PROSPECTS OF CREATING INNOVATIVE BUSINESS STRUCTURES IN THE METALLURGICAL INDUSTRY

[1]Sofiya SHEVTSOVA, [2]Kamila JANOVSKÁ, [3]Šárka VILAMOVÁ

[1]VSB - Technical University of Ostrava, Faculty of Materials Science and Technology, Ostrava, Czech Republic, EU, sofiya.shevtsova.st@vsb.cz

[2]VSB - Technical University of Ostrava, Faculty of Materials Science and Technology, Ostrava, Czech Republic, EU, kamila.janovska@vsb.cz

[3]VSB - Technical University of Ostrava, Faculty of Materials Science and Technology, Ostrava, Czech Republic, EU, sarka.vilamova@vsb.cz

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Abstract

The transition of the most developed countries' societies to a new phase based primarily on the creation, dissemination and use of knowledge, i.e. innovative development, has become a typical feature of modern economies. Activating innovation requires fundamental changes in the structure of social production and education and in the system of management and organization as well as the coordination of activities, the exchange of information, the mutual interaction of enterprises and the transfer of technologies.

The effective and controlled mutual cooperation of selected international scientific organizations, scientific and research centres and companies leads to reduced costs of product innovation through the use of synergies from the mutual cooperation of participating entities, creating an effective environment for sharing and disseminating knowledge, optimizing business processes and streamlining the subject of the innovation process. The article presents the outputs of the project, the aim of which is to analyze the mutual cooperation of selected entities in reducing the cost of developing innovative technology of the electrolysis process at work in the Russian Federation through an association of entities mentioned hereunder

Keywords: Metallurgy, electrodeposition, business combination, innovative development, engineering

1. INTRODUCTION

A characteristic feature of modern economic development in any area of activity is the transition of the most developed countries to a new phase of forming an innovative society - building an economy based primarily on the creation, dissemination and use of knowledge, i.e. innovation development [1].

At present, there is an increasing emphasis on the effective management of industrial enterprises as well as on innovation, as these are becoming key conditions for success in the knowledge economy. The changing demands and expectations of customers, the presence of competition, new developments in technology, a favourable legislative environment and increasingly globalized and dynamic markets – these are all factors that create opportunities for innovation. Innovation can reduce production costs, gain new markets and increase competitiveness. It creates profits, new jobs, and an increased share of the market, thus becoming a driving force of business performance. In addition to streamlining production, reducing costs and increasing product quality, companies are also forced to analyze new possibilities for obtaining important data not only from their own, but also from external systems. Activating innovation requires fundamental changes in the structure of social production and education and in the system of management and organization as well as the

coordination of activities, the exchange of information, the mutual interaction of enterprises and the transfer of technologies.

In order to streamline the innovation process, thus reducing the costs of product innovation and the production process, industrial companies can use the synergetic effect resulting from mutual cooperation with selected international scientific and research centres and universities.

Developing an innovation strategy that relies heavily on university-industry (UI) collaboration is a widely used strategy in developing countries to compensate for firms' limited internal R&D capabilities [2]. Universities play a strong role in building China's national innovation capacity [3]. The impact of university-industry (UI) collaboration on business innovation efficiency was analyzed using peer panels of 443 innovative companies in China between 2008 and 2011. The results show that UI collaboration has a positive impact on business innovation efficiency, has different effects at different stages and innovation processes and egional institutional factors mitigate the effects of UI cooperation on innovation effectiveness. However, the conclusions of the analysis show that the results are based on a survey of innovative companies and therefore any generalization of the findings contained in this study must be careful and needs to be further explored [4].

Czech industrial companies continue to lag behind the European Union countries in quality, equipment, effectiveness or innovation. For that reason, some operational programmes have been opened to help industrial firms achieve the above goals. In particular, this concerns the Operational Programme Enterprise and Innovation for the period 2007-2013 [5]. In the Czech Republic, the competence centres serve for long-term research cooperation among industry, research institutes and universities. The Czech competence centres were supported in 2012 by the Czech Technology Agency. Due to the short history of the Czech competence centres, it is not possible to evaluate the impact of the Programme. In the first phase, collaborative projects should produce new patents, proven technologies, utility models, industrial designs and prototypes. Subsequently, these results should be transformed into new innovations with market potential [6].

