



# SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

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这些会议文结合了会议的材料 – 研究论文和科学工作者的论文报告。它考察了职业化人格的技术和社会学问题。一些文章涉及人格职业化研究问题的理论和方法论方法和原则。

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分析教育机构中育儿实践应用质量的方法要素

**ELEMENTS OF A METHODOLOGY FOR ANALYZING THE  
QUALITY OF APPLICATION OF PARENTING PRACTICES IN AN  
EDUCATIONAL ORGANIZATION**

**Bandurin Alexander Vladimirovich**

*Doctor of Economics, Professor, Chief Researcher*

*Institute of Management Research and Consulting,*

*Financial University under the Government of the Russian Federation,*

*Moscow, Russia*

摘要。本文探讨了评估高等教育机构教育过程质量的主要问题。考虑了质量评估的主要方向以及高等教育机构教育过程中的相关方。证实了作为质量评估主要主体之一的利益相关者群体。提出了选择基准指标的选项，以确定所实现的指标是否符合基本基准。

关键词：教育实践；教育过程；教育过程质量；教育过程利益相关者。

**Abstract.** *The article examines the main issues of posing the problem of assessing the quality of the educational process in higher educational institutions. The main directions of quality assessment, as well as interested parties in the educational process in higher educational institutions, are considered. The groups of stakeholders who are one of the main subjects of quality assessment are substantiated. Options for choosing benchmark indicators are presented to establish compliance of the achieved indicators with the basic benchmarks.*

**Keywords:** *educational practices; educational process; quality of the educational process; stakeholders of the educational process.*

Analyzing the quality of application of educational practices in an educational organization requires the creation of an appropriate methodology that allows answering the question of whether the practices used correspond to various expectations and requirements. Here we proceed from the previously formulated definitions of quality. For example, in a broad sense, «quality is a set of properties, characteristics of products, goods, services, works, labor that determine their ability to satisfy the needs and demands of people, meet their purpose and requirements» [6].



A narrower interpretation is given in the Federal Law «On Education in the Russian Federation», where «the quality of education is a set of properties, signs of activities aimed at personal development, the formation of hard work in students, a responsible attitude towards work and its results, the creation of conditions for self-determination and socialization of students based on sociocultural, traditional Russian spiritual and moral values (OR simply education), which determine the ability to satisfy the needs and demands of people, meet its purpose and requirements» [5, 6].

To further specify the concept of quality in educational work, it is advisable to use N. Afonina's approach, according to which, «the quality of educational work is an indicator of achieving the goals and objectives of the educational process at a specific level and stage of education» [1]. Accordingly, «the educational process is a professionally organized closed sequence of using educational practices within the framework of relations between students and other persons, characterized by joint activities of stakeholders, cooperation, cultural content and methods of cultural development» [4].

A very important element of the educational process is the use of educational practices as a special object for quality assessment. We agree with the opinion of S.V. Kulikova that «educational practices are generalized groups of effective forms and methods of education that arose in Russia under the influence of socio-cultural conditions, domestic and foreign pedagogical ideas, social and pedagogical movements used within the framework of the educational process» [3].

For example, S. V. Kulikova in her research identifies the most effective means of education, which can be considered as educational practices that have proven their effectiveness in the pre-revolutionary and Soviet periods of development of higher education [3]:

- projective methods, which include involving students in the development and implementation of projects, defending graduate works in the form of startups, and taking the initiative to implement their own ideas in student incubators;
- stimulating extracurricular creative activity, for example, in the form of students' participation in amateur performances, student theater productions, cheerful and resourceful competitions;
- organization of student self-government, including in the form of student councils at various levels, periodic delegation of powers and responsibilities;
- museum work and excursion activities, based on students' own initiatives to search for information, information, objects, exhibits for student or university museum exhibitions;
- volunteerism, which has become especially important in the last two years, aimed at supporting a special military operation and other internal and external initiatives;

- labor teams that have proven their applicability through effective team building and participation in the construction of socially significant facilities;
- a physical education movement that promotes the harmonious development of personality, not limited only to improving knowledge.

It is also necessary to supplement this list with relatively new practices that have emerged as a result of the development of technology and the expansion of the boundaries of scientific and educational cooperation:

- individualization of knowledge transfer, when teachers take into account the individual characteristics of each student, his abilities, interests and needs, in order to provide the most effective format for knowledge transfer;
- development of self-regulation skills, during which the student can independently plan his educational activities, monitor his progress and evaluate his achievements, for example, through a combination of classroom and extracurricular work;
- the formation of value orientations in the learning process, which allows students to form value orientations, for example, love for the Motherland, immersion in the national traditions of the country, respect for other people, honesty and responsibility;
- development of communication skills in the information environment, aimed at improving information hygiene, increasing the effectiveness of communication, developing the skills of competent and reasoned expression of one's thoughts and ideas;
- the use of innovative techniques related to distance learning technologies, immersion in the digital environment, the use of artificial intelligence to expand the coverage of the source base;
- development of critical thinking, when students acquire skills in analyzing information, establishing cause-and-effect relationships, critical attitude to information, and making informed decisions;
- personal example when the teacher's behavior is a value guide for students.

