

## President of the Russian Federation Vladimir Putin visited SPbPU and got familiar with SPbPU scientific breakthroughs

A two-day visit of the President of the Russian Federation Vladimir Putin to St. Petersburg began with a visit to Peter the Great St. Petersburg Polytechnic University (SPbPU). On April 26 the President opened the plenary session of the Eleventh Congress of the Russian Union of Rectors with a speech. After the plenary session he got acquainted with the scientific developments of the university.



In the hall of the New Research Building SPbPU Rector, Academician of the Russian Academy of Sciences Andrey Rudskoy introduced the President to the technologies capable of increasing competitiveness of Russian industry in the global markets. In particular the focus was on machine building. Although SPbPU Rector underlined the fact that “the university has a range of significant developments in the field of electronics, IT and energy technologies”.



Today 30,000 students and graduate students study at the university; there are over 1,800 faculty members and the education model is closely linked to industrial process and research institutions activities. Students from the first years are in close contact with the industry and solve the real tasks from the industrial companies. SPbPU customers and partners are trying to develop and bring the product to the market faster, cheaper and better. To contribute to this process the university creates “digital twins” of products, materials, production processes and machines.

The Rector explained: *“You can see an example of the “digital twin” application on the slide. With the help of highly adequate computer models, a virtual car has been created that can exactly replicate all the life cycle processes of a real car. The results are manifested in the high correspondence of virtual and real crash tests.”*

*“Intelligent digital twin” gives precise information about the properties and behavior of each point of the object at each moment of time. This model helps to work out design options, to conduct virtual tests, with the results almost identical to the ones of real tests. And on the computer you can conduct tens and hundreds thousands of tests. For example, if in the development of a new car model it was necessary to crash 100 cars in order to achieve the desired characteristics, then after virtual tests you need only five and only in the final stage to confirm the quality of development. “However, it is not just a matter of lowering the cost and timing, but also we aim at achieving a better quality of development by changing*

*the construction*" - added Andrey Rudskoy

A simple, but significant example of the use of modern design technologies, which was demonstrated to the President, is the reflector bracket already installed on one of the Russian satellites. *"When optimizing the design, the "non-working" part of the material is thrown away, like on the butterfly's wing,"* Andrey Rudskoy explained. Such delicate constructions are beyond the intuition of the engineer and they can be created only with the help of supercomputer and additive technologies. This approach is called bionic design for the external similarity of with natural objects. *"There is nothing superfluous in this bracket, and it is not inferior to the original one in terms of strength and other parameters. It is almost twice as light, which means it is more economical when sending it to the space,"* continued SPbPU Rector.



Another and more complex example of bionic design is the concept of an electric vehicle. It was designed and prepared for production by young engineers of the Polytechnic University in just one year. The car developed is different due to significant progress in aerodynamics, passive safety and comfort. The design technology includes a digital development platform, development of "smart digital twins", bionic design, additive technologies for manufacturing as well as new materials and composite structures. In 2017, this design technology was awarded the National Industry Prize of the Russian Federation "Industry".

However, the university is not limited to designing. Breakthrough projects in the field of artificial intelligence have been developed at SPbPU. For example, intelligent systems for early diagnosis of cancer. The President was shown the intellectual system of diagnosing lung cancer. The system was developed at SPbPU by the Laboratory of Intellectual Analysis in cooperation with the St. Petersburg clinical scientific and practical center for special types of medical care (oncology-oriented) (head of the Center – Doctor of Medicine, Professor, Honored Doctor of the Russian Federation Vladimir MOISEENKO). Andrey Rudskoy explained that the system is “trained” on real data from the oncology center's analysis and provides the probability of correct detection of lung cancer by 96%, which is one of the best results in the world. The system is accompanied by visualization modules of computed tomography and serves as an assistant to an oncologist.



