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PARADIGM OF TECHNOSCIENCE AND RESPONSIBLE RESEARCH AND INNOVATION APPROACH

Irina V. Chernikova (a, b)*

* Corresponding author

(a) National Research Tomsk State University, 36 Lenin Ave., Tomsk, Russia
(b) National Research Tomsk Polytechnic University, 30 Lenin Ave., Tomsk, Russia, E-mail: chernic@mail.tsu.ru

Abstract

The paper gives comparative analysis of the three priority phenomena of the contemporary science, namely the programme of the research marked by the term "Responsible Research and Innovation" (hereafter RRI), transdisciplinary research marked as Technology Assessment (hereafter TA) and the phenomenon of Technoscience (Science Technology and Society Studies). Philosophic analysis of the contemporary science trends of development allows showing that science is no longer a matter of the armchair scientists, but an action included to social practice. Fundamental research, technoscience and technology assessment convergently interact. As a result, the new is not revealed, but is constructed in the space of interaction between science and society. Since the subject of the technoscience is represented by complex self-developing systems including a human being, scientific activity begins to be regulated by additional compared to traditional science ethical norms. There is a need to carry out additional reflection on scientific knowledge in the form of socio-ethical expertise of models and projects, for example, in order to identify social risks. The paper shows that in technoscience knowledge is produced not only in the context of revelation and fundamental grounding, but in the context of the assessed aftereffect as well(social assessment of technology).

Keywords: Technoscience; technology assessment; responsible research and innovation; knowledge.

1. Introduction

The concept of the Responsible Research and Innovation (RRI) was formed in scientific and socio-political discourse in the early XXI century. It evolved in frames of the European cooperation in sustainable development and innovations with the support of the European Commission Programme "Science with and for the Society". The programme of the research marked by the term RRI is the integration of technoscience, politics, social science, education and business into the unique megaproject. Not only the character and the structure of the research are crucially changed, but also the mode of being of science in the society. Science and society are "inscribed in each other" as Latour (2003) says.

Functions of science are not limited to fundamental research; they include contribution to production and grounding of the social decisions. The main principle in the assessment of the scientific research results is their usefulness for the society. Scientific quality, social relevance and viability are considered as the basic criteria of the scientific activity assessment (Standard Evaluation Protocol 2015−2021).

2. Problem statement

Science is expected not only to be guided by the challenges that society faces. Science must consider the innovations aftereffect and predict the results in the broad social context. Society, in its turn, shall form the position of the responsible relation to innovation technologies. Contemporary transdisciplinary research, such as technology assessment, social expertise, concepts of the collective responsibility and the whole subject are focused on this issue. As it is highlighted in the materials of the Horizon 2020 Strategy, implementation of the RRI approach assumes social expectations forecast regarding scientific research and innovation, as well as assessment of socially significant aftereffect of the scientific research results (Science with and for Society, Horizon 2020).

3. Methods

Changes in the contemporary science are connected with the repositioning of the scientific activity from cognitive to projective and constructive. Science gradually integrates to a newly organized system of interaction between science and technology. This phenomenon is called techno science (Chernikova, & Chernikova, 2015). The most significant examples of techno science are so-called NBICS-technologies (nanotechnologies, biotechnologies, information technologies, cognitive technologies and social technologies). All technologies display synergistic interaction, complement and intensify each other. They create unparalleled, extremely powerful tools for transformation of humane being and earth civilization. For example, convergence of information and cognitive technologies is used for reinforcement of the human intellect. At the contemporary stage, they mostly complement natural abilities of the human being in processing the information. In future, elements of the artificial intelligence may be integrated into human mind by means of the "brain – computer" direct interfaces. According to forecasts, it may happen in 2020-2030. With the help of nanotechnologies, we manage to transmit gens to definite type of cells with the help of nanoparticles, which are used as a transport. Combining nanoparticles with drugs will result in new types of therapy.

NBICS-convergences represent a brand new stage of the technological development, providing highly efficient influence to nature and society. The programmes of the social development on the basis of the NBICS-technologies were adopted in Europe and the USA (Converging Technologies for Improving Human Performances; Converging Technologies for European Knowledge Society). These programmes are targeted at improving the quality of life. However, NBICS-technologies are not limited to regular technological improvement; they "explode" the human world and transform the human nature and identity. NBICS-convergences open the possibilities of the humanity's evolution as of consciously guided process of the human nature transformation.

