Integration of educational and industrial organizations in the implementation of the roadmap in the field of engineering and industrial design

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Abstract. The article deals with the integration of educational and industrial organizations. In this case we are taking into account the goals and objectives of the roadmap in the field of engineering and industrial design. The Russian Union of scientific and engineering public associations is an integrator of public scientific and technical organizations that are voluntary self-governing non-profit associations of scientists, engineers, teachers and teachers. The article presents the activities of RUSEA to preserve the history of science and technology, in which a large number of commemorative events have been implemented. Network structure of RUSEA, which includes the basic centers of science and technology, provides training and retraining of personnel, provides opportunities for additional education for specialists of different levels, enables the international scientific-technical conferences, seminars, round tables on topical issues of science and education.

1. Introduction

The high level of development of science, technology and technology is considered as the most important resource of the economy and society, the basis of competitiveness and internal security of the country around the world. The need for rapid practical use of modern scientific knowledge, increasing the efficiency of research and development, puts engineering at the forefront of the economy and culture. This means that a high rate of assimilation of new knowledge, identification, training and support of talented engineers and scientists becomes a priority for both the state and society as a whole [1].

Strengthening the intellectual and creative potential as a strategic resource of the nation is of paramount importance in the Russian Federation. It should be noted that the Government of the Russian
Federation provides state support for the scientific and technological development of the Russian Federation and the preservation and development of its scientific potential.

2. “Roadmap” in the field of engineering and industrial design

The recently approved “road map” in the field of engineering and industrial design, which is designed for 5 years—从 2020 to 2025, is aimed at integrating educational and industrial organizations and is focused on creating a set of state support measures for the engineering and industrial design industry, mechanisms for providing tax benefits, and developing national, educational and professional standards in this area.

As part of the implementation of the roadmap, a number of measures are planned to improve the status of engineering education, aimed at popularizing engineering professions.

Another important area of the roadmap is the growth of the share of small and medium-sized businesses in the structure of engineering and industrial design. This direction is planned to be implemented by supporting regional engineering centers and transferring the best regional practices for the development of small and medium-sized businesses.

In General, the implementation of the action plan (Road map) in the field of engineering and industrial design is designed to ensure:

- significant growth of the engineering industry and the formation of the domestic industrial design industry;
- diversification of the engineering and industrial design industry in areas (mechanical engineering, electronics, biotechnology, composite materials);
- creation of national leaders in the field of services for the complex creation of construction projects, including project management (EPC (M) contracts);
- development of small and medium businesses in the engineering and industrial design industry;
- modernization of sectors of the economy and development of a new significant industry of the Russian Federation;
- training of highly-qualified personnel in the field of engineering and industrial design.

The goals of the “roadmap” are:

- modernization and development of the Russian economy with the services of domestic companies in the engineering and industrial design industry;
- creation of an institutional environment and infrastructure for the development of small and medium businesses in the field of engineering and industrial design;
- providing the economy with new jobs and appropriate skilled personnel in the field of engineering and industrial design;
- reducing the gap between the Russian Federation and developed countries in terms of EPC (M)-competencies for the implementation of high-tech projects in metallurgy, chemistry and other manufacturing industries, the development of shelf fields and Eastern Siberia, creation of new domestic technologies in the field of natural gas liquefaction;
- expanding the export of engineering and industrial design services.

Three central tasks of the “roadmap” can be formulated. The first task is related to the development and implementation of the following standards and regulations:

- national standards of the Russian Federation and regulatory legal acts in the field of engineering and industrial design;
- regulations on an engineering center and an industrial design center based on an innovative territorial cluster;
• updating federal state educational and professional standards in the field of engineering and industrial design.

The second task is to develop a set of government support tools, including:

• formation of an open register of companies - participants in the market of engineering services, industrial design services and engineering equipment used in providing engineering and industrial design services;
• development of tax incentive measures;
• development of financing measures on the basis of such organizations as the state development corporation "VEB.RF", JSC “Russian venture company”, the federal state autonomous institution “Russian Foundation for Technological Development”, the federal state budgetary institution “Fund for Promotion of the Development of Small Businesses in the Sphere of Scientific and Technology”, non-profit organization “Foundation for Development of Innovation and Commercialization Center”, JSC “RUSNANO”; 
• development of measures to stimulate demand for the products of national suppliers of equipment and services in the field of engineering and industrial design.

