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TRAINING THE SPECIALISTS OF COMBINED ENGINEERING AND ECONOMIC PROFILE AT RUSSIAN UNIVERSITIES: CLUSTER APPROACH

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TRAINING THE SPECIALISTS OF COMBINED ENGINEERING AND ECONOMIC PROFILE AT RUSSIAN UNIVERSITIES: CLUSTER APPROACH

This paper proposes and describes an approach to the organization and development of educational-technological clusters as the most favorable environment that allows training specialists. Principles of educational-technological cluster formation, combining the innovative enterprises and technological universities, are presented. It is confirmed that cluster approach allows maximizing the synergistic effect of interaction between the educational institutions and industrial systems in the process of re-industrialization of the Russian economy and training of competitive specialists of combined engineering and economic profile.

The current state of the industrial system in the Russia of post-Soviet period is characterized by the re-industrialization[1]. It is the main vector of the development and modernization of the Russian economy. Training of highly qualified engineering and management specialists of a new formation has one of the highest priorities in the list of activities to be implemented within the framework of re-industrialization process. The innovative industrial enterprises demand the specialists of combined engineering and economic profile who possess interdisciplinary technological and business competences and practical skills to work in the conditions of modern industry. This requires the development and realization new approaches in the training of such specialists at universities.

At present time, a significant part of Russian universities do not provide the needs of the national economy, because of, among other factors, the lack of possibility to train students using modern industrial facilities. At the same time the industry is vitally interested in well-trained professionals who are familiar with the new technologies and could work without additional instructions and teaching. In this case, the unique opportunity of professional training, meeting all the requirements of the labor market, is provided by high-tech industrial enterprises, equipped with sophisticated expensive equipment and organized in clusters with innovative universities.

Last years justly could be called as series of tests for both the Russian economy and society as well. The economic crisis deeply affects all economy sectors, negatively influencing on lives of the overwhelming majority of the population, whose level of well-being became rather low. The period of relative economic stability, that lasted until the crisis of 2008-2009 has been ended. Once again, there were exposed the variety of old problems, which solution was postponed in conditions of deceptive prosperity based on high prices for exported hydrocarbon raw materials.

According to experts, at present time the entire industrial system in Russia is in a state of stagnation and needs decisive and systemic measures to eliminate this condition and transfer to innovative development. For example, the degree of technological gap between Russia and industrially developed countries is very significant (Fig. 1).

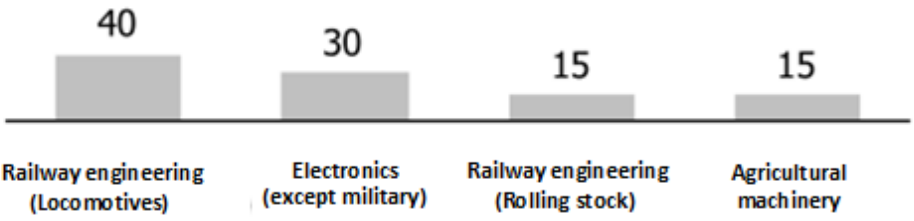

Fig. 1. The gap between the levels of development of various segments of machine-building in Russian Federation and industrially developed countries, years.

As can be seen from the scheme, the backlog of Russian railway engineering (in particular, in locomotive's building) is about 40 years, electronics (except military electronics) is about 30 years, rolling stock is 15 years, and agricultural machinery is also about 15 years. These figures are very eloquent and indicate a deep stagnation of this branch of industry. Other indicators also confirm this fact. For example, that is the average level of large machine-building enterprises profitability (Fig. 2).

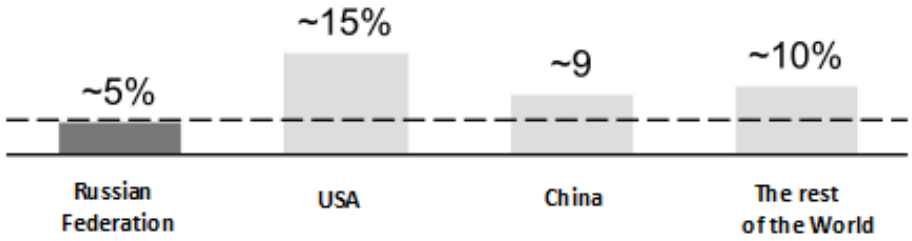

Fig. 2. Average profitability of Russian large machine-building enterprises.

