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# СОЦІАЛЬНА ФІЛОСОФІЯ
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## PHILOSOPHY OF SCIENCE AND TECHNOLOGY IN MODERN WORLD

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*Issues related to the cardinal changes taking place in modern science and social practice and their significant effects on research issues in the field of theoretical and social philosophy, philosophy of science and philosophy of technology are highlighted. It is substantiated that the radical transformation of science (its transformation into techno-science) and its role in society inevitably leads not only to the destruction of demarcation lines between scientific and non-scientific knowledge and the replacement of scientific theories with discourses created in non-scientific practices, but also significantly affects all spheres of society. life - production, culture, education, etc.*

*In modern conditions, the influence of constantly changing and improving technologies on the physical, mental, intellectual and other meanings of society and man actualizes philosophical research in this area. One of the reasons for this is the uniqueness of the modern stage of scientific and technological development of society, which is often referred to as "techno-science". The current situation in science, which has entered the era of post-classical science, requires an interdisciplinary, even transdisciplinary approach and an integrating unity of natural, technical and socio-*

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*humanitarian fields for the development of scientific knowledge. The basis of such unity should be provided by philosophical knowledge, which is a much more complex type of unity than a simple reduction to a single beginning. Since it is philosophy, while remaining the most free type of thinking.*

*Today there is a kind of return of metaphysics to science. The point is that scientists in their reasoning quite often go to the so-called metaphysical section, or rather forced to come to such an interpretation of certain concepts that is similar to the metaphysical. This is possible due to the fact that, despite the independence of the spheres of philosophy and science, their boundaries are not completely impenetrable. Which, by the way, is not surprising, since all sciences in one way or another came out of philosophy, generated by it and cultivated by it. Another interpretation of the connection between science and philosophy is possible. It consists in the fact that both philosophy and science exist in a single space, in a single field of meanings. Therefore, modern philosophy must not only respond quickly to the radical changes taking place in all spheres of social life, but also to anticipate the main trends, prospects and especially the humanitarian and ecosocial consequences of these changes.*

***Keywords:*** *science, techno-science, engineering, technology, nanotechnology, philosophy, philosophy of engineering, philosophy of education, transformation, society.*

## ФІЛОСОФІЯ НАУКИ І ТЕХНІКИ В СУЧАСНОМУ СВІТІ

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*Висвітлюються питання пов'язані з кардинальними зрушеннями, що відбуваються в сучасній науці і соціальній практиці та їх істотних впливах на проблематику досліджень в царині теоретичної і соціальної філософії, філософії науки і філософії техніки. Обґрунтовано, що радикальна трансформація науки (її перетворення в технонауку) та її ролі в суспільстві неминуче призводить не лише до руйнації демаркаційних ліній між науковим і позанауковим знанням та заміщенням наукових теорій дискурсами, що створюються в ненаукових практиках, а й істотно впливає на всі сфери суспільного життя – виробництво, культуру, освіту та ін.*

*У сучасних умовах вплив постійно змінних і вдосконалюваних технологій на фізичні, психічні, інтелектуальні та інші значимості суспільства й людини актуалізує філософські дослідження в цій сфері. Однією з причин цього є своєрідність сучасної стадії наукового і технологічного розвитку суспільства, яку часто позначають терміном "технонаука". Нинішня ситуація в науці, яка вступила в епоху постнекласичної науки, вимагає міждисциплінарного, навіть трансдисциплінарного підходу й інтегруючої єдності природничих, технічних і соціогуманітарних галузей для розвитку наукового знання. Основу такої єдності й повинне забезпечити філософське знання, яке саме постає значно складнішим типом єдності, ніж простим зведенням до єдиного початку. Позаяк саме філософія, залишаючись найбільш свобідним типом мислення, завдяки рефлексії над універсаліями культури забезпечує збереження та сталість культурної традиції й водночас виходить за межі цих універсалій, руйнуючи тим самим традиції й створюючи нові значимості та смисли.*

