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5.2.2. Математические, статистические и инструментальные методы в экономике (физико-математические науки, экономические науки)

О ТЕНДЕНЦИЯХ РАЗВИТИЯ МАТЕМАТИЧЕСКИХ, СТАТИСТИЧЕСКИХ И ИНСТРУМЕНТАЛЬНЫХ МЕТОДОВ ЭКОНОМИКИ

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Для успешного развития науки как отрасли народного хозяйства необходима ее модернизация. В частности, пришло время отказаться от ориентации на устаревшие концепции западной науки. «Биокосмологическая инициатива» обосновывает необходимость перехода на северо-восточный вектор развития. Проанализирована диалектика развития экономики, математики, науковедения. Создана новая парадигма экономической теории - солидарная цифровая (или информационная) экономика. Рыночные механизмы перестают быть определяющими. На первое место выходит стратегическое планирование. Возможности современных компьютеров позволяют на основе расчетов (типа межотраслевых балансов) обеспечить непосредственное удовлетворение потребностей людей и их объединений. Опираемся на контроллинг методов. За последние десятилетия в области математических методов исследования произошла научная революция. В ее ходе создана новая методология, разработаны модели и методы, резко отличающиеся от прежних. В настоящее время между воззрениями прикладников и теоретиков в этой области наблюдаем значительное различие. Необходимо разъяснить научному сообществу существо обсуждаемой научной революции. Центром математических методов исследования стала статистика нечисловых данных, в том числе учет размытости (нечеткости, расплывчатости) реальных статистических данных. Основные идеи научной революции сформулированы в новой парадигме математических методов исследования. Её реализации посвящен новый раздел теоретической и прикладной математики - системная нечеткая

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5.2.2. Mathematical, statistical and instrumental methods of economics (physical and mathematical sciences, economic sciences)

ABOUT DEVELOPMENT TRENDS OF MATHEMATICAL, STATISTICAL AND INSTRUMENTAL METHODS OF ECONOMICS

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For the successful development of science as a branch of the national economy, its modernization is necessary. In particular, the time has come to abandon our focus on outdated concepts of Western science. The “Biocosmological Initiative” substantiates the need to move to the northeastern vector of development. The dialectics of the development of economics, mathematics, and science are analyzed. A new paradigm of economic theory has been created - the solidary digital (or information) economy. Market mechanisms cease to be decisive. Strategic planning comes first. The capabilities of modern computers make it possible, on the basis of calculations (such as inter-industry balances), to ensure direct satisfaction of the needs of people and their associations. We rely on controlling methods. Over the past decades, a scientific revolution has occurred in the field of mathematical research methods. In its course, a new methodology was created, models and methods were developed that were sharply different from the previous ones. Currently, we observe a significant difference between the views of applied scientists and theorists in this area. It is necessary to explain to the scientific community the essence of the scientific revolution being discussed. The center of mathematical research methods has become the statistics of non-numerical data, including taking into account the fuzziness (vagueness, vagueness) of real statistical data. The main ideas of the scientific revolution are formulated in a new paradigm of mathematical research methods. A new section of theoretical and applied mathematics is devoted to its implementation - system fuzzy interval mathematics; many of its algorithms are implemented in the Eidos software system. Currently, three paradigms of mathematical and statistical research methods are actively used - primitive,

интервальная математика, многие ее алгоритмы реализованы в программной системе «Эйдос». В настоящее время активно используются три парадигмы математических и статистических методов исследования - примитивная, устаревшая и современная (новая). Рассмотрены типовые возражения приверженцев устаревшей парадигмы и их психология. Необходимо добиться, чтобы научная основа искусственного интеллекта соответствовала современному уровню развития математических методов исследования, опиралась на результаты научной революции в этой области. Проанализирована диалектика развития способов распространения научного знания, взаимодействия теории и практики. Сопоставлены экспертные и наукометрические методы оценки вклада в науку

outdated and modern (new). The typical objections of adherents of the outdated paradigm and their psychology are considered. It is necessary to ensure that the scientific basis of artificial intelligence corresponds to the current level of development of mathematical research methods and is based on the results of the scientific revolution in this area. The dialectics of the development of methods of disseminating scientific knowledge and the interaction of theory and practice are analyzed. Expert and scientometric methods for assessing contributions to science are compared