From the scheme on Fig. 2 it can be seen that Russia is at a very low position in this rating, behind almost all economically developed countries. Low profitability in practice means low economic efficiency of Russian enterprises that leads to a systemic industrial crisis. Obviously, such a situation is unacceptable and results in decreased efficiency of the entire Russian economy.

According to the opinion of a number of leading Russian scientists, the political leadership of the country, economic authorities and scientific community declared re-industrialization as the basic trend of modernization of the Russian economy that is a new industrialization based on the advanced technologies.

Under the re-industrialization, the authors of this article understand systematic and purposeful measures for organizational, structural, economical, innovative, technological, personnel and intellectual development of enterprises, based on the actual paradigm of production development and aimed at the formation of an adaptive and competitive industrial system.

Training of the relevant personnel and intellectual potential is one of the most important tasks of re-industrialization. The shortage of qualified specialists is one of the most urgent problems for the Russian industry. Without its solution other measures for restoring and developing of enterprises are of no sense. Training of specialists for enterprises should be multi-level, including training of young people in technical schools and colleges, as well as education of high-level specialists in technical universities. The educational programs themselves should be practice-oriented and include not only industrial practice at enterprises, but also the lectures and seminars held by real professionals of engineering and engineering-economic profiles.

It should be mentioned that the complexity of the problem requires the development of a systemic solution that will combine the necessary tools for re-industrialization within a unified organizational and technological configuration. Such a structure, according to the authors of this article, should include both the enterprises and institutions that directly contribute to solving the tasks of innovative development.

Considering the possible organizational forms of cooperation between enterprises and technological universities, the *cluster structur*e is to be the most efficient[2]. Clusters are the most progressive integrated organizational structures, allowing to maintain the relative independence of the participants, while forming the uniform technological and economic processes. Moreover, the cluster structure is the next stage in the evolutionary development of the current types of integration of industrial and educational institutions in Russia, for example, in the form of so called scientific and educational centers.

Taking into account the specific features of the problems under consideration, the authors have developed theoretical basis for the formation of *educational-technological cluster*s as a scientific approach to their solution. Educational-technological cluster is the integrated organizational structure, which includes industrial enterprises and technological universities that provides their effective educational, scientific and professional integration with the aim of forming and implementing joint innovation and investment projects, as well as developing the personnel and technical potentials for industrial enterprises.

The appearance of educational-technological clusters as scientific and industrial structures is stipulated by modern problems of the Russian industry[3]. The breadth and multidimensionality of these problems suppose the multi-level integration among the cluster participants with the aim of formation of sustainable social, economic, and scientific relations. Interaction of technical universities and industrial enterprises within the cluster may be considered as one of the forms of implementing public-private partnership.

The first direction of cooperation is the training of specialists and their employment in cluster's enterprises. This assumes the development of effective personnel training and the consistent involvement of students into the real industrial processes. The current gap between industry and higher education does not allow the realization of such a scheme in a full mere. Certain isolation of enterprises from the educational environment determines some difficulties for young people who want to pass industrial practice and study the real internal processes of the enterprise.

The second important area of cooperation is the implementation of joint innovation and investment projects. This assumes scientific, technical, and economic collaboration between the university and enterprise, aimed at joint commercialization and introduction of new technologies into manufacture, development of innovative products.
The third direction of cooperation within the framework of educational-technological clusters is the re-training of employees of cluster's enterprises. This direction is a logical continuation of the first one, related with the attraction of young specialists to the enterprise. Each employee of the enterprise is an individual with a certain intellectual and professional potential and experience. His professional competences influence the quality of the work and the ability to solve complex tasks.

The fourth direction is scientific and technical assistance to the enterprises in their technical modernization. Under the technical modernization we understand the complex automation of the enterprise, the increase of its technological potential and energy efficiency. This direction ensures the solution of the main problem from which the majority of Russian industrial enterprises suffers, namely high degree of equipment obsolescence and low quality of products. Automation of enterprises is quite complex and multifaceted process from a technical point of view. It requires profound and systematic knowledge of Integrated Control Systems, its hierarchy, and relationship between various ICS subsystems.