Another example of a medical development is a complex for non-surgical removal of benign and malignant tumors of the lacteal and thyroid glands. One part of it is an artificial intelligence system for detecting tumors, and the second is a robot that removes tumors. This is a surgery without scars, also is being tested in the Clinical Oncology Center. And scientists of the Polytechnic University in cooperation with the Almazova National Medical Research Center developed the intellectual system of monitoring patients in the postoperative period (head - Academician of the Russian Academy of Sciences, Honored Scientist of the Russian Federation, President of the Russian Society of Cardiology, Chief Cardiologist of the City of St. Petersburg and the North-West federal district of Russia Evgeny Shlyakhto). The system provides for making an optimal decision on the treatment of the patient. The system can also detect latent anomalous behavior of the patient's parameters, which significantly increases the survival rate.

In cooperation with the Russian Scientific Research Institute of Traumatology and Orthopedics named after its first director Roman Romanovich Vreden for the first time in Russia SPbPU scientists developed with the help of 3D technologies an individual prosthesis of the hip joint. It was made of domestically produced titanium alloy powder and successfully implanted. On the basis of SPbPU medical developments a center "Additive technologies in medicine" is being created. In the center implants will be produced for clinics of the North-Western region.

*"Of course, such developments are impossible without the unique arsenal of engineering competencies, software and computational resources gathered in our university,"* noted Andrey Rudskoy. First of all, the Rector means the third supercomputer in Russia with a total peak performance of more than 2.3 petaflops. Secondly, these are all types of software that are used by the largest global industrial companies. Thirdly, these are competences, experience of specialists of a new type - "system engineers", "engineering special forces", possessing deep physics and mathematical, computational, technical and technological expertise. At the same time, the head of the university underlined that such technologies are applicable for different industries - medicine, aircraft engineering and shipbuilding.



The cross-sectoral nature of the university's activities is vividly reflected in the consortium where the Polytch is leader. In 2017 the National Technological Initiative (NTI) Center of Excellence in New manufacturing technologies was established at SPbPU. This became a logical continuation of the university's work

with high-tech companies. The Center united about 40 SPbPU partners - leaders in science, education and high-tech industry, including leading Russian universities and research centers. It is significant that the consortium has representatives from key industries - PJSC United Aircraft Corporation (UAC), United Engine Corporation, Holding "Helicopters of Russia", Rostek and others. *"The main task of the NTI Center of our university is to ensure the development of competencies of Russian companies in the field of advanced manufacturing technologies,"* the Rector explained. *"This includes the implementation of large interdisciplinary research projects in the field of advanced manufacturing technologies and educational programs for specialists of these enterprises."*

Such a broad research spectrum also requires an appropriate research infrastructure. Therefore, the Polytechnic University plans to develop through the organization of a special research and technology complex based on the principles of public-private partnership. So, the President was shown a model of an innovative technological complex, which is planned to be constructed on an area of 8 hectares next to the Polytech campus. It will comprise competences for all types of new manufacturing technologies applicable in various industries: automotive, aircraft engineering, shipbuilding and engine building. *"Polytechnic University, having the competence, infrastructure, work experience, is capable of and should become, in fact, the basic university for the introduction of advanced manufacturing technologies in the Russian high-tech industry,"* the Rector summed up.



After presenting the innovative projects Andrey Rudskoy told the President of the Russian Federation about the history of the university. The Rector noted that next year the university is celebrating its 120th anniversary, and its founders were the Minister of Finance of the Russian Empire Sergey Witte and the great Russian chemist Dmitry MENDELEEV.

Polytechnics as well contributed to creating a history of our country. Graduates of the university, including Mikhail SHATELEN, Vladimir MITKEVICH and Nikolay PAVLOVSKY, took part in the creation and implementation of the GOELRO plan (the first-ever Soviet plan for national economic recovery and development). Our graduates made a significant contribution to the achievements during the war; contributed to the Road of Life establishment and defended Leningrad. “The legendary hero Victor LYAGIN also studied at the Polytech”, said SPbPU Rector. “And the nuclear power project, which began to develop in the Soviet Union in 1943, was started at our university. Among its founders was the academician Kurchatov and a big role in the project was played by the polytechnics FLOROV, ZELDOVICH and HARITON”.

Polytechnic students have contribute a lot to space exploration. Taras Sokolov, the developer of automated control systems also comes from our university.