Thus, an analysis of the quality of the application of educational practices in an educational organization is «a set of procedures for determining, establishing and studying the signs that characterize the state of activity aimed at personal development, the formation of hard work in students, a responsible attitude towards work and its results, the creation of conditions for self-determination and socialization of students on the basis of sociocultural, traditional Russian spiritual and moral values (OR simply education), which determine the ability to satisfy the needs and demands of people, meet their purpose and requirements, to predict possible

deviations and prevent violations of the normal mode of their work and activities” [2, 5, 6].

The traditional approach to quality assessment always involves identifying the person in whose interests the assessment is being carried out. Therefore, in our opinion, when developing a methodology for analyzing the quality of application of educational practices in an educational organization, it is necessary to establish the main categories of stakeholders. We believe that the educational process in Russian education covers the interests of the following six main groups of stakeholders, who are not only directly involved in the educational process, but can also make reasonable demands on the quality of application of educational practices:

1) students are teenagers receiving education, at whom educational practices are aimed;

2) teachers - employees of educational organizations who, in the process of transferring knowledge, implement educational practices, including them in the educational process, conduct classes and take care of the education of students;

3) parents - play an important role in the process of implementing educational practices through emotional stimulation of the student's personal initiative outside the educational organization;

4) educational organizations - specialized legal entities that provide infrastructure and conditions for the implementation of educational practices;

5) group curators - persons from among the employees of the educational organization, vested with the right to initiative and responsibility for involving students in educational practices during extracurricular hours;

6) the state is the coordinator of legislation, the main interest in educational work, the generator of values and the source of resource support for the educational process.

All of the listed stakeholders work together to develop the personality and obtain knowledge of students within the framework of the educational process in Russia. Therefore, each group of stakeholders has its own ideas about the possible and required results of the educational process. In our opinion, taking into account the listed factors, it is advisable to form three basic directions for analyzing the quality of educational practices:

1) regulatory direction - covers the parameters of compliance of the achieved results with the requirements of federal and regional legislation, national standards and internal regulations of educational organizations;

2) target direction - allows you to assess the level of achievement of set goals, compare the results obtained with best practice examples, and also assess the lag or superiority, including based on benchmarking;

3) consumer direction - includes quantitative and qualitative parameters for measuring stakeholder satisfaction with the results obtained and the achieved level of application of educational practices.

In our opinion, each direction should be analyzed independently. Therefore, it is advisable to consider quantitative methods for assessing quality in relation to directions, but using universal calculation methods.

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中俄跨境合作中的产业对接与互补发展  
**INDUSTRIAL DOCKING AND COMPLEMENTARY  
DEVELOPMENT IN CROSS-BORDER COOPERATION BETWEEN  
CHINA AND RUSSIA**

**Shi Weichang**

*Doctor of Economics*

*School of Economics, Russian People's Friendship University*

**摘要：**随着全球化深入发展，中俄跨境合作逐渐加强，特别是在两国产业对接与互补领域展现出巨大潜力与显著效益。本研究以中俄跨境合作为研究对象，通过实证分析和深度访谈等方式，调查了中俄地区间产业发展现状和合作进程中存在的问题。研究聚焦于两国主要合作产业——能源、农业、高新技术，并采集了相关跨境企业的生产数据与合作案例，系统分析了中俄产业链的衔接情况以及双方产业互补的具体表现。研究发现，中俄跨境合作在促进区域经济发展方面发挥着重要作用，尤其是在边境地区的经济活动和就业问题上有着显著影响。然而，合作过程中也存在诸多不适应和不匹配问题，比如投资环境、贸易便利化和产业标准对接等方面的挑战。为应对上述挑战，本研究提出了一系列优化跨境合作的策略和措施，包括但不限于加强政策沟通、完善法律法规框架、促进贸易便利化、提高产业链整合度等，旨在为两国加强合作、实现互补发展提供理论支持与政策建议。

**关键词：**中俄跨境合作；产业互补；产业链整合；贸易便利化；投资环境

**Abstract.** *With the in-depth development of globalization, cross-border cooperation between China and Russia has gradually strengthened, especially in the field of industrial docking and complementarity between the two countries, which has shown great potential and significant benefits. This research takes cross-border cooperation between China and Russia as the research object. Through empirical analysis and in-depth interviews, it investigates the current situation of industrial development between China and Russia and the problems in the process of cooperation. The research focuses on the main cooperative industries of the two countries—energy, agriculture, and high-tech. It also collects production data and cooperation cases of related cross-border enterprises, and systematically analyzes the convergence of the industrial chains of China and Russia and the specific performance of the complementary industries of the two sides. The study found that cross-border cooperation between China and Russia plays an important role in promoting regional economic development, especially*

