Strategic Partners and Leaders of World Innovation Peter the Great St. Petersburg Polytechnic University and Tsinghua University

Presentation of the Rector of Peter the Great St. Petersburg Polytechnic University, Academician of the RAS A.I. Rudskoi within the frame of the Tsinghua Global Vision Lectures at Tsinghua University (China); April 15, 2019

Dear Chairman of the University Council Professor Chen Xu, distinguished First Secretary of the Embassy of the Russian Federation, representative of the Ministry of Education and Science of the Russian Federation in the People's Republic of China Igor Pozdnyakov, distinguished academicians of the Chinese Academy of Sciences and professors of Tsinghua University, dear students and graduates, dear colleagues!

It is a great honor for me to be here today in this Hall of Tsinghua University, a strategic partner of Peter the Great St. Petersburg Polytechnic University, as a speaker of the Tsinghua Global Vision Lectures, earlier attended by rectors of global world universities, leading experts and prominent political figures.

Tsinghua University is the leader of China's global education. You hold with confidence the first place in the national ranking and are among the top-rank universities in the world. Peter the Great St. Petersburg Polytechnic University is one of the top 10 Russian universities and the largest technical one, the leader in engineering education in the Russian Federation. Our universities, as leaders of global education, are facing the essential challenge of ensuring the sustainable development of society, creating and introducing innovations.

This year, Peter the Great St. Petersburg Polytechnic University ranked 85th and got in the top-100 world universities in the Times Higher Education (THE) University Impact Rankings. For the first time ever, universities were ranked by the level of their impact on the sustainable development of society and contributions to the achievement of sustainable development goals outlined by the United Nations (UN). In the presented ranking, universities were assessed by 11 socio-economic indicators in accordance with the goals of UN sustainable development.

Our universities are not only centers of education and science, but also sources of the formation of culture, producing enormous impact on the economy, the level of human capital, and the innovative potential of their countries. Yet a few decades ago, universities could take the liberty to stay on the periphery of the processes taking place in society; however, in the modern knowledge-driven economy they are in the focus of events, far beyond their traditional boundaries, and cultivate the external environment. At present, the United Nations’ Sustainable Development Goals (SDGs) are focused at strengthening the health of all nations, fighting inequality, poverty, starvation and the consequences of global climate change,

improving people's access to education, drinking water, labor and affordable energy, promoting social justice and peace. By these indicators, our universities, Peter the Great St. Petersburg Polytechnic University and Tsinghua University take the lead.

We are very proud of and highly value that you are our strategic partner. Nobel Prize Winners in Physics Tran Ning Yang and Tsang Dao Lee graduated from your university; Nobel Prize Winner in Physics Pyotr Kapitsa and Nikolai Semenov, Nobel Prizeman in Chemistry, studied and taught at Polytechnic university. Nobel laureate Zhores Alferov worked at our University for many years. And we remember that Chairman Xi Jinping also is your graduate.

Many Chinese graduates of SPbPU became prominent Chinese scholars: academician Gao Jingde, rector of Tsinghua University in 1983–1988; professor Ni Wei Dou, vice rector for science of Tsinghua University from 1988 to 1994; professor Gu Luo Guo, rector of Chongqing University in 1986-1992; professor Fu Hyun Ji, President of Northwestern Polytechnic University in Xi'an from 1984 to 2000; and there are many others. Professors of your university are Honorary Doctors of SPbPU. These are the Chairman of the Board of Tsinghua University, professor Chen Xu; professor Ni Wei Dou and professor Xiong Jia Zong.

How do some modern philosophers interpret the present? The present is the integration point where the future is rapidly turning into past. For this reason, I am going to devote my speech in this gorgeous hall to modernity, but also to the future of our countries and universities.

