

Hierarchy of Communications and Cultural Environment of The Global Technogenic Civilization

Oleg Pobol

Razumovsky Moscow State University of technology and management
Moscow, Russia

Georgy Firsov

Federal Research Institute named after A.A. Blagonravov
Russian Academy of Sciences
Moscow, Russia

Abstract—Overview of the evolutionary model of technosphere as a complex synergetic system. Analysis of the structure and hierarchy of the communicative links between its elements. Demonstration of the particular role of science and education system in facing environmental challenges, as well as of the prospects of forming noospheric civilization, insuring the environmental safety of the technosphere.

Keywords—*evolution; technosphere; synergetics, communication; ecology; noosphere*

I. INTRODUCTION

Toward the middle of the past century, the developed nations mostly accomplished forming industrial civilization. In the industrial, agricultural and transport sectors, machines exercised labor-intensive operations, while qualified specialists performed management and intellectual works. The social sphere preserved the actuality of the traditional cultural values such as justice, solidarity and priority of the spiritual over the material. In the latter half of the 20th century, after the computers had been invented, the global industrial civilization achieved its information phase. Mankind obtained a new type of energy – scientific knowledge externalized by intelligent machines (wherein computers exercise the intellectual work), and created an artificial habitat, i.e. the technosphere. In the course of the globalization, a unified information structure of the technosphere management has been formed, including international banking system, the Web and global mass media. Science, associated to engineering by means of the information and communication technologies (ICT), has become the principal productive power and the leading factor of the social life. On the basis of the scientific and materialistic worldview and the rejection of the traditional cultural values, liberal monetarism of the informational civilization has been formed. Techno-economic capacities of the mankind have increased manifold, as well as its polarization, and the social disparity has consequently risen. Meanwhile, the informational society in possession of the intelligent machines capable of converting bioenvironmental items into goods aggressively destroys the nature by superseding it with the technogenic environment. Establishment and growth of the universal technogenic civilization involve an increasing number and raising scope of

technological catastrophes, epidemics, wars and natural disasters, i.e. global environmental crisis' enhancement.

II. ECOLOGICAL PROBLEMS OF TECHNOSPHERE

The principal technosphere development problems are actually related to its environmental threat to the biosphere and mankind. For the purposes of their breaking, the concept of sustainable development worked out by the UN at end of the past century is being diligently implemented, namely: satisfying the needs of the present generation without prejudice to those to come. The concept comprises three components: economical (optimization of the limited resources and implementation of the environmentally compliant technologies), social (preservation of the social and cultural systems' stability) and ecological (protection of the biological and physical natural systems integrity and sustainability). This is presumed to be the way to stop the degradation process of the current long business cycle. Nevertheless, in the context of the free market economy it leads to a slowdown in the scientific and technical development (especially, in the energy engineering, transport, medicine, biology), and to the ethical degradation of the society, without having altered the conceptual orientation of the technosphere processes to supersede the biosphere.

Social and environmental problems of such an extent may be solved on the basis of analysis of the technosphere structure and properties, as well as of those of its integral technogenic systems (TS) involving notions of the systems theory, informatiology, synergetics and other newer sciences. Systemic approach and inferences of the recent decades researches demonstrated the incongruity of the mechanistic paradigm (primary importance of the material substance) of the classic science to the modern realities [1-6]. Synergetic model of the Universe appears as an informational supersystem. It is composed of subsystems united by a general goal (idea), interaction algorithms and functional environment (of ergo-informational and material substances), and represents living and rational Universum.