*in economic activities and employment issues in border areas. However, there are also many adaptations and mismatches in the cooperation process, such as challenges in the investment environment, trade facilitation, and the docking of industrial standards. In order to meet the above challenges, this research proposes a series of strategies and measures to optimize cross-border cooperation, including but not limited to strengthening policy communication, improving the legal and regulatory framework, promoting trade facilitation, and improving the integration of the industrial chain. It aims to provide theoretical support and policy suggestions for the two countries to strengthen cooperation and achieve complementary development.*

**Keywords:** *Cross-border cooperation between China and Russia; complementary industries; industrial chain integration; trade facilitation; investment environment.*

### **Introduction**

As the world's important emerging market economies, China and Russia have broad room for cooperation in the process of regional economic integration. With the in-depth advancement of China's "Belt and Road" initiative and the implementation of Russia's strategy to turn to the east, China-Russia cross-border economic and trade cooperation has entered a new stage of development. In 2018, the bilateral trade volume between China and Russia reached US107.06 billion, an increase of 27.1% year-on-year, a record high [1]. However, there are still problems such as insufficient industrial complementarity and insufficient depth of cooperation in China-Russia economic and trade cooperation. How to seek breakthroughs in the docking of Sino-Russian industries under the new situation and achieve mutual benefit and win-win situation has become a topic worthy of in-depth discussion.

From the theoretical point of view, there are significant differences between China and Russia in terms of industrial structure, element endowment, and technical level, which provides an objective basis for the two sides to carry out industrial division of labor and cooperation. According to the H-O model, the two countries should give full play to their comparative advantages and realize complementary advantages in industries with different intensities of capital, labor and other elements [2]. At the same time, (R.Vernon) Product life cycle theory points out that the production transfer of products in the international market follows the law from developed countries to developing countries [3]. With the continuous upgrading of China's industrial structure, some labor-intensive industries have gradually been transferred from coastal areas to the central and western regions and the northeast regions, creating conditions for undertaking the industrial transfer of the Russian Far East.

The path of Sino-Russian industrial docking and complementary development can be explored from the following aspects. First, strengthen cooperation in the

energy field. Energy cooperation is an important pillar of Sino-Russian economic and trade cooperation. In recent years, with the rapid growth of China's energy consumption demand and the strategic adjustment of Russian oil and gas exports, the cooperation between the two sides in crude oil, natural gas, coal, electric power and other fields has been deepening. In the future, on the basis of ensuring the security of energy supply, we should actively promote diversified cooperation in the energy field, improve energy utilization efficiency, and develop renewable and clean energy. Secondly, expand the space for agricultural cooperation. China is a large consumer of agricultural products, while the Russian Far East is rich in agricultural resources such as land and water. The two sides can strengthen cooperation in agricultural product trade, agricultural investment, agricultural science and technology, and agricultural infrastructure construction to achieve complementary advantages and improve agricultural production efficiency and added value. In addition, China and Russia also have a good foundation for cooperation and broad development prospects in strategic emerging industries such as equipment manufacturing, information technology, new energy, transportation and logistics. Through the joint construction of cross-border industrial parks, strengthening upstream and downstream cooperation in the industrial chain, and building innovative cooperation platforms, the two sides can realize industrial docking in more fields and nurture new economic growth points.

## 1. Background of cross-border cooperation between China and Russia

### 1.1 The historical evolution of cross-border cooperation

China and Russia have a long history in the field of cross-border cooperation. As early as the 17th century, with the signing of the Treaty of Nebuchadnezzar, China and Russia began trade in the Far East. In April 1996, the heads of state of the two countries signed the "Sino-Russian Joint Statement", establishing a strategic cooperative partnership for the 21st century. In July 2001, the heads of state of China and Russia signed the "Sino-Russian Treaty of Good-Neighborliness, Friendship and Cooperation", which laid a solid legal foundation for the development of bilateral relations in the new period [4].

In recent years, in the context of the strategic docking of the "Belt and Road" initiative and the Eurasian Economic Union, cross-border cooperation between China and Russia has entered a completely new stage. According to statistics from the General Administration of Customs of China, the total trade between China and Russia in 2020 reached US\$107.38 billion, an increase of 2.7% year-on-year. Among them, China exported US\$55.58 billion to Russia, an increase of 1.4% year-on-year; imports from Russia were US\$56.8 billion, an increase of 3.9% year-on-year. Russia has become China's largest source of crude oil imports for 11 consecutive years. At the same time, China has become Russia's largest trading partner, largest export destination and main source of imports, and the

economic and trade cooperation between the two countries has achieved mutual benefit, win-win situation and common development.