The third task of the “roadmap” in the field of engineering and industrial design is related to the preparation and implementation of priority projects with the use of state support, including:

• prioritization, preparation and implementation of promising projects of engineering companies, as well as organizations of the industrial design sector;
• scaling the program for creating engineering and industrial design centers based on educational institutions of higher learning, scientific organizations and state-owned companies, companies with state participation and private companies, as well as developing centers of technological superiority based on private companies;
• development of a unified information platform based on the state information system of industry;
• implementation of systematic administrative support for localization and exchange of technological competencies with foreign companies - leaders in the field of EPC(M)-services.

It should be noted that a number of issues discussed by public scientific and engineering associations are reflected in the adopted roadmap [2, 3]. This includes, for example, the draft law on engineering, the announcement of the year of the engineer in the Russian Federation, and the organization of an engineering competition. At various events of the Russian Union of scientific and engineering public associations (RUSEA), issues are discussed in detail and solutions are implemented aimed at the development of engineering, engineering, engineering practice, and industrial design, which can be taken into account. when implementing the roadmap under consideration.

Public scientific and technical organizations, which are voluntary, self-governing, and non-profit associations, provide a great deal of assistance in the practical implementation of state policy in the scientific and technical sphere at the Federal and especially regional levels of the country. scientists, engineers, educators, and teachers. As socially oriented organizations, they are United in the Russian Union of scientific and engineering public associations and can act as integrators of educational and industrial organizations for the implementation of the roadmap in the field of engineering and industrial design.

3. Experience in engineering training for high-tech industrial organizations
The experience of training a Russian engineer has been accumulated at the Zheleznogorsk enterprise JSC "Information satellite systems". Academician M. F. Reshetnev", where a comprehensive program
of measures to attract, retain and promote young employees has been implemented since 2003. It starts at school, continues at partner universities, and includes subsequent adaptation in production.

As part of career guidance, physical and mathematical profiling is supported in the city's schools, assistance is provided in equipping the educational and material base, and visits to the demonstration and exhibition center and business units are organized. At the final stage, an off-site dive of grade 11 students is held, where the children implement their first project to create a spacecraft within a few days. According to the results of competitive selection, the most talented school graduates are sent to higher education institutions for budget places in the framework of targeted training.

In order to closely cooperate with higher scientific institutions, ISS has signed contracts with 11 leading Russian universities for targeted training of specialists. Among them, first of all, MAI, Bauman Moscow state technical University, D. F. Ustinov Baltic state technical University, Tomsk state University and others. These agreements provide for the passage of all types of internships and diplomas in JSC "ISS", the introduction of relevant disciplines, taking into account the specifics of the enterprise, the appointment of additional scholarships for students starting from the 2nd semester of the 1st. year and responsibilities of the student to work at the Zheleznogorsk enterprise for 3 years after graduation.

Innovative forms of student learning are also used, including group project-based learning. For example, in 2008, ISS specialists and students of the Siberian state aerospace University created the “Yubileyny” small spacecraft. In addition, the Zheleznogorsk enterprise has basic departments and branches of the departments of the Siberian state aerospace University and the Siberian Federal University in the areas of "Spacecraft", "automated spacecraft control Systems", "Space engineering ", "Electronic devices and communication systems", and "CA production Technologies". Thus, candidates and doctors of technical Sciences from among highly qualified specialists and managers of JSC ISS can pass on their scientific and practical experience of satellite builders to students.

The main activities for training engineering personnel in JSC "ISS" are carried out directly at the enterprise. A special support system has been developed for young specialists in the first years of working in the design and production departments of the company.

One of the important aspects of personnel policy of JSC "ISS" is the constant training of personnel and creation of conditions for development of scientific potential of staff of the company. Every year, more than 2000 employees of the company are trained and retrained at various levels. At the same time, a significant part of employees receive on-the-job training at courses organized by the company. More than 200 people a year improve their skills in higher education institutions, universities and other training centers.

The company tirelessly encourages the desire of young people to engage in scientific and engineering activities. Today, more than 100 employees of ISS are enrolled in the postgraduate program. It should be noted that this is a third of the total number of graduate students in the country's space industry. There is also a system of incentives for those who want to achieve real success in research and development.

In JSC "ISS" valid Scientific and technical Council, chaired by the General Director of the enterprise N. Testoedov, employees annually take part in various Russian and international scientific conferences. One of them is the international scientific conference "Reshetnev readings", which is held by the Siberian state aerospace University together with the company Zheleznogorsk. The scientific forum is dedicated to the memory of the founder and first head of the company, academician Mikhail Reshetnev.

The management of ISS JSC persistently strives to form a team of professionals in their field in order to maintain leadership in the field of space technology production. A well-thought-out personnel policy gives results. Namely, information satellite systems named after academician M. F. Reshetnev LLC became the undisputed leader in the number of winners of the all-Russian competition "Engineer of the year" in the aviation and cosmonautics industry. The competition has been held by RUSEA for more than 20 years.

