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### EXPERIENCE AND FUTURE PROSPECTS FOR INTERNATIONAL COOPERATION OF UNIVERSITIES WITH INDUSTRIAL ORGANIZATIONS AIMED TO AEROSPACE EDUCATION DEVELOPMENT UNDER TEMPUS EUROPEAN PROGRAM

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The number of countries making their contribution to space technologies development is increasing. Taking into consideration achievements in various fields of knowledge, new approaches to development, design, production, and testing of space systems are created.

To ensure an up-to-date educational level of experts engaged in space industry, it is necessary to pay a continuative attention to development of the aerospace educational system, notably to create new specialties, to launch new educational programs and to work out study guides, as well as to modernize equipment for university laboratories etc.

The long-term cooperation of Yuzhnoye with Dnepropetrovsk National University (DNU) aimed to training of experts is a successful example of integration of science, industry and education, while leading scientists and industry experts actively participate in training process, and teachers and students of the university are involved in solving topical scientific and technical problems. The report represents analysis of experience and results of Yuzhnoye and DNU cooperation.

The other good example of aerospace education development, which is worth studying and distribution, is cooperation of 11 leading universities of Ukraine, Russia, Kazakhstan, Germany, Belgium, and the Netherlands under Tempus European program (2009-2011). The project is intended for implementation of newly developed curricula, focusing on microsatellites development (on the basis of the advanced technologies of Berlin Technical University) and aerospace management, in the universities of Ukraine, Russia, and Kazakhstan. The report presents analysis of the results and prospects for future cooperation of Ukrainian, Russian, Kazakh and European universities.

Specialists of high-level skill are required to develop such complex hardware as space-rocket. The Soviet Union had a peopeware system of the space-rocket branch, which operated successfully in conditions of state planned economics. In particular, Dnepropetrovsk Rocket Center (comprising Yuzhnoye SDO and Yuzhny Machine-building Plant) was being staffed during formation with the best representatives of the leading scientific schools of the USSR – graduating students of Moscow Aviation Institute, Bauman Moscow State Technical University, Moscow University, Leningrad Military Mechanical Institute, Kharkov Aviation Institute, Kazan State Technical University and many other institutions of higher education. Simultaneously, in composition of Dnepropetrovsk University in early 50<sup>th</sup> the Faculty of Physics and Technology was established in order to on-site train engineers and scientists for rocket industry; about 20 thousand specialists graduated from this Faculty.

In new conditions of economical and social development of Ukraine (being the space country) a necessity to form a new concept of provision of the space-rocket branch with qualified engineers and

scientists as well as increasing efficiency of the engineering education system has raised.

For today, the main problems connected with the provision of the space-rocket branch with engineers and scientists are the following:

- aging of personnel of enterprises, reducing the layer of specialists in the age of 35-45 years that leads to breaching the succession of generations, weakening or loss of scientist schools emerged during decades;

- the today's young generation does not consider scientist or engineer work as prestigious that creates significant difficulties in efforts of attracting and anchoring the promising young specialists at an enterprise;

- decreasing the training level at comprehensive schools and colleges that creates significant difficulties in training of specialists in institutes of higher education for high-technological enterprises;

- insufficient participation of research institutes and industrial enterprises in training of specialists;

- insufficient participation of faculties, postgraduate students, and students in resolution of pressing scientific and technical problems of enterprises;

- practically full absence of legal base and mechanisms of distribution to enterprises of young specialists that were trained at the expense of state funds.

The general strategy of resolution of these problems consists in consolidation of efforts of the comprehensive schools, institutes of higher education, and industry enterprises in order to early identifying most capable pupils and involving them into the system of training the specialists for the space-rocket branch according to the continuous education scheme: school – institute – enterprise.

The very significant link in establishing the continuous education scheme is cooperation between industry and institutions of higher education in the area of specialists training. The successful example of such cooperation is long-term interaction between Yuzhnoye SDO, Yuzhny Machine-building Plant, and Dnepropetrovsk National University, when industry scientists and specialists actively participate in an educational process, and lecturers and students – in resolution of pressing scientific and technical problems.

The educational process of the Faculty of Physics and Technology of Dnepropetrovsk National University from the very beginning was closely coupled with the scientific and industrial activity of Yuzhnoye SDO and Yuzhny Machine-building Plant. Yuzhnoye SDO and Yuzhny Machine-building Plant helped to the University to create its own laboratory base. Similar integrated system of specialists training gives possibility to make the most efficient combination of university technical education and industrial science and manufacturing.

Forms of cooperation between higher school and industry are continuously being changed and improved. At the present time there are a number of affiliates of Dnepropetrovsk National University (DNU) departments and a Kharkov National Aerospace University (KhAI) department working at Yuzhnoye SDO and Yuzhny Machine-building Plant. Scientists and specialists of Yuzhnoye SDO and Yuzhny Machine-building Plant are educating the last year students of DNU and KhAI at these departments. The lecturers from Yuzhnoye SDO besides good academic education have wide practical experience of designing, development, and experimental workout of space-rocket hardware; regular university lecturers usually do not have such an experience. As a result the students are trained in advanced technologies and adapt to working conditions of an enterprise. This assists to inflow of

talented youth into the industry and research centers, increases the quality of engineering education and provides anchoring the young specialists at an enterprise.