Cross-border cooperation between China and Russia has also achieved fruitful results in the field of infrastructure construction. On December 2, 2019, the China-Russia Eastern Natural Gas Pipeline was officially put into operation. The pipeline has a total length of about 5,111 kilometers and a designed annual gas transmission capacity of 38 billion cubic meters. It is a landmark project of China-Russia energy cooperation. A number of major projects such as the China-Russia Tongjiang Railway Bridge, the Heihe Highway Bridge, and the Dongning Mutual Market Trade Zone have been completed one after another, providing a more convenient channel for cross-border logistics between the two countries. In addition, the two sides have actively promoted cooperation in agriculture, forestry, fisheries and other fields in the Far East to jointly build a “green food corridor” and improve the level of agricultural trade.

Cross-border financial cooperation between China and Russia is also showing good momentum. In June 2019, China and Russia signed a local currency settlement agreement during the 23rd St. Petersburg International Economic Forum. The two sides agreed to gradually expand the scope and scale of use of local currency settlement. On December 11, 2020, the China-Russia local currency exchange quota was increased from 150 billion yuan/815 billion rubles to 150 billion yuan/1.4 trillion rubles [5], and the exchange period was extended to 5 years, which can be extended according to the unanimous wishes of both parties. The proportion of local currency settlement between the two sides has increased from 3.1% in 2014 to 24% in 2020, and the position of the renminbi in cross-border settlement between Russia and China has become increasingly prominent.

In general, cross-border cooperation between China and Russia has a long history. On the basis of mutual political trust, the two sides have continuously deepened pragmatic cooperation in economic and trade, energy, infrastructure, finance and other fields, achieving mutual benefit and win-win and common development. It has made important contributions to promoting the process of regional integration and building a community of human destiny. In the future, as the construction of the “Belt and Road” advances in depth, the Sino-Russian comprehensive strategic cooperative partnership will surely usher in broader development prospects.

#### 1.2 Analysis of the current economic situation between China and Russia

At present, China and Russia are in a key position in the international political and economic landscape. In 2022, the total trade between China and Russia reached US\$190.271 billion, a year-on-year increase of 29.3%, a record high. China has maintained Russia’s largest trading partner status for 13 consecutive years. In this regard, the leaders of the two countries said that the Sino-Russian economic and trade relations have great potential and will expand bilateral trade to 200-250 billion US dollars [6].



But the Chinese and Russian economies also face many challenges. Russia is facing pressure from Western sanctions, inflation has risen to 14.3%, and the ruble exchange rate has fluctuated sharply. Russia's domestic consumer demand has declined and its foreign exchange reserves have decreased. China's economy has also been hit by the epidemic, with GDP growth of only 3% in 2022, a 40-year low. Structural problems such as population aging and unbalanced regional development have become prominent.

Nevertheless, the Sino-Russian economy is still relatively resilient. In 2022, although Russia's GDP fell by 2%, the decline was smaller than expected. The ability to generate foreign exchange from crude oil and natural gas exports remains strong. Russia has actively promoted the integration of the Eurasian Economic Union, and its eastward policy has achieved remarkable results. China's ultra-large-scale market advantages are prominent, and active fiscal policies and sound monetary policies are expected to promote economic recovery. New growth points such as "new infrastructure" and the green economy continue to emerge.

Overall, in the current complicated international environment, there are many opportunities and certain challenges for cross-border cooperation between China and Russia. On the one hand, China and Russia are geographically adjacent and economically complementary, and the two sides have carried out extensive practical cooperation in energy, infrastructure, finance and other fields. On the other hand, changes in the external environment such as rising regional security risks and reshaping of the global industrial chain have brought new effects to China-Russia economic and trade relations. Therefore, grasping the changes in the situation, taking the initiative to take action, and continuously deepening industrial docking and complementary development are of great significance to promote the quality improvement and upgrading of cross-border cooperation between China and Russia.

## 2. Industrial docking mechanism and path

### 2.1 The theoretical basis of industry docking

The industrial docking of cross-border cooperation between China and Russia requires a solid theoretical foundation as support. From the perspective of new economic geography, the evolution of industrial space layout is the result of mutual games between the market, enterprises and the government [7]. In the context of globalization, multinational companies have promoted the formation of global value chains and the integration of regional industrial chains through the allocation of internalization advantages, geographical advantages and property rights advantages [8]. In the theory of heterogeneous enterprises, Melitz pointed out that differences in enterprise productivity are the key factors affecting their participation in international trade and overseas investment [9]. Therefore, the level of industrial complementarity and comparative advantages of China and Russia will directly affect the depth and breadth of cross-border industrial cooperation.

Differences in the systems of the host country and the home country will also affect the strategic choices and performance of multinational companies in the host country. Based on the perspective of institutional differences, scholars such as Lai Hongchang of Peking University empirically tested the relationship between OFDI location selection preferences of Chinese companies and the institutional environment of their home countries [10]. Scholars such as Xu Ningning of the Shanghai Academy of Social Sciences analyzed the influence of factors such as the host country's industrial policy and ownership structure on the international operation of Chinese enterprises [11]. It can be seen that system complementarity and system integration are the key points that need to be paid attention to in cross-border industrial cooperation between China and Russia.