The People’s Republic of China is the foremost strategic partner of the Russian Federation. We can see that bilateral efficient cooperation reinforces the power of both countries, expands competitive advantages and boundless opportunities to implement the most ambitious plans affecting the development of all mankind, solidifies the unity of nations and augments cultural capital and the emergence of innovative ideas. Everything we do is for the sake of the future, for the sake of the new generation, for you - the students, our common support and hope.

Two years ago, a “One Belt, One Way” forum took place in Beijing, at which Russian President Vladimir Putin and Chinese President Xi Jinping spoke about the need to strengthen the partnership relations between our countries, both in the economic and humanitarian spheres. These statements once again proved the relevance of the tasks we jointly solve. Our universities, Tsinghua and Polytechnic Universities, are at the forefront of partnerships between the countries.

Just in two weeks, Russian President Vladimir Putin will again take part in the “One Belt - One Way” forum in Beijing. And we are very pleased that within the framework of this forum, a regular meeting of the leaders of our states will take place.

For the development of strategic partnership with universities and enterprises in China and strengthening its international reputation, Peter the Great St. Petersburg Polytechnic University established the SPbPU Representative Office in Shanghai,

officially opened in April 2016. I would like to specifically note that Polytechnic University was the first Russian university to establish its permanent representative office in the PRC. Acting as pioneers, we are gaining invaluable experience. We have formulated several practical principles that guide the work of our Representative Office in the PRC.

The first principle is the “effect of live presence” in your great country, which allows us address directly all issues that could’ve otherwise been remotely discussed for a very long time.

Our second principle of “proactive outreach” means that we are actively looking for topics and areas of mutually beneficial cooperation, rather than waiting for them to come up.

The third principle is “perseverance in disclosing the potential of cooperation:” not everything works out right away; one must be patient, diligent, and willing to better understand and take into account the specifics of the other party.

Our fourth principle is “we work for the entire Russia and all of China.” For two years, the Representative Office has been a platform for friendly dialogue for many organizations in Russia and China.

Thanks to the opening of the Representative Office, we have leapfrogged in expanding cooperation with our Chinese partners. Currently, Polytechnic University is implementing more than 20 large research projects with Chinese universities and companies. We are pleased that we have several joint projects as part of our strategic partnership with Tsinghua University. Our scientists jointly develop wireless sensor network technologies for automatic monitoring of engine systems; study plastic deformation, microstructure and mechanical properties of light alloys; work together on intelligent systems and control of industrial robots; study the mechanisms of destruction and restoration of structural elements; assess environmental safety and research on climate change with consideration of various factors.

Today, at Tsinghua University, we have launched a joint laboratory in the field of aerospace and electronic technologies, which are among priorities for both our universities. The SPbPU Institute of Physics, Nanotechnology and Telecommunications and the Institute of Aerospace Engineering of Tsinghua University work closely in this area. The new international laboratory will help consolidate our scientific potentials and speed up the introduction of the latest research results to the industry.

Today, digital technologies and artificial intelligence systems are playing the role of the engine of technical progress. Exactly these factors determined the priorities of cooperation between Polytechnic University and Chinese research centers. The most ambitious part of the research carried out jointly by scientists from SPbPU, institutes of the Chinese Academy of Sciences and universities of the People's Republic of China is research in the field of quantum informatics aimed at creating fundamentally new topological nanostructures that will be used in the

development of mesokubits, quantum objects taken as the basis for the quantum computing architecture of the future. Such nanostructures have no analogues in world practice, which can give Russian and Chinese researchers at our two universities a significant priority in the development of quantum informatics.

Another essential area of our joint scientific work with Chinese colleagues is the use of the latest machine learning technologies in medicine. Polytechnic University has patented the technology of cancer pathology diagnostics with the use of multimodal neural networks, which now shapes the basis of advanced practical developments in this sphere.

In addition, together with Chinese and Indian colleagues, Peter the Great St. Petersburg Polytechnic University is an active participant in the BRICS STI Framework Program. Two major projects in the sphere of processing laser geoscanning data are under implementation. This is an essential scientific area at the junction of information technology, visualization, and mathematical modeling, which is booming around the world.

