engineering education and to build up digital competences in the prospective transport and logistics field staff.

Next step is the establishment of the Network University of High-Speed Rail Transport. Currently, the PGUPS is actively working in this area according to the plan for 2021 – 2025.

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The network form of the educational programme addresses the compelling need for elimination of what may be called "staff separation" issue, i.e., the lack of links between professors and practicing professionals, by ensuring interactions between the University and the employer thus making the latter a full-fledged participant of the educational process. Such format of education ensures curricula which allow students for making up for specific demanded competencies, e.g., digital ones, not provided for by Federal State Education Standards (FGOS), but necessary for the students’ future careers.

Trilateral or multilateral format of educational programme implementation appears to be advantageous. This format implies the participation of two different educational institutions, one of which guarantees building of engineering competencies, and another of the digital ones, while the employer provides production facilities or other material and technical support for the development of practical skills of the students within project activities or work placement.

2 Materials and Methods

Setting the goals and priorities of the study, the authors relied on both the guidance of the Russian regulatory framework, which provides strategic directions, conceptual approaches and regulations, patterns, scientific and business experts’ opinions on digital transformation of transport education [1-5].

The 'Strategy of Information Society Development in the Russian Federation for 2017-2030' was adopted by the Decree of the President of the Russian Federation of May 9, 2017 No. 207. This document enacts the development and implementation of programmes of cooperation between higher education institutions and Russian high-tech organizations in different aspects including improvement of curricula.

'The Roadmap for Training Transportation Industry Specialists until 2035', which was approved by the Resolution of the Government of the Russian Federation of February 6, 2021 No. 255-p, defines the following key challenges to the present-day transport education (Fig. 1, Block A), as well as several features of transport education (Fig. 1, Block B):

**Fig. 1. Priorities of the digital educational ecosystem concept for the transport complex.**

This document draws attention to the necessity of a significant revision of the transport education paradigm as such, including R&D, the intensity of participation of talented people in transportation industry education and research, engineering of new management models.
One of the most dynamic new forms of higher professional education has been its network form. The pivotal regulatory act governing this field of educational activities is Article 15 ‘Network Form of Curricula Implementation’ of the Federal Law ‘On Education in the Russian Federation’ of December 29, 2012 No. 273-FZ. According to it, this form provides students with the possibility of mastering a curriculum or its separate parts (subjects, modules, practices) using the resources of several organizations, including foreign ones, and they can be both educational and non-educational institutions. Such non-educational institutions are the ones possessing the resources necessary for the implementation of educational activities in line with the relevant curriculum. Thus, the network form allows for inclusion of the employer in the educational process as a full-fledged participant.

Another important document regulating the issues of the network form of education is the Order of the Ministry of Science and Higher Education of the Russian Federation and of the Ministry of Education of the Russian Federation of August 5, 2020 No. 882/391 ‘On the Organization and Implementation of Educational Activities within the Network-Based Curricula’. This Order contains detailed regulations of the educational process carried out in the network form. This is mainly a framework document, as the local regulatory and legal acts govern the network form in detail, and yet some of its provisions have changed the legal regulation in the said field.

Legal literature shows different points of view on the correctness of the designation of the parties to the network form contract. The parties to certain contracts sometimes designate themselves as the main (primary) and resource organizations. This designation is not rigorously exact, because both parties are equal participants and provide certain resources for the implementation of the curriculum, so it would be more accurate to name them ‘Party 1’ and ‘Party 2’. This difference seems to exist only in the second type of network education contracts where the employer is involved and thus it is not of fundamental importance. At the same time, the party to the contract, which is an educational institution, must have a license for conducting educational activities, and of course it must meet the established national requirements for educational institutions.

One of the important obligations of the parties to the contract is working out an educational programme (EP) with its type and level indications, assessment materials, and learning and teaching support materials, for the programme to be implemented in all the disciplines, modules, and practices it provides. The EP having been developed must be approved by the primary organization either alone or jointly with the partner organization. This issue should be settled in the contract on the network form of education. Also, it appears that in the first case when EP is approved by the primary organization alone, the second party is deprived of the opportunity to participate in creating the list of professional competencies and indicators of their achievement which are in fact very important to it as an employer.