In addition, innovation network theory emphasizes the importance of knowledge overflow and technological complementarity between innovation subjects. Research by Professor AnnaLee Saxenian of Stanford University shows that the formation of Silicon Valley semiconductor industry clusters stems from the support of multinational technology community networks [12]. Professor Zhao Changwen of Tsinghua University and others systematically expounded the evolution path and organizational model of the global innovation network [13]. China and Russia should give full play to their respective advantages in basic research, application development, pilot production and other links, and promote the effective convergence of innovation chains, industrial chains, and supply chains.

In short, cross-border industrial cooperation between China and Russia needs to be based on comparative advantages, promote complementarity of systems, and embed in the global innovation network in order to achieve the goal of mutual benefit, win-win situation and common development. In the future, it is necessary to further explore the new path and new momentum of Sino-Russian industrial cooperation from the perspective of the reconstruction of the global value chain and the rise of the digital economy.

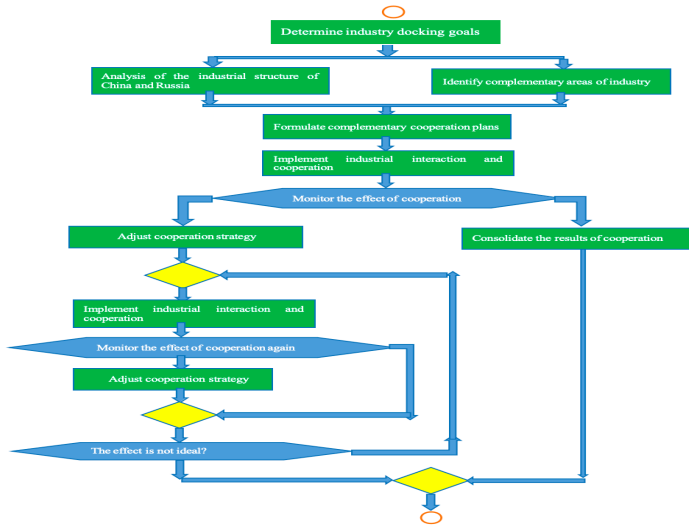
## 2.2 Discussion on complementary development strategies

When exploring the complementary development strategies of cross-border cooperation between China and Russia, it is first necessary to clarify the common goals pursued by both partners. Based on the guiding principles of the schematic diagram of the Sino-Russian industrial interaction and cooperation model, a preliminary idea of industrial cooperation has been established. As a result, through data mining and expert consultation, the characteristics and development levels of the industrial structures of the two countries are analyzed in detail, and the complementary areas of industries that exist on this basis are identified. For example, Russia has obvious advantages in the development of energy and mineral resources, while China has a leading position in manufacturing and information technology. Such complementarity provides a solid foundation for cooperation.

Subsequently, combined with the determined industrial docking goals and the identified complementary areas, a detailed complementary cooperation plan was formulated. The plan consists of multiple stages, including a short-term implementation path and a long-term development vision. In order to ensure the implementation intensity and accuracy of the plan, quantitative economic models are used in parallel with qualitative scenario analysis to lay the scientific basis for decision-making. In the process of implementing industrial interaction and cooperation, pay close attention to the macroeconomic trends of the two countries, adjust the investment structure and cooperation methods in real time, and ensure the efficient advancement of projects.

In the process of cooperation, a complete monitoring mechanism has been established to evaluate the effectiveness of cooperation in real time. The mechanism includes not only regular audits of financial indicators, but also evaluation criteria for industrial chain synergies. If the effect is not ideal, the cooperation strategy needs to be quickly adjusted based on the monitoring data. For example, technical problems or market changes in resource development projects can be solved by introducing innovative technologies or optimizing market layout. When the effect is ideal, efforts should be made to consolidate the results of cooperation, such as strengthening brand building and expanding the scope of cooperation, in order to achieve sustainable development.

The entire research process strictly follows the proposed flow chart path, ensuring the scientific and practical application value of the research results. At the same time, a large number of empirical data and case studies are used to support the research, and through in-depth mining of the logical relationship behind the data, a new perspective on industrial cooperation is revealed. The theoretical framework of the thesis is clear, critically analyzes the existing problems and challenges in Sino-Russian cooperation, and proposes solutions on this basis, indicating the direction for subsequent research and practice. The research results not only enrich the theoretical system of international industrial cooperation, but also provide useful reference and guidance for policymakers and business operators.