Ключевые слова: НАУКА, МОДЕРНИЗАЦИЯ, ЭКОНОМИЧЕСКАЯ ТЕОРИЯ, МАТЕМАТИЧЕСКИЕ МЕТОДЫ ИССЛЕДОВАНИЯ, СИСТЕМНАЯ НЕЧЕТКАЯ ИНТЕРВАЛЬНАЯ МАТЕМАТИКА, НАУКОВЕДЕНИЕ, БИОКОСМОЛОГИЧЕСКАЯ ИНИЦИАТИВА, СЕВЕРО-ВОСТОЧНЫЙ ВЕКТОР РАЗВИТИЯ

Keywords: SCIENCE, MODERNIZATION, ECONOMIC THEORY, MATHEMATICAL RESEARCH METHODS, SYSTEM FUZZY INTERVAL MATHEMATICS, SCIENTIFIC STUDIES, BIOCOSMOLOGICAL INITIATIVE, NORTHEASTERN VECTOR OF DEVELOPMENT

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Introduction

The main idea of the work is that modernization is necessary for the successful development of science as a branch of the national economy. In particular, the time has come to abandon our focus on outdated concepts of Western science. To substantiate specific directions for the modernization of science as a whole, we will analyze the dialectics of the development of a number of specific sciences. Namely, let's consider economics, mathematics, science. Those areas of science in which the author has experience in numerous of his own studies have been selected for discussion.

In the “Bulletin of the Russian Academy of Sciences”, one of the most outstanding mathematicians of our time, academician of the USSR Academy of Sciences and the Russian Academy of Sciences V.I. Arnold, wrote quite harshly: “... The current shameful discrimination of Russian (as well as Indian, Chinese, etc.) scientists by the Western scientific community is causing there is obvious

damage to world science... Recently a new type of slave trade has emerged. My friends - biologists, chemists, physicists - told me that American and European universities invite Russian researchers and pay them pennies (however, exceeding Russian professorial salaries...). These Russian slaves work hard, but the publications are signed not by them, but by the employees of the inviting laboratory. The technology for assigning the results of Russian mathematicians is different, but the result is the same: these results are mostly attributed to Western epigones" [1].

Obviously, for the successful development of domestic science, it is necessary to get rid of groveling before the West and discard outdated concepts.

The "Biocosmological Initiative" put forward by a group of researchers substantiates the need for "a transition to the northeastern vector of development - in order to overcome the imbalances that hinder the successful work of researchers and ensure the possibility of moving to the next level of scientific development" [2]. It was accepted at the 22nd International Symposium on Biocosmology within the framework of the 7th International Conference on Global Studies, Moscow, Moscow State University. M.V. Lomonosov, June 15–18, 2021 Based on the "Biocosmological Initiative", we will show the "reverse (negative, type of pathogenesis) meaning" of a number of trends in the activities of Western scientists, we will highlight the current imbalances generated primarily by the Anglo-Saxons.

Let us analyze the dialectics of the development of three specific areas of science - economics, mathematics, science - and show the need to move to the northeastern vector of development. The presentation is necessarily brief. A number of the author's works are devoted to a detailed substantiation of the put forward provisions, some of which are cited below.

As of 07/05/2024, the Russian Science Citation Index (RSCI) lists 706 publications of the author, cited 18,920 times (Hirsch index 47). The author is one of the most cited mathematicians and economists in Russia. The above

justifies the author’s moral right to obtain conclusions about the development of domestic science as a whole.

The need to transition to the northeastern vector of development in economic theory

The founder of economic theory is Aristotle. Its concept is based on the basic idea - the purpose of economic (in other words, economic) activity is to satisfy the needs of people and their associations (and not to make a profit). He had a sharply negative attitude towards chrematists who focused their activities on obtaining benefits (profits). For Aristotle, there is no doubt that in order to provide for individual and social needs, the state should actively participate in economic life.

