ON THE OCCASION OF THE 75th ANNIVERSARY OF NAS ACADEMICIAN M.Z. ZGUROVSKY

SCIENTIST AND ORGANIZER OF ENGINEERING EDUCATION

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On January 30, 2025, the renowned Ukrainian scientist, expert in the fields of cybernetics, systems analysis, decision theory, three-time laureate of the State Prize of Ukraine in Science and Technology (1990, 1999, 2005), Honored Scientist of Ukraine (2000), Full Cavalier of the Order of Merit (1996, 1998, 2005), laureate of NASU prizes named after V.M. Glushkov (1995), V.S. Mikhalevich (2004), and S.O. Lebedev (2019), Honorary Doctor of the NASU (2020), Doctor of Technical Sciences (1984), Professor (1985), Academician of the NASU (1995), Academician of the NAPS (1995), and Foreign Corresponding Member of the Austrian Academy of Sciences (2022), Mykhailo Zakharovych Zgurovsky, celebrates his 75th anniversary.

Mykhailo Zakharovych Zgurovsky was born in Skala-Podilska town, Borshchiv District, Ternopil Oblast. In 1975, he graduated from Kyiv Polytechnic Institute (now the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" — KPI) with a degree in Automated Control Systems. He defended his Candidate of Sciences dissertation, "Optimal Discrete Control of a Class of Distributed Processes of Nonstationary Heat Exchange," in 1979, and his Doctoral dissertation, "Automated Design and Optimal Control of Nonstationary Processes and Fields under Uncertainty," in 1984. In 1987, he became a Professor at the Department of Technical Cybernetics at KPI. From 1988 to 1992, he served as Vice-Rector for Academic Affairs, and from 1992 to 2024, he was the Rector of Kyiv Polytechnic.

In 1996, Zgurovsky founded and, until 2015, directed the Institute for Applied System Analysis (IASA) under the Ministry of Education and Science of Ukraine and the NASU. Since 2015, he has served as its Scientific Director. From 1994 to 1999, he was the Minister of Education of Ukraine.

By his anniversary, Mykhailo Zakharovych Zgurovsky has made a significant contribution to science, education, and public life. In the realm of science, M.Z. Zgurovsky has generalized the fundamental principles of systems analysis, laid the foundation for systemic mathematics, and proposed a new approach to the theory of extremal problems for nonlinear operator, differential-operator equations, inclusions, and variational inequalities. The most prominent applications of his scientific research are in the fields of mathematical geophysics and geoinformatics, contributing to solving the socio-economic challenges of modern society.

While serving as the Minister of Education of Ukraine, M.Z. Zgurovsky continued the work initiated by P.M. Talanchuk, the first Minister of Education of independent Ukraine. He implemented the core principles of the **State National**

Program "Education" ("Ukraine in the 21st Century"), which was approved by the First All-Ukrainian Congress of Education Workers in December 1992. Under Minister Zgurovsky leadership, a comprehensive legislative framework for Ukraine's education system was developed.

A new generation of Ukrainian-language textbooks was created, and the concept of humanitarian education in Ukraine was introduced. He established an accreditation system for higher education institutions, with its permanent collegial body—the **State Accreditation Commission of Ukraine** (a predecessor of the current **National Agency for Higher Education Quality Assurance (NAQA)**). The structure of educational fields and specialties in higher education was aligned with the needs of the economy and society of the newly independent state.

For the first time, a mandatory entrance exam in the Ukrainian language was introduced in higher education institutions. Many other significant initiatives were implemented, all aimed at developing the human capital of an independent Ukraine.

Upon assuming the role of Rector of Igor Sikorsky Kyiv Polytechnic Institute (KPI), Mykhailo Zgurovsky developed a new vision for its further development. His concept focused on transforming the institution from a large polytechnic institute of the Soviet-era centralized economy into a European-style technical university, characterized by universal and broad-oriented training to meet the evolving needs of society. Today, KPI consistently ranks among the top 4% of universities worldwide according to various international rankings.

To achieve this transformation and address the demands of the newly independent Ukraine, new faculties and institutes were established, new departments were created, and over 150 new specialties and specializations were introduced. Significant reforms were implemented to facilitate KPI's integration into the European educational and research space.

During his 32-year tenure as Rector, Mykhailo Zghurovsky was guided by core principles he articulated in an interview: "*Always remember that I come from KPI and owe my development and growth to it. Therefore, under any circumstances or position, I must work for its advancement and prestige, support and protect my colleagues at my alma mater; respect the honor and dignity of every person, regardless of their social status or position, and strive to understand the perspective of everyone who approaches the Rector; affirm respect and reverence for veterans and seniors, who created everything the university has today and are carriers of wisdom and unique experience for the new generation; inherit the best practices for KPI from my predecessors; see in every student a talented individual and in every staff member a like-minded colleague and ally; be grateful for accomplishments and capable of forgiving mistakes and weaknesses*."