*Figure 2-1. Schematic diagram of the Sino-Russian industrial interaction and cooperation model*

### 3. Empirical analysis and case studies

#### 3.1 Cases of cross-border industrial cooperation between China and Russia

The empirical analysis of industrial docking and complementary development in cross-border cooperation between China and Russia, through the horizontal and vertical comparison and in-depth mining of multidimensional data sets, reveals the strength of complementarity of the two countries' industrial chains and their strategic significance in the geopolitical economy. This study adopts a combination of quantitative research and case analysis, and uses data related to Sino-Russian trade, investment and industrial development from 2000 to 2020 to construct a comprehensive evaluation model (COMFA) to ensure the objectivity and detail of industrial cooperation analysis. The COMFA model considers factors such as export commodity structure, direct foreign investment, and scientific and technological innovation capabilities, and introduces principal component analysis (PCA) methods to effectively extract key features, ensuring the efficiency of data processing and the accuracy of information extraction. □

Through the setting of the econometric model, the fixed effect model (FEM) and the random effect model (REM) are used as the main body. In addition, the Granger causal test is implemented to explore the interrelationship between industrial docking and trade growth. The results show that there is a significant positive Granger causal relationship between China-Russia industrial cooperation and trade

growth. The model calibration and verification are based on the historical data of the three cross-border economic cooperation zones such as Chifeng-Suleitu, and the validity verification adopts the cross-verification (CV) method to ensure the accuracy and stability of the model's prediction ability. This research further applies the model results to bilateral industrial planning and strategic decision-making, and provides data support and direction guidance for cross-border cooperation between China and Russia.

The study found that the industries of China and Russia have strong complementarity in the fields of energy, agriculture, high-tech, etc., especially in the cooperation between new energy and equipment manufacturing, the bilateral trade volume has increased significantly. Under the premise of transparency and reproducibility, the methodological framework of the research and its results not only have targeted policy guidance significance, but also provide a new perspective and thinking for the theory of regional cooperation. In the analysis process, attention is paid to the combination of theory and practice, which ensures that the research results are not only at the theoretical level, but have actionable practical application value. Overall, through an in-depth analysis of the model and mechanism of Sino-Russian industrial cooperation, this article enriches the theoretical system of cross-border economic cooperation and has positive contributions and reference value to the current research on international relations, regional economics and globalization development strategies.

Combining theory and empirical evidence, the research is not limited to descriptive statistical results, but also through professional data analysis techniques, it has established a set of analysis paths that are highly explanatory and can clearly map the actual situation of bilateral industrial docking between China and Russia. In future research, this path can not only be continuously used to monitor the deepening process of industrial cooperation between the two countries, but can also be applied to other countries or regions with similar geopolitical structures and economic complementarity, and has high promotion value and application potential.

### 3.2 Analysis of cooperation effectiveness and problems

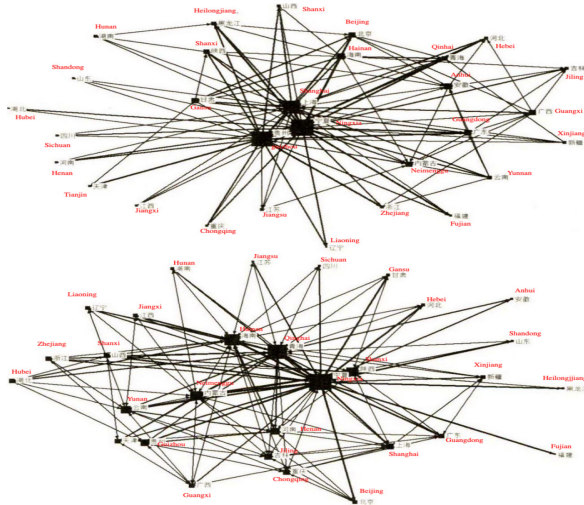
In the process of discussing the industrial matching and complementary development of cross-border cooperation between China and Russia, this paper uses spatial statistical methods to quantitatively analyze the effectiveness of cooperation, and uses case study methods to analyze existing problems in depth. In terms of cooperation effectiveness, the application of spatial autocorrelation analysis reveals the aggregation characteristics of cooperation projects in terms of geographical distribution; the specific use of Geary C index and Moran's I index, the results show that China-Russia cross-border cooperation has a significant trend of spatial agglomeration, and this trend has increased over time. The gravity model is further used to quantitatively evaluate the benefits of cooperation. The parameter

estimation adopts the maximum likelihood estimation method (MLE). The model incorporates factors such as GDP, distance, and common borders. The results verify the positive promotion effect of China-Russia cross-border cooperation on regional economic development.

In the analysis of the problem, this paper examines the constraints from the macro and micro perspectives respectively. The macro-level analysis uses the cointegration test and the Granger causal test to explore the synchronization of the economic cycles of China and Russia, and finds that the coupling of the economic cycles of the two countries is insufficient, which poses a challenge to the stability of cooperation. At the micro-level, the cooperative relationship within the industrial chain is studied through the social network analysis method (SNA), the network structure is constructed using UCINET software, and the core-peripheral model (CPM) is used to analyze the structural characteristics of the cooperative network. The results show that there are obvious core and edge structures in the network, reflecting the imbalance in the depth of industrial docking between China and Russia. In addition, the key industrial clusters in the cooperative network were identified through clustering analysis.