In case of participation of a foreign partner in the contract on network education, academic instruction for some of the modules can be delivered in a foreign language.

### 3 Results and Discussion

The objectives of the study were achieved owing to several reasons, including rich methodological material accumulated by the scientific community of PGUPS and through cooperation with the transport industry specialists of Russia and other countries [6-10].

In order to develop engineering education and build digital competencies in prospective transportation industry workers, 'Innovative site for international educational programmes of proactive training of high-speed railway personnel' was established in PGUPS in 2020. Its goal is to create an innovative scientific and educational environment for the students to acquire professional competencies in the field of high-speed rail transport on the basis of modern digital technologies and to ensure a technological breakthrough in the specified field.
The goals of the innovative educational site (IES) are the following:

- establishment of sustainable educational and methodological networks between school, university, and business under conditions of technical and technological breakthrough in the transport industry;
- fostering scientific and pedagogical schools of professors and teachers who are able to arrange educational process which will meet the requirements of the prospective level of transport development;
- establishment of proper educational and methodological, laboratory, simulation equipment bases;
- creation of a digital environment that provides proactive training of personnel for high-speed railways.

The main idea of the IES: training students at all levels of education to solve production, engineering and scientific problems in the field of high-speed rail transport in the short-term and long-term perspectives through digital transformation of Russian and foreign experience in design, construction, and operation of innovative systems of high-speed land transport.

A quantum leap in the innovative educational project can be made due to a synergetic effect of combination of resources and opportunities of the state, business, science, and education. During the implementation of the innovative educational project, provision will be made for acquiring "industry-wide" interdisciplinary competencies by the managers and specialists working in the field of high-speed rail transportation infrastructure and rolling stock, including those competencies which are relevant for the digitally transformed economy: digital modelling, BIM technologies, Big Data and business analytics; artificial intelligence; Blockchain; information security, cloud technologies, virtual and augmented reality technologies, and flexible management.

Relying on Russian and foreign experience, PGUPS is planning to establish the Network University of High-Speed Rail Transport (NU HSRT) in 2021-2025. Several Russian, European, and Asian universities have united to work on this project under the patronage of the International Union of Railways (UIC) and the UIC Alliance of Universities for High-Speed Rail. The establishment of the NU HSRT is another step taken by PGUPS to advance in its ongoing projects.

The idea of the Network University of High-Speed Rail Transport was supported by the founder of a prospective employer, The Federal Agency for Rail Transport (Roszheldor), and by representatives of 37 universities in Russia, China, India, Brazil and South Africa, as well as Germany, Spain, Kazakhstan, and France. The International Union of Railways (UIC) saluted the establishment of the NU HSRT. The implementation of joint scientific and educational programmes by PGUPS and UIC in the field of HSR is stipulated by the Memorandum signed by PGUPS and UIC on September 9, 2020.

The Network University of HSRT is designed to be an open educational project, which actively utilizes different types of activities, both online distant instruction and classroom instruction when professors and students meet face to face. The parent organization of the NU HSRT is the applicant organization, PGUPS.

An important goal of NU HSRT is implementing a methodology of teaching students in the form of continuous and successive build-up of digital economy competencies. They will be necessary for the future successful, productive, and responsible work of the graduates in RZD JSC.

The methodology is being developed taking into account the peculiarities of divergent thinking evolvement in future specialists during their professional training in the higher education institution. The methodology should provide:
- optimization, adaptation, and digital transformation of existing curricula to meet the requirements of digital economy thus allowing the implementation of digital economy competencies and digital literacy at all levels of education;
- development of a new basic professional educational programme of personnel training in the situation of digital economy, in particular Digital Logistics;
- establishment of a portfolio of practically oriented supplementary educational programmes with inclusion of specialized professional modules that build digital competencies in the students based upon brand new educational content within the process of integration of education and business, which in its turn is based on integration of a consolidated repository of objects and peer-to-peer (P2P) interaction in the digital educational environment.