There has been a sharp decline in the level of economic development in the Russian Federation as a consequence of the 2013–2014 sanctions, as many industries are heavily dependent on imported components. In this respect, developing the industry, strengthening links with foreign partners and creating innovative structures that make international cooperation easier, faster and more efficient have become important prerequisites [7].

The main role of an innovation ecosystem in the metallurgical industry in Russia is to facilitate the sharing of knowledge between the innovation ecosystem’s actors, expressed by all respondents. The knowledge shared can originate from universities and research institutions [8]. The development of the Russian systém of higher metallurgical education is the key element in the development of the sectoral innovation system as it provides the sustainable increase in the international competitiveness of the Russian steel industry in the long run [9].

The article presents the outcomes of the planned project, the aim of which was the analysis of the possible mutual cooperation of selected entities - a Chotkovo enterprise for the production of innovative paints and varnishes, Dmitry Mendeleev University of Chemical Technology of Russia (MUCTR) and a RUSSIAN HELICOPTERS holding, to reduce the cost of developing innovative technology of the electrolysis process at work in the Russian Federation.

2. PROBLEM FORMULATION

The most common method of coating metal surfaces in some Russian companies is the method of anodic electrodeposition. In the modern electrolytic deposition technology there is a transition from the anodic to the cathodic method of deposition including the treatment of coating systems with highly dispersed additives of a polymeric and non-polymeric nature. The cathodic electrodeposition (cataphoresis) is a modern industrial production process for the protection of steel structures against corrosion in an electrolytic bath [10].

The technological diagram of applying the deposited material by cataphoretic electrodeposition is shown in **Figure 1**.

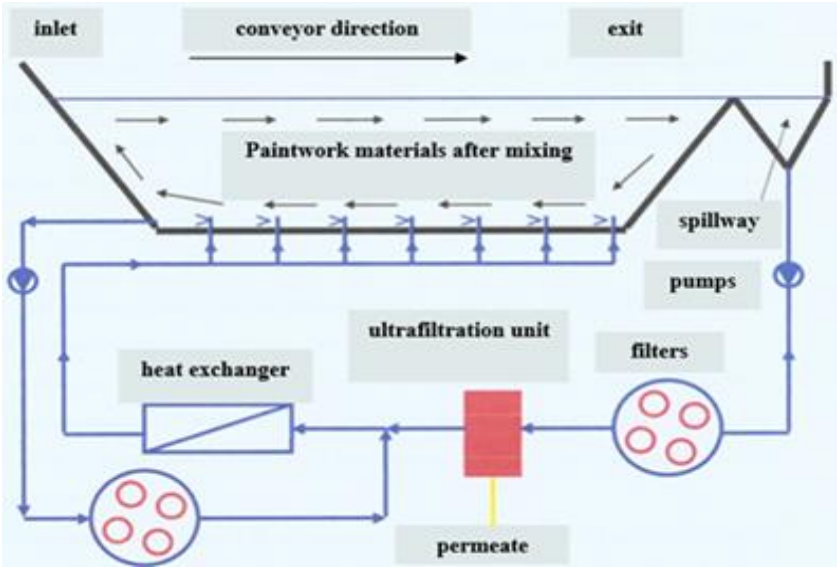

Figure 1 Diagram of industrial cataphoretic electrodeposition line [10]

Innovating the cataphoretic deposition technology process in Russian companies (where the anodic electrodeposition technology is commonly used) consists mainly in developing a new electrolytic bath, which forms part of the whole cathodic electrodeposition industrial line. However, the desired innovation of the electrolysis process requires the extensive investment and cooperation of a large number of experts from the engineering, metallurgy and chemistry fields.

To find a solution to the aforementioned problem in a specific company (the enterprise for the production of innovative paints and varnishes NPO LKP Chotkovo), it was proposed to establish an "ENGINEERING CENTRE", which could effectively use the synergy effect of the mutual cooperation of selected cooperating entities to achieve significant financial and time savings in solving the innovation of electrolytic deposition technology.

3. EXPERIMENTAL PART

In solving the task related to the required innovation of the electrolysis technology process in the particular enterprise, a network group of cooperating entities was created according to a plan. Three key entities were selected to participate in the innovation of the electrolysis process and the creation of a joint "Engineering Centre", namely the enterprise for the production of innovative paints and varnishes NPO LKP Chotkovo, Dmitry Mendeleev University of Chemical Technology of Russia (MUCTR) and the Russian Helicopters holding. The plan of the organizational and managerial model of the selected scientific and research organizations and companies participating in the planned innovation of the electrolysis process technology within the planned model of the "Engineering Centre" presented in the form of a structural matrix is shown in **Figure 2**.