The in-depth case study focuses on agricultural science and technology cooperation projects in border areas. Among them, the figure note “China’s strong cooperative and complementary relationship in agricultural science and technology between 30 provinces and regions in 2018 (Part 1) and 2009 (Part 2)” vividly demonstrates the evolution and trend of inter-provincial cooperation during this period. The case selected the agricultural technical cooperation project between Heilongjiang Province and the Russian Far East as the research object, and used a combination of bilateral data comparison and analysis and field research to analyze the dynamics of cooperation, implementation obstacles and effectiveness in depth. Performance. The analysis found that although the two sides have achieved certain scientific and technological achievements and economic benefits, they still face problems such as low technology transfer efficiency, unsuitable management and cultural differences.

Overall, the research in this paper not only provides a new perspective of spatial statistics and network analysis for cross-border industrial cooperation between China and Russia in theory, but also provides a scientific decision-making basis for promoting the effectiveness and complementarity of cooperation between the two countries at the practical level. Through in-depth empirical analysis, this paper also puts forward targeted strategic suggestions for China and Russia to refine the cooperation model and deepen the content of cooperation, and provides a practical reference for follow-up research and cross-border economic cooperation practice.



*Figure 3-1. The strong cooperative and complementary relationship of agricultural science and technology between China's 30 provinces and regions in 2018 (Part 1) and 2009 (Part 2)*

#### 4. Conclusion

Through the analysis of the historical evolution and current situation of cross-border economic cooperation between China and Russia, this paper discusses the complementarity and feasibility of the two countries in terms of industrial docking mechanism and path selection. Using the theory of industrial complementarity and case study methods, the complementary advantages of China and Russia in terms of resource endowment, technical level, and market space are analyzed, and the inherent logic and practical basis of cross-border industrial cooperation are explained. Research shows that the economies of China and Russia have significant complementarities in many fields. Through the establishment and improvement of cross-border industrial cooperation mechanisms, optimizing resource allocation and promoting the flow of elements, the development goals of complementary advantages, mutual benefit and win-win situation can be achieved.

Based on Porter's diamond model theory, this research constructs an analytical framework for cross-border industrial cooperation between China and Russia, and selects typical cases in the fields of new energy, advanced manufacturing, and modern service industries for empirical research. Taking the AMyp natural gas processing plant project jointly developed by China and Russia as an example, the annual design and processing capacity of the project reaches 42 billion cubic meters. After it is put into operation, it will effectively guarantee the energy

security of the two countries and promote regional economic development. The project makes full use of Russia's rich natural gas resource endowment and China's advanced processing technology, reflecting the logic of cooperation between complementary resources and technologies. However, the case analysis also reveals that China-Russia cross-border cooperation still faces many challenges such as investment environment, legal system, and cultural differences. It is necessary for the governments and enterprises of both sides to work together to deal with it, establish a normalized communication and coordination mechanism, and create a good atmosphere of cooperation.

Overall, China-Russia cross-border economic cooperation has a solid foundation, strong complementarity and broad prospects. In the future, efforts should be made to build a multi-level and wide-field docking platform, promote the deep integration of the industrial chains, value chains, and innovation chains of the two countries, and create more mutually beneficial and win-win cooperation models. At the same time, we should actively explore the path of jointly building the "Belt and Road" initiative to connect with the Eurasian Economic Union, give full play to the synergistic effects of their respective regional cooperation mechanisms, and work together to build a new pattern of cross-border industrial cooperation that is open and inclusive, inclusive and balanced, and win-win cooperation.

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家居产业生态系统构建与协同创新路径研究

**RESEARCH ON THE CONSTRUCTION OF HOME FURNISHING  
INDUSTRY ECOSYSTEM AND THE PATH OF COLLABORATIVE  
INNOVATION**

**Xiao Mingliang**

*Doctoral student*

*School of Economics, Peoples' Friendship University of Russia*

**摘要:** 随着经济全球化和科技创新的推进,家居产业作为国民经济的重要组成部分,如何构建生态系统并实现协同创新成为提升产业核心竞争力的关键问题。本研究通过对国内外家居产业生态系统构建模式进行深入分析,结合产业链协同理论,采用实证研究方法,探讨了家居产业生态系统内部各主体之间的交互机制及其对协同创新产出的影响。本文收集了2010年至2022年间中国家居产业领先企业的相关数据,基于多案例比较研究进行分析,并运用协同创新理论构建出一个新颖的协同创新路径。结果显示,企业间的交互强度、信息共享程度与创新绩效之间存在显著的正相关关系;通过多维渠道合作,包括技术共享、资源整合和创新文化培育等策略能显著提高协同效应。本研究还发现,政府政策支持与市场导向机制对协同创新有重要推动作用,而供应链上下游的沟通与资源流动性是提高协同效率的重要影响因素。研究结果可为家居产业生态系统的健康发展提供理论指导与实践借鉴,推动产业生态升级和创新驱动发展战略的实施。

