

Convergence of Science, Technologies and Society: Research-on-Research Aspects

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Abstract: In the article, research of research-on-research aspects of science, technologies and society is conducted. It is discovered, that convergence of science and technology is related to syntagmatically built sciences, including knowledge of different types. Studying of such sophisticated system demands research-on-research and syntagmatic approach to convergence as to complicated formation, built on synergian interaction of mono-disciplinary sciences and technologies.

Key words: Convergence • Science • Technologies • Development • Society • Research-on-research Aspects

INTRODUCTION

The second half of the 20th century was marked by significant transformations in the social life of the mankind. One of the most important factors, led to the transformation, was scientific-technological development, which encouraged appearance of the new phenomenon- convergence of science, technologies and society. First attempts of making sense of the occurring processes began to appear in theories and concepts, maintaining the arrival of principally new type of society: informational, society of knowledge, society of risk, etc. Most of the authors of these theories consider to be reasonable opinions about beginning of convergence epoch, which introduces new 'rules of the game' not only to technological, manufacturing sphere, but also to social, cultural, existential.

Though the term 'convergence epoch' doesn't appear in the theories of society, but the definitions of convergence, convergent technologies are present in whole range of conceptions of modern society. Science knows such form of disciplinary integration of knowledge, as interdisciplinarity, pluridisciplinarity, multidisciplinary, polydisciplinarity.

The beginning of the 21st century was marked by a new form of integration-convergence, which during the process of science and technologies development, has become comprehensive and wide-spread, that it can be

called convergence phenomenon. Though convergence became well-known due to so-called NBIC-convergence- convergence of nanotechnologies, biotechnologies, informational and cognitive technologies, nevertheless, it should be mentioned, that it appears spontaneously, in all spheres of science, technologies, society [1]. Convergence provoked widest resonance in scientific circles and society, became dominant factor of development of science, technology and society itself, has achieved prevailing role in processes of interaction of science, technology, human and all society in whole.

Convergence, being accidental, appears suddenly in different spheres of society, for example, in science, technologies, education. Due to convergence special phenomenon of 'technoscience' appeared, detecting it in merging of science and technological applications. Such convergence can be called convergence in the narrow sense. It represents special, new form of interaction separate objects within one field of activity, for example, convergence of scientific disciplines or convergence of technologies. Convergence in the wide sense represents interlocking, interaction and interpenetration of different spheres of the society, which results in appearance of new synergian effects, leading to rapid transformations of scientific-technological and social development of society, provoking, finally, not only scientific-technological progress, but dangers, risks of the human civilization existing.

Thereby, appearance of convergence had caused a range of problem situations, which were not shown before. A problem becomes detecting of position and value of convergence phenomenon as fundamental basis for modern scientific-technological and social development. In view of the foregoing, there is a strong need of detecting genesis, reasons, mechanisms of appearance and significant impact of convergence on science, technologies, society and human, understanding of such impact and revelation of convergence mechanisms of science, society and high technologies.

Fundamental changes, happening in the relationship of science, technics and society, in correspondence with scientific policy of the state, efficiency of science in all spheres of society become the subject of research-on-research, determined as a science about science. It is a complex discipline, which studies all sciences. Science concerns all sides of the life, useful and harmful for the human. But according to A. Rakitov, 'achievements of the science, remaining doubled-edged and being dialectically contradictory, can serve to the mankind being not injurious to the next generations and the environment just with the help of modern research-on-research, without which state, corporative decisions, increase or cessation of financial support of these or those researches, will be voluntaristic... That is why general-theoretical analysis of modern research-on-research is premised by a particular research-on-research study, oriented on salvation of precisely specified problems in the field of high technologies, scientific-technological activity and modernization of scientific-labour potential' [2].

With the advent of convergence, science changes have introduced principally new attitude to the technology, new dynamics of science and technologies relationship, which influences all fields of social reality and introduces opportunity of radical modernization of cognitive mechanisms, which should be conceived in research-on-research aspect. What new is happening in the science due to appearance of technology convergence? What new does it introduce to development of society?

Principally different attitude to technology is connected with development of society during its all stages and among the others, with dynamics of scientific-technological development of the modern society, which was accompanied by two contradictory processes-uniting and disuniting, convergence and

divergence. The modern stage of world history is characterized by intensive scientific-technological development of society, which, undoubtedly, defines convergence problem urgency. If previously convergence process was characterized by stability and steadiness and was realized through traditional uniting technologies, approved by some generations, modern social process of globalization, technization and informatization demand qualitatively new strategies and tactics of merging, taking in account all diversity, difficulty and multidimensionality of modern changes, from human and social institutions.

Since the end of 20th century convergence has become the dominant factor of dynamics of society and all of its subsystems, which draws separate developments of subsystems, elements and society institutions together, encouraging formation of single integrated system of science, technologies and society.