Internationalization is an essential trend in the development of the leading universities of the world. Our universities pay particular attention to openness of our institutions and sharing best educational practices, networking partnerships, attracting leading foreign scientists and talented students from all over the world. Polytechnic University cooperates with almost 400 universities from all continents. I am pleased to note that among the 14 strategic partners of our university, Tsinghua University has the leading place. Peter the Great St. Petersburg Polytechnic University is ranked 1st among Russian technological universities in terms of the number of international students: more than 7,000 international students study at Polytechnic University; of those, almost 2.4 thousand are from China.

Polytechnic University pays major attention to the development of international educational programs and academic mobility programs. SPbPU implements more than 100 international graduate and undergraduate programs in English together with leading foreign universities; within these programs foreign teachers are invited to lecture at SPbPU, including professors from Tsinghua University. Both our universities participate in the BRICS Network Educational Program.

The International Polytechnic Winter and Summer Schools are well developing. In 2018, more than 700 students from all over the world attended the programs of the International Polytechnic Summer School, including 32 students from Tsinghua University. This year, we are going to increase the number of participants of our School to 1000 people and we hope that a noteworthy part of them will be from your university. Today I handed over to the management of your university a certificate for scholarships for Tsinghua University students to participate in the Polytechnic Summer School – 2019.

We make particular emphasis in the SPbPU international activities at promoting and popularizing the Russian language in China. Polytechnic University regularly holds Days of the Russian Language and Culture in various provinces of the PRC;

by now, more than 1,000 students have taken part in those. The activities include short-term Russian language courses for schoolchildren and students, teacher training courses, quizzes and contests on the knowledge of the Russian language and culture. We are ready to hold such Days of Polytechnic University in the near future at Tsinghua University. At the same time, we are paying a lot of attention to promoting Chinese language and culture in Russia: we launched International Relations and Regional Studies educational programs at the SPbPU Institute of Humanities, and every year, there are more and more applicants willing to learn the Chinese language and culture.

Dear Colleagues! A 21st century engineer is more than a specialist in one field; they are people with broad outlook, specialists that are able to work on the scientific and engineering frontiers, use advanced world technologies, efficiently combine research, design and business activities. This is exactly why the strategies of our universities rest on the triad of education, science, and industry, with the leading role of its engineering component. Alike Tsinghua University, Peter the Great Polytechnic University relies on partnerships with prominent global companies, thus promoting the newest science-driven technologies to the world market.

Our university has established a system of long-term partnerships with benchmark Russian and foreign companies, such as Gazprom, RosAtom, Russian Technologies, RusHydro, Rostelecom, AvtoVAZ, BMW, Bosch, Philips, Boeing, Airbus, AVL, British Petroleum, Siemens, LG, Huawei Technologies and many others. Altogether, we have more than 200 industrial partners. It is important to note that these partnerships lead to the creation of joint structures both at the University and on the basis of the enterprises.

We saw many joint laboratories at Tsinghua University, where staff and students can study advanced technologies and conduct research in collaboration with industrial companies. Polytechnic University has also been actively developing in this direction for a number of years. On our campus, we have established a number of joint laboratories and research centers in key areas together with leading foreign and Russian companies, such as Siemens, Kawasaki, Gazpromneft, SAP, LG and many others. Now we are in the process of developing and launching a new format of joint, “mirror” engineering centers with global high-tech companies.

An example of successful partnership between university and industry is the creation of pilot production in Chancing, established by SPbPU in cooperation with the Chinese ENV Company. The construction of a large factory for the production of lithium-polymer batteries is nearing its completion there. The technology is based on our developments in materials science. Along with the production, a joint Innovation Institute is under development; professors and young researchers from Polytechnic University and Chinese universities and companies work there. The institute is developing the new area of additive technologies, the use of which in medicine allows the prototyping methods to create “backup” human organs to replace damaged ones. Along with that, the Research and Education Center for Additive Technologies and Functional Materials was established at SPbPU, where

Russian and Chinese specialists are trained in relevant areas. All this is a perfect example of well-coordinated work and joint development of two entities: a science and education site at Polytechnic University and a research and practice site in China.