Such educational-technological cluster is organized in the framework of training specialists of combined engineering and economics profile at one of the leading Russian technical universities – the Moscow Aviation Institute (National Research University), see Fig. 3.
It is worth to mention that it was a really difficult task to organically integrate engineering, technological, and economic competencies into unified information blocks with interactive educational materials and practical cases derived from the experience of Russian enterprises. The emphasis on the interactivity of the learning process and the integration of real examples

of project implementation helps students to develop the proper motivation, research activity and real interest in the subjects studied. All these factors contribute to the development of educational environment in which students at a certain stage of training become the participants in real projects. They learn to analyze effectively their strengths and weaknesses, the technologies used, and evaluate the effectiveness of the investments.

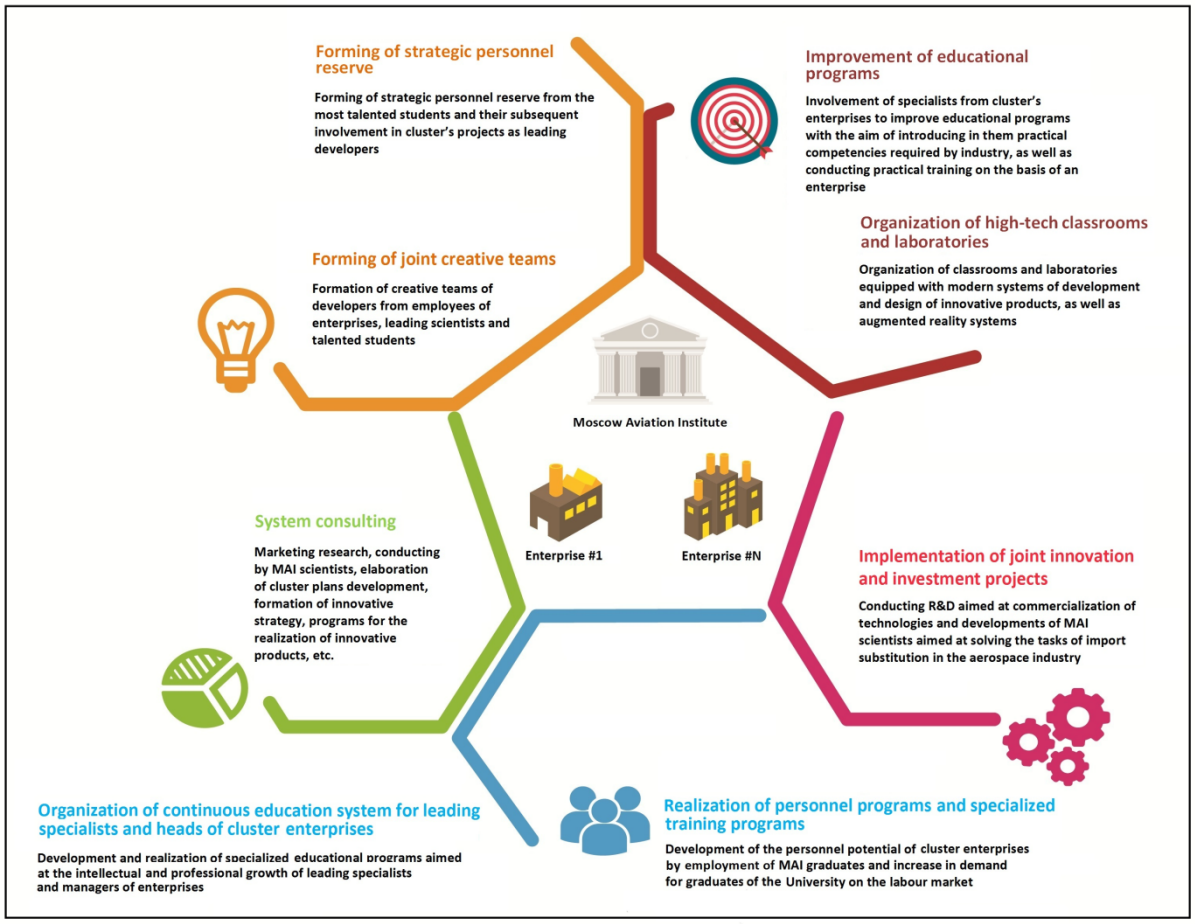

Fig. 3. Scheme of Moscow Aviation Institute educational-technological cluster.

