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The Man on the Border of the Potential and Actual: the Performance of Knowledge, Technology of the Second Order

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Abstract

The question of the necessity of a new model of scientific knowledge and new models of technological development came to us in the process of developing and implementing a number of projects in machine-building and instrument-making. In these projects the necessity has arisen to introduce a new component of technologies, which enables the control of accessible complexity. Technology with such a component use knowledge about knowledge, which we call knowledge of the second order. These technologies work going on at once in the several modalities: the modalities of production and modalities of the internal organization of the man and his knowledge. These technologies include elevators through the rapids available to the complexity of knowledge. Technology with such a component we call the trans-modal technology or the technology of the second order. These technologies open up new opportunities of the person not only in the development of production, but also in the humanities and social practices.

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1. Introduction

Crises and disasters of modern development show that the current model of the specialist does not provide solutions to the critical issues of the day. And it is not in the absence of the necessary scientific knowledge. Even the best modern specialist is not able to adequately integrate the rapidly increasing volume of such knowledge. From this point of view, we have already reached the limits of a possible knowledge to the model of a specialist.

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Before our research group we have set the task of developing a new generation of technologies for the transition through this limit of possibilities.

The question of the necessity of a new model of scientific knowledge and new models of technological development came to us in the process of developing and implementing a number of projects in machine-building and instrument-making. In these projects the necessity has arisen to introduce a new component of technologies, which enables the control of accessible complexity. Technology with such a component use knowledge about knowledge, which we call knowledge of the second order. These technologies work going on at once in the several modalities: the modalities of production and modalities of the internal organization of the man and his knowledge. These technologies include elevators through the rapids available to the complexity of knowledge. Technology with such a component we call the trans-modal technology or the technology of the second order. These technologies open up new opportunities of the person not only in the development of production, but also in the humanities and social practices.

Let us consider the question about the introduction of such technologies.

2. Technological standstill current model of scientific knowledge

The Russian Academy of Science is the system of institutions, which work on the border of the possibilities of modern knowledge. It has the best Russian scientists. But even with the best experts we go out to the limits of the possible for them the complexity of knowledge. It becomes a constraint for technological development. We begin to realize that the current model of formal scientific knowledge and implemented in it the reduction of complexity do not meet the requirements of the new conditions of technological development. We constantly encounter with what could be called of irreducible complexity.

Here are a few examples.

My research on robotics and engineering I started in 1975. While on a business trip at the factory, where it was created the first in the USSR industrial robot, I found the lack of theoretical models of mechanics (mechanical engineering research Institute of the Academy of Sciences of the USSR) and the information management theory (Institute of problems of management of the Academy of Sciences of the USSR) for the description of the selected me phenomena of robotics. In these experiments, the accuracy of operation of the robot exceeded a theoretical possibility. This opened up completely new opportunities of the development of robotics.

I reported on these observations, the Director of the Institute of mechanical engineering of the Academy of Sciences of the USSR. He appreciated these preliminary results, as the future of the opening.

I started to analyze the mathematical foundations of mechanics of machines and information management theory. Here I first discovered that even the greatest scientists are not able to work at once with several modern mathematical theories. All they restricted the complexity of their designs, which led to erroneous constructions and conclusions. In the robotics this led to a complete shutdown of the most important features of the development of this class of machines. These works were unclaimed.

Following this experience, I was working with a new computer complex, which was created in the Institute of problems of management of the Academy of Sciences of the USSR. Expected me opportunities of this complex were destroyed by software developers. Here again the group is very strong professionals could not work at the appropriate level of complexity. This is now limited the possibilities for the development of new architectures of computer technology.

The collapse of the USSR showed that such a situation braking of development of high technologies are taking place in all branches of science and practice.

3. Trans-modal economy

Competence of scientific knowledge is determined by its adequacy for decision-making. When the specialist does not cope with the situation, and when disaster strikes, we blame the specialist.

Many years of our observations show that there is a ceiling complexity of the knowledge available to a modern model of a specialist. We also constantly discover that the difficulties encountered in various fields, cannot be reduced to this level of the existing model of a specialist. We constantly meet such irreducible complexity. All specialists conduct reduction of complexity to the level available to them. However, even the best of them do not use the expertise and knowledge of specific technologies to enhance the available complexity. Ability to work with the complexity they consider innate. As a result of these reductions, even the best experts take wrong decisions. These are permanent disaster because of the incompetence of the existing model of a specialist.

We have studied the problem of formation of the knowledge economy. We have linked this issue with the problem of the abilities of an expert to work with complex knowledge.

This ability we have identified as a component of human capital, without which there is no transition to a new technological system of the 21st century. We have identified the technologies of knowledge management as the basis of scientific knowledge. This was the development of humanitarian (human-dimensional) technological bases of post-non-classical science (project of the Institute of philosophy, RAS "Philosophy of governance in the world of complexity") and the beginning of the formation of a new sector of high-tech humanitarian production - preparation of specialists, which greatly exceed the present day model on its efficiency.