III. TECHNOGENIC SYSTEM AS THE BASIC ELEMENT OF TECHNOSPHERE

The TS resulting from the scientific and technological progress represent complicated self-developing man-machine complexes, which mutual communicative links insure interchanging energy, materials and information with the environment. They process the biosphere's energy and substance into consumer goods and scientific knowledge. The TS fundamental distinction from the natural organisms consists in the opposition of regularities of their interaction with the ecological factors. For them, the limiting factor principle turns into the initiating agent one, the tolerance rule – into its opposite, i.e. into the principle of the unlimited enhancement of the stability bounds. By the principle of feedback, each improvement of the technogenic system increases its negative impact over the nature: this is how it was initially programmed. These properties of the technogenic systems strengthen in the course of the evolution: the ecological niche of their technosperic habitat expands, the level of ecological problems rises due to the toughening of the existing ecological factors regimes for the natural organisms. For the socium it means dependency over the machines environment under the control of a unique center, and increase of polarization: the society divides into the “machines owners” and the service staff, whereby the TS become progressively independent from the socium due to the increasing growth of automation, i.e. they display mentality and anti-tolerance to a still greater degree.

Industrial and nonindustrial TS are nonlinear dynamic open-type systems which principal properties manifest themselves in the self-organization of a complex hierarchical structure ordered from the higher to the lower level. The process of self-development is characterized by the polycyclic change of steady-state correlation forms comprising bifurcations and fluctuations and being accompanied by the developing organization of the systems. Self-organization is a manifestation of the rationality of non-organic and organic structures [1-3]. The synergetic paradigm considers their evolution from the perspective of the general rules of self-organizing systems operation, the future capacity of forecasting their behavior and their parameters' management in process of evolution. Permanent time-stable internal factor of properties in terms of the continuously changing environment conditions and communication relationships represents the common characteristics of the self-developing systems.

The synergetic technogenic systems fundamental properties, with due consideration of the features reliant on the existing automated machine components, are as follows:

- ♦ Mentality – rational living system conscious of the aims and essences at its level, each having its own control center defining its evolution vector.
- ♦ Anti-tolerance – aiming for the infinite extension of the stability limits through the displacement of natural objects of the functional environment.

- ♦ Hierarchy principle – each studied dynamic system represents an element of a higher-level technogenic system setting its objective, whereas the subsystem consists of multiple subordinate elements.
- ♦ Integrity – conceptual irreducibility of the system properties to a sum of qualities of the constituent subsystems, whereas the newly formed unity always exceeds the totality of its constituents, which sets forth the potentials of the hierarchy highest levels.
- ♦ Structuredness – primary relationship between the system properties and its structure, i.e. the dynamic relations network of the constituent subsystems (social included).
- ♦ Permeability – permanent exchange of energy, materials and information with the environment, whereas the system forms and demonstrates its properties through the process of rational interaction with the technosperic environment consisting of nonequilibrium dynamic systems of various levels, the environment factors playing the determinative part.
- ♦ Non-equilibrium and non-linearity – immanent to all evolving systems, spontaneous creation of the new local entities, modification at the macroscopic level, development of the new properties for the technical objects, stages of self-organization and fixation of the new properties of the system, whereas:
 - in the nonequilibrium states, bifurcational mechanisms of the existing short-term furcation points in passing to one or another relatively long-term system mode (attractor) operate;
 - nonlinearity demonstrates itself by the distinct disproportion between the input and output signals, whereas an infinitely large response may correspond to an infinitely small impact.
- ♦ Corporativity – under the nonequilibrium (extreme) conditions, an element observes the whole system and adjusts its behavior not only with the nearest, but also with remote elements pertaining to divers hierarchies, whereas the educational and ethic levels of the respective hierarchies' specialists prove to be of a particular importance.
- ♦ Similarity, determining the analogy between the objects of various hierarchies, whereas each object reflects and latently concentrates all the information on the ambience.
- ♦ Cyclicity and dimensionality – each object moves and develops under the harmonic rhythms of its own level, as well of the higher ones'.
- ♦ Polarity – simultaneity of the processes of development and degradation of the objects of technosphere, action and reaction.