It can be assumed that the process of innovation of the electrolysis process technology within the created model of the "Engineering Centre" can proceed more efficiently, because it will optimize the management processes of all business and innovation activities, simulate financial flows and, above all, create an effective environment for sharing and disseminating knowledge and conditions for the use of the synergetic effect gained from the mutual cooperation of the participating entities and also to respond operatively and effectively to possible changes and deviations from the planned course of activities.

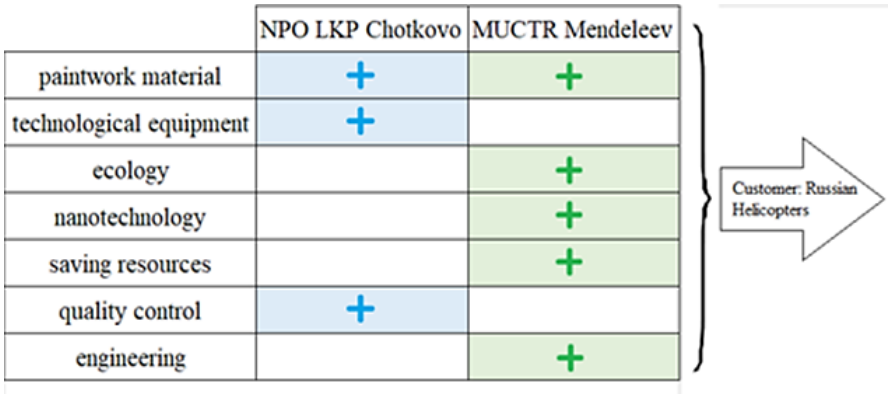

Figure 2 Structural matrix of the planned innovation "Engineering Centre" model

The process of participation of selected cooperating entities within the "Engineering Centre" model including the process of development, purchase and implementation of innovative electrolysis process technology applied for the need of the RUSSIAN HELICOPTERS holding is presented in **Figures 3, 4** as an individual process as well as in the form of comparing the process with the newly created "Engineering Centre" model.