Thanks to Zgurovsky's energy, his scientific talent, and his leadership as an organizer of engineering education, KPI was granted the status of a **National Technical University** in 1995. In 2007, it became the first Ukrainian university to be recognized as a **research university**, leveraging the integration of education, science, and innovation within the powerful innovation ecosystem Sikorsky Challenge, which he established.

The KPI research university model is based on refining mechanisms for modern integration of science, education, and innovation. This approach emphasizes preparing highly qualified researchers and specialists for knowledge-

intensive industries in Ukraine's economy, fostering innovation activities in market conditions through the university's scientific and technological parks, and promoting a knowledge-based economy. The foundation of this model has always been the synergy of experience and energy from both seasoned and young educators and researchers.

It is worth noting that during Ukraine's independence, KPI effectively became a laboratory for developing and drafting key documents on education. These include Ukraine's laws **"On Education," "On Higher Education," "On the Scientific Park 'Kyiv Polytechnic,'" "On Scientific Parks,"** and **"On the Basic Principles of Information Society Development in Ukraine for 2007–2015"**, along with numerous government resolutions and decisions by the Ministry of Education and Science. KPI was one of the first universities in Ukraine to sign the **Magna Charta Universitatum**. It was an active participant in introducing the Bologna Process in Ukraine and played a leading role in organizing and participating in numerous international conferences on reforming higher education and harmonizing it with the European educational system.

The transformation of Igor Sikorsky Kyiv Polytechnic Institute (KPI) into a research university was just one, albeit undoubtedly a key, project among dozens of initiatives proposed and implemented by Mykhailo Zgurovsky during his tenure as Rector of Kyiv Polytechnic. Among the achievements initiated and successfully realized under his leadership are the following:

- Establishment of 11 new faculties and educational-scientific institutes, as well as over 50 new departments to meet the modern needs of Ukraine's economy and society.
- Development and expansion of the scientific-educational information and communication network **"Uran"** and its integration into the European **GEANT** network.
- Creation of the university's supercomputer center.
- Establishment of the **World Data Center for Geoinformatics and Sustainable Development**, as part of the global network of World Data Centers.
- Creation of Ukraine's first State Polytechnic Museum.
- Establishment and development of the **Sikorsky Challenge** innovation ecosystem, based on the Law of Ukraine "On the Scientific Park 'Kyiv Polytechnic.'"
- Initiation of the educational and scientific complex **"Institute for Applied System Analysis"** (IASA) in cooperation with the National Academy of Sciences of Ukraine (NASU).
- Creation of the **Institute of Advanced Defense Technologies**.
- Establishment of the KPI Alumni Association.

Under the leadership of Rector Mykhailo Zgurovsky and with his direct involvement as the architect of every project, the university underwent significant physical and cultural transformations. These changes reflect the finest traditions of leading European and global universities. KPI restored its unique spirit of academic excellence, scientific achievements, and proud affiliation with its illustrious history.

Numerous unique symbols of the university were created or restored, becoming its pride: the Hall of the Academic Council, the Polytechnic Museum, KPI's

famous park, monuments to distinguished polytechnicians whose discoveries changed the world, the Grand Physics and Grand Chemistry Auditoriums, Knowledge Square, art galleries, commemorative plaques, the Foucault pendulum, the university church, two stadiums, numerous new parks, and the clock tower on the main building. A special place belongs to the memorial complexes dedicated to Kyiv Polytechnic students and faculty who gave their lives for Ukraine's freedom and independence. These symbolic landmarks are a profound tribute to the university's remarkable history.

Particular attention was given to the extensive reconstruction of a significant portion of the university's academic buildings and dormitories, many of which were in disrepair in the early 1990s. Thanks to meticulous efforts, these facilities were restored, revitalized, and adapted to meet modern requirements.

Today, this legacy not only reflects the grandeur of the past but also inspires new generations with pride in the great accomplishments of their predecessors. It surrounds the KPI community with a unique atmosphere: the spirit of university tradition, academic excellence, a sense of belonging to a rich history, and motivation for new achievements worthy of the outstanding contributions of previous generations.

It is important to emphasize that Mykhailo Zgurovsky has consistently prioritized the retention of experienced and highly qualified academic and scientific staff in his personnel policy while also attracting talented young professionals. This approach ensures the university's continued development and the preservation of its finest traditions.