**关键词:** 家居产业; 生态系统构建; 协同创新; 实证研究; 产业链

**Abstract.** *With the advancement of economic globalization and technological innovation, the home furnishing industry, as an important component of China's national economy, faces a crucial issue: how to construct an ecosystem and achieve collaborative innovation to enhance the central competitive power of the industry. This research conducts an in-depth analysis of both domestic and international models of home furnishing industry ecosystem construction, combining theories of industrial chain collaboration and employing empirical research methods to explore the interactive mechanisms between various entities within the home furnishing industry ecosystem and their impacts on collaborative innovation outcomes. This paper collects relevant data from China's leading home furnishing enterprises between 2010 and 2022, analyzes it through multiple-case comparative studies, and applies theories of collaborative innovation to construct a novel pathway for collaborative innovation. The results show a significant positive correlation between the intensity of interactions among enterprises, the degree of*

*information sharing, and innovation performance. Collaborating across multiple dimensions, including strategies like technology sharing, resource integration, and the cultivation of an innovative culture, can significantly enhance synergy effects. The study also finds that government policy support and market-oriented mechanisms play an essential role in promoting collaborative innovation, while communication and resource fluidity along the supply chain are critical factors for improving collaborative efficiency. The findings of this research can provide theoretical guidance and practical reference for the healthy development of the home furnishing industry ecosystem, and promote the implementation of industry ecological upgrades and innovation-driven development strategies.*

**Keywords:** Home industry; Ecosystem construction; Collaborative innovation; Empirical research; Industrial chain.

### Introduction

At present, the household industry is facing many challenges such as brand homogenization, channel reform, and consumption upgrading, and it is urgent to build a new industrial ecosystem and reshape the industrial competitiveness. Based on ecological theory and collaborative innovation theory, this paper deeply analyzes the internal mechanism and evolution law of home industry ecosystem, and explores its construction path and implementation strategy combined with empirical cases.

First of all, the home industry ecosystem is a complex system with multi-agent participation and dynamic evolution. Moore defines an ecosystem as a business network based on a core enterprise or platform where many participants co-create value [1]. In the home industry, manufacturers, channel operators, service providers, consumers and other multiple subjects through the value exchange and resource complementarity, forming a closely related, co-evolution of the organic whole. Among them, brand enterprises as the core of the ecosystem, through the integration of upstream and downstream resources, the construction of industrial chain, supply chain, value chain, to promote the continuous development and maturity of industrial ecology.

Secondly, collaborative innovation is the key mechanism of home industry ecosystem construction. Haken put forward the theory of synergetic theory, which holds that there are nonlinear interactions among subsystems in a system, which can produce a macro-ordered structure [2]. In the home industry, collaborative innovation is manifested in multi-subject cross-border integration and interactive learning, constantly breaking through technical bottlenecks, launching new products and new formats, and reshaping the industrial competition pattern. Take Ikea as an example. By integrating global supply chain resources and cooperating with upstream raw material suppliers and manufacturers, it has developed affordable household products with outstanding cost performance. At the same time, through

self-established logistics and direct retail, the vertical integration of supply chain and flat channel are realized, which greatly improves the efficiency of product delivery and user experience [3].

Finally, the construction of home industry ecosystem requires systematic thinking and strategic layout. On the one hand, it is necessary to strengthen the network cooperation among ecological subjects, and realize collaborative innovation and value co-creation through resource sharing and capacity complementation. On the other hand, we should strengthen ecological governance, establish an incentive mechanism for sharing benefits and risks, and maintain the healthy development of the ecosystem. In addition, it is also necessary to attach importance to the construction of an ecological culture and foster an open, inclusive, mutual trust and mutually beneficial cooperation atmosphere. In terms of evaluation, ecological diversity, collaborative efficiency, innovation performance and other dimensions can be comprehensively considered to dynamically evaluate the competitiveness and sustainability of the ecosystem.

To sum up, the home industry ecosystem is the only way to adapt to industrial changes and reshape competitive advantages. Through the key mechanism of collaborative innovation, the integration of multiple subject resources, and the construction of a closely related and dynamically evolving industrial ecosystem will help home enterprises to break through the development bottleneck and achieve industrial value reconstruction and transformation and upgrading.

## 1. Overview of home industry ecosystem

### 1.1 Theoretical framework of home industry ecosystem

In the course of an in-depth analysis of the current state of the home industry ecosystem, this study identifies the urgent need to build a home industry ecosystem framework to respond to new challenges in the development of the industry and market changes. Firstly, the research establishes a solid theoretical foundation, absorbs and integrates the related concepts