The Conceptual Bases of the Scientific Direction "Technosphere Safety"

I V Aladyshkin¹, S V Kulik¹, S V Efremov¹

¹Higher School of Social Sciences, Peter the Great Saint-Petersburg Polytechnic University Organization, 29, Polytechnicheskaya str., St. Petersburg, 195251, Russia

E-mail: i-bez@yandex.ru

Abstract. The paper is dedicated to the analysis of the conceptual foundation of the research area "Technosphere Safety". It analyzes the conditions under which the ideas were formed in the Soviet past and the circumstances of their convergence with the field investigating the issues of hazards and threats. The authors conclude that the current situation in exploring the problems of safety relates to concrete historic dependence of renovation processes taking place in the post-Soviet scientific space. The evolution of the system of scientific knowledge connected with the integral research area called Life Safety (LS) is studied separately. This study shows that the conceptual grounds of the research area "Technosphere Safety" lie at the confluence of diverse trends and attitudes towards technical reality, qualitative rethinking of the nature of hazards and risks of technogenic society, and some attempts to renovate the system of training safety experts. This combination has brought about many contradictions and problems in today's condition of the theoretical foundation of technosphere safety issue

1. Introduction

The work on developing the new research area "Technosphere Safety" started in 2004-2005 [1]. In 2006 the first issue of the scientific-methodological and information journal "Safety in the Technosphere" was published, and in 2013 the electronic and print journal "Technosphere Safety" was started by Ural Institute of State Fire Service of the Russian Emergencies Ministry. It was also the time when scientific schools related to technosphere safety were formally set up. An example can be when the Ministry of Education and Science in 2007 recognized the scientific-philosophical school of socio-natural research of forming global technogenic (industrial and post-industrial) society and technosphere, its effect on the biosphere and the earth, which started on the basis of the Bryansk regional department of the Russian philosophical society.

"Technosphere safety" was formally established as an area for training specialists in the field of labor safety, industrial safety and minimization of technogenic influence on the natural environment in 2009. At the same time this field of scientific knowledge was addressed at the governance level with a number of programs related to ensuring human safety in the technosphere [2]. Yet, the key ideas of the theoretical and practical components of technosphere safety were put forward much earlier.
2. Originality and scholarly importance of the topic with brief literature review

National researchers have made some attempts to develop the theoretical-methodological ideas of this research area. However, no single or solid concept has been framed. There is no definition of the term "technosphere safety" in dictionaries, encyclopedias or reference books. The key category components of the research area - technosphere and safety - are very multidimensional. As a result, there is an open question about the limits of the technosphere and, consequently, about the sphere of safety and about the object of safety itself.

In the national historiography the content characteristic of the term technosphere and related notions have been addressed many times [3, 4, 5, 6, 7]. Despite the fact that the term technosphere has become spread primarily in the national scientific space, western researchers also contributed to defining it in a more precise way [8]. However, apart from a rare exception, the history of the term did not attract authors' attention [9, 10]. As a result, the causes and circumstances under which the ideas of the technosphere emerged and spread were, for a long time, out of focus even for those researchers who wrote about the development of noxology in Russia.

A similar situation arose with regard to the research area we discuss. In the national literature new trends have been discussed concerning learning and teaching about safety issues [11, 12]. However, the causes and circumstances of establishing the research area "technosphere safety" have not been looked into for quite a while.

3. Problem statement

The current situation in learning about the issues of technosphere safety refers to the history of notions formed about technosphere and circumstances of their convergence with the field in which safety issues are studied. The evolution of the system of scientific knowledge, connected with the integral research area called Life Safety (LS), should be studied separately. The research area "technosphere safety" arose primarily in the course of updating the academic parameters of life safety rather than technical knowledge. It could be suggested that a considerable share of contradictions in the theory of the technosphere agenda was the consequence of concrete historic dependence of renovation processes taking place in the post Soviet scientific space investigating hazards and threats of modern society.