Thereby, actualization of convergence problem of science, technology and society, is, directly, specified by scientific-technological changes and social factors of nowadays. Globalization and informatization of society life should be marked among them and, as consequence, began in the end of the last century and persisting to present day, intensive changes in all spheres of life, possessing truly radical character.

Theme of the study is also actualized by the fact that scientific-technological changes, convergence process were the dominating idea of which, became the necessary condition of society development, due to both the laws of society development and universality of convergence mechanism, which preserves and broadcasts human experience, new social practices and among them convergent.

Thereupon, especially relevant becomes the problem of the internal interaction of technologies and science and external convergence of society, science and technology, business and manufacturing, which would fully correspondent the conditions of the modern world.

Gnoseological factors, determining the urgency of the given topic, first of all are connected with the weak theoretical readiness of the problem introduced, poor knowledge base of the experience and current practice of convergent processes under the conditions of transformation of modern science, technologies and society and with weak methodological elaboration of cognitive instruments and learning means of historical processes of joint development of science, technologies and science.

The main part. Solution of the set problem cannot be achieved just within the philosophical analysis. Gnoseological and social factors, listed above, allow to say that convergent problems are among the most relevant topic and aims of the modern science and philosophy. However, not only complex and integrated philosophical comprehension of convergence phenomenon as a factor of development of modern scientific-technological and social development, reflection upon its formation prospects, social and anthropological consequences, is needed, but also high-professional research-on-research analysis, which is a necessary condition for understanding the modern stage of scientific-technological development, trends of modern society development and working out state decisions contributing them.

There are a lot of philosophic works about science, philosophical school about science, discussing on its essence, ideals, norms, valuables. However, they are weakly oriented to the modern problems solving, solving of practical tasks of designing, projecting, managing, etc. Academic character of such studies is related to research-on-research (A.I. Rakitov), to the stage, previous to the modern research-on-research. On this stage science can be compared with the Babylon Tower. Going upward the steps of the scientific-technical revolutions to the sky among ecological alarms and global dangers, it is not prohibited to forget about the biblical scenes and its most disastrous interpretations: archaic ends up with Babel and the builders give up their original mission-get to the sky, to God. Nowadays there is an understanding that it is hardly possible to get to the sky, ascending the steps of scientific-technical revolutions. Nevertheless, Babylon Tower symbolizes revolution breakthrough to the future, significant shift, revolution. In order not to repeat the fate of its precursor, remain it unfinished, it is ought to build on the basis of the new integrated, nonsegmented knowledge, which can change the 'geometry of building' from vertical to horizontal, from hierarchical organization to network one. Communicative networks-visible and cognitive networks-invisible tie different scientific disciplines, organizations, problem fields, create scientific communities and the science itself.

'Meta-science', super-science, which let uniting problems of the science in whole, without interdisciplinary dividing, is necessary. For a long time functions of such a 'meta-science' were carried out by philosophy. Nowadays just philosophy is not enough, because a large

class of tasks, connected with complicated systems, for solving of which knowledge, related to different monodisciplinary sciences, are simultaneously, needed, appeared through synthesis of science, technologies and manufacturing. Nowadays, in such cases definitions of 'complex research' and 'interdisciplinary research', related to the period of transit, shift, adjusting science from monodisciplinary to polydisciplinary, are used.

Analyzing the scientific knowledge changes, explorers talk about formation of communicative science, holistic paradigm of science. While studying historical development logic of every civilization type, science marks out the main sociocultural regulating mechanism or configurators: cumulation, divergence, adaptation, synthesis, selection and convergence. Each stage of development of civilization, culture, society, has its own regulating mechanism. Philosophical analysis marks out a group of conceptions, which is characterized by uniting tendencies in the scientific-technological development of society and sober and considered approach to social consequences of scientific-technological and informational revolutions. Works of O. Toffler, V. Masuda, A. King, E. Laszlo, M. Castells and others, appeared in the beginning of 1970-th, are among them. They regard the scientific-technological development in the relation with social development as panto-civilisation process, provoking both positive and negative consequences and problems.

Holistic approach to society represents as an important feature of E. Toffler's conception [3]. In his own conception of 'bifurcation century' E. Laszlo pays attention to definition 'holistic alliance' he had introduced. He sees the features of a new revolution, firstly, in integration of sciences about nature and society, holistic alliance of science, technologies and society; secondly, in increasing social significance of science; third, in making out dynamics of the evolutionary process of the modern society [4].

The author of conception, who was one of the first to pay attention to the phenomenon of increasing convergence in the modern society, was Manuel Castells, competent thinker and researcher of the modern world. In the book 'Information Age: Economy, Society and Culture' (1996-1998) he pays attention to existing of complicated relation of technologies and society: 'My observations show that there is difficult interaction between technology, society, economy, culture and policy, which transforms the world, but not necessarily

improves. This entirely depends on us, how we, people, use these technologies and adjust them to our needs, our dreams, our projects in particular life conditions in every society and for every person'[5]. The sensemaking factor of the new world, in opinion of M.Castells, was the new technological paradigm, built around informational technologies. Through this paradigm he studies transformation of 'material culture', which is characterized by pervasiveness that is penetration to all fields of human activity not as an external source of impacts, but as a material, which such an activity is woven into. Moreover, in contrast to any other revolution, the core of transformation, which we face today, is connected with technologies of information processing and communication' [6].