The concept of the teaching methodology embraces the experimental results achieved while the University was implementing the model and securing pedagogical conditions for the emergence of divergent thinking in future specialists during their professional training, and it is grounded on the Base Model of Competencies (BMC), which is schematically presented below. Substantially, it is a regulatory document that settles a system of uniform requirements (Fig. 2):

![Fig. 2. The scheme of BMC.](image-url)

The Base Model of Competencies is being developed considering the realities and prospects of the 4th Industrial Revolution and therefore this model is proactive.

There was a risk analysis undertaken to assess the challenges the University ecosystem may face in the course of implementing the system of proactive training of HSR transportation specialists. As a result, potential risks related to the IES implementation were identified, the impact of negative factors was assessed, proposals and specific measures to mitigate those risks were worked out. With the length restrictions which apply to this paper,
it is not possible to present the results of the study in full. An excerpt from the results follows ad exemplum (Table 1):

Table 1. Excerpt from risk analysis results for the university digital educational ecosystem during the implementation of the system of proactive HSR specialist training.

<table>
<thead>
<tr>
<th>Negative factors (risks)</th>
<th>The effect of a negative factor</th>
<th>Measures of evening out negative factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenging demographic situation</td>
<td>Reduction in the admission to the high-speed rail transport educational programmes.</td>
<td>– raising the target admission under the landed partnership agreements with non-railway organizations; – boosting the advertising campaign through social networks with the aid of the university student activists and targeting it at prospective students from other cities and countries; – a differentiated approach to pricing of the student fees for different fields of study in relation to the demand.</td>
</tr>
<tr>
<td>Rapid changes in the environment</td>
<td>The necessity of ongoing upgrades to the material and technical educational equipment due to the rapid development of modern technologies</td>
<td>Development of fund-raising mechanisms, endowment fund. Signing contracts on network interaction with partner enterprises concerning utilization of their material and technical base</td>
</tr>
<tr>
<td>Insufficient innovation readiness level of the economy and society</td>
<td>Lack of motivation of business structures and industrial enterprises towards commercialization and technology transfer</td>
<td>Development of innovative and entrepreneurial structure and culture of the University. Popularization and promotion of advances in science, culture, education, positive public image of the transport industry in the regions of Russia and abroad. Development of educational programmes on technological and engineering entrepreneurship.</td>
</tr>
<tr>
<td>Insufficient level of proficiency of prospective students</td>
<td>Level of proficiency of students and graduates insufficient for implementation of innovative projects</td>
<td>Development of integrated educational programmes that ensure interaction between comprehensive schools, children's science parks and children's railways, vocational training schools (colleges), and the university. Development of adaptive, practically oriented and flexible educational programmes at the higher education institution.</td>
</tr>
</tbody>
</table>

It appears to be optimal when the interaction between the educational organization and the employer begins prior to the stage at which a network curriculum is worked out. During the collaboration it is necessary to have the employer describe their needs and to proceed from this description when elaborating the definitions of the professional competencies. A prospective employer is well aware of the demands of the labour market. Therefore, having analysed the career gap, this employer must identify what kind of personnel is needed, how high their qualification must be, and how many employees are required.

4 Conclusion

Today, when the digital transformation of the economy requires the development of new professional competencies to be acquired by the transport industry workers, and the implementation of innovations to improve the efficiency of the railway industry also creates
a need for the specialists of new profiles, it is the network form of education that provides opportunities for interaction between the employer and the education institution, as well as between different higher education institutions, in order to develop an educational programme that will meet the demands of the labour market.

The network form of education allows to achieve consolidation of the educational resources of the University and the material and technical resources of the employer — corresponds to industry intellectual priorities and the format of the digital educational ecosystem.

It appears that in the near future creation of such digital integrated educational projects such as the Network University of High-Speed Rail Transport will be one of the leading trends in the development of the higher education system and an important element of the structure of the modern higher education which allows to develop academic mobility and thus ensure a technological breakthrough in the transport field.

References

1. O.V. Belozerov, Railway Transport 1, 4-10 (2018) DOI: 10.17816/transsyst201734150-178