4. Theoretical part

The initial formation of notions about technosphere, at least the corresponding term, traces back to the 1960s, to the period of qualitative changes in the Soviet technical knowledge in the context of high-potential successes of the technological revolution. Initially the term "technosphere" appeared in the Soviet geo-ecological literature, where it got a very simple, at first sight, but at the same time very ambiguous interpretation. A possible example can be one of the first definitions of the term (1963) made by N.I. Kriger and R.K. Sarukhanov: "The technosphere is an active envelope of the planet within the limits of which the force of technology governed by mind is the most energetic geological force." The definition generates more questions than answers. What is the nature of activity of the planet envelopes and how can the energy of geological forces be measured, and, most importantly, what should be understood as the force of technology "governed by mind"?

The first work dedicated to the technosphere with an attempt to introduce a relevant concept was a small popular science book by geologist and popularizer of science R.K. Balandin "The planet is attaining knowledge: The biosphere is the technosphere" (1969) [13]. The popular science nature of the book impacted the narrative, which abounded with quite figurative comparisons and poorly justified generalizations. The initial point of the author was combining the controversial statements of V.I. Vernadsky about the spheres of the Earth with the ideas of technogenic impact of man on the environment and an eclectic range of new notions about technology of that time. But eclecticism did not result in original conclusions, and the technosphere, again, appeared as the environment where technology and technogenic processes acted. Equally, it is very difficult to say something definite about the technosphere judging from the constructions by R.K. Balandin or other writers of those
years. He did not provide with distinctive, specific features (though in a certain combination) common
exceptionally for the technosphere, rather than any other generalizing images of technical reality.

Spreading ideas about the technosphere in national socio-humanitarian studies, especially in the
1990s made the definitions change noticeably. Historic and philosophic literature articulated no less
broad, but more abstract definitions of the term "technosphere", which acted as a synthesis of the
natural and artificial, created by man and sustained to meet the needs of society [14]. Philosophy and
sociology used somewhat different but also abstract interpretations. For example, V.M. Rozin, a well-
known expert in the philosophy of technology, understood the technosphere as a certain "technical
supersystem", determining development and formation of all other technical systems and acting as its
totality, whose development level is preconditioned by the achieved technology and diverse
sociocultural factors and processes [15].

Many researchers do not limit themselves with the sphere of technology. They include in the
technosphere, together with technology itself, the elements of nature which are a direct aim of
applying technical means, i.e. technologically convertible and already converted fragments of nature
(even if partially artificial landscapes) . However, there are also many authors who emphatically
interpret the technosphere as "an artificial nature-free technological world".

Quite a few expert specializing in the related fields of technical knowledge (philosophic-historic,
philosophic-sociological, philosophic-ecological, etc.) strive for specification and elaboration. Such
tendencies reduce, as a rule, to numbering direct technical-technological components of the
technosphere. For example, B.I. Ivanov sees the technosphere as a certain totality of technical means
and types of technology, namely: an area for technology research, creation and operation; converted
and convertible nature; results of technical impact, which are consumed by society; non-designed
antropogenic objects (waste, emissions, etc.) [16]. Another variant of specification is implemented due
to making definitions more narrow. Few researchers limit the definition of the term exceptionally by
production parameters. Then, the technosphere looks, for example, as an area of man's production
activity, aimed at converting the objects of animated and inanimate nature into products aimed at
meeting diverse needs of man. Many specialists accept only a tool and material format of the
technosphere, recognizing it as a certain totality of technical means created by civilization or other
"material means" to convert nature by man.

The only thing which all the authors are unanimous about is the agreement to see the technosphere
as a certain field of technical-technological activity, which proves to be not just a combination of
engineering and technology, but a certain new level of their existence. Then endless variant readings
follow. Moreover, they refer not to details or individual nuances of the definition of the term, but
fundamental grounds of technical knowledge. It is because some of them defend only the material
forms of the technosphere with a unity of technical objects and products of their operation, while
others are inclined to see it as a totality of all technical-technological processes, actions and operations
[17].

Not fewer disputes arise due to the dilemma if we should see the technosphere as implementation
of man's reasonable activity, a certain means to meet his needs, or to consider it a result of more
complex social, biological and technical processes. The authors also disagree about whether to defend
the "artificial" nature of the technosphere and, correspondingly, opposition to natural laws, or to accept
the "synthesis of the artificial and natural", "sections of converted nature". The size of the
technosphere is also disputable: local-regional or global, strictly production or universal (embracing
all forms of human activity). In the recent years there have been doubts about the reality of the
technosphere as a phenomenon - a technical-technological system, available for empirical observation.
Some authors point out that it is more reasonable to consider the technosphere as a model or concept
of the analytical practices working predominantly in the Russian scientific space.