For the period from 2003 to 2019, JSC ISS has 9 winners in the category "Professional engineers" for specialists with work experience of five years or more, and 13 young specialists up to 30 years received awards in the category "Engineering art of young".
Among the winners from the Zheleznogorsk satellite builders are 3 doctors and 7 candidates of technical Sciences. ISS specialists awarded by the all-Russian competition have 128 patents for inventions, 730 scientific publications, 162 copyright certificates for inventions and 7 certificates of registration of computer programs.

Many of the winning specialists were awarded high government awards and prizes. Thus, doctor of technical Sciences Albert Kozlov, who headed JSC ISS from 1996 to 2006, was awarded four orders, is a laureate of two state prizes, author of more than 200 scientific papers, and has 17 patents of the Russian Federation. Vladimir Akchurin, the author of 54 patents of the Russian Federation and 140 copyright certificates for inventions (of which more than 80% are implemented in production), holds the title of "Honored inventor of the Russian Federation". At the world salon of inventions "Brussels-Eureka 2003" he was awarded a Gold medal and a Diploma for the invention of "communication, broadcasting and information relay Satellite". Valery Patraev, doctor of technical Sciences, author of 24 scientific papers, one monograph, four patents of the Russian Federation, highly qualified engineer in the field of spacecraft reliability, was awarded the title "Veteran of Russian cosmonautics" in 2009.

Young specialists of JSC "ISS" are not far behind from experienced engineers. For example, Alexander Khvalko, PhD in physics and mathematics, author of 16 scientific papers and one patent for an invention, is one of the direct participants in a successfully completed project to develop a unified series of electronic modules based on the system-na. - chip technology for control and power systems of space communication devices. His colleague Ekaterina Shangina, author of 24 published scientific papers, worked in the group on creating structural and layout diagrams of the Express-AM5, Express-AM6 and Express-AT1 spacecraft launched and successfully operating in orbit. Evgeny Chubenko, author of four scientific publications and one patent of the Russian Federation, is one of the main participants in the development of a flexible solar battery with amorphous silicon phototransformers for communication and navigation satellites.

So, taking into account the above, we can say with confidence that JSC "information satellite systems named after academician M. F. Reshetnev" (Zheleznogorsk) has created a full-fledged ENGINEERING SCHOOL.

Let's formulate the main features of the engineering school of JSC "ISS":

- recognized by domestic and foreign experts the relevance of engineering (design, technological, design) developments and a high level of results in the field of space technology;
- continuity of the conceptual views of the leaders of the School of Engineering on the progressive development of the enterprise and the transfer of passionate energy from one general designer to another (from S P Korolev to M F Reshetnev, then to A G Kozlov and N A Testoedov);
- harmonious combination of basic (university) and professional (post-university) education;
- an integrated approach to the training of engineering personnel directly at the enterprise (various material and moral incentives, a clear plan for continuous professional development, various forms: conferences, competitions, etc.);
- organization of JSC "ISS" joint structures with partner universities with a heterogeneous scientific focus in order to create a synergistic effect.

4. Conclusion
Thus, as part of solving the problem of integration of educational and industrial organizations in the field of engineering and technology, RUSEA is not just a distributor of scientific and technical knowledge, but also helps the younger generation to master it in every possible way, which becomes the driving force of modern scientific, technical and technological development in accordance with the priority areas determined by the state.

An important aspect of the work of formation of scientific literacy, the production of popular scientific literature, as well as issues of improving the quality of engineering education, introduction of new educational technologies and staff training.
The network structure of RUSEA, which includes basic centers of science and technology, provides training and retraining of personnel, provides opportunities for the system of additional education of specialists of different levels of training, conducts international scientific and technical conferences, seminars and round tables on the topic: current issues of science and education [4-12]. These events are communication platforms for sharing the latest knowledge, selecting research areas and evaluating their results, implementing modern technical solutions and new technologies, and identifying and forming public opinion on current scientific and technical issues. It is obvious that the dissemination of new ideas in various industries, in various fields of technology is impossible without constant contacts between specialists, constant contacts between engineers and scientists, including through the publication of scientific and popular science literature, periodicals, conference materials, etc. seminars. Most scientific and technical problems can be solved only by consolidating the efforts of scientists, engineers, scientists and specialists.

The global coronavirus epidemic is changing working conditions, but despite this, the scientific and technical community, which is led and consolidated by RUSEA, continues its work on integrating educational and industrial organizations and is able to make a significant contribution to the implementation of national and international projects and to solving the current problems that arise at the current stage of scientific and technological development.

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