Traditions of development and modern problems of technical sciences

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The most important role of science and technology in today's rapidly developing technological civilization is obvious and universally recognized. All the technical and technological progress of the last century and as a result of its rapid change in the life of society are based on the use of scientific achievements and engineering developments.

Fundamental Sciences study the basic laws of nature, phenomena related to the environment and the universe. As a result, a new phenomenon can be discovered or a completely new technology, such as a laser, can be obtained, which is inaccessible from the level of technical Sciences. Laser technologies in the modern world have acquired a significant role – from LEDs to optical media technologies and military applications (sights, guidance systems, weapons systems, etc.). As a rule, new discoveries in fundamental science radically change certain ideas about phenomena and allow us to discover common technical solutions.

Unlike fundamental Sciences, applied, engineering (technical) Sciences have exclusively practical purpose. Technical Sciences are aimed at achieving specific goals (for example, given tactical and technical characteristics), in predetermined conditions (terms, costs). It was the formulation of a purposeful task that led to the creation of the first thermal engines, aircraft, including space vehicles.

Modern civilization, which determined the path of scientific and technological development at the beginning of the XIX century, depends primarily on technology. It is thanks to the use of new technologies that the countries of Southeast Asia (China, Japan, South Korea), without their own developed schools of fundamental Sciences, have taken leading places in the world economy.

As the experience of industrialized countries shows, the basis of innovative economy is engineering activity. The problems of practical use of scientific knowledge, increasing the efficiency of research and development put engineering at the forefront of Economics and culture.

Engineering Sciences together with education, production are the drivers of socio-economic development of civilization. Scientific discoveries, technologies and related production of equipment and products have determined the modern civilization and the balance of power on the planet.

The creative nature of engineering work is manifested in the creation of systems and processes that can not arise without human intervention. Engineering creativity and scientific research are linked, but this relationship is not linear: there are cases in history when systems created by engineers forced scientists to radically revise their ideas about scientific knowledge. Innovations is an engineering activity. It can be argued that modern civilization was created by engineers.

Russia has a deep tradition in engineering: it is impossible even to list the unique technical solutions of domestic specialists in various fields. For example, the incandescent lamp in its present form is known as the "Edison bulb", but the first proposed to use tungsten filament in lamps and twist the filament in the form of a spiral Russian scientist, a member of the Russian technical society Alexander

Nikolaevich Lodygin in 1870 Thomas Alva Edison received a patent for an incandescent lamp only in 1879.

On May 07, 1895 Alexander Stepanovich Popov, Russian physicist and electrical engineer, inventor of radio, member of the Russian technical society, made a report at a meeting of the Russian physical and chemical society "On the relation of metal powders to electrical vibrations" and demonstrated the transfer of Morse code signs without wires. In memory of this event since 1925 in our country on may 7 the professional holiday - Day of radio which is annually celebrated by workers of all branches of communication and radio engineering is celebrated.

Boris L. Rosing, Russian physicist, scientist, teacher is the inventor of television. On may 9, 1911, at a meeting of the Russian technical society, Rosing demonstrated the transmission of television images of simple geometric shapes and their reception with the reproduction on the screen of an electron beam tube. For these experiments, the Russian technical society later awarded him a Gold medal and the K. G. Siemens prize.

The Russian technical society (RTS), whose 150th anniversary was celebrated by the Russian Union of scientific and engineering associations (RUSEA) in 2016, and later by the all-Union Council of scientific and technical societies (UCSTS) had a significant impact on the development of technology, industry and technical education in Russia. According to its Charter, the Russian technical society had the main goal "to promote the development of technology and technical industry in Russia".

Advanced scientists, engineers, designers and technologists, educators and teachers, navy figures and industry organizers, United in the ranks of the Russian technical society, were advocates of independent industrial development of the country, actively contributed to the formation of the main industries, research and use of domestic raw materials for industry. The company's activities covered many areas of science and technology.