*Сьогодні спостерігається своєрідне повернення метафізики в науку. Йдеться про те, що вчені в своїх міркуваннях доволі часто виходять на так званий метафізичний зріз, чи точніше змушені виходити на таке тлумачення тих чи інших понять, що подібне на метафізичне. Це стає можливим завдяки тому, що, незважаючи на самостійність сфер філософії і науки, їх межі не є абсолютно непроникними. Що, до речі, й не дивно, позаяк всі науки так чи інакше вийшли з філософії, нею породжені і нею ж вирощені. Можливою є й інша інтерпретація зв'язку науки і філософії. Вона полягає в тому, що і філософія, і наука, існують в якомусь єдиному просторі, в єдиному полі смислів. Тому сучасна філософія зобов'язана не лише швидко реагувати на кардинальні зміни, що відбуваються в усіх сферах суспільного буття, а й передбачати основні тенденції, перспективи й особливо гуманітарні та екосоціальні наслідки цих змін.*

***Ключові слова:*** *наука, технонаука, техніка, технології, нанотехнології, філософія, філософія техніки, філософія освіти, трансформація, соціум.*

**Introduction of the issue.** In modern conditions of globalization and technologization of society, the influence of constantly changing and improving technologies on the physical, mental, intellectual and other characteristics of man and society is becoming a trend of modern philosophical research. Most researchers believe that one of the main reasons for this is the uniqueness of the current stage of scientific and technological development of society, which is often referred to as "techno-science". It is the subject area of philosophy of science and technology as a direction that accumulates both socio-humanitarian and scientific and technical component of knowledge, was at the intersection of various problems generated by techno-science. What is and what characterizes the field of modern research in the field of philosophy, methodology and sociology of technology, starting with techno-science and its cultural and historical dimensions, social evaluation of technology and innovation, NBICS technologies (nano-, bio-, information, cognitive and social technologies) and socio-humanitarian approaches to solving emerging problems and ending with transformations in the field of engineering education and training in terms of fundamentally new advances in engineering and technology become central to the development of research in philosophy and science in the late twentieth – early twenty-first century. Modern science, which has entered the era of post-classical science, requires an interdisciplinary, even transdisciplinary, approach and complementary unity of natural, technical and socio-humanitarian disciplines for the development of scientific knowledge, which faces new challenges of scientific and technological development. The basis of such transdisciplinary unity should be philosophical knowledge, which is a much more complex type of unity than a simple reduction to a single beginning. After all, the unity of philosophical knowledge itself is a kind of "unity of the diverse" or "diversity of the one". Unlike specific sciences, philosophy does not strive for accuracy, and its most important feature is less unambiguity and flexibility of the concepts used. However, the inflexibility of philosophy is compensated by its ability, on the one hand, to most widely embrace being, and on the other - to become a secondary, interpretive, level of this being. It is philosophy, while remaining the free type of thinking, that, through reflection on the universals of culture, ensures the preservation and stability of cultural tradition and at the same time goes beyond these universals, thereby destroying traditions and creating new meanings. Many philosophers, as well as some philosophical thinkers, note that there is now a kind of return of metaphysics to science. The point is that under certain circumstances, scientists in their reasoning may go to the so-called metaphysical plan, or rather forced to come to such an interpretation of certain concepts, which will be similar to the metaphysical. This is probably made possible by the fact that, despite a fairly high degree of independence of the spheres of philosophy and science, their boundaries are not completely impenetrable. Which, by the way, is not surprising, given that all the sciences somehow came out of philosophy, it is generated and grown by it. There is also a slightly different interpretation of the connection between science and philosophy.

**The aim of the article** is in analysis of philosophy and science may exist in a single space, field of meanings, discourses, paradigms, and so on. In addition, this space is imbued with some end-to-end elements that bind it together, making it something integral,

unified, meaningful, and universally acceptable. It is clear that both philosophy and science interpret these elements differently, but the elements remain the same.

**Results and discussion.** The creation of new meanings in the development of techno-science as a new stage in the development of modern science and technology is possible only through the close interaction of technical, natural and social components. Modern techno-scientific reality has at least two beginnings - the capitalization of science, which leads to a fundamentally different regime and modality of science and scientific knowledge, and theorizing and autonomy of the techno-sphere, within which the instrumentally of all levels of cognitive activity and knowledge production is of particular importance, construction of reality and the resulting problem of the ontology of objects of scientific research and social practice.

Among the variety of intensive developments in the philosophy of science, technology and scientific and technological development, two areas of research are becoming dominant: the dynamics of nonlinear interactions in super-complex systems and the social assessment of technology (SAT). "Technology assessment", which emerged in the 1960s as part of expert policy advice aimed at shaping knowledge as a basis for action and decision-making on technology and its social application, now covers not just interdisciplinary but transdisciplinary research sphere, which is formed at the junction of the tripartite connection "science - technology - business" as an applied format of techno-science. Jamison notes: "The boundaries between academia and the business world are gradually blurring" [2].