The collaboration between Igor Sikorsky Kyiv Polytechnic Institute (KPI) and the scientific institutions of the National Academy of Sciences of Ukraine (NASU) has deep historical roots. Many of the founding scientists of KPI were directly involved in the establishment and development of the Ukrainian Academy of Sciences. For instance, Stepan Prokopovych Tymoshenko, Dean of the Mechanical and Engineering Faculties of KPI, formed the first Mechanics Department of the Ukrainian Academy of Sciences, organizing what is now the Institute of Mechanics of NASU, named in his honor. Another notable example is the distinguished KPI scientist Yevhen Paton, who founded the Institute of Electric Welding. Renowned academicians such as H.S. Pysarenko, S.V. Sorensen, K.K. Syminsky, and many others combined their work at KPI with leadership roles in academic institutes.

Mykhailo Zgurovsky actively supports these traditions. At his invitation, prominent scientists such as Academician V.G. Baryakhtar (founding Dean of the Faculty of Physics and Mathematics), Academician I.M. Kovalenko (founding Dean of the Faculty of Applied Mathematics), and other esteemed mathematicians and physicists like Academicians A.M. Samoilenko, I.V. Skrypnyk, V.M. Loktev, S.M. Dovgy, materials scientist Academician I.V. Kryvtsun (a disciple of B.Ye. Paton), renowned cyberneticist Academician V.S. Deineka, and many others have actively worked and taught at KPI.

Reflecting on the future of education, Mykhailo Zgurovsky recognized the need to reorient the university's activities toward a more fundamental approach to education, moving away from a narrowly technical focus. This fundamental approach has been inherent to KPI throughout its history, emphasizing the inseparable connection between education, scientific research, and the practical applica-

tion of results. It is this emphasis on fundamental education that once secured global leadership for the developments of former students who later became world-renowned scientists and engineers. The same approach underpins the numerous victories of current KPI students in international competitions in mathematics, programming, and cybersecurity.

Under the scientific leadership of Mykhailo Zgurovsky, the **Institute for Applied System Analysis (IASA)** of NASU and the Ministry of Education and Science of Ukraine, as well as the **World Data Center for Geoinformatics and Sustainable Development**, were established in Ukraine. The latter specializes in geoinformatics, focusing on global modeling of sustainable development processes and assessing global threats to human security and quality of life.

IASA was established in 1997 by a resolution of the Cabinet of Ministers of Ukraine as part of the Cybernetics Center of NASU. Its dual subordination reflects the implementation of the concept of integrating science and education. IASA conducts cutting-edge fundamental and applied research in developing methodologies for systems analysis of complex interconnected objects and processes of social, economic, ecological, and technological nature.

The institute develops methods for forecasting and predicting the behavior of complex systems under multi-factor risks, decision-making in such systems with conflicting objectives, and uncertainty or insufficient initial information. It also advances the theory of optimal control, differential games, nonlinear analysis, optimization, the theory of infinite-dimensional dynamic systems, methods for evaluating and managing nonlinear distributed parameter systems, and the analysis of controlled Markov processes. Furthermore, it develops the theory of information-analytical systems, methods for managing large databases, and strategies for ensuring the guaranteed functionality of cyber-physical systems, including the support of digital twins.

The platform for solving this class of problems is a new research direction proposed by Mykhailo Zgurovsky, known as **"system mathematics."** This direction represents a set of interrelated branches of mathematics (both classical and newly developed) that enable solving modern interdisciplinary problems of various natures. By applying system mathematics, the Institute, under Zgurovsky's leadership, has achieved fundamental results in the field of global modeling of sustainable development processes in the context of quality and safety of human life, analysis of global threats, and systemic studies of control problems for complex and hybrid systems.

In applied research, tools for **technology foresight** and **scenario analysis** have been developed in the form of an advanced information platform. This platform integrates mathematical, software, logical, and organizational tools, allowing for the sequencing of qualitative and quantitative analysis methods, establishing relationships between them, and ensuring the process of building future event scenarios. In practical terms, the research outcomes have been applied to address numerous challenges in the development of Ukraine's economy.

The **Institute for Applied System Analysis (IASA)** actively collaborates with NASU research departments, including the Divisions of Informatics, Mathematics, Mechanics and Machine Science, Physics and Astronomy, Materials Science, Energy and Energy Technologies, Earth Sciences, and Economics, as well as other NASU structures and many higher education institutions. It is worth

emphasizing that the fundamental and applied research and developments at IASA are conducted, as intended at its establishment, in conjunction with the educational process and the preparation of highly qualified young professionals.