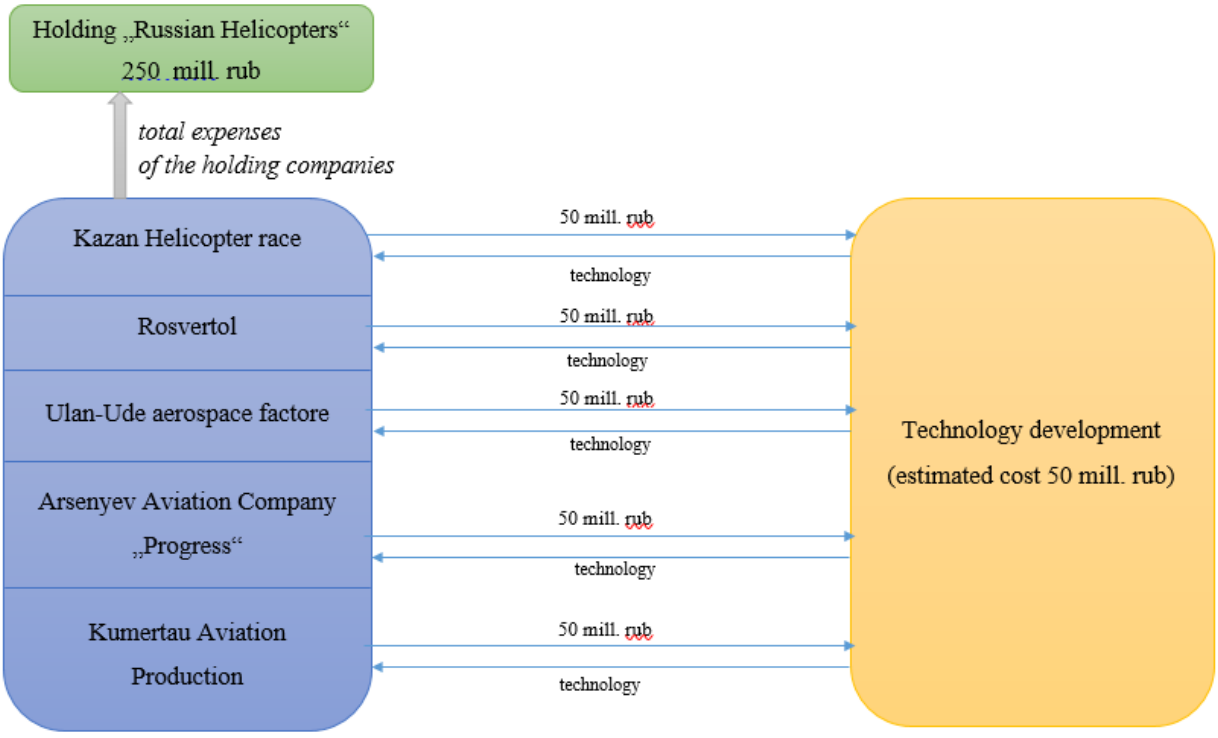

Figure 3 Comparison of the process of innovation of the new electrolysis process technology for the needs of the RUSSIAN HELICOPTERS holding applied individually by the holding (shown on the right) and using the proposed model of the "Engineering Centre" (shown on the left) – part 1

If the innovation of the electrolysis process technology was resolved individually for each company of the RUSSIAN HELICOPTERS holding, the total costs incurred for the entire RUSSIAN HELICOPTERS holding would amount to 250 million Rubles, as opposed to the cost, almost four times lower, allocated for the development of the aforementioned technology by using the synergic effect of cooperation of the chosen scientific-research organizations and individual businesses in the context of the "Engineering Centre" model (investment of 250 million Rubles x investment of 55 million Rubles).

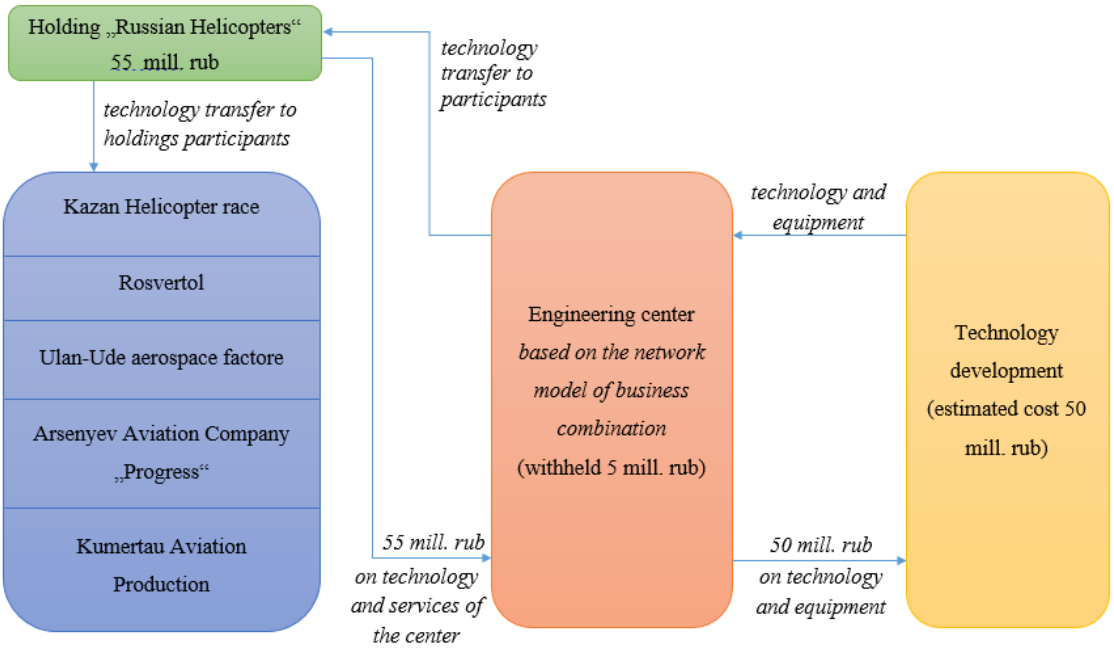

Figure 4 Comparison of the process of innovation of the new electrolysis process technology for the needs of the RUSSIAN HELICOPTERS holding applied individually by the holding (shown on the right) and using the proposed model of the "Engineering Centre" (shown on the left) – part 2

As part of the calculations related to the evaluation of the efficiency of the planned "Engineering Centre", the part-time spent basis and financial resources related to the innovation of the electrolysis process were also quantified, see **Table 1**. The table shows the partial activities and their financial evaluation and duration of each activity for a specific innovation under specific conditions of the companies cooperating within the modelled "Engineering Centre”.