The term "technosphere" in the area learning about safety issues became wide spread in the first
post-Soviet decade. It was the time when the conceptual grounds of this field of scientific analysis and
professional training were being renovated, which was, to a large extent, caused by the wish to
develop a new integration theory and methodology of their study. However, it was not easy to find a
suitable format for them, in particular, a new category expression, which would meet the objectives to integrate the segmental areas studying safety issues and, at the same time, to update the theoretical grounds. This search was largely caused by the drawbacks in the field of knowledge which was attempted to be brought together within the context of the integration research area Life and Safety (LS) [18].

It was expected that LS will be a kind of scientific approach which would unite special disciplines concerning creating and maintaining healthy and safe conditions of human life and activity, and, in addition, the basis for general education in this field of knowledge. In the academic process, LS was seen as a standard humanitarian-technical discipline, generalizing the data on the relevant scientific and practical activity and forming the conceptual-category, theoretical and methodological framework, necessary for studying safety issues.

Meanwhile, the destruction of the single Soviet system studying safety issues and spontaneous attempts to renovate it led to more inconsistencies and contradictions, which started with the reference categories of hazard and safety. The loss of state control, lack of considered prospects of reorganization and a single paradigm for analyzing hazards only strengthened the amorphousness of the general theory of safety, which was turning into a set of inconsistent research strategies. There was no concept that could bring together new methods/means of protection from threats and hazards with the promising development areas of the general theory of their study. So, the notions about technosphere then seemed a suitable format, especially at the beginning of the new millennium [19].

There was a pressing need to adopt the technosphere parameters, since the understanding of the human habitat and the essence of interaction between society and nature underwent qualitative changes in the national science. For a long time the term "environment" was predominantly used to describe the natural conditions on the surface of the Earth, and how its local and global ecosystems interact with humans. But with a growing analysis of technical reality and its role in human life today in the technogenic world, the interpretations of the environment have been changing. The latter one was gaining more and more technogenic features. Recognizing the irrepressible growing of the "artificial" world and pushing out the "natural" factors of its development led to the fact that the environment has been seen as something more than just natural elements. It became obvious that today's man is, most probably, surrounded by a totality of systems of artificial and natural origin.

The technicalization of society, which was gathering pace, and the obvious penetration of technical and technological components into all its spheres determined new technogenic landmarks of safety problem development. However, the changing theoretical and methodological grounds used for analyzing the environment of human life and hazards, generated by technogenic society were not properly considered in LS. Moreover, the old anthropocentric priorities of LS with the former applied nature of understanding technology as a simple tool of human activity contradicted with the new understanding of modern man's environment.

It should be also noted that realizing a considerable share of autonomy and independence of technical systems, preconditioning human life and the surrounding nature, brought about conclusions about direct dependence of social safety on the condition of the world of engineering and technology. As consequence, the agenda was to set the problem of safety of the technical-technological sphere and, correspondingly, to develop methods and means of its protection.

Contradictions with the general theory of safety, new understanding of technogenic hazards and threats and drawbacks of LF as an integral science were the stimuli to search for another theoretical format to analyze safety issues. There was need for other concepts and reference categories, which could connect the previous areas of research and practical provision of human life safety with the relevant conditions and technologies preventing hazards and threats in the technogenic environment surrounding modern man.

It should be agreed that the term "technosphere" was distinctive among other categories.

