School of Engineering Entrepreneurship as a driver of the development of a digital educational ecosystem for transport and logistics

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Abstract. The article substantiates the relevance and practical significance of the transition of the educational system from traditional to fundamentally new forms that integrate into the digital ecosystem, taking into account global trends in digitalization, the provisions of the state strategy of the digital economy, intellectual priorities of sectoral development. The article reflects the conceptual foundations of the development and implementation of an innovative educational model – the School of Engineering Entrepreneurship (SEE) – created by the team of the first engineering transport university of Russia – the St. Petersburg State University of Railways of Emperor Alexander I (PSUREA). The result of a comprehensive analysis of the already implemented stages of the activities of the SEE, the characteristics of the project directions are presented.

1 Introduction

Introduction of new digital technologies, the progressive digitalization of all spheres and sectors of the economy, the consequences of the spread of the COVID-19 virus, as well as the acute political situation in the global space with regard to Russia, which may entail new international sanctions in the field of IT technologies, require the creation of innovative, providing leadership in the global competition of scientific and educational ecosystems, the trajectory of formation educational strategy of the transport and logistics industry.

Increasing the competitiveness and independence of Russian companies and their suppliers is possible only by reducing the existing gap between the level of introduction of new digital technologies and the speed of their creation in the industry. The development of not only engineering, but also entrepreneurial competencies will be able to ensure a rapid influx of innovations into the Russian transport and logistics ecosystem.

The role of higher educational institutions and federal innovation platforms operating in the field of transport education is increasing, which are not only suppliers of personnel for the transport and logistics industry, responsible for the formation of necessary digital competencies among graduates, but also who are currently themselves subjects of an integrated digital educational ecosystem, creating innovations and performing an important

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role of experts in the field of acceleration of synergy of contributions of scientists and practitioners to create a world-class scientific and educational environment.

In this regard, it seems a very timely step to launch the School of Fig Entrepreneurship, a fundamentally new educational model integrated into the global educational ecosystem in the future. The priority of the School of Engineering Entrepreneurship is the creation of a human-centered hub, where students develop both engineering and entrepreneurial skills and knowledge necessary to improve the functioning of the transport and logistics ecosystem.

2 Materials and Methods

The digitalization of all sectors of the economy has radically changed the structure of demanded professional competencies among university graduates, and, in particular, future professionals of the transport and logistics industry. The sphere of railway transportation today has a great potential for increasing the level of digitalization of its services. However, in order to solve the problem of personnel training, on the one hand, in accordance with federal state educational standards, and on the other hand, meeting the requirements of the existing labor market, higher education institutions have to introduce new educational practices aimed at developing the innovative potential of graduates. In order to solve the ambitious task of making a technological breakthrough in order to introduce intelligent technologies in the transport sector, industry universities should simultaneously activate both the field of research and innovation development, and build their educational programs taking into account the goal of developing a digital ecosystem of intelligent priorities for transport and logistics.

The creation of federal innovation platforms (FIA), within the framework of which educational projects aimed at achieving this goal are implemented, is one of the ways to improve both the quality of education and obtain a synergetic effect from combining innovative research activities with the educational process. The activities of the FIAs "School of Engineering Entrepreneurship (SEE)" of PSUREA are aimed at obtaining knowledge and practical skills for the implementation of projects aimed at creating developments for the development of a digital ecosystem of intellectual priorities for transport and logistics.

The theoretical development and practical testing of models and methods of the digital educational ecosystem for the transport and logistics sector is based on the current provisions of the programs of strategic development of the country, its transport and logistics complex, educational system, highlighted in the research of scientists, teachers of the St. Petersburg State University of Railways of Emperor Alexander I [1-9]. The research of SEE technologies is directly correlated with the tracks of the University's development until 2030, the provisions of the Priority 2030 project and other important guidelines for the research and educational activities of the PSUREA.

The main idea of the innovative educational platform (IEP is to prepare students of all levels of education for the optimal solution of engineering and technical problems for a technological breakthrough through the creation of innovative technology for the implementation and commercialization of research results in a continuous relationship from school to postgraduate education.

The high quality level of the expected results of the proposed innovative educational project is associated with obtaining a synergistic effect by combining the resources and capabilities of the state, business, science and education. The implementation of the innovative educational project will ensure the formation of "end-to-end" interdisciplinary competencies of managers and specialists working in the field of engineering entrepreneurship, including those implemented in the digital transformation of the economy: digital modeling, BIM technologies, Big Data and business analytics, artificial intelligence,
Blockchain, information security, cloud technologies, virtual and augmented reality, flexible technologies in management.