On the initiative and with the participation of RTS conducted major experimental work, widely known in Russia and abroad. At the meetings of the RTS for the first time were made reports on research and discoveries of prominent representatives of domestic science and technology. In the aeronautical Department of RTS D. I. Mendeleev, carried out a large and fruitful work on the study of the elasticity of gases in relation to Aeronautics, D. K. Chernov published the work "On the occurrence of the possibility of Aeronautics without the help of a balloon" and proposed a project of a helicopter. K. E. Tsiolkovsky put forward a project of a metal controlled balloon and laid the scientific foundations for the conquest of outer space. N. E. Zhukovsky developed the theory of "Attached vortices", A. F. Mozhaysky proposed a project of the aircraft.

At conferences and congresses of RTS the most important technical problems of industrial development of the country were considered. RTS arranged about 30 all-Russian exhibitions, convened

15 congresses, which discussed the most important problems of development of the main sectors of domestic industry and transport.

RTS also stood at the origins of technical education in Russia. According to the Charter of the RTS "promotion of technical education" was one of the most important tasks of the Society. For this purpose, a Permanent Commission on technical education was established under the RTS, which for the first time in the history of Russia was engaged in the creation of a system of vocational technical education, the problem of training qualified workers, including vocational education for women.

The authority and recognition gained by the Russian technical society in the field of theoretical and practical development of issues of vocational education, put it on the role of the all-Russian public center, around which experts in the field of vocational education were grouped.

With the active participation of RTS, new technical and Polytechnic institutes and universities were opened.

RTS was engaged in the fundamental technical problems of industrial development of the country — the creation of coal and metallurgical base in the South of Russia, the construction of oil pipelines Baku — Batumi, TRANS-Siberian railway, the development of new industries, such as oil industry, rail transport, radio engineering, energy, automotive, shipbuilding, aviation, etc.

RTS in its activities focused on the promotion of scientific and technological research and inventions. It took a direct part in competitions and awarding special prizes named after famous scientists, Industrialists and public figures.

Thanks to the Russian technical society, innovations were tested, supported, distributed and used in many sectors of the economy.

Leading scientists and engineers of the country took part in the work of RTS and its departments. At different times in the RTS were included and actively collaborated with such outstanding scientists as D. I. Mendeleev, P. N. Apple, N. N. Benardos, A. S. Popov, M. O. Dolivo-Dobrovol'skii, D. K. Chernov, A. N. Krylov, V. G. Shukhov, M. A. Chatelain, G. O. Graftio, N. E.Zhukovsky, I. M. Gubkin, A. V. Vinter, as well as the big Industrialists L. E. Nobel, S. I. Mamontov, S. I. Maltsev, N. And.Putilov, etc.

Among the honorary members of the RTS were such leading scientists in Europe and America as the inventor of the light bulb Edison and the Creator of the Eiffel tower and the Statue of Liberty Gustave Eiffel.

In the post-revolutionary period, scientific and technical societies actively participated in the industrialization of the country, developed recommendations for the development of energy, engineering, chemistry and other industries, the reconstruction of transport. The electrification of the country has become the most important element of economic and technological progress, capable at the same time in

the short term of the basis for the rise of all industries. The plan for its implementation went down in history as the GOELRO plan. In the development and implementation of the electrification plan was attended by figures VI electrical engineering Department of RTS, such as G. O. Graftio, M. A.Chatelain, A. V. Vinter. One of the ideologists of the GOELRO plan was G. M. Krzhizhanovsky, who later headed the all-Union Council of scientific engineering societies. Joint work on the problems of industrialization of the country ensured the continuity of advanced traditions from the pre-revolutionary to the new Soviet technical intelligentsia.

The activities of scientific and technical societies have expanded and gained momentum. Cells of companies were created at enterprises that were directly involved in solving specific problems of production. At scientific and technical societies committees of assistance to construction of five-year plans were created, societies took part in the solution of questions of creation of new industries, development of coal and metallurgical base of the country, construction of the Moscow subway, organized reviews of introduction of advanced equipment.

During the WWII, the company assisted defense enterprises in the accelerated development of their production for the needs of the front, organized consultations, worked on the problems of finding and using reserves for the defense of the country and the defeat of the enemy, developed measures to restore the destroyed enterprises and infrastructure. The need to restore cities, to recreate industries contributed to the fact that engineers began to play a decisive role in the economic development of the USSR.