Also, within the framework of cooperation with China's leading logistics company SINOTRANS LOGISTICS, Polytechnic University is working on a joint project in the field of diversification of logistical procedures for the delivery of industrial products. Together with colleagues from the Chinese company, a SPbPU research team is developing a new look for the information environment on the basis of high-performance computing.

Our university is developing RTS (Real Time Simulation) control systems for hybrid electric power systems (direct and alternating current) based on a new component base together with the largest Chinese energy company NARI.

There is another essential project: SPbPU physicists adapted the SmartFoil technology (smart foil) at the enterprises of Henge Medical Technology (Shanghai) manufacturing medical equipment. The SmartFoil technology is the technology of ultrafast cold soldering. The advantage of the method is that it allows you fasten those elements that cannot be soldered in the usual way, which is extremely important in medicine.

In recent years, SPbPU has actively entered the Chinese automotive market. The automotive industry is, as we all know, an extremely high-competitive industry, a true driver of the high-tech industry. Polytechnic University is involved in more than 10 projects; our partners are the largest Chinese automakers: Chery, BYD, Great Wall, ChangAn, DongFeng, Geely, BAIC Group, etc. The development of engineering services for industrial companies allowed our university to become a considerable player in the Chinese market, among other things, thanks to collaboration with the largest Chinese research center CATARC (China Automotive Technology Research Center). Among the projects under implementation are engineering services of various degrees of complexity: from optimization and production facilitation of individual automotive components and assemblies, ensuring the safety of pedestrians, drivers and passengers, to participation in the development of fundamentally new vehicles, including solar-powered cars. Polytechnic scientists are engaged in the development of promising ultra-light structures to reduce the mass of an electric car body and the development of digital twins (Digital Twins).

Presently, Peter the Great St. Petersburg Polytechnic University and Tsinghua University are top-line technological universities of their countries, participants of the state national Excellence University Program 5-100-2020 and, therefore, the Project 985. The strategic goal of these ambitious programs for our universities is the further modernization and development of the universities as national clusters of the future, integrating modern engineering education, multidisciplinary research, industry-leading technologies, and world-class high-tech innovations.

Innovative economy is moving onward at great speed, and this is a serious

challenge for universities. Aware of this situation, St. Petersburg Polytechnic University of Peter the Great is profoundly transforming the educational process, aiming it at a new demand pattern: graduates of engineering fields of study, so-called “engineering special forces” for new labor markets.

As a result of the accomplished fourth industrial revolution, and this is how we should interpret the current situation, serious transformations take place in technologies, systems, and the very nature of industrial production. These changes outline the requirements that modern higher engineering education and university graduates must meet. The key factor now is the uppermost scientific and engineering competencies in the high-tech sector of the economy. Engineers for the knowledge-driven economy and industry 4.0 must be entirely different specialists by their skills, professional and global professional competencies.

The “engineering education of the future” should be able to meet the challenges of the knowledge-driven economy and industry 4.0. For that reason, Peter the Great St. Petersburg Polytechnic University got actively involved in the implementation of the National Technology Initiative (NTI), the strategic vector of technological development of Russia, proclaimed by the President of the Russian Federation V.V. Putin.

The NTI is a state program of measures to support the development of promising industries in Russia, which can turn into the basis of the world economy over the next 20 years. It focuses on the markets emerging on the basis of the “new technological order, the transition to which developed countries plan to implement in the next 10-20 years.” Within the framework of STI, 9 markets have been designated: AeroNet for the air transport; Avtonet for the road transport; Marinet for the sea transport; Neuronet for neurocommunications; Helsnet for medicine; Foodnet for food; Energynet for power; Technet for the industry and Safenet for security. It’s a great honor for Polytechnic University that the Government of the Russian Federation has entrusted to us to head the Center for NTI Technet Competences.