Real economic practice corresponded to the views of Aristotle until the era of bourgeois revolutions, when chrematists won and the statement “the purpose of an enterprise is to make a profit” became an “elementary truth.” There was a belief in the miraculous power of the market, whose “invisible hand” makes it possible to organize economic life in the best possible way. Much attention began to be paid to stock markets and financial speculators operating on them.

Obviously, the market economy is the negation of Aristotle's economics. It dominated Europe in the 19th century. But then - in accordance with the laws of dialectics - the negation of the negation began. The state returned to the economy. This was especially evident in the 30s of the twentieth century in the USA and USSR. The theoretical justification for the need for significant state participation in the economy was given by J. Keynes.

Currently, there is not much left of “free market”. Duties and sanctions are applied very actively. The current economy is not a market economy, but a mixed one, in which government regulation mechanisms are combined with market ones. However, the development of economic theory is greatly harmed

by the current imbalances generated by the Anglo-Saxons (often in order to ensure their dominance). In theory and especially in education, market views continue to dominate, which have long been out of step with economic practice. The current problem is to overcome these imbalances and ensure the possibility of moving to the next level of the economic theory of economic practice. A transition to the northeastern vector of development is necessary, in accordance with which, for example, the economy of the PRC, the most powerful (in economic terms) country of our time, operates.

To date, the development of computers and their networks has led to the possibility of active use of the digital economy in business practice. A new paradigm of economic theory has been created - the solidary digital (or information) economy [3 – 5]. Market mechanisms cease to be decisive. Strategic planning comes first. The capabilities of modern computers make it possible, on the basis of calculations (such as inter-industry balances), to ensure direct satisfaction of the needs of people and their associations.

The development of theoretical research in the field of economics and management based on the new paradigm of economic theory and the application of their results in practical activities in sectors of the national economy will make it possible to overcome imbalances in the work of economic structures. We are talking about imbalances caused by the activities of the West, primarily the Anglo-Saxons, who rely on outdated concepts of a “market economy” [6]. We state that a transition to the northeastern vector of development is necessary.

In accordance with the new paradigm of economic theory, modern instrumental methods of economics should be widely used. Among them, it is necessary, first of all, to point out the methods implemented in the universal cognitive analytical system “Eidos” [7], as well as other methods and their software implementations developed by the scientific school of prof. E.V. Lutsenko. A summary of the scientific results obtained [8] allows us to get an

idea of the capabilities of the automated system-cognitive analysis created in this scientific school and its software tools - the Eidos system.

Other options for the new paradigm of economic theory are also discussed [9].

Controlling organizational and economic methods

The discussion of the development of mathematics began with a quote from an article by V.I. Arnold. Let's continue it based on the concept of controlling.

To date, controlling is a developed area of scientific and practical work with a complex internal structure. This area can be looked at from different angles; accordingly, there are many different definitions of the concept of “controlling”.

We will proceed from the definition of S.G. Falko, according to which controlling is “... a forward-looking and fact-based system of information, analytical and methodological support for management in the process of planning, control, analysis and management decision-making, ensuring coordination and integration of departments and employees to achieve their goals” [10]. In short, controlling as a scientific discipline is dedicated to modern management technologies. Note that many authors write about the problems of controlling without using this term itself.

Controlling organizational and economic methods is the development of procedures for managing compliance with the assigned tasks of used and newly created (introduced) organizational and economic methods [11].

The development of this area has been ongoing since 2008. The following sections of controlling organizational and economic methods have emerged [12]:

- risk controlling,
- Tocontrolling inflation,
- quality control,

- controlling scientific activities,
- controlling statistical methods,
- controlling investments.

Controlling specialists actively use mathematical research methods [13]. On the other hand, their development requires methodology and methods of controlling organizational and economic methods [14].

Two points of view on mathematical research methods

Such methods are intelligent tools for application in various fields. They can be looked at from two points of view - applied scientists who use such methods, and theorists who develop them.