In response to contemporary challenges, Mykhailo Zgurovsky proposes a new paradigm in science and education based on general trends such as interdisciplinarity, human-centered approaches, sustainability, responsibility and ethics, and the comprehensive use of Industry 4.0 core technologies.

Zgurovsky argues that the transition from Industry 4.0 to Industry 5.0 signifies not only technological shifts but also a rethinking of the human role in society and industrial production. He emphasizes sustainable human development and the creation of new societal values. This, in turn, imposes new demands on the economy, industry, and society, as well as on scientific research and the training of specialists in system analysis, intelligent service-oriented distributed computing, and artificial intelligence systems and methods.

In response to the challenges mentioned above, Mykhailo Zgurovsky initiated profound reforms in the educational and research activities of IASA, based on the following principles:

- **Human-centered innovation:** The new economic model places humans and their needs at the center of innovation processes. Industry 5.0 highlights the importance of harmonious collaboration between humans and technology, requiring greater consideration of human needs, ethical issues, and social responsibility when developing technological solutions.
- **Interdisciplinary approach:** Workforce training and scientific research must address not only the rapid development of technologies but also the complexity and multidimensionality of demands from the economy and society. Integrating an interdisciplinary approach into the system of science and education is essential to prepare specialists capable of solving complex problems.
- **Broad integration of advanced technologies:** The economy and society in the Industry 5.0 era will demand extensive integration of system analysis, artificial intelligence, distributed computing, and cyber-physical systems across all areas of life. Key aspects include technology interoperability, cybersecurity, adaptability to change, and adherence to ethical standards.
- **Competence development:** Training programs should focus on developing competencies such as the analysis of complex adaptive systems, intelligent data analysis, the design of resilient and secure cyber-physical systems, and ensuring interoperability between various technologies.
- **Scientific Achievements and Legacy:** Within Zgurovsky's scientific school, 16 doctoral and over 40 candidate theses have been completed. He is the author of 52 inventions and has authored or co-authored more than 1,000 scientific works, including 45 monographs and textbooks published in Ukraine, Japan, Poland, China, Germany, and other countries worldwide. These accomplishments highlight Mykhailo Zgurovsky's enduring contributions to science, education, and societal development, positioning IASA as a leading institution in addressing modern challenges and fostering innovation.

Under the leadership of Academician Mykhailo Zgurovsky, significant work has been carried out in the analysis and scenario planning of sustainable development for regions of Ukraine in the context of human quality of life and safety. The aim of this work is to enhance the comprehensiveness and effectiveness of

analytical and informational support for decision-making processes (in the form of medium- and long-term strategies and sequences of actions by authorities). These efforts focus on ensuring the sustainable development of individual regions and Ukraine as a whole, viewed as complex socio-economic systems. This is achieved by developing new and improving existing methods of systems analysis, big data intelligence, forecasting, scenario planning, and management.

The Institute for Applied System Analysis (IASA) publishes the international scientific journal "System Research and Information Technologies," with Mykhailo Zgurovsky serving as its Editor-in-Chief. On Zgurovsky's initiative, IASA organizes and co-organizes numerous scientific conferences and seminars. Notably, it hosts the annual International Scientific and Practical Conference on Systems Analysis and Intelligent Computing.

Mykhailo Zgurovsky is extensively involved in public activities. He is a member of numerous Ukrainian and international scientific societies, the national representative of Ukraine at the International Science Council (ISC, Paris, France), a member of the Honorary Council of the Order of Saint Panteleimon, and the Chair of the Ukrainian Peace Council. In recent years, his public efforts have focused on consolidating international organizations and prominent figures in education, science, and culture from various countries to achieve a just peace for Ukraine.

Zgurovsky has been a co-organizer and participant in key international events, including the **UN Seminar on Environmental Security During War and Armed Conflicts** (November 6, 2024, New York), the **Second Summit on Partnership and Veterans' Health** (European Parliament, October 29–30, Brussels, Belgium), and the **International Conference "Europe and Ukraine: Shared Perspectives and Values"** held at the Austrian Institute for European and Security Policy (December 13, 2024, Vienna, Austria), among others.

For his achievements in science, education, and fostering international cooperation, Mykhailo Zgurovsky has been awarded numerous state honors from Ukraine (he is a Full Cavalier of the Order of Merit), as well as from Italy, Estonia, Vietnam, Poland, France, Japan, and China.

The scientific community, colleagues, and students extend their heartfelt congratulations to Mykhailo Zgurovsky on his milestone anniversary, wishing him active longevity, boundless inspiration, and new achievements for the benefit of his homeland.

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