- The term referred to a common variant of differentiating the planetary envelopes and, at the same time, seemed a new category, not burdened with a set of rigid definitions established in encyclopedia literature.
- The image of the technosphere was comfortably consistent with the intellectual traditions of the national scientific space and with the new understanding of the world of engineering and technologies, and, most importantly, with the important topics of the discourse of safety.
- The presentation of the technical reality surrounding man as technosphere removed the obvious anthropological reductionism of LS. Indeed, the term "technosphere" was a good way to describe the realities of growing technicization of society with corresponding transformations of the environment.
- The technosphere model representing the environment of modern man was seen as a certain limit of generalization, suitable for analyzing both local and global technical structures and sociotechnical safety, in particular, global problems of modern age (depletion of resources or reduction of biodiversity, etc.)
- The range of ideas about technosphere matched the popularity of interdisciplinary strategies, integration concepts and system analysis. The methodology corresponding to them turned out to be focused on learning about individual links of the technogenic environment as elements of the hierarchy of systems of an integral world and its polysystem nature. The technosphere was initially seen not as a certain abstract range of techniques and technologies, but as their integrity with a specific order of connection between them.
- Focusing on integrity and consistency corresponded to the important areas of engineering and technology development of safety systems. The processes of broad automation sped up the integration of life support systems and maintenance of stable operation of the objects of sociotechnical infrastructure.
- The technosphere format of safety is seen as more adequate in comparison with the paradigm of integrated safety and security dominating at the moment. Today, in addition to technical-technological innovations, more active attempts are made to organize integrated safety and security management of territories with single coordination of the necessary bodies, efforts, means, and resources. While in the past safety and security were seen and ensured primarily by their types and directions - military, industrial, information, natural, etc.
- At first sight experts in safety issues stay away from the endless disputes of national philosophers, sociologists, technology historians with regard to the issues relating to the nature and content of the term technosphere. Distance from discussions is ensured by commitment to formal definitions of the technosphere as part of the geographic envelope of the biosphere, affected by technical means and human activity [20]. In some sections of national noxology these definitions can be supplemented by the recognition of the technosphere as human habitat or by pointing at the aim of its appearance, which, as a rule, is a strive for the best correspondence of the environment to the needs of society [21, 22].

The technosphere is considered to be some vague sphere of technology existence or, not a less vague "artificial envelope of the Earth manifesting human labor." It is hardly worth saying that these very obscure and ambiguous interpretations do not provide any clear insight. The above definitions lack attributive qualities and that is the reason why the technosphere cannot be singled out among other generalizing terms, such as technogenic environment, technical reality, etc. The term "technosphere" specified by experts in safety issues do not make it any clearer. As a rule, specifying turns out to be a random enumeration of the components of the technosphere, up to specific technical systems and objects.

Probably, it seemed to experts in safety issues that introducing the term "technosphere" contributes to a certain shift towards new understanding of the environment as well as hazards and threats related to it. It looks that there were also hopes that with the approved technosphere parameters of analysis, the differently directed vectors of studying hazards and threats of technogenic society were going to be better harmonized. However, the hopes for conceptual renovation and a new order still remain hopes to a large extent.

The conceptual grounds of the considered research area, which lack elaboration, result in a striking inconsistency in stating the problems, conditions and objects of safety. Consequently, "technosphere safety" coexists with the "safety in technosphere" and "safety of technosphere." What is actually
meant: ensuring safety in the modern technogenic world, human safety from technogenic hazards and threats or security of technical and technological systems? A similar situation persists with regard to another reference category of the considered research area - "safety."

5. Practical relevance, suggestions and results of implementations
Referring to the history of interpretation of the notions about the technosphere and their convergence with the field of safety issues, it becomes clear that technosphere safety cannot be considered a narrow concept.

This situation generates a reverse motion – strive for clear definitions and rigidly formalized meanings. The need for consistency of interpretations within the theory and practice of safety provision calls for:
- working out a single system of methods;
- formulating a local base of reference categories with a clear formalization of definitions;
- creating a consistent order of recognized concepts of sociotechnical reality;
- developing common philosophic and outlook grounds for understanding technosphere safety.

6. Conclusions
It is worth recognizing that in updating safety issues, the term "technosphere" was picked in haste, having no clear definition or consistency with the theoretical grounds of safety issues. There are reasons to believe that the technosphere format of studying about safety issues was chosen due to a strive to "pull" their common theoretical grounds to the interpretations of the modern state of technogenic society, fixating the terminology distinctions of the relevant technology discourse. The category "technosphere", which became widely popular only in post-Soviet Russia and has very many definitions, maintained a façade of renovated safety issues in accordance with the existing variants of understanding the technogenic nature of modern society.

Currently, for the research area "technosphere safety", it is principally important to renovate and accommodate the conceptual grounds in accordance with the relevant general theoretical models of representing generalized pictures of sociotechnical reality.

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