At the present time Ukraine participates in realization of large-scale international space projects such as Sea Launch, Land Launch, Dnepr, Cyclone-4, Vega, Taurus-2, Egyptsat-1 etc. in cooperation with leading enterprises of the USA, Russia, Italy, Norway, Egypt etc. This makes the increased demands for qualification of work participants, combining the engineering and managing professions in one person, knowing the foreign languages etc.

One of directions of further improvement of the quality of specialists training is development of international cooperation of universities and industry enterprises for exchange of the know-how, modernization of education programs, and forming the common strategy of training and job placement of graduates of aerospace educational institutions. In this connection the experience of joint work of leading universities of Germany, Belgium, the Netherlands, Russia, Ukraine, Kazakhstan, and also of a number of scientific institutes and industrial organizations under the Tempus European Project “Reformation of curriculums in the space technology area in Kazakhstan, Russia, and Ukraine (2009-2011)” is of great interest.

Consortium of the project is 11 universities and 13 organizations from 6 countries, including:

#### *Europe*

- Germany – Technical University of Berlin, Institute of Aeronautics and Astronautics;
- Belgium – Lessius University, De Nayer Institute;
- the Netherland – Fontys University, Institute of Business and Management.

#### *Russia*

- St. Petersburg – Voenmekh Baltic State Technical University;
- Samara – Samara State Aerospace University;
- Krasnoyarsk – Siberian Aerospace University.

#### *Ukraine*

- Dnepropetrovsk – Dnepropetrovsk National University;
- Kiev – National Technical University of Ukraine “Kyiv Polytechnic Institute”;
- Kharkov – National Aerospace University “Kharkiv Aviation Institute”.

#### *Kazakhstan*

- Astana – Eurasian National University;
- Karaganda – Karaganda State Technical University.

The Consortium also consists of major enterprises of space industry, including Yuzhnoye State Design Office (Ukraine), Progress State Research and Production Space Center “TsSKB-Progress” (Russia) etc., and also German Society for Aviation and Space (Germany), Ministry of Education and Science and National Space Agency of Kazakhstan, Federal Agency of Education (Russia) etc.

In Ukraine all the leading universities that train specialists for the space-rocket industry are members of the Consortium of the project.

The general purpose of the project is to jointly develop and implement on the basis of the international cooperation the following new educational programs of higher education in the space technologies area:

- Designing and operation of space micro- and nanosatellites;
- Management of the aerospace industry.

After coordination meeting and kick-off conference of the Tempus – CRIST project in Dnepropetrovsk on February 18-20, 2009, a leading body for managing the project – Project Board was elected and the project working plan, which was refined at subsequent conferences, was elaborated.

The project plan envisaged the following:

- Development of educational plans “Microsatellites design”, “Space radio communication”, and “Management of the space activity” (including “International business and management”);

- Establishing and introduction in the educational process of new computer classes on designing and development of satellites, planning and analysis of business processes;

- Establishing and introduction in the educational process of the network of training ground stations for controlling the small satellites;

- Development of educational and methodological materials;

- Training the educational and managing personnel;

- Organization of the project working groups with participation of young lecturers, scientists and students.

Visits and trainings in Technical University of Berlin (Germany), De Nayer Institute (Belgium), and Fontys University (the Netherlands) were conducted in the frames of the project. Project conferences were conducted in Dnepropetrovsk National University and Yuzhnoye SDO, Voenmekh Baltic State Technical University in St. Petersburg, and National Aerospace University “KhAI” in Kharkov.

Cooperation of the universities and industry enterprises in the frames of the Tempus project allowed to obtain a number of positive results:

1. New educational programs on microsatellites designing (on the basis of advanced technologies of Technical University of Berlin) and aerospace industry management are introduced in universities of Ukraine, Russia, and Kazakhstan.

2. New educational laboratories for microsatellites and computer classes for design and development works and also for business processes planning and analyzing are created and equipped.

3. The project participants became familiar with achievements in the area of space researches of famous scientific schools of Europe, Russia, and Ukraine and have exchanged the experience of educational process organization.

4. As a result of the conducted trainings young lecturers and students significantly improved their own qualification.

As a whole, this allowed to pass to a new level of the student education, to motivate them to master the advanced space technologies.

Team work of the universities and industry enterprises has led not only to the mutual knowledge enrichment. Common approaches on development of the aerospace education system and its unification were formed. In particular, it was found that the issues of formation of continuous space education system, strengthening the role of scientific organizations and industry enterprises in training and job placement of the specialists are actual not only for Ukraine but for other countries.

The most important result of the Tempus project is a fact that cooperation of scientific teams able to solve complex issues in the area of space researches was formed; these issues are the following:

- development of small spacecrafts (e.g. university satellites) for remote sensing, navigation etc.;

- creation of the ground stations network for data reception and processing etc.

This cooperation has formed new prospective goals.