Polytechnic University is developing services for the Digital Platform for designing and manufacturing globally competitive products of new generation. Our engineers conduct virtual tests and participate in the creation of “digital twins” of products and their production processes. The digital platform, created at our university, won the “Eurasian Digital Platforms,” the International Competition of Innovative Projects, in the nomination “The Best Digital Projects of the Eurasian Economic Union.”

As the core of the NTI Technet network, the NTI Competence Center was established at SPbPU. It coordinates at the national level the largest project consortium in the area of “New Production Technologies” (digital design and modeling, digital twins, new materials, additive technologies). The consortium comprises about 50 participants, including 4 state corporations, 16 leading universities and major scientific organizations, and more than 25 partner companies. By the way, the leading automotive research center of China, CATARC, is so far the only foreign member of the consortium of the SPbPU Center for

Competence NTI.

At the same time, it should be clearly understood that in the era of the 4th industrial revolution and digital transformation of economy, when the cost of goods, services and information is rapidly declining, human capital becomes the main asset of all states. We do not mean a human being in general, but someone with competencies in the field of new technologies, abilities to research and implement new achievements and capacities to improve the already existing. And we are speaking not even about individuals but groups of people who can combine and actuate. And Polytechnic University is nowadays training such groups of people. We train students in prospective areas of science and technology, including engineering, energy, space technology, computer engineering, optoelectronics and information technology, operating large data sets, developing nanostructured materials, biomedical technologies and much more.

When training our students in the STI paradigm, we shape the “engineering special forces” of young people, high-end professionals, leaders in competitive industries, capable to develop and bring modern Russian science and industry to the forefront, independently introduce technologies corresponding to the industry 4.0.

We strive to ensure that graduates of Polytechnic University with deep fundamental and newest engineering and technical expertise would stand to gain global competitiveness, the key to a successful future that is being shaped now.

This year Peter the Great St. Petersburg Polytechnic University celebrates its 120th anniversary. Last February, on the eve of the anniversary, I had a momentous meeting in the Kremlin with the President of the Russian Federation V.V. Putin, who approved the vector of our development strategy and the accomplishments in shaping a new paradigm of engineering education. To accelerate the development of Peter the Great St. Petersburg Polytechnic University, a project to create at our base a national scientific and educational cluster, the Federal Technopolis Center, was approved at the highest level. This mega-project promises to be an essential milestone in the modern history of Peter the Great St. Petersburg Polytechnic University and a forerunner of our future.

I would like to assure you that the active cooperation of SPbPU with Tsinghua University, our joint participation in the “One Belt, One Way” initiative will become an integral part of this future. As it was said in the “Book of Changes,” the polarity comprised in the heart of the world makes some parts attract other ones, creating a special rhythm of life. Today, our two universities are attracted to each other to the best of our strength and aspirations, and create this eternal rhythm of life.

In conclusion, let me remind you that in 2011, when the 100th anniversary since the founding of Tsinghua University was celebrated, a delegation of our university was here. In honor of this event, many trees were planted; one of them symbolizes the friendship between our universities. I hope that this tree, planted in Tsinghua earth by the hands of the Polytechnic in honor of the centenary anniversary, will forever blossom and bear fruit of cooperation to both our universities.

Thank you all for your attention!

I wish all students of Tsinghua University new interesting experiences, excellent learning, and a successful future! I wish good health and grateful talented students to the respected professors.

Dear friends! A Russian proverb says, “a picture is worth a thousand words.” Therefore, I invite all of you to visit our university, and in conclusion of my lecture I would like to show a short video for you to get the first impressions of what Peter the Great St. Petersburg Polytechnic University, a leader of engineering education in Russia, is today.

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