3 Outcomes and Discussion

The idea of the concept of creation and practical implementation of the model of the School of Engineering Entrepreneurship (SEE), integrated into educational ecosystem of PSUREA that is a timely response to the state request for innovative digital transformation and a productive response to global market trends.

The research has shown the possibility of practical use in the SEE of both elements (stages/levels) of the traditional educational model and the best practices of the Russian education system, as well as the introduction of significant qualitative transformations taking into account the intellectual priorities of the development of the ecosystem of the transport industry. In the presented conceptual model, the SEE covers four levels of training of engineers: pre-university, secondary professional, higher and additional professional. It is important to note that continuing education within the framework of the SEE in PSUREA begins with professional orientation and additional pre-university training in secondary educational schools and colleges (Table 1, Fig.1).

As features of the innovative SEE model, built on the formation of advanced education, the integration of science, education and production, it should be noted the combination of modular and problem-based approaches to the formation of educational programs in order to build a system of continuing education aimed at anticipating the demands of the labor market.

Table 1. Planning of levels and training facilities in the SEE PSUREA taking into account intellectual priorities for transport logistics

<table>
<thead>
<tr>
<th>Level of training</th>
<th>Education</th>
<th>Type of preparation</th>
<th>Training facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level I</td>
<td>Pre-university training</td>
<td>Faculty of Pre-university training, schools of the city, region and regions</td>
<td>Malaya Oktyabrskaya (children's) railway</td>
</tr>
<tr>
<td>Level III</td>
<td>Higher education</td>
<td>Postgraduate study</td>
<td>Departments of PSUREA, Committee for the Development of Entrepreneurship in St. Petersburg, St. Petersburg GBU &quot;Center for...</td>
</tr>
<tr>
<td>Level of training</td>
<td>Education</td>
<td>Type of preparation</td>
<td>Training facilities</td>
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<tr>
<td>Magistracy</td>
<td></td>
<td></td>
<td>the Development and Support of Entrepreneurship, JSC &quot;Russian Railways&quot;, Directorate of JSC &quot;Russian Railways&quot;, IPEBU, PJSC &quot;Lengiprotrans&quot;, Russian and foreign innovative companies, foreign partner universities; commercial banks, research organizations, design and survey organizations.</td>
</tr>
<tr>
<td>Specialty</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor course</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level IV</td>
<td>Post-university supplementary vocational education</td>
<td>Retraining</td>
<td>The Institute of Advanced Training and Retraining of PSUREA, departments of PSUREA, JSC &quot;Russian Railways&quot;, foreign partner universities, commercial banks, research organizations, design and survey organizations, Russian and foreign innovative companies, partner organizations participating in international educational programs.</td>
</tr>
<tr>
<td>Professional development</td>
<td></td>
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</table>

The School of Engineering Entrepreneurship implements its activities in the following areas taking into account the tracks of the digital economy intellectual priorities in transport and logistics: "Transport of the future", "Polytransport systems", "Artificial Intelligence", "Digital solutions in transport", "Engineering of transport technologies". Educational activities within these areas of the SEE contribute to the purposeful formation of competencies for the comprehensive training of engineers for innovative activities in the field of engineering and technology.
3.1 Transport of the future

The origin of the direction was at the first stage of the development of the "School of Engineering Entrepreneurship" for the period of the 1980s - early 2000s, when in the USSR, then in the Russian Federation, the goal of creating environmentally friendly high-speed rail transport was set at the state level. At that time, there was no formalized concept of "Innovative Educational Project", but its goals and objectives, as well as substantive components, including a set of research works, the formation of a proper team of professors and teachers, the creation of an educational and methodological base and information support, were already being implemented. Within the framework of this direction, undergraduates and postgraduates studying in engineering specialties participate in the design of transport and logistics facilities, make infrastructure decisions, plan sustainable development of transport companies, offer advanced transport technologies and products, which is confirmed by patents, certificates on the implementation of diploma projects and dissertations, awards with international, all-Russian and regional competitions.