Returning from the past to the present, the Rector of the Polytechnic University drew the attention of Vladimir Putin to the university activities in the field of

international cooperation. "We cooperate with 390 universities from 68 countries, including the key ones like Tsinghua University in Beijing, universities of Munich, Stuttgart, Milan, Madrid, Bombay and Sao Paulo. Over the past year, we have had 200 invited foreign faculty from partner universities", underlined Andrey Rudskoy.

Particular attention at SPbPU is paid to relations with China and the countries of the Asia-Pacific region. SPbPU became the first Russian university that officially opened its Representative Office in China (Shanghai, Pudong New Area). The main objectives of the Representative Office is to contribute to the competitiveness and systemic promotion of the Russian education brand in general, to develop cooperation with universities and companies of the People's Republic of China to carry out joint research, and to provide for technology transfer and developments commercialization. Its work is actively supported by the Consulate General of the Russian Federation in Shanghai and personally by the Consul General Aleksey Evsikov. Representative Office facilitates the participation of the University in the Silk Road Initiative.

The number of students from China has grown to a thousand people (25% of the total number of foreign bachelor's and master's degree students) due to the Representative Office activities. In addition, more than 6 thousand foreign students from 115 countries of the world are enrolled at the university in various programs. In this respect, SPbPU ranks third in the total number of foreign students among all Russian universities and 1st among technical universities.

As well the Rector told the President that the university is carrying out 81 international educational programs, 29 double-degree programs with leading European universities of Berlin, Hanover, Paris, Graz and others. Over 1,800 students take part in international mobility programs, and the International Summer Polytechnic School is one of the largest in Russia - about 500 students from 50 countries take part every year. 17 international research and educational centers of 85 research and high-tech partner centers of the university have been integrated into the structure of SPbPU. Among our foreign partners - Siemens, LG, SAP, Schneider Electric, ENV, etc.





The manufacturing area of the Polytechnic University was showed to the President of the Russian Federation Vladimir Putin. The modern industrial equipment is located there: high-precision metal working machines; robots performing surfacing; new machines created by the Polytechnic University; a unique complex "Matec-40P", that is intended for friction welding and mechanical materials processing. It is possible to implement technological processes in various combinations with the help of such equipment.