High technologies of production could not be separated from the high humanitarian technologies of education and science. Only together they form a modern trans-modal production. A considerable lag of technologies of education and science lead to a disastrous mismatch of the abilities of the expert and the complexity of the production. Education does not produce the necessary number of specialists able to solve complex tasks. In this complex high technology begin to determine the modern production. A significant part of the world production is not provided by the specialists of the required level. This creates a permanent risk of technogenic accidents.

We introduced the concept of trans-modal knowledge economy [1, 2]:

explores the resources of production of the vital worlds of man and society (carried out in a multitude of social, economic, cultural, spiritual, psychological, legal, educational, etc. modalities of individual and social being);

defines the complexity of as a factor, on which depends the efficiency of the economy;

highlights the complexity of the trans-modal structure of knowledge;

defines thresholds complexity of the development of such production;

detects and generates a group of technologies of trans-modal crossing of such thresholds;

considers the issues of modern convergent technologies development, where the high humanitarian technologies of knowledge management play the role of the elevator through such thresholds.

4. The limits of knowledge. Second-order technology and new cultural patterns of life

The rapid development of communication at the turn of the 20-th and 21-th century, radically changed the idea of people about possible for them cultural samples life. The problem is: how and due to what resources the person can move its potential opportunities in the space of actual individual and social being.

The productivity of knowledge had been allocated to us as a resource. We looked at the issue of technological maintenance of this resource. It is easy to see that the ability to obtain results (performance of the same formal knowledge in obtaining on their basis of life results and production results) in different individual and group subjects may differ literally by several orders of magnitude.

This example arose in the summer of 2011 in our work with the materials of the Unified State Examination (USE) on a variety of subjects, from which the mathematics is the most convenient for analysis revealed here new goals and values of education.

The practice of school exam in mathematics shows that the individual tasks of section C in 2010 are solved in less than one of the 500 graduates: C1 - 20%, C 2 - 4%, C3 - 1.5%, C4 - 0.18%, C5 - 0, 22%, C6 - 0.16%.

We see that the learning outcomes can be increased by 500 times.

It depends on the formed or not formed a special subject knowledge structure - their internal organization of the individual and group entity. Knowledge is of a personal nature, allows a person to obtain the results on the basis of trust to his sense of professional or life situation (his special perception - perceptual base) and ability to implement effective communication with the world, others and with yourself (his transactional bases).

All of these experiences have taught me that scientific knowledge is closely associated with its internal organization of a human. The factor that limits the available complexity of the knowledge is a well-established (in the science and practice) norm profane control the complexity of knowledge (profane reduction) - without the use of knowledge about knowledge and special humanitarian and social technologies. Limitations of available difficulties lead to the fact that the person psychologically protected from overloads of the psyche of complexity. Man is encapsulated in the reduced-form models of knowledge, familiar and available to him. Even in case of serious threats (Chernobyl, the collapse of the USSR, executing the laws of the Russian Federation), even a very good specialist takes decisions available to him in the complexity of the models, ignoring the difficult knowledge known to him the other facts that contradict the reference model. My further studies were aimed at the study of this structure and its influence on the effectiveness of the work of the specialist.

From Mathematics and Mechanics of machines I switched to psychology, sociology, and philosophy.

We attempted to evaluate the distribution of specialists on the characterization of the available complexity of knowledge. For this we used the statistics of single state exam for secondary school graduates. Here each year there are about two and a half million deployed measurements. These measurements show that only one out of five hundred school graduates can perform tasks of high complexity. There is a system of elite higher education, which focuses on the selection of these outstanding students. The rest study at the accessible them a lower level of complexity of the knowledge. The end result is 0.2% of the specialists, able to work with complex knowledge. Further, these 0.2% of leave in the United States or Europe or lost in the incompetent communities.

Results of our experiments have shown that the ability to work with complex knowledge can be generated when using the developed by us high humanitarian technologies. This group of technologies we call the subjective structure of knowledge. We believe that the number of professionals who can work with high complexity can be increased a hundred fold. We think that such an increase in the efficiency of professionals is a necessary condition for the development and use of high technology and to reduce the risks of technological development.

We offer a wide international project of development of a new generation of high humanitarian technologies of work with complex knowledge.

My position corresponds to the understanding of scientific knowledge, which was formed at the Institute of Philosophy of the Russian Academy of Sciences. In this model, we have to consider the human dimension of science [3]. To view this new dimension, we used the results of philosophy, sociology, psychology, neurobiology, and other branches of science.

We have begun to develop models of different branches of science, including in the human dimension of these models: the mathematics of the second order, second-order computer science, the second order mechanics of machines, psychology, education, law and others. These models include a special knowledge about knowledge, which we call the knowledge of the second order. They also include special kinds of experience: an empirical base, perceptual base, transactional base.

This is a very sophisticated knowledge. This knowledge combines many scientific disciplines. Such knowledge is present in many modalities: formal academic, personal, connected with the peculiarities of feeling, communication, self-awareness of man defined goals and values of man and society.

Everyone understands that his knowledge is built on a certain experience, formed in his special sensitivity and special means of communicating with others and with ourselves. However, this component of scientific knowledge will be given for the brackets of scientific knowledge as not included in this knowledge. We bring back this component in the system of scientific knowledge, as its inseparable part.