3.2 Polytransport systems

The direction appeared at the second stage of the activity of the "School of Engineering Entrepreneurship". On the basis of the university, the scientific and educational center "Innovative Technologies in Railway Transport" was created, the activity of which implies the process and result of purposeful formation of competencies for comprehensive training of specialists for innovative activities in the field of engineering and technology. Within the
framework of the School of Engineering Entrepreneurship, in order to attract students to research activities, stimulate the scientific work of graduate students and young scientists and identify works worthy of introduction into the commercial activities of companies, presentation at international and All-Russian competitions, scientific events are held annually at the university.

The project office "Student Project Office" (PSUREA) for the development of supraprofessional skills and the formation of teams for solving interdisciplinary practice-oriented tasks functions at the university within the framework of the SEE. Classes were held as part of webinars with the involvement of young scientists and experts in the field of project management from St. Petersburg, Moscow and Ufa. The process of introducing the achievements of the research work of the team into educational activities is an important component of the educational activities of the University. The use of research results allows to improve the quality of the educational process, to acquaint students with new achievements and current developments, with the use of innovative technologies and techniques in practice, which allows them to gain competence in bringing engineering ideas to their use in the activities of commercial companies.

In recent years, the University has been actively working on the implementation of large-scale investment projects of the railway network of the Russian Federation, acting as a technical auditor of the Government of the Russian Federation. Specialists of the university participate in numerous experimental developments that allow solving actual problems of railway transport. In particular, PSUREA is a partner in the Kolarctic CBC Program project. This project is aimed at developing cross-border cooperation and joint scientific research in the field of railway transport. Within the framework of the project, specialists from the participating countries were given a unique opportunity to share technical know-how and advanced solutions in the field of railway management in order to improve the reliability of the railway infrastructure.

Thanks to innovative technologies and solutions in the field of polytransport systems, higher efficiency of maintenance, repair and monitoring of railways will be achieved, as well as the formation of tools for a unified transport and logistics system integrated into the infrastructure of transport corridors and systems.

### 3.3 Digital solutions for transport

The direction arose at the third (modern) stage of the activities of the SEE. The development of all levels of training of students, due to the digitalization of education and the desire to expand the scope of educational activities of the university, including the international level, is aimed at creating network educational platforms. Preparatory work for the international competition of the ERASMUS+ educational program was carried out with the participation of PSUREA. A consortium of universities from a number of countries was formed, which won an international competition by offering an educational project "Economics, Ecology and Infrastructure of the HSR". The project is designed for the period 2018 – 2024. Within the framework of the Erasmus+ international grant, the project is being implemented jointly with 8 universities from Russia, Germany, Spain, Poland and Kazakhstan.

In 2020, the university developed programs used in the implementation of the main professional training programs for engineers and retraining of specialists of JSC "Russian Railways" within the framework of digital competencies:

- "Virtual and Augmented Reality technologies (VR/AR technologies)"
- "Distributed Registry Systems (Blockchain)"
- "New production technologies (SCT NPT)"
- "Neurotechnologies and artificial intelligence"
Within the framework of additional professional education programs, the following modules of disciplines are used to improve the digital literacy of students and teachers:

- Management and marketing in the digital economy;
- Personnel training: fundamentals and prospects of industrial Internet development;
- Digital trends, their place and role in business;
- Search engine promotion in the digital environment;
- Analytics in the digital environment;
- The practice of using professional digital services;
- New communication technologies: mobile applications, bots in the context of digital business transformation;
- Business informatics as a synthesis of knowledge on business and IT technologies.

Within the framework of the professional development program, the program "Work of a duty officer at an operational locomotive depot in the conditions of the implementation of the Digital Railway project" operates. The branch research laboratory "Automatic maintenance, diagnostics and monitoring of railway automation and telemechanics systems" has also been established and is functioning. Created in 2018-2019, the creative laboratory for creating digital projects Hackathon PSUREA "Uni.Digit", allows university students to offer their Internet ideas.

The direction of the School of Engineering Entrepreneurship "Digital Solutions in Transport" can be considered as a tool for solving the problem of increasing the competitiveness of one of the most important sectors of the economy - transport and logistics, which provides an opportunity for growth in other areas of the national economy.