Table 1 Components of the process of transition to a new technology

Process of electrolysis technology process innovation - cataphoretic deposition technology:			
1.	Development of a new coating material for cataphoretic deposition technology	6 months	10 mill. Rubles
2.	Technology development	3 months	10 mill. Rubles
3.	Creating technological equipment	3 months	25 mill. Rubles
4.	Cathode power supply test production	6 months	5 mill. Rubles
5.	Introduction of innovative technology in a specific company	4 months	15 mill. Rubles

From the results of the performed analyses it can be stated that activities 1-5 can be effectively performed within the modelled "Engineering Centre”. Only activity 5 must always take place separately in each company of the Russian Helicopters holding.

4. RESULTS AND DISCUSSION

In assessing the concept of a joint "Engineering Centre" model on the example of electrolysis process innovation, we concluded that the creation of the "Engineering Centre", where scientific and research organizations and companies work together through information and knowledge sharing is highly effective due

to the synergy effect resulting from a joint action of cooperating entities through which significant financial and time savings can be achieved.

A coordinating organization (the “Engineering Centre” model in the analyzed case) created on the basis of the structural matrix thus allows the identification of overlapping areas of activity of enterprises and cooperating scientific and research organizations and finding the optimal solutions to the innovation process effectively and quickly while reducing the costs of product innovation and production processes. For the successful operation of the "Engineering Centre" model, it was necessary to create a single information and computing node for structuring and distributing the tasks of participants in innovation projects and processes in production areas, which allowed monitoring processes in the economic, logistics and management areas.

It can be assumed that if a real coordinating organization were built on the basis of the "Engineering Centre" model which would provide professional services and apply the outputs of scientific and research activities of the involved scientific and research organizations to solve specific problems of industrial practice of several enterprises en block, including interactions, it would make it possible to stimulate the growth of the development of industry as a whole, as well as to increase the role of technical universities as key sources of the scientific base and sources of innovation.

The performed analyses also showed that while there are conditions that lend themselves to the development of scientific and technical cooperation of scientific and research centres and universities with industrial enterprises in the territory of the Russian Federation, they are not ideal. The results of the analysis also show that Russian companies have many advanced innovations in material technology, but due to legislative, legal and international restrictions and sanctions, complicated public procurement procedures and the inactive participation of many organizations, it is very difficult for Russian companies and research organizations to establish effective cooperation with foreign partners.

In Russia, interaction and effective cooperation with foreign companies, research centres and universities is addressed individually, mainly due to the applicable legislative and legal conditions in the Russian Federation and problematic international relations. The process of solving the cooperation is very demanding in terms of time and finances and in many cases does not ultimately lead to the creation of an effective environment for the sharing and dissemination of knowledge and the use of a synergistic effect from the mutual cooperation of the participating entities.

5. CONCLUSION

At present, there is an increasing emphasis on the effective management of industrial enterprises as well as on innovation, as these are becoming key conditions for success in the knowledge economy. The changing demands and expectations of customers, the presence of competition, new developments in technology, a favourable legislative environment and increasingly globalized and dynamic markets – these are all factors that create opportunities for innovation.

The results of analyzes also show that Russian companies have many advanced innovations in the field of material technology, with a focus on the use of paints and varnishes to protect materials against corrosion. But due to legislative, legal and international restrictions and sanctions, complicated public procurement procedures and the inactive participation of many organizations, it is very difficult for Russian companies and research organizations to establish effective cooperation with foreign partners.

A higher level model is being prepared as part of the solution, which will enable conceptual cooperation not only between selected entities from the metallurgical, engineering and chemical industries in the Russian Federation, but also as a combined involvement of several other countries (cooperation is planned between the Czech Republic and Germany) to make the most of the synergy effect of cooperation in innovation, while respecting the specific conditions of each country. We assume that the proposed model will be able to relatively accurately define the possibilities and limitations of cooperation of individual stakeholders so as to maximize

the synergy effect of innovation cooperation while respecting the specific conditions of each country, including legislative, legal and economic differences.

From a practical point of view, the proposed model will especially be beneficial because it will allow to quantify the potential economic resources spent on the development of the subject of the innovation process before its start in a company and subsequently initiate effective cooperation with selected international scientific and research centres and educational institutions to effectively implement scientific research and development activities focused on permanent cooperation in innovation and the transfer of technology.

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