Today, techno-science itself, as a multifaceted scientific knowledge, deals with a field that includes not only objects, but also the coordinated activities of people and structures. In techno-sciences research, the construction of an object is not only inseparable, but also due to the material and technological infrastructure of the study. Moreover, since the determinants are practical goals (interventions), the trajectory of the object and its essential characteristics are set and *directed*, which involves the creation of experimental objects, simulations and "epistemic things" – i.e. a kind of "machines", model systems for obtaining data and constant testing of their ability to perceive certain parameters [5].

Such a complex organization of the field of techno-science requires a transition to a new nonlinear way of thinking. The SAT is formed as a modern complex scientific and technical discipline, which is not focused on any one basic natural science, scientific and technical or socio-humanitarian theory, but on the whole complex of scientific (and non-scientific) knowledge and includes not only comprehensive research but and system design. In addition, within techno-science, design becomes an independent method of acquiring knowledge and in addition to the practical result is no less important to be able to produce new knowledge with technology [6], which, gaining independence for the next generation of engineers, designers, experimenters, begin to act in the role of objectified reality, which mediates nature. Socio-technical design becomes an analytical tool that allows you to assess the potential opportunities and risks of the development of new technologies. The technologies themselves, being a stage in the development of technology and interacting with large techno-social projects, become an active aspect of technology, which, in turn, is: activities to create artifacts; purposeful use of the effects of nature (first and second); moreover, such use, which works for man and society (by the way, and against, too), allowing them to realize

their plans; and finally, technology, as Heidegger pointed, is the existence of man – not only the tools, machines and environment that he creates, but also an inalienable aspect of his life.

Modern technology affects all areas and branches of knowledge, as a result of which humanitarian technologies are in high demand in modern society. Therefore, the philosophy of technology can be called today the philosophy of equipment and technologies. A holistic and multifaceted understanding of technology allows us to conceptualize it as a "social body" that requires the development of SAT methodology as a new type of scientific knowledge designed to comprehend the fact missed by traditional interpretations of technology that it is a significant factor in social interactions and their results. The institutionalization of the SAT reflects the response to the challenges posed by scientific and technological progress to modern civilization, and globalization poses new challenges due to the widespread use and influence of technologies used in a variety of scientific and socio-cultural contexts. Problems such as environmental pollution, climate change, global warming, covid-19 and others go beyond nation states. This causes a growing need to evaluate science and technology at the global level. Thus, along with the development of national, a common (common) foundation is laid for the creation of a global SAT. This is facilitated by the emergence of a more or less common definition of the SAT as a scientific, interactive process, the purpose of which is to promote the formation of public and political opinion on the social aspects of the development of science and technology.

This definition contains a number of essential principles of the modern SAT. It is about forming an opinion, not informing about an opinion, because the main tasks are the analysis of values and the widest representation of all stakeholders. Although the SAT is still interpreted as a scientific process, it is also a communicative process aimed at creating the conditions and providing the necessary means to overcome deadlocks in social debates, i.e. not only assessing risks but also bringing together perspectives and conflicting values. In addition, the SAT is an interactive process, as it considers the interaction between disciplines and experts as a primary element of its method. Ultimately, the SAT is a social initiative because it focuses on those aspects of technology that are relevant to society, both in terms of ethics and the environment or the economy. As can be seen from the evolution of the SAT, it has learned to respond quickly and adapt to ever-changing situations in the fields of science, technology, engineering and social practice.

The socio-technological discourse of modern techno-science, due to inter-disciplinarily, also combine both theoretical research and socio-humanitarian technologies. This "adjustment" of people and things, in the terminology of Bruno Latour [4], characterizes a new type of relationship in modern science and is reflected in information, cognitive and biotechnology. Due to the addition of nano- bio-, information and cognitive technologies, modern social technologies are expanding a single set of NBICS technologies that open new technological perspectives for the development of philosophy of science and technology. NBICS convergence has become one of the most important for the philosophical understanding of technological innovation. In modern concepts of techno-science is a synthesis of "knowledge that" and "knowledge as", and in the classical triad of tasks of science "description - explanation - understanding" is built into the design and forecasting [6].