In the postwar years, the engineering profession became a key profession in the Soviet Union: new engineering universities were opened, the number of students and graduates-engineers increased. At the same time, the state actively contributed to the development of the scientific base.

Scientific and technical societies (STS) have become mass associations of scientists, engineers and innovators. The all-Union Council of scientific and technical societies was established. This approach allowed the Soviet Union to largely realize the engineering potential that existed in the country. Common tasks and priorities, the right direction of development of the scientific and technical society have become the key to high quality engineering activities in the USSR.

STS organizations along with the development of individual scientific and technical issues began to participate in the development of areas of technical development of sectors of the economy, enterprises, in the formation of state plans for the development of science and technology, in the implementation of these plans. With the active participation of scientific and technical societies solved many problems associated with the development of the most advanced industries, such as the creation of new materials, the development of electronic computers, radio electronics, television, spacecraft, etc. On the basis of the recommendations developed by the STS, a number of resolutions of the Council of Ministers of the USSR and the councils of Ministers of the Union republics were adopted.

In the activities of the STS, a significant place was occupied by the propaganda of achievements of science and technology, assistance engineering and technical staff and workers in increasing their technical and scientific knowledge, strengthened ties with the Academy of Sciences, created by the Russian engineering Academy, etc.

Courses and seminars on the study of new technology, schools of excellence were created. Scientific and technical societies published a number of industrial technical journals, exhibitions, conferences and lectures were held in the houses of science and technology.

Scientific and technical societies of the Soviet Union began to establish contacts, actively cooperate and enter into international engineering organizations. The Chairman of the all-Union Council of scientific technical societies, an outstanding Ukrainian scientist-mathematician, academician Aleksandr Yulievich Ishlinsky for 20 years he held leading positions in the World Federation of Engineering Organizations (WFEO): since 1971, was Vice-President of the WFEO, from 1987 to 1991-President of the WFEO, after 1991 and until the end of his life he held the position of honorary President of WFEO.

In 1973, scientific and technical societies were awarded the highest state award – the order of Lenin for their great contribution to the development of scientific and technological progress, active work to promote scientific and technical knowledge among workers.

At the present stage, the Russian and international Unions of Scientific and Engineering Associations (RUSEA and USEA), historical heirs and successors of RTS and UCSTS, continue and develop the tradition of consolidation of the scientific and technical community, following the goal of RTS "to promote the development of technology and technical industry in Russia", constantly pay attention to the support of gifted and talented engineers, scientists, specialists and technicians.

USEA consists of 10 national scientific and engineering associations and 35 professional societies and associations, among which the Russian geological society, Nuclear society of Russia, Russian scientific and technical society of shipbuilders named after academician A. N. Krylov, the Russian technical society of radio engineering, electronics and communication named after A. S. Popov, tunnel Association of Russia, Association of technical universities (ATU), the Association for engineering education of Russia, Association of engineering universities and others. Each of these associations is a large and reputable organization. The ATU, for example, includes 129 universities (including from the CIS countries). RUSEA consists of 23 Russian scientific and technical societies, has 25 regional organizations and branches and 19 houses of science and technology in major cities of Russia (Krasnoyarsk, Tula, Yekaterinburg, Tyumen, Saransk, Yaroslavl, etc.).

RUSEA sees its main task in broad involvement in scientific and technical societies, in the process of innovative development of the country (in the interests of sustainable development) of both young and already established scientists and specialists, providing full consulting, information and methodological

support to inventors, innovators, having interesting, socially significant projects, technologies, engineering developments.

An important role is played by the all-Russian competition "Engineer of the year" and the all-Russian competition for the youth prize in science and technology "Hope of Russia" held annually by the RUSEA. The competition "Engineer of the year" is held since 2000, and the competition "Hope of Russia" - since 2009. The competitions are a well-established form of continuation of the glorious traditions of the Russian engineering school, the largest social project implemented in Russia in order to identify and disseminate best practices and achievements of engineering personnel, the best in their field of activity. The range of engineering specialties submitted to the competitions is expanding in accordance with the changing needs of modern social production. Thus, in the competition "Engineer of the year – 2018" were presented specialists in 44 categories in the main industries, such as electronics, chemistry, shipbuilding, computer science, nuclear power, electricity, engineering, aviation and space, oil and gas industry and many others, as well as in the relatively new – the organization of management of scientific and engineering activities, industrial production, construction. In 2019, a new 45th nomination "International cooperation" appeared in the competition.