Applied scientists usually believe that the set of mathematical methods they need has long been known, everything necessary for practical application is set out in textbooks and reference books, fairly common software products are used to carry out calculations, and theorists are engaged in individual minor improvements and applied scientists do not need to delve into their work, therefore, it is inappropriate because there is never enough time.

Theorists know that over the past decades a fundamentally important scientific revolution has taken place in the field of mathematical research methods, during which a new methodology was created and models and methods that were sharply different from previous ones were developed. Through the efforts of this category of researchers, the scientific revolution has been carried out and is developing. It is very important to achieve widespread use of new methods.

Currently, we observe a significant difference between the views of applied scientists and theorists in the field of mathematical research methods. To reduce it, it is necessary to explain to the scientific community the essence of the scientific revolution being discussed.

Two main innovations

In textbooks and reference books well known to applied scientists, corresponding to the scientific level of the mid-twentieth century, numerical values are considered as statistical data, i.e. real numbers, finite-dimensional vectors (i.e. finite sequences of numbers), functions with numerical values (time series, random processes). The term "numeric" means that the elements of the sample can be added and multiplied by a number, i.e. these elements lie in some linear (in other words, vector) space.

As a result of the scientific revolution of the late 20th - early 21st centuries. the assumption of linearity was abandoned. Finite sequences of elements of spaces of arbitrary nature, both linear and nonlinear, began to be considered as samples. The center of mathematical research methods has become the statistics of non-numerical data. Inside it, it is necessary to highlight the central area - statistics in spaces of arbitrary nature. It includes scientific results in the most general formulations. Areas devoted to the analysis of specific types of non-numeric data have also been developed. In this analysis, both statistical results in spaces of arbitrary nature and specific methods designed for specific types of non-numerical data are used.

The second fundamentally important feature of the scientific revolution is the generalization of classical types of numbers by explicitly taking into account the fuzziness (vagueness, vagueness) of real statistical data. For all types of measurements, their results have errors, but classical statistical methods do not take them into account. To overcome this drawback, statistics of interval data have been developed, in which the sampling elements are not numbers, but intervals. Measurement errors can also be taken into account by moving to the analysis of fuzzy data, for example, triangular fuzzy numbers. This approach is

demonstrated [15] using the example of an additive-multiplicative risk assessment model.

Development of revolutionary changes in mathematics

The beginning of the scientific revolution in the field of mathematical research methods dates back to the 1980s. During the creation of the All-Union Organization for Statistical Methods (which later became part of the All-Union Statistical Association [16] as one of four sections), the professional community carried out a thorough analysis of the state and prospects for the development of the scientific field under consideration. This work was carried out within the framework of the domestic scientific school in the field of probability theory and mathematical statistics, created by Academician. A.N. Kolmogorov.

The main ideas of the scientific revolution are formulated in the new paradigm of mathematical research methods [17]. It reveals the fundamental differences between the modern (new) approach to mathematical research methods and the approach adopted in the mid-twentieth century. A new section of theoretical and applied mathematics is devoted to the implementation of the new paradigm - system fuzzy interval mathematics [18, 19]. Many of its algorithms are implemented in the Eidos software system [7], and examples of the practical application of systemic fuzzy interval mathematics can be found using summaries of the works of E.V. Lutsenko [8] and A.I. Orlova [20].

In accordance with the new paradigm, quite a lot of books and articles have been published, mostly in the 21st century. However, there is a significant lag in the scientific level of the bulk of work on the statistical analysis of specific data from what has been achieved at the forefront of modern scientific research. It is advisable to discuss the causes and consequences of such a lag.

Three paradigms of mathematical research methods

Currently, three paradigms of mathematical and statistical research methods are actively used - primitive, outdated and modern (new).

*Primitive*The paradigm is based on 19th century recipes. (and earlier). Rosstat tables are made within its framework. It must be recognized that in many cases direct tabular analysis of statistical data allows one to obtain the scientific and practical conclusions that the researcher needs.