IV. MODEL TECHNOGENIC SYSTEM AND HIERARCHY OF COMMUNICATIONS

Technosphere may be characterized by a complex hierarchic structure of the industrial technogenic systems placed in ascending order, starting with the primary rank: machine; workshop; enterprise; industry sector; industrial production, national and transnational corporation,

technosphere in general. Also it includes nonindustrial systems of the analogous structure (fig.1).

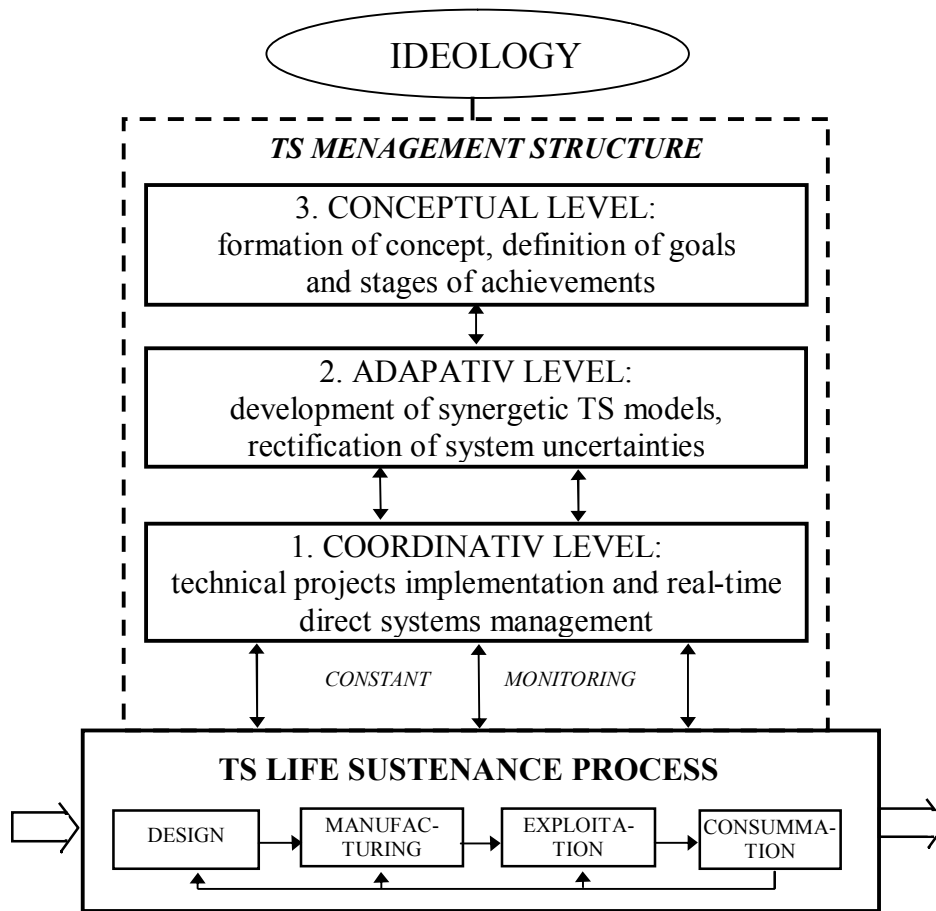


Fig.1. Block model of the technogenic system and its management structure

The object's hierarchical structure (TS) appears as a consequence of the development process, resulting from the complex synergetic systems multivariate behavior. They develop in the context of openness, ab extra inflow of energy and information, nonlinearity of the inner processes and the existence of several steady-state conditions. In a generalized sense, the TS evolutionary dynamics manifests itself through four phases of life sustenance (ref. fig.1), related to conceptualization and designing of products, technology, material and equipment; technological equipment manufacturing; equipment exploitation and manufacturing technological materials and products; product consumption and waste recycling, with the assistance of four levels qualification specialists.

Within the TS informational environment, a three-level management structure appears, maintained by the specialists of corresponding qualification:

- ◆ Conceptual – strategic level (3rd ♦ highest) – project conceptualization, defining the goals and phases of achievement;

- ◆ Adaptive – tactic level (2nd ♦ medium) – development of the technogenic systems synergetic models, synchronization and rectification of the system uncertainties within the systems life sustenance;
- ◆ Coordinative – operational level (1st ♦ lowest) – technical projects implementation and real-time direct systems management.