The need of creation and development of high-tech industries seeking to launch into an absolutely new quality level of the system of engineering personnel training, enhance the prestige of the engineering profession. A special role is played by the leading technical universities, because they must ensure the high quality of engineering education, prepare the personnel reserve for innovative transformations, technological growth of the industry.

The growing importance of engineering education as the dominant global trend was noted in the Declaration of the V World Congress of Engineers: "engineering education is important to enable people to effectively use modern scientific knowledge and technical means and processes, to promote technology to improve the quality of life... Engineering education should be introduced at every level of human development."

In modern conditions, due to the constant development of information technology, one of the necessary conditions for the professional growth of an engineer is the constant improvement of his professional skills. If earlier to solve a technical or production problem the engineer had enough knowledge obtained within the framework of classical technical disciplines, today a modern specialist needs to constantly replenish the baggage of professional knowledge and skills, to undergo training courses. The concept of continuing education assumes that a person's life is not divided strictly into the period of study and the period of work, and learning is a constant process throughout his life.

RUSEA is actively working to attract public attention to the problems of engineering and scientific activities, as well as continuing education. Houses of science and technology of RUSEA conduct training and retraining of personnel, providing the system of additional education for specialists of various levels of training, conduct scientific and technical conferences, seminars and round tables on topical issues of

science and technology. The idea of development of information and communication platform for open exchange of new knowledge and distribution of electronic educational resources within the network is developed.

In the life of modern society, engineering plays an increasing role, engineers are always involved in the constructive development of projects for the development of society, so that they are always in direct and close contact with the environment. Engineers should always remember that the problems of technological development of society and the environment are inseparable and must be solved together. The engineer must first assess the environmental and social consequences of their actions, and in cases where the negative consequences outweigh, abandon their technical ideas. In other words, engineers should develop such technologies, the introduction of which will not cause degradation of nature or increase poverty, will not increase the level of security of the city, country, civilization. Their activities should be guided by the following objectives: improving the quality of life; saving energy consumption; equal opportunities for all people to enjoy the benefits of the environment; equitable access of the entire population to limited resources; biodiversity conservation, which is correlated with the action plan adopted by the UN General Assembly in 2015 to achieve the 17 sustainable development goals for the period up to 2030.

In this regard, it should be noted that in modern conditions, extremely important features of high-quality engineering work are not only knowledge and skills that contribute to the efficiency and effectiveness of scientific and technical developments, but also moral principles that impose prohibitions on particularly dangerous for human methods of experimentation and transformation of reality.

An important milestone in the activities of the Union is the adoption and observance of the Code of ethics of scientists and engineers. The code defines the basic moral principles of creative activity and relationships of members of public associations, members of the USEA. These principles are developed by the social, scientific and technical practice of the developing society, reflect the moral values, the accumulated experience of the public associations included in the USEA, formed both on professional creative interests and on a regional basis, based on the glorious history and traditions of the RTS − UCSTS.

Thus, for the successful development of modern science and engineering, it is important to have a developed public opinion and independent non-governmental organizations that express it, which guarantee real responsibility and control over the implementation of socially significant tasks, which without this can remain only declarations. Every scientist and engineer values the opinion and recommendations of the professional community to which he belongs, and more broadly - the society of which he is a citizen.

RUSEA is based on the history and traditions of the Russian technical society. The use of this moral potential in the formation of a spiritually rich and highly professional personality of the Russian scientist, engineer, inventor should become the basis of his active citizenship, affirmation of the true

value of scientific and engineering work, increasing the authority of the engineer profession and improving the level of technological security, including in the information sphere.

ACADEMICIAN GULYAEV YURI VASILIEVICH

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Gulyaev Yuri Vasilievich was born on September 18, 1935 in the village of Tomilino, Lyubertsy district of the Moscow region.