Most concepts of techno-science, fixing the turn of science to practice,

recognize the inseparability of knowledge from the material conditions of its production, pay attention to the heterogeneity of modern technical knowledge. In the era of development of NBICS technologies and the complexity of the field of science, the rigid distinction between the humanities and natural sciences, exact and inaccurate sciences, and at the same time, on the theoretical, methodological, technological levels, their integration takes place. Multidisciplinary as a distinctive feature of modern post-classical techno-science is reflected in the formation and development of a new scientific and technical discipline, which combines both interdisciplinary and disciplinary fields – nanotechnology. The epistemological basis of nanotechnology was, on the one hand, the principle of unity of the world on a nanoscale, which is understood as a potential opportunity to construct macro-objects with given properties from nanostructures, and on the other - an activist approach to improving natural objects up to human physiological and mental states, and the principles of reductionism and constructivism.

A distinctive feature of modern biotechnology is the epistemological attitude to the understanding of life as a text and life as a transformation, and their humanistic component is aimed at "improving man". According to the Kourany, "in the 21st century, the goals of improvement go far beyond all that has been in the past. They are aimed at a total redesign of man, his body and mind, in order to overcome all its inherent limitations. This plan includes everything that we consider important: our cognitive abilities and talents, emotions, the structure and boundaries of our bodies, our relationships with each other and with the world around us, our personalities" [3: 983]. Convergent processes occurring in the field of NBICS technologies directly affect the formation of the problem field of both philosophy and philosophy of technology. From the peripheral component of modern philosophy, the philosophy of technology is transformed into an independent philosophical discipline, precisely due to the issue of convergent technologies, which according to G. Hottois are both "natural environment and engine of development" [1: 61].

Indeed, the problems of convergent technologies have, on the one hand, actualized and, on the other, exacerbated many philosophical and social problems related to the ethical, legal, value, and personal aspects of human existence in modern technological society. The problem of personal identity is becoming one of the most important problems in the era of technocracy, because human nature changes in accordance with the changes that occur with the surrounding technologies. For example, modern information and biomedical technologies not only form new ways of human-technical interaction, but also significantly transform the mentality, psyche and human behavior. Therefore, a comprehensive analysis of techniques and technologies, taking into account the many influences on man and the formation of personality, requires due attention not only from philosophers and scientists, but also institutions in general, especially educational. It should be understood that modern research in this area concerns the training not only of medical, pedagogical, engineering, etc. personnel, but also the concept of building a modern model of education in general. "Basic education" replaces "fundamental education".

Fundamental education, as opposed to the base - is education, which combines humanities, natural sciences and technical knowledge by studying a wide range of issues "education too deep" and "wide education," which has both basic and applied value. Fundamental education today changes and

complements the meaning of the concept of "competence". The latter is now understood as the formed integrated ability to solve specific problems. This ability implies not only the availability of a significant amount of knowledge, but also the ability to dynamically update them in accordance with constantly changing conditions. The main intention of the competency-based approach in education is a sharp increase in its practical orientation and social significance. In this sense, philosophical and sociological studies of science and technology STS (Science and Technology Studies) together with the ACT project (American College Testing) should play one of the key roles in solving the problems of modern education, which should be aimed at developing the personality of each person, studies in the technogenic world.

In the range of constant changes of equipment and technologies the problem of transformation of professional education in general, engineering, medical, and pedagogical in particular arises. As the subject of research in post-classical science becomes more and more anthropo-dependent and human-dimensional, the urgent need of the latter is its humanization and humanitarianization. Changing and complicating the subject of research in post-nonclassical science requires the addition to technical means of solving problems of socio-humanitarian component and thus takes it beyond techno-science in the field of culture and society, and its (post-nonclassical science) epistemological principles form the need for medical, technical, engineering etc. sociologists.

The modern technological way of life creates new conditions and therefore places new requirements on professional and engineering education. After all, the modern world is a highly competitive world for mastery and domination in the field of high technology. And the key role in this confrontation is played by research centers and laboratories, production experimental sites and technical and technological universities. And behind all this are the figures of a scientist, engineer, experimenter. The modern engineer becomes a central figure of scientific and technological progress. Its activity is nothing but a creative application of scientific principles to the planning, creation, management, operation, management or operation of technical systems. That is why it is important to build a new model of training of the engineer of the future - a specialist who can constantly self-learn, quickly find the necessary information, integrate the latest ideas from various fields of science and technology, and have a developed mechanism for technical decisions at the inventive level, to see, but also to be aware of the social context of their activity and its consequences, etc. Responding to the challenges of the future, modern technical and technological universities in training new engineers must take into account that the new technological system dramatically changes the requirements for human capital and, consequently, approaches to education, which forms such "capital" (and not just capital, and "start-up capital"). The growing pace of new knowledge and the corresponding professional competencies must be accompanied by adequate dynamism of the education system, which, due to objective and subjective factors, always lags behind.