The limits of knowledge - it is a problem of modern economic development - the knowledge economy.

Education and science are areas of trans-modal production of this model of the economy. The limits of available specialist complexity of knowledge, is constantly appear as sedation of technological development and the technological catastrophe in all areas of practice. Today we need a more effective organization of knowledge management in education and science.

5. Burova A-V: Neurobiological resonance as humanitarian technology

Observation of patterns of activity in the brain electrophysiological method of determining the intensity of cerebral energy metabolism with the help of the registration and analysis of the level of the permanent capacity of the brain [4] has enabled us to discover the phenomenon of resonance of these patterns in communication. The phenomenon of resonance brain activity in communication we refer to the manifestation of the work of mirror neurons. Our experiences of the use of such a wide resonance as the expansion of transactional bases in education has shown the possibility of a sharp increase of the complexity of the knowledge available to the student.

Necessary volume of knowledge of a specialist is constantly growing. In universities, this leads to the reduction of the hours of training on already available in the program of courses for the introduction of new ones. But it may not ensure the inclusion in the curricula of all new knowledge. The further intensification of training of the existing educational technologies leads to unacceptable overload and a deterioration in the health of students and reduce the quality of education. This gap learning opportunities and the requirements of production as insufficient level of training of graduates of institutions of higher education becomes one of the factors limiting the potential for further economic development [5].

We appealed to the statistics of the CSE as the most large-scale programs of measurement of learning outcomes. Statistics of the unified state examination shows that only a small part of the submitting able to perform complex tasks of the group C. So in 2012, more than 80 points (pass mark in the Moscow state University and elite universities) on the Russian language gained 10.4% of graduates in mathematics - 1,8% [6]. It does not allow the majority of students to master the complex program of education. In the conditions of impossibility of the further intensification of the training, the problem of effective learning is becoming one of the most topical today.

No doubt that such a complex process as the training includes many different components, determining its effectiveness. One of such allocated by us components is a neurobiological resonance. Neurobiological resonance in the process of learning we define as the phenomenon of increase of activity in the brain of a trainee, which repeats the picture of activity in the brain training - resonance patterns of brain activity. Here we rely on some of our experiences of the monitoring activity of the brain in the communications, conducted in the laboratory of Fokin V.

Registration process for the objective of this resonance is now used MRI and PET. These devices are expensive and inconvenient for the study of learning processes. Affordable, more convenient and sufficient for our study is the electrophysiological method of determining the intensity of cerebral energy metabolism by recording and analyzing the level of the permanent capacity of the brain. This method allows us to observe quite sufficient for our purposes a general picture of brain activity in the pedagogical and therapeutic communication - patterns neurobiological resonance.

In our research, we combine the fundamental psychology and applied psychology. These models psychology are built on different methodological grounds. We use the theoretical constructs and patterns of Applied Psychology, its features empirical, perceptual and transactional basis. Here we develop a theoretical construct neurobiological resonance.

Neurobiological response as a necessary component of effective teaching is creating new demands on the learning process and provides an understanding of the need to implement it in a certain way [7].

First, for the emergence of neurobiological resonance, it is necessary interpersonal interaction. It has been experimentally shown that mirror neurons are only triggered during the observation of the actions of biological

entity [8]. Therefore, training solely by computer software manuals and books from this point of view, is inefficient, they cannot replace the teacher.

Second, it is necessary that the teacher actions that he wants to teach, first - as an example of the correct action, and then - with the student. It is in the process of joint action neurobiological conditions for resonance, it is possible to adopt the way of the implementation of this action. For example, in solving the problem, the teacher should be the process of the solution, rather than simply playing the final answer in advance.

Our experiments and observations manifestations of this phenomenon have shown, that in a condition of resonance trainee performs inaccessible to him previously difficult tasks.

We determine that one of the important factors of knowledge management is the activity of the brain. Effective transfer of knowledge cannot be separated from the transfer of the relevant forms of brain activity.

We have identified the phenomenon of direct transmission pattern of brain activity in the communication - resonance patterns of brain activity. We used this phenomenon to prepare for the unified state exam and university entrance. This phenomenon we define as the neurobiological resonance. We associate it with the work of mirror neurons.

These and some other experiments have shown us that a person's ability to work with complexity can be repeatedly improved through the use of high humanitarian technologies. These experiments show that effective knowledge can only be acquired through direct contact with the person in possession of such knowledge. Books and the Internet only complement this communication.

6. Conclusion

Many moments of pedagogical experience are beyond the boundaries of the empirical base of scientific pedagogy. They are mysterious component of the pedagogical skill. They do not become technologies. For the disclosure of hidden and creation of technologies it is necessary to refer to the latest results of science and philosophy. These new results provide the interface required to work with this experience. The proposed transition from screening gifted students to their mass production is a necessary condition of a competent development of production and reduction of the global risk of contemporary anthropogenic development.

Only by common efforts we will be able to cope with the total incompetence and inability of the best contemporary specialists to work with the complexity trans-modal and trans-disciplinary knowledge.

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