### 3.4 Artificial intelligence (AI)

One of the trends in the implementation of projects on end-to-end digital technologies in PSUREA is the direction of "Artificial Intelligence" (AI), which arose at the present stage of the activities of the SEE. AI is allocated in a separate direction. This is due to the fact that the current stage of digital transformation in transport is characterized by a rapid acceleration of machine learning. Transport management information systems independently form rules and find optimal solutions using algorithms for analyzing large amounts of data. This indicates the need for students to master the technology of artificial intelligence, as it actively penetrates into the sphere of cargo and passenger transportation. Although the process of artificial intellectualization is dynamic, it is characterized by the duration of test tests and the progressive nature of implementation in educational projects. This direction in the "School of Engineering Entrepreneurship" gives students the opportunity to gain competencies that ensure the implementation of all phases of the life cycle of the development of transport products and innovations, including the commercialization of ideas, as well as to gain skills in the development of construction, operational, international and computer engineering projects.

During the implementation of the innovative educational project "School of Engineering Entrepreneurship", it is planned to achieve the following key results:

- digital models of management of entrepreneurial ideas, development and implementation of business projects;
- ensuring the annual generation of innovative projects (startups) with the creation of interdisciplinary project teams;
- formation of fundamentally new systems of collective management in the field of engineering entrepreneurship;
– creating an educational product designer;
– formation of a portfolio of educational resources for creating online content;
– implementation of additional professional training courses for employees of universities and JSC "Russian Railways" on the use of digital competencies in three types of activities: educational, scientific, managerial;
– implementation of the digital information platform SEE;
– implementation of modules in educational programs for the development of basic digital competencies for different categories of students.

The main effect of the implementation of an innovative educational project is the achievement of targets and the solution of the system of tasks of the project, in the bowels of the project model of digital transformation of the educational process at the University.

Research has shown that in order to achieve this goal, the University needs to solve a set of the following tasks:
– increasing the speed of decision-making;
– increasing the variability and flexibility of business processes according to the client's requests;
– the use of paperless and sparsely populated technologies;
– implementation of digital transformation of logistics;
– ensuring intersectoral information exchange;
– creating open service ecosystems;
– functioning of the state segment of the unified trusted space in transport;
– ensuring the availability, quality, reliability and security of supply chains;
– standardization of information interaction in transport.

The need to create an innovative educational project School of Engineering Entrepreneurship is due to the importance of forming an effective system for identifying and developing the abilities and talents of schoolchildren and students, aimed at self-determination and professional orientation, commercialization of research results in a continuous relationship from school to postgraduate education.

One of the reasons hindering the wider use of engineering entrepreneurship in Russia is the lack of specialists capable in the near future to develop, create, implement, operate and commercialize new transport systems and devices using in order to improve the efficiency of the transportation process, improve the environment, increase energy efficiency and energy conservation, led to the filing of an application for the creation of a federal innovation platform, on the basis of which the formation of such specialists will be carried out. PGUPS will become a center consolidating graduates of various specialties and areas working in the fields of science and technology, directly or indirectly related to rail transport and able to effectively manage technical and technological processes in the industry and elements of the digital ecosystem at the operational and strategic level.

4 Conclusion

The answer to the new challenges of our time, requiring the concentration of efforts to implement integrated digital educational projects in the field of transport and logistics services, combining both engineering and entrepreneurial knowledge and practical skills, was the format of creating innovative educational platforms based on industry universities that have become a provider of the best relevant educational technologies. Within their framework, the created flexible scientific and educational ecosystem allows us to concentrate efforts on the creation and promotion of new innovative technologies in the areas of the
introduction of artificial intelligence technologies, engineering of transport technologies, digital solutions in transport and the development of the transport ecosystem of the future.

The SEE of the St. Petersburg State University of Railways of Emperor Alexander I are based on modern principles of innovation in engineering education, the best world practices, proven research, the results of which are published in the latest scientific publications [1-9]. The presented directions of functioning, educational technologies and methods of the School of Engineering Entrepreneurship can be considered as a well-formed, but dynamically developing integrated complex of the digital educational ecosystem.

It can be concluded that the development and scaling of such projects as the School of Engineering Entrepreneurship will become a significant trend towards the development of industry transport education, providing competent personnel in the field of transport and logistics services to create a technological breakthrough that will increase the competitiveness of both the industry as a whole and individual innovative technologies and practices at the global level.

References

2. A. Benin, M. Guzijan-Dilber, L. Diachenko, A. Semenov, Finite element simulation of a motorway bridge collapse using the concrete damage plasticity model, E3S Web of Conferences, 157, 06018 (2020) doi: 10.1051/e3sconf/202015706018