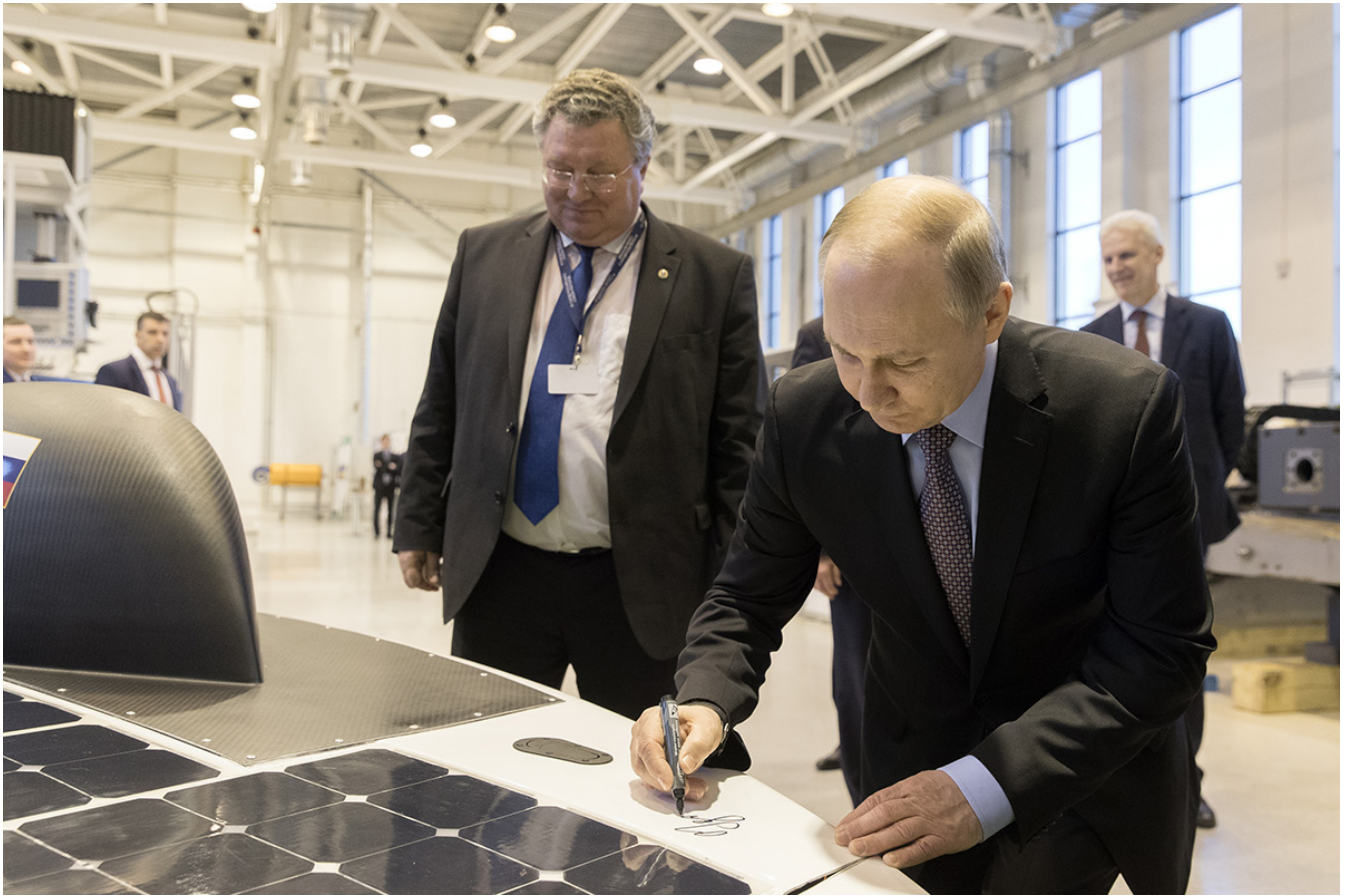
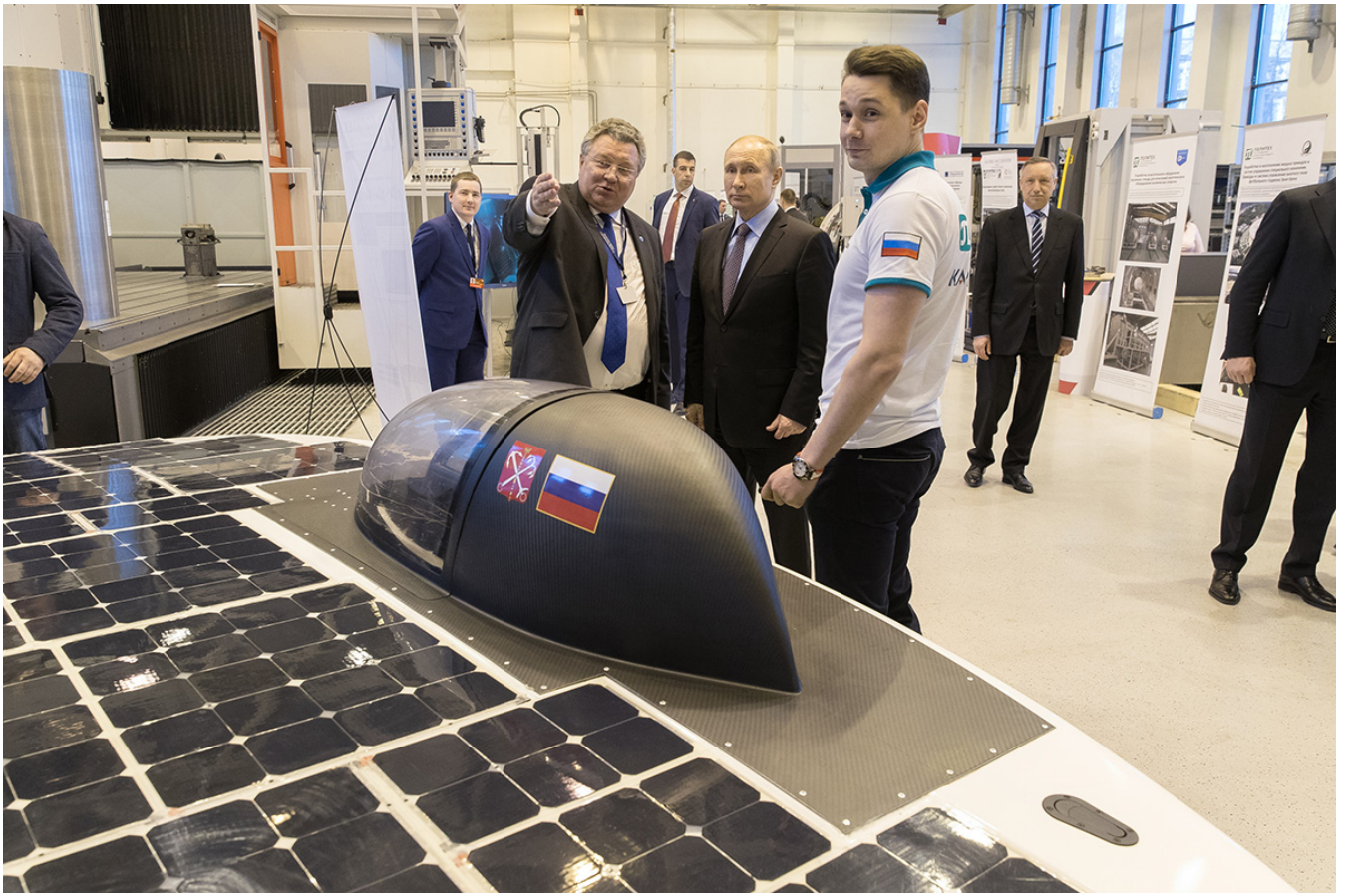
Introducing Vladimir Putin to the robotic technology of electric arc creation, SPbPU Rector mentioned the following: "Using the Japanese robot, we created the Russian "brains", our technology and software». This method is characterized by high productivity, which is 2-4 times higher than existing growing technologies, while the cost of raw materials is about 10 times lower. These indicators were achieved through the use of wire and electric arc instead of powder and laser. "But the most important result that have been achieved so far is that the strength of the metal grown this way is higher than for the same metal supplied in strips", concluded Andrey Rudskoy.