In 1952 Y.V. Gulyaev graduated with honors from the Lyubertsy secondary school, in 1958 - the Moscow Institute of Physics and Technology (MIPT), the radiophysical faculty (with honors). In 1958 he enrolled in full-time postgraduate study at the Institute of Radio Engineering and Electronics of the Academy of Sciences of the USSR (now the V.A. Kotelnikov Institute of Radio Engineering and Electronics, Russian Academy of Sciences (IRE), where his supervisor was Professor Viktor Leopoldovich Bonch-Bruevich. In 1960, Y.V. Gulyaev was recruited to the institute as a junior research fellow, in 1962 - defended his thesis and in the same year was sent to study in England, where for 10 months he worked at the Manchester, Oxford and Brunel universities. In 1970 he defended his doctoral dissertation.

In IRE Y.V. Gulyaev went from junior research fellow to director. Currently, Y.V. Gulyaev - chief research officer, scientific director of IRE.

In 1989-91 years. Y.V. Gulyaev - People's Deputy of the USSR, Chairman of the Committee on Communications and Informatics of the Supreme Soviet of the USSR.

In 1979, Y.V. Gulyaev was elected a corresponding member of the USSR Academy of Sciences (now the Russian Academy of Sciences), in December 1984 he was elected to the full membership of the USSR Academy of Sciences. Since 1992 - Member of the Presidium of the Russian Academy of Sciences. Currently, Y.V. Gulyaev - Deputy Academician-Secretary of the Department of Nanotechnologies and Information Technologies (ONIT) of the Russian Academy of Sciences, Chairman of the section of computing, location, telecommunication systems and elemental base of ONIT RAS.

Academician Y.V. Gulyaev has been active in pedagogical activity for more than 45 years. Since 1972, he heads the chair of solid-state electronics and radiophysics of the Moscow Institute of Physics and Technology, he has prepared more than 100 candidates of science, of which more than 20 people became doctors of science, including one academician and one corresponding member of the Russian Academy of Sciences.

Academician Yu.V. Gulyaev is a well-known scientist in the field of radiophysics, electronics and computer science, one of the founders of new areas of solid-state physics and engineering - acoustoelectronics, acousto-optics, spin-wave electronics. In 1968 Y.V. Gulyaev and independently and simultaneously with the American physicist J. Blueshtein, a new fundamental type of surfactant, known in the world literature as the Bluesin-Gulyaev waves (Blustein-Gulyaev waves), was predicted and studied. These and other works Y.V. Gulyaev in the field of acoustoelectronics led to the emergence of a new direction in the technology of information processing, communications, radar. The world output of acoustoelectronic products, which are important components of TV sets and radios, radar systems and communications, and in recent years of cellular phones, today is billions of pieces per year.

Yu.V. Gulyaev made a great contribution to the development of spin-wave (magnetic) electronics. They predicted the existence of so-called "second spin waves" in ferromagnets (an analog of the second sound in liquid helium, predicted by LD Landau) and constructed their hydrodynamic theory.

Yu.V. Gulyaev proposed and successfully developed a new "radiophysical" approach to the study of the functioning of the human body, based on a complex measurement of physical fields and human radiation in the process of its life. Based on these measurements, together with the teams of several leading medical organizations, new methods of non-invasive early medical diagnostics are developed and continue to be developed, which is the basis of preventive medicine of the future.

Academician Y.V. Gulyaev published alone and co-authored more than 700 scientific papers, including 11 monographs, and received about 100 copyright certificates for inventions and patents.

Y.V. Gulyaev is the editor-in-chief of the journals "Radio Engineering and Electronics", "Applied Nonlinear Dynamics", "Biomedical Radio Electronics", "Science and Technology in Industry", a member of the editorial boards of several journals.

Academician Y.V. Gulyaev has a high scientific authority in Russia and in the world. He heads the International and Russian Union of Scientific and Engineering Associations, the Russian Scientific and Technical Society of Radio Engineering, Electrical Engineering and Telecommunications. A.S. Popov, Academy of Engineering Sciences. Y.V. Gulyaev is a foreign member of the Polish and Moldavian National Academies of Sciences, a foreign member of the Chinese Academy of Engineering Sciences, a member of the Scientific Advisory Board of the Development Fund for the Center for the Development and Commercialization of New Technologies in Skolkovo, for a long time was a member of the Executive Committee of the World Federation of Engineering Organizations.