Such management levels exist in the separate techogenic systems, as well as within the technosphere in general.

The TS model within the technosphere management environment, i.e. informational matrix of the system, in an extended sense, may be described by a generalized cognitive equation

$$S \rightarrow [Z, Str, Tech, Econ, Fin, Evol, Bio, Tes, K] \quad (1)$$

whereas *Z* – totality of goals; *Str* – totality of structures (manufacturing, organizational, social, etc.) for the goals achievement; *Tech* – totality of technologies (methods, means, algorithms, etc.); *Econ* – totality of economic factors and methods of creation, functioning and development; *Fin* – complex of methods and informational and communicational technologies of the financial sector; *Evol* – complex of evolutionary states of the system; *Bio* – totality of factors of interaction with the biosphere; *Tes* – summary of knowledge and percepts of adequate specialists on the proper system and environment; *K* – percept of the system within the consciousness of a particular researcher (observer).

V. CULTURE AS A MAJOR COMPONENT OF THE FUNCTIONAL ENVIRONMENT

This mental model is such a real form of existence of an object in the informational space as its materialization in the real space is. The meaning of the equation (1) fully reveals itself at the highest TS hierarchy levels, whereas the ethic position of the socium elites is crucial. Mental and ethic orientation of the society defines the vector of its development.

The communication links hierarchy of the 2nd and 3rd levels of management maintains the power vertical of the social elite – of the «automated machines masters», whereas the automated TS local projects implement themselves at the

coordination level of management. At each phase of the life sustenance of TS and corresponding levels of management, specialists deal with the simplified models of processing facilities, representing a particular case of the equation form (1) by its separate information units, as

$$Y \bullet R[Z, X, X^*(Y^*), Tes, K] \quad (2)$$

whereas *Y*, *X* – the system input and output signals; *R* – reflection operator of the system as a technical object; *X** – the input signals self-assessment depending on the expected result *Y**. The equation form (2) depends upon the target goal, the *Tes* thesaurus of the system and the *K* position of the operator-researcher.

The system thesaurus and the operator’s position, i.e. summary of knowledge and percepts of the specialists, and modules of proper systems of the automated management and design, over the object and the environment, characterize (within the system structure and properties with its reflection operator *R*) the behavior of the system. Whereas, the functional system – technosphere represents a supersystem vis-à-vis the treated technogenic system (fig.2).

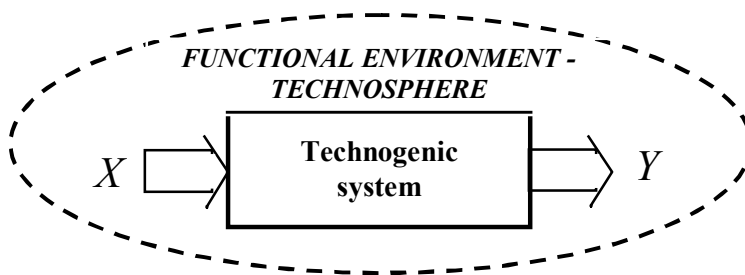


Fig.2. TS and its functional environment, whereas *X*, *Y* – multitudes of input and output signals

With its integral management structure, the TS self-operates and self-develops in accordance with the target goals and the thesaurus’ knowledge obtained from the higher hierarchies’ systems, as well as from the surrounding functional environment.

As aforesaid, life sustenance of the technosphere as a whole, and of its hierarchical subsystems, should be conceived as a realizable conceptual project of globalization. This is a complex of plan-coordinated and managed processes intended for the achievement of the target goal and restricted by time, resources and financing meant for attaining the required results. The important part of the project is creation of the tolerant pluralistic culture upon the standards of the western civilization superseding the traditional ones. Thus, the conceptual orientation of the leading elite of the socium (3rd level of management) represents the crucial factor thereof.