In the framework of cluster approach authors proposed one of the options for realization of the general educational model of the unified structure – "Arrow of Industrial Competences". It is introduced in Moscow Aviation Institute for the training of specialists of combined engineering and economic profile. This model supposes the systematization of the educational activities of appropriate university departments and the development of student's professional competencies, taking into account the place and role of graduates in the products life cycle. In simplified form one variant of this model is presented on Fig. 4.

Principles of the "Arrow of Industrial Competences" educational model design are the following:

1. *Principle of Systematic*. The arrow of competences is formed on the basis of the system approach for staff training for various stages of the products life cycle. This approach includes the development of unified educational model, analysis of the compliance of its criteria with the department's educational programs and their improvement by including the required professional competencies.

2. *Principle of Synchronism*. The sets of competences should be adequate as much as possible with the actual principles, methods and technologies used in modern industry. Each competency should be clearly related to a specific professional skill according to the principle "Know – learn – apply the skill in the real job situation".

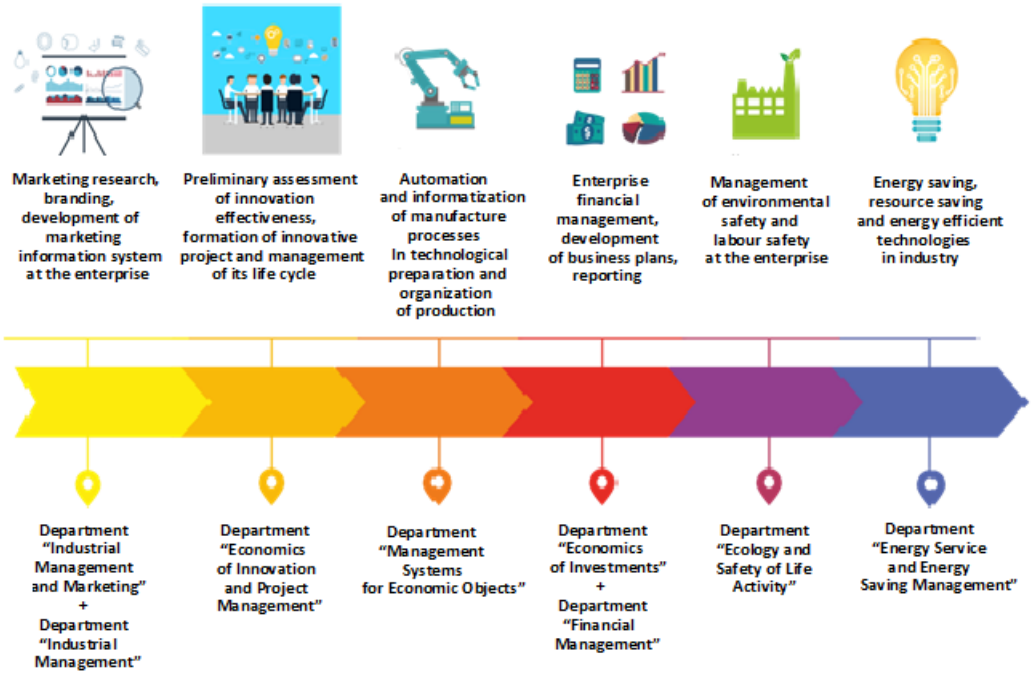

Fig. 4. Arrow of Industrial Competences.

3. *Principle of Universal Intellectual Development*. Teachers also work to increase their competence in the organization and management of manufacture processes, learning in theory and in practice the most modern and effective methods and technologies used in real production. Due to this, the gap is decreased between theoretical university training and industrial requirements to the graduates.

The approach proposed has proved its efficiency and graduates of combined engineering and economic profile from Moscow Aviation Institute are of high demand on labour market in Russia and abroad.

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