Structural changes in technology change not only man, but also the reality in which he lives and interacts with. That is why the most important component of the problems of modern philosophy and methodology of science and technology is the movement and transformation of not only the techno-sphere but also the cultural environment. Already familiar in scientific circles, the triad "technology – information – intelligence" reflects the

key components of modern culture, in which, along with technological transformation is erasing the boundaries not only of disciplinary and interdisciplinary differences, but also fundamental dichotomies: inhuman, individual – collective, etc. Network electronic and information culture of everyday life, the technologies of which are part of the life of the individual and society, are a new type of culture and socio-technical and technological reality. Man always, interacting with innovative technologies, becomes actually dependent on them. And this indicates that the noosystemic reality is a dynamic unity of social and technical. In other words, modern man exists in a constantly changing (and therefore constantly new) reality.

Techno-science today is not just a mode of knowledge production, which involves huge technological and organizational resources; it is not just the instrumentalization of knowledge, the replacement of representation by intervention, the priority of the engineering component over high theory, and so on. It is a mode of science that is imperatively required to produce knowledge that must be transformed into market-value goods and services, as well as the infrastructure that ensures their creation, circulation and consumption. Techno-science today is a re-assembly of science, mainly of the economic order, a regime in which science must ensure the expanded reproduction of the economy by creating more and more new technical objects – reproduction, which is supported today by social, technological, ideological, economic, legal, moral and other mechanisms of liberal capitalism.

Techno-science in the modern world is the accelerated colonization of our social and natural worlds by techno-objects. In this sense, the description of techno-science means at the same time the description of the modes of our existence, including the most routine and intimate spheres, in which techno-objects with their own, often conflicting protocols of functioning are increasingly squeezed. Techno-objects, and hence techno-science, overcoming the boundaries between external and internal, are already everywhere – around us and in ourselves, and often replacing us.

In fact, the principles of algorithms and tools offered by modern technology become a new reality, a new ontology and guarantee objectivity, i.e. compliance with the object. This, in turn, leads to the fact that it is not the choice of problems that dictates the choice of method, but, on the contrary, the choice of method determines the formulation of problems, tasks, their embodiments, and so on. Therefore, the problem with techno-science is not to conduct another round of conceptual explications, to make new theoretical distinctions or to blur old technological connections, but to turn specific implementations of techno-science into empirical objects of study, the description and explanation of which were not reduced would be the most legitimate forms of their self-presentation. Perhaps one of the most important questions about techno-science is how modern techno-science research practices should be built and organized, which, if not structurally, would at least similarly correspond to the heterogeneous complexity of its object.

**Conclusions and research perspectives.** What can we expect from this new reality and how long-term and global will its consequences be? Is techno-science only a modern stage in the development of the so-called Great Science; but is there anything new that has its own epistemological and sociocultural values, which replace traditional academic science and are designed to replace it and become a new project of "knowledge-power" and

the basis of a new techno-social system? Can traditional academic science in general and philosophy in particular be completely transformed, and, in the end, be supplanted by technological science, etc.? As historical experience shows, no, because both science itself and its self-reflection (philosophy) are and will remain a resource for the expanded reproduction of techno-science and other spheres of social life. Although, of course, current trends are such that new forms of production of scientific knowledge within techno-science and new techno-sciences are capitalized, become a public, progressive type of modern research and generate systemic changes at all levels of cognitive and practical activities. It is possible that the abandonment of the classical scientific ethos will destroy the current status of the scientific community, which will lead to the degradation of existing educational practices, which still directly embody the enlightenment dream of a single and comprehensive rational knowledge, and a gradual return to the quasi-medieval world qualitatively complicated compared to the era, which may be a prototype of the near future. Therefore, modern theoretical and social philosophy, philosophy of science and philosophy of technology must not only respond quickly to the radical changes taking place in all spheres of social life, but also anticipate the main trends, directions, prospects and especially humanitarian and ecosocial consequences of these changes.

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