Within the framework of the actually implemented project, for the purposes of maintaining the technosphere, a consumer society is being formed, separated from the elite by the functional environment of automated TS. Due to the advancing automation of TS, this breach extends, while, within the technospheric paradigm, the majority of mankind has no commercial value.

As an estimated figure for the quality of a solution, we may consider the probability of compliance to all the required

$$K \bullet \prod_{i=1}^n P_i$$

conditions and specifications: $\rightarrow i$ – relative importance of the *i*-th requirement; P_i – probability of realization of the *i*-th requirement. The decisive resolutions are taken at the highest hierarchical levels whereat, in the context of the liberal

ideology, the relative importance of the ecological and social factors is minimal, compared to the economic ones’.

Money play specific role in the technosphere management involving ICT. At the lowest operative level of management, these are traditionally universal commodities – the expenditure extent, means of payment and saving. They maintain the horizontal communications in the course of the TS projects implementation, as well as the functioning of the sphere of goods and services consummation. At the highest and medium management levels, those are virtual finances maintaining the vertical power communications of the global banking system, as well as definition of directions and scope of implementation of the technosphere development globalization projects.

The existence of the vertical management structure under the liberal ideology of market economy spurs involution processes within the technosphere, increases geopolitical and social polarization, aggravates ecological problems and leads to an environmental collapse. There is no solution to the ecological problems of the technosphere at the technology level $\bar{\kappa}$ they require the noospheric ecological reformatting of the public consciousness, the education system and creation of the new cultural environment.

The operational sequence is determined by the goal decomposition tree for various hierarchical levels. At the same time, goal decompositions may remain non-specified, which requires, for the purposes of the results optimization, the synergetic interaction of elements and subsystems, as well as cognitive exploitation of the thesaurus and the environmental factors. Thus, the level of education and ethics of the specialists maintaining the inter-hierarchical feedbacks becomes particularly important – the major part of the GDP of the developed nations is being formed within the intellectual environment. The education system represents to the informational civilization one of the major branches of industry: production of specialists for automated TS of various levels.

VI. CONCLUSION: PROSPECTS FOR CREATION OF THE NOOSPHERIC CIVILIZATION

Fractality, i.e. self-similarity of the system and its integral parts, is the fundamental property of the global Universum being an infinite and everlasting, living and rational super-system, ensuring instant and accurate data transmission between the structure levels with various coefficients of concordance. This ensures the optimal mode of the system functioning provided by the state of inner harmony, which results in permanency within the given constants space of the universe. Within a harmonic mode, systems of various hierarchical levels operate in the manner of interaction and coherence. Disruption of the harmonic integrity with the higher hierarchies manifests the structure splitting in the course of transition to a new phase of the evolution. Harmonic interaction restores at the bifurcation points (critical state of the socium).

As a baseline for the implementation of the noospheric developmental variation, one should consider the general paradigm of the all-encompassing unity of the corporeal world and the informational world of ideas, maintaining the coevolution of the transformed socium and the Universe within the framework of the noospheric civilization [7]. Ecological transformation of the consciousness and formation of the system mindset and respective ideology of the cooperative interaction and rational self-confinement represent the basis for such a transition. On the whole, it refers to the reconstruction of the world noospheric culture in accordance with the national traditions.

The technosphere development should be oriented onto the implementation of this process, whereas continual formation of a new type is the main production method [8]. Informational energy being obtained, the noospheric science will create the basis for the ecological culture which restricts the machines exploitation and guarantees the utmost personal self-development within the noospheric civilization. Under such conditions, procreation of an educated, ethically and physically sane humankind is the goal of the economy based on the new systems of education and science; ecological expediency represents its efficiency criterion. Thus, the global technosphere environmental safety issues may find their solution in the ideology of the system mindset, and not in the industrial technologies.

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