The Polytechnic University closely cooperates with Russian enterprises. In the production area a joint project with JSC «Baltic Industrial Company» is presented, within the framework of which a domestic additive installation for direct gas-powder laser growing has been created. For the first time in Russia, at selective laser smelting machines RSC Energia has developed a unique technology for

manufacturing the inner shell of the combustion chamber of a liquid-fueled rocket engine with complex internal cooling channels made of heat-resistant copper alloy. *"Listing our partners can continue for a long time"*, said Andrey Rudskoy. - *In cooperation with The All-Russian Institute of Aviation Materials (VIAM), for the first time in Russia, we have developed the technology and produced prototypes of the air flow swirler, which is a part of the engine PD-14 of the aircraft MS-21. Together with Klimov plant we have developed turbine blades for the engine and the list can be continued further"*.



The center of the SPbPU manufacturing zone is the Laboratory of Lightweight Materials and Structures, which was created under the Russian Federation Resolution No. 220. And the heart of the laboratory is a 5-axis metal-working complex, unique, specially manufactured for the implementation of not only lathing and cutting operations and friction stir welding, but also impulse friction stir welding. *"The addition of impulse action when connecting parts ensures the strength and fatigue characteristics of the joints, which is especially important when creating critical structures such as fuel tanks of carrier rockets, body and wing elements of civil aircraft, bodies of boats and of aluminum alloys"*, - according to Andrey Rudskoy.



At the university it is impossible not to mention the developments and achievements of students. The Rector showed the first Russian solar car designed by the students and graduates to participate in the championship between the world's leading universities, which will be held in the US in 2018 in summer. *"Here is a constructed car developing a maximum speed of 120 kilometers per hour and charging from the energy of the sun. Our project is supported by the Ministry of Industry and Trade of Russia, ASI, as well as by leading Russian companies, including Kaspersky Lab and Rostech,"* underlined Andrey Rudskoy. Vladimir Putin got acquainted with the project and even promised to personally test the solar car. The president also left "good luck" wishes in the upcoming competitions on the car body.

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