Contemporary science comes to a new stage of the cognition of human being; which can be literally called construction of the human being. Its social results are actively discussed. On the one hand, biotechnologies prolong human life; on the other hand, we face many challenges. For instance, what will happen with the employment of the young, if the share of the elder working population dramatically increases? What will be the consequences of an even greater increase in anthropogenic load on the biosphere? Where the decreasing evolutionary diversity with improving the gene pool will bring us? Biotechnologies create genetically modified products; its consumption and existence itself affects the nature by transpollination, and, for instance, genome transformation of the living species may have the irreversible character. Implementation of nanotechnologies is alarming as well; rapidly propagating radio identifiers – electronic devices consisting of a chip and antenna, are associated with the restriction of personal and civil liberties. On the one hand, such devices can be useful in the care of people suffering from loss of memory and in chipping pets. On the other hand, there is a danger of manipulation of consciousness, deprivation of liberty of action.

Thus, changes in scientific inquiry setup are typical for technoscience: research orientation is determined not only by the nature cognition, but also by social and ethical assessment of the scientific research and practical application aftereffect.

It is well-known that scientific knowledge today considerably depends on specific and extremely complicated making; at the same time, practical objects of the research are represented by the parts of nature that can be "carved out" by the corresponding operational procedures. The first stage of the evolution of science was connected with the progress in mathematics, and then the fundamental breakthroughs of the contemporary science were made in symbiosis with high technologies and complex experimental techniques. Therefore, contemporary science can be rightfully called technoscience. Technoscience, according to Vitaly Gorokhov (2014), is a hybrid entity. Classical science strived to create theoretical models of nature; technology was to control the world and to change "natural" sequence of events with technical interference. Yet, in hybrid "technoscience", theoretical representation interlaces with technical interference. In technoscientific research, theoretical representation cannot be separated*as a matter of principle*from the material conditions of the knowledge production.

The basic attribute of technoscience is tight interconnection of research with the practice of production and implementation of NBICS-technologies. The core of the knowledge production is no longer an academic laboratory, but the R&D departments of the large corporations. This shift naturally results in commercialization of science and its transformation into a business-project. The triple connection "Science – Technology – Business" is formed, which is not an extrinsic eclectic entity, but a brand new integrated structure. In its turn, transformation of technoscience social environment with its involvement into new practical contexts creates conditions for changes in the methodology of scientific activity and transformation of the cognition subject.

Technoscience deals not with objects as they are, but with the extensive outlines which include joint concerted activity of the various persons and social structures. Involvement of science into the broad context of social activity, obviously, stipulates changes of the projective and constructive conscience character. Science cannot cross the borders of the empiric technologism and construction of the

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engineering structures based exclusively on the objectal worldview. Though, evolvement of technoscience by no means cancels the challenge of studying objectal natural connections, and thus design and engineering in traditional meaning. However, as it was mentioned above, being a part of the extensive social activity work of the projective and constructive conscience is inevitably connected to the consideration of “human factor” and various socio-cultural aspects. It is the questions of the science and technology influence on society, natural environment and human being thatcometo the fore. Therefore, the RRI agenda is closely connected with this sphere of research.

Results of the classical science theoretical research found their practical application with the significant delay. In the contemporary innovation technologies, processes of theoretical research and implementation are synchronous. For instance, the implementation of the social request for mapping of the human genome initially was fundamental theoretical research in bio- and information technologies. The gap between research and implementation shrank; therefore, the probability of the negative aftereffects increased significantly. Thus, the menace of the expansion of the advanced, but not duly tested technologies escalated. To this end, special attention is given to interdisciplinary research of the aftereffects themselves. Thereat, the significance of technology assessment and RRI comes.

In the process of the scientific and technical development, it was found that human knowledge cannot scientifically predict all the risks; it is only possible to foresee the degree of the new technologies hazardous effects. Therefore, a researcher shall analyze his own scientific activity and correlate his actions with the explored nature not as with an object of manipulation, but as with a live organism able to adapt and react to challenges. Moreover, specialists are to consider the opinion of the stakeholders involved into the sphere of their research at the stage of the preliminary assessment of the aftereffects of the newest scientific and engineering technologies. In this regard, production of the scientific knowledge is inseparable from its implementation, and both of them from the ethics of the researcher and engineer, which in its turn is connected with the technology assessment as applied philosophy of technology (Gorokhov, &Grunwald, 2011).

Changes in the system of the scientific knowledge resulted in its tight bonds with society and politics. This twist is often called the postnormal science. Otherwise, science becomes not only interdisciplinary, but transdisciplinary, so it takes part in development and grounding of social decisions. The concept of “political epistemology” is discussed (Latour, 2003). The up-to-date trend of the research in the contemporary philosophy of science is the research of interaction between science and politics. The idea of the collective subject and omnipotence of the laboratory is called to replace an individual cognizer. Considering the opinion of Bruno Latour on the fact that the new sources of power are generated in the laboratories, collective epistemology problematizes the reduction of the individual knowledge to collective, and inversely, with the inclusion to epistemology of the notions like agreement and disagreement, the role of minority and majority in decision making, evidence, collective grounding, epistemic virtues, summarized knowledge, distributed knowledge and etc. (Kasavin, 2016).

Not only the paradigm of scientificity is rethought; Bruno Latour defines the problem in the following manner: “… it is necessary to reassemble the social”. To research does not mean being impartial and afterwards being involved in accordance with the principles revealed as a result of the research. Each scientific discipline at the same time extends the range of the existing substances and rigorously participates in forming of new social connections. To research means being involved in politics in a sense that accumulation and construction of the substance the common world is made ofare a matter of politics (Latour, 2005).

In the new concept of science marked as postnonclassical science, technoscience and knowledge of the Mode 2 knowledge are produced not only in the context of the exploration and fundamental grounding, but in the context of the assessed aftereffect as well. Therefore, notions Technology Assessment (TA), Science – Technology – Society (STS), Hazard Analysis, Innovation Analysis, etc. are close enough. In this context of research, an axiological aspect of the philosophical foundations of technoscience is of special significance. Risks of technoscience, social and ecological consequences of the technological disasters, the necessity of the social expertise introduction determined the development of the new scientific discipline and social practice "Technology Assessment".

The research trend "Technology Assessment" (TA) appeared in the 1960s. The project was aimed at developing knowledge as a basis for action and decision making. Professor Armin Grunwald notes that still, there are no theory of technology assessment. However, in practice, this type of activity requires theoretical modeling. Mainly, two groups of theoretical constructions are concerned, the theory of social context which includes TA (theory of functional differentiation, theory of technical evolution, theory of political sociality,etc.), and theoretical interpretations of the current and relevant regarding TA evolution (globalization theory, network society, knowledge society, sustainable development,etc.).

In accordance with the opinion of Armin Grunwald, TA is social, scientifically proved practice which responds to the needs of society in generation and implementation of the definite types of consistent knowledge regarding science and technology. TA is consideredas a type of social practice. At the same time, Armin Grunwald highlights conceptual origin of this activity, and that allows speaking of the TA theory. As a theory, he considers those things common that are in the basis of the various social practices – orientation of aftereffects, scientificity, orientationtowards social necessity of political consulting.

Scientific and technical progress made us think of aftereffects of scientific discoveries and inventions a long time ago. Social assessment of technology is consideredas applied philosophy of technology (Bekhman, & Gorokhov, 2012). Authors highlight that TA is not only interdisciplinary, but transdisciplinary research as well. The latter means its correlation with the vast social problematics. Moreover, this research is focused on the future, and therefore is not only problem-oriented, but project-oriented as well, being at the same time a system research and a system project, close by its sense to a social project.

Transdisciplinarity entered the scientific practice as a research strategy, which crosses discipline borders and develops a holistic view of the phenomena and processes (Chernikova, 2015). The prefix "trans" (*lat. trans – through, across*) pointsto the new type of knowledge production. If interdisciplinarity is intrascientific phenomena, then transdisciplinarity crosses the borders of the natural sciences and humanities to the sphere of the applied problems.Erich Jantsch was the first who used the term "transdisciplinarity" to define the coordination between education and innovation. Today,transdisciplinarity as a methodological prescription for cognition of historically changing complex multidimensional systems is especially significant in accordance with the development of technoscience and convergent technologies.

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4. Findings

Therefore, the problematics of technoscience, TA and RRI involve a lot of significant issues of epistemological, ontological and axiological character. Fundamental and applied sciences act as parts of the whole study, the results of which form a unique complex "Human – Nature" with direct communications and feedback. The responsibility of the researchers for their inventions in the sphere of technoscience dramatically increases. Thus, social expertise is urgent nowadays. Formerly, it was possible to assess the result of technology implementation by using scientific practices. Today,the human nature and the inner world become an object of transformation. We are to think on the results of such interferences at the stage of theoretical research. A part of the world is already aware that high technologies are not exclusively positively charged. Therefore, long before the implementation, such technologies are to become a subject of social expertise. In Western Europe, this practice becomes the rule;thus, innovations in nuclear engineering, transgenic technologies, etc. are to be examined by the expert society. As a result of social expertise, usually, several variants of the discussed technology implementation and forecast models are offered. Politicians are involved in the decision making process. This approach contributes to risk minimization.

5. Conclusions

Contemporary high-technologies, including NBICS-technologies, exert crucial influence on the environment and human; therefore, they cannot be considered as a territory of the armchairscientists. The issues of science and technology ethics gained fundamental importance in philosophy. The introduction of complex technical systems with their increasing complexity is characterized by hard to predict hazardous aftereffects. Technology assessment and ethics are to contribute to the development of the mechanisms for self-control and self-restraint under conditions of uncertainty. The process of assessment cannot be limited by the professional activity of the scientists and engineers; it assumes participation of the expert society and public representatives.

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