M. Castells includes genetic engineering and all its achievements and application, into the field of informational technologies. Possibility of such unite he sees in the single basis of genetic engineering and informational technologies, which is confined in single processes of decoding, managing and reprogramming of informational codes of living substance. Even in 1990th approachment and interaction of biology, electronics, informatics occurs. At that, this approachment, which can be called convergence (from Latin con-together and verger-get closer), occurs at different levels: conceptual approach and practice results in the form of inventing of new materials.

The views of M. Castells, represented above, introduce revolutionary point of view at convergence as mechanism, configurator of society development, intertwined into one wholeness by technological and material culture. To opinion of Russian philosopher V.Arshinov, M.Castell's views allow to divide history in two periods: pre-castell epoch and, beginning since the middle of 1990-th, post-castell epoch [7]. His contribution consists in the fact, that in the middle of 1990th he paid attention to the phenomenon of 'increasing convergence of particular technologies in high-integrated system, in which old isolated technological trajectories becomes literally indistinguishable'. At the same time, he noticed that 'technological convergence is increasingly spreading on rising interdependency between biological and microelectronic revolutions, both materially and methodologically' [8].

Two last decades of the 20th century were marked by continuing of convergent processes around the informational technologies core in the field of new materials, sources of energy, medicine, manufacturing

technics, including nanotechnologies. Moreover, current process of technological transformation is expanding exponentially, because it is able to create interface between technological fields through common digital language, by the means of which information is created, stored, extracted, processed and broadcasted.

The further development of methodological aspects of convergence occurs in the works of philosopher and sociologist of science Helga Novotny [9]. In 2005 Helga Novotny introduced definition of emergent interface into everyday life. The situation of 'sudden meeting' of different fields of knowledge determines the situation of emergent interface appearance.

The modern epoch has shown that cardinal changes happen not only within the science, but in the relations of science, technic and society. Thomas Kuhn in his famous book 'The Structure of Scientific Revolutions' represents science development with the help of definition of paradigm. Pre-paradigm stage of 'normal science 1' with appearance of new important invention, experiment, theory, which don't fit the dominant theories, demands new theories, new science, changing the 'activity pattern', which is called paradigm. Thereby, a new stage of 'normal science 2' appears and transition from the old paradigm to a new one, which T. Kuhn calls 'scientific revolution' [10].

The definition of paradigm settled down so much in the scientific knowledge that went far past the boundaries. A. Rakitov notices: 'for the last half a century in scientific, science-based and even antiscientific literature the definition 'paradigm' (Greek-example, pattern, evidence) became wide-spread. It is employed to the point and not the point, but it's just half of the problem. The problem is not even in the fact that it creates an illusion of scholarship, but that most often it generates visibility of scientific content and understanding. This definition has become not just wide-spread, but to a certain extent even harmful cliché' [2].

Convergence of science and technologies is a principally new phenomenon, consisting of merging of scientific and technological knowledge. A problem appears: is it possible to study such a complicated system of scientific and technological knowledge, which is not monodisciplinary, as interdisciplinary and to employ paradigmalconception to this system. Answer to this question can be given just by modern research-on-research, sharply contrasting with protoresearch-on-research.

Firstly, interdisciplinary research are related to such class of events, which are at the junction of different sciences and can be studied simultaneously by different monodisciplinary sciences. With this approach the analyzing phenomenon remains 'between sciences'. Secondly, definition of paradigm originally was employed to interdisciplinary knowledge and, cannot be transferred to polydisciplinary knowledge without sufficient ground. Research-on-research, representing form of self-consciousness of science, instrument of its studying, represent apparatus for studying of complicated systems, used for solving a wide class of theoretical and practical tasks, in the form of special syntagmatic approach. As a part of its arsenal there is system forming principle, called syntagma.

Tasks like convergence of science and technologies cannot be solved on the monodisciplinary basis. They demand syntagmatic approach and syntagmatic knowledge, different by the origin and contents, but oriented exactly on the given type of tasks. Syntagma (ancient Greek-'co-order') is a multivalued term, which is translated as classification, systematization, composition, distribution. Such knowledge, based on the complex of heterogeneous scientific, engineering and technological sciences, allow to convert cognitive tasks to constructive and projective aims of creation of new classes of systems and technologies and managing of social processes for solving dangers and conflicts undesirable for society.

CONCLUSIONS

Convergence of science and technology are related to syntagmatically built sciences, including different types of knowledges. Studying of such polydisciplinary system demands research-on-research and syntagmatic approach to convergence as to sophisticated building, based on synergian interaction of monodisciplinary sciences and technologies.

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