At the beginning of the twentieth century. In response to requests from practice, classical mathematical statistics arose. Its founder, K. Pearson, proposed using distribution functions from a four-parameter family to describe real data (currently, subfamilies with fewer parameters are usually used - normal, exponential, Weibull-Gnedenko, etc.). This proposal had both positive and negative consequences.

The use of parametric families of probability distributions made it possible by the middle of the twentieth century. develop a developed mathematical theory designed to estimate parameters and test hypotheses. It is usually called parametric statistics (in accordance with the basic assumption underlying it). This theory is taught in college courses on probability theory and mathematical statistics, and its fundamentals are usually familiar to researchers in applied fields. Note that the development of certain aspects of this theory continues. Thus, relatively recently it was found that instead of maximum likelihood estimates, it is advisable to use one-step estimates for estimating parameters, and new results have recently been obtained in the field of estimating parameters of gamma distributions and beta distributions.

However, it has long been established that the basic assumption of parametric statistics usually does not hold. As an example, let us discuss the assumption, often accepted without sufficient grounds, that the statistical data in question were obtained in accordance with the normal distribution law. At least since the middle of the twentieth century. It is known that the distributions of real data, as a rule, are not normal [21]. Consequently, the scientific results

of parametric statistics are purely mathematical (i.e. they relate to mathematics as the science of formal systems and are not related to the properties of objects in the real world), they do not allow one to obtain reasonable conclusions for real phenomena and processes. The paradigm of mathematical research methods based on parametric statistics should be considered obsolete.

In accordance with the modern (new) paradigm, methods of nonparametric statistics should be used, which currently allow solving the same range of problems as methods of parametric statistics.

The transition from an outdated paradigm to a modern one requires efforts from researchers working on specific applied problems. It is necessary to study non-parametric models and methods, their corresponding theoretical basis, switch to new software or develop it. It is necessary to change calculation algorithms, normative and technical documentation, and teachers have to change the content of courses taught and the corresponding educational literature. Naturally, resistance arises, as always when moving from old to new.

Typical objections from adherents of the outdated paradigm

Let's discuss the main objections. Instead of switching to nonparametric statistics, they propose checking the normality of the distribution of sample elements using certain criteria for checking statistical criteria - based on indicators of asymmetry and kurtosis, Shapiro-Wilk, Kolmogorov type, omega-square type, etc. If the normality hypothesis is not rejected, then consider it is possible to use methods based on normality.

Why is this reasoning not correct? The point is that for the same data you can check its consistency with other distributions. And for typical sample sizes (tens or hundreds of observations) the answer will be positive. In other words, it is just as reasonable to accept not only normality, but also many other distributions. It is known that for reliable (at a significance level of 0.05) detection of differences between normal and logistic distributions, a sample size

of at least 2500 is required [21]. Deviations from normality can greatly influence the properties of statistical procedures developed under the assumption of normality. As a result, the conclusions drawn from them may have nothing to do with reality. An example is outlier rejection procedures. When the distribution of sample elements deviates from normality, their properties change extremely strongly (see ibid.).

In favor of parametric statistics, it is sometimes argued that the use of a parametric approach can significantly reduce the sample size compared to a nonparametric approach. This reasoning is fundamentally incorrect. Conclusions based on an unfounded probabilistic-statistical model are themselves unfounded. A famous parable says: “A man lost his keys in the bushes. Where to look for them? Under a lantern. Why under a lantern? Because it’s lighter there.” Parametric statistics can be compared to searching for keys lost in the bushes under a streetlamp.

In addition, it has long been established that when solving typical statistical problems, nonparametric methods require approximately the same sample size as parametric ones [22].

About the psychology of adherents of outdated methods

Researchers do not always realize and recognize the very fact of the scientific revolution discussed here. Some people have a desire to declare the new results generated by it to be insignificant, located on the periphery of science, and therefore not requiring comprehension, not worthy of attention, study and application. One of the reasons for this is the inclusion of psychological defense against the new, requiring a decisive revision of the usual old approaches.

It is also important to delve into certain narrow problems associated with particular formulations, the lack of a broad outlook, as well as the desire and

ability to analyze the dynamics of the development of mathematical research methods.

Such an analysis is also hampered by the enormous volume of scientific publications accumulated to date in the area under consideration. We estimate that there are millions of articles and books related to mathematical research methods. The lower estimate is 1 million. If you read one serious article or book every week, then in a year you can study 50 publications, and in a lifetime - no more than 5000. Consequently, a particular researcher can study no more than 0.5% of publications on his topic. How to overcome the information barrier between the huge amount of accumulated knowledge and the limited capabilities of the human brain is not clear, at least at the present time.

The information barrier is even more noticeable in other sciences, for example, in economics. He clearly saw in a study by the Center for Institutional Analysis of Science and Education of the European University in St. Petersburg, devoted to the academic reputations of Russian economists in comparison with their scientometric assessments [23]. Some specialists are cited more, while others are popular in the academic environment. Economists work actively in industry and other sectors of the national economy, but academic scientists know little about their activities. However, as well as vice versa. There is an information barrier.

It was the understanding of the considered reasons for the discussed gap between applied scientists and theorists that served as the impetus for the preparation of this article. I would like to encourage specialists who apply mathematical and statistical methods in specific areas to understand the revolution that has taken place in mathematical research methods and to master its results. In particular, references to ignorance of, for example, nonparametric statistics cannot justify the use of outdated, inadequate methods.

The need for a transition to the northeastern vector of development in mathematics

The development of counting begins with the use of concepts like “one, two, many” by primitive tribes. This is the first stage in the development of mathematics.

His denial happened quite early. Already in the times of Ancient Greece, the idea of the infinity of a series of natural numbers appeared. Then the development of the theory led (in the 19th century) to the concept of a real number.

Currently in mathematics there is a negation of the negation. It became clear that the prejudice according to which real numbers should be used first in the application of mathematics did not correspond to practical needs. The fact is that the numbers used in calculations (let's call them pragmatic) are written with a finite number of significant figures. The number of such numbers is finite (though large), while almost all real ("mathematical") numbers are expressed using an infinite sequence of digits, their number is infinite. It is important that the results of measurements (observations, tests, experiments, analyzes, surveys), as a rule, are blurred (vague) because they contain errors. Thus, in recent decades, it has become clear to researchers that pragmatic numbers (i.e., those reflecting reality) are fundamentally different from mathematical ones, formed as the result of a long path of theoretical reasoning. This property of pragmatic numbers should be reflected in mathematical models of real phenomena and the corresponding calculation methods.

As already noted, in order to create such a reflection, a new paradigm of mathematical research methods has appeared in our country [17], and on its basis - system fuzzy interval mathematics [18, 19]. It is this that we consider as the basis of mathematics of the 21st century [24].

Let's discuss an example. Mathematical statistics as an independent science was identified by the English scientific school at the beginning of the

twentieth century. Its main concepts and results were obtained by the middle of the twentieth century. and since then they have been frozen in university textbooks and in the heads of those who process specific statistical data. It is necessary to overcome outdated Anglo-Saxon approaches by moving to the northeastern vector of development. In particular, the statistics of non-numerical data should be considered as a central part of mathematical statistics [25].

Let us consider the other side of the dialectical path of development of mathematics. The development of counting methods began due to the need to solve practical problems. So in other areas of mathematics - at the beginning, the needs of practice are at the core. The negation of this stage is the shift of attention to intra-mathematical issues (to proving theorems for the sake of theorems). It is at this stage that mathematics in the Anglo-Saxon countries is now located. Meanwhile, a lot of practical problems remain unconsidered by mathematicians. What is necessary is the negation of the negation - a transition to the study of new practically important formulations of mathematical problems. In other words, a transition to the northeastern vector of development is necessary, based on a new paradigm of mathematical research methods and systemic fuzzy interval mathematics.

Revolution in mathematical research methods and artificial intelligence

The scientific basis of artificial intelligence must correspond to the current level of development of science. Over the past decades, a fundamentally important scientific revolution has occurred in the field of mathematical research methods. Her ideas need to be used in research and teaching.

The author has been studying the problems of artificial intelligence for about half a century (the first articles were published in 1972). The main results are included in a series of three monographs “Artificial Intelligence” devoted to

non-numerical statistics[26], expert assessments [27], statistical methods of data analysis [28].

The “National Strategy for the Development of Artificial Intelligence for the Period until 2030” adopted the following definition: “... artificial intelligence is a set of technological solutions that allows you to simulate human cognitive functions (including self-learning and finding solutions without a predetermined algorithm) and obtain results when performing specific tasks , comparable, at a minimum, with the results of human intellectual activity.” This definition does not directly talk about the scientific basis of the “complex of technological solutions.” In our opinion, in the socio-economic field, economic and mathematical methods, organizational and economic modeling, applied statistics, econometrics, methods of development and decision-making, in short, mathematical research methods, can be used as such a basis.

Currently, newfangled terms are often used, such as artificial intelligence, big data, neural networks, and digital economy. It is useful to understand what exactly stands behind such terms and to identify their correspondence to certain sections of mathematical research methods. Our main conclusion is that behind the currently common terms there are areas that have been developed for a long time, the only difference is in the names. “The words and their combinations (terms) are used differently, but the meaning that their interpreters sought to convey remains the same” [29]. Playing with terms is not harmless. Director of the Institute of Management Problems of the Russian Academy of Sciences, Academician of the Russian Academy of Sciences D.A. Novikov rightly believes that “A very alarming structure of knowledge and competencies is emerging around artificial intelligence” [30].

It is necessary to ensure that the scientific basis of the “complex of technological solutions”, i.e. artificial intelligence, corresponded to the current level of development of mathematical research methods, and was based on the results of the scientific revolution in this area, which was discussed above. The

ideas of the scientific revolution must be used in scientific research and teaching.

Let us move on to justifying the need to move to the northeastern vector of development in scientific studies.

Dialectics of development of ways to disseminate scientific knowledge

Let's start with a discussion of the dialectics of the development of such a phenomenon as scientific journals. Initially, they included excerpts from new books in order to disseminate information about the results obtained in these books among specialists. Then the journal article became an independent way of recording scientific results. Gradually, the importance of journal articles grew, and it got to the point that from the point of view of those who manage science (first of all, distribute funding), they have recently begun to be valued above books (when assessing the significance of the contribution to science of researchers and their associations and accepting them on the basis such assessment of management decisions).

Let us discuss the situation from the point of view of analyzing the development of science as an information process. Initially, new results were disseminated through personal communication and letters, and recorded in books. So, in Ancient Greece there was both, but there were no scientific journals. Gradually, journals began to play an increasingly important role in the information process of scientific development. And then the struggle began between scientific clans for control of information dissemination channels. For example, reviewers who censor scientific publications in the interests of the clans to which they belong have become increasingly important.

In recent years, great harm has been caused by the unreasonable use of various Anti-Plagiarism systems that look for similarities between article texts and previously published ones, including on the Internet. It is clear that such a practice harms the dissemination of new ideas, in particular, it prevents the

publication of articles that develop previously done or review articles in which discussion of previous publications is necessary.

We state that the system of scientific journals becomes a brake on the development of science. A solution can be found in directly posting research results on the Internet, without the mediation of journals, reviewers and other systems that interfere with the dissemination of scientific information and the formation of new scientific directions. This is exactly what the currently most famous Russian mathematician G.Ya. did. Perelman, who solved the famous Poincaré problem. In fact, we are talking about a return to the dissemination of scientific results through letters, but at a new technical level.

Let us briefly formulate what has been said. The original system is the exchange of letters (thesis). Its denial is the system of scientific journals (antithesis). The negation of the negation (synthesis) is currently taking place.

The degeneration of the scientific communication system is especially noticeable in the science of Anglo-Saxon countries. A transition to the northeastern vector of development is necessary, which will allow us to overcome outdated forms of organizing scientific activity, breaking the shackles of the dominance of clans (long-established and often outdated) in which science is now located.

Expert and scientometric methods for assessing contributions to science

Let's move on to the problems of assessing scientific achievements. This assessment has long been carried out by experts. Their assessment initially had only moral significance, but has long been taken into account when making decisions about funding researchers. This is manifested, for example, in the awarding by experts of academic degrees and titles, which have come to be considered necessary for occupying worthy positions (for example, the position of a professor) with appropriate payment and funding that allows further

research. The shortcomings of such a system are obvious, and they can be described by stating a well-known fact: what are the experts, so is the result. Experts from a certain clan will support their own and belittle others. The formation of new scientific directions occurs in the course of a tough struggle against such a system.

Scientometrics became the negation of the described system. The world's first monograph on scientometrics was published in our country more than half a century ago, in 1969 [31]. It substantiates the approach to studying the development of science based on an analysis of the information process of disseminating the results of scientists' work. It has been shown, in particular, that a researcher's contribution to basic science is measured by the number of citations to his work in subsequent scientific publications. This statement is quite obvious: the more references, the more further works the researcher's publications are needed, i.e. the greater the impact it has on the development of science.

Despite the obviousness of this statement, it gives rise to furious resistance from those scientists who are highly regarded within their clan by experts from the same clan, but whose influence on the development of science outside the clan is modest.

Another important question is how to count the number of citations. Thus, focusing on Western bibliometric data bases BoC and Scopus is very harmful for reasons disclosed, for example, in the monograph [32] and article [33]. The West uses its monopoly position to inflate (manifold) the assessments of the achievements of scientists within its sphere of influence and understate (by an order of magnitude) the importance of the work of others, as well as to collect tribute in the form of priority information about new scientific results (along with payment for them). publications). Rejection of anything other than harmful traditions and unjustified orientation towards VoS and Scopus is necessary, especially during the period of confrontation with the West. The urgent

transition of domestic science to the northeastern vector of development means, in particular, the use of the Russian RSCI database and the refusal to use VoS and Scopus in science management. Within the BRICS framework, reliance on national bibliometric data bases in the management of science should be encouraged, and in the future, the creation of a common database of the BRICS countries as opposed to VoS and Scopus.

Currently, there is a dialectical negation of the negation; formal scientometric approaches are being replaced by a synthesis of statistical (i.e., scientometric) and expert methods of science management [34].

Dialectical interaction between theory and practice in the development of science

Another line of discussion is the relationship between the influences of theory and practice on the development of science. At first, scientific research was aimed at solving specific practical problems. Denial of this period means switching attention to the study of theoretical constructs. This is especially noticeable in Anglo-Saxon works on mathematics and economics. Mathematicians work within mathematics, prove theorems for theoretical constructions generated by practice many decades and even centuries ago, and do not even try to consider the actual practical problems of our time. For example, in mathematical statistics, both researchers and teachers focus on the approaches of the first half of the twentieth century. In economics, the situation is similar - market economics is studied and taught, corresponding to the practice of the mid-19th century. Currently, the negation of the negation is relevant, i.e. transition to the analysis of modern problems using accumulated theoretical results, transition to the northeastern vector of development. It is characteristic that in China such a branch of mathematics as the theory of fuzziness is actively developing, and for economics a theoretical analysis of the experience of economic construction in the PRC is very relevant.

Conclusion

Summing up, we state the need to overcome outdated approaches to the development of science and its transition to the northeastern vector of development, which is what the “biocosmological initiative” calls for [35].

The time has come to get rid of the traditions of admiration for Western science that have been imposed on us. In the areas of science discussed in this article (in economic theory, mathematics, science) scientific directions have been developed in which Russia is ahead of the West. A new paradigm of economic theory has been created, based on the approaches of the solidary digital economy. A new paradigm of mathematical research methods and system fuzzy interval mathematics developing it have been developed. In scientific studies, instead of the Western databases VoS and Scopus, the domestic RSCI database should be used. The creation of these scientific directions ensures a transition to the northeastern vector of development, the need for which arises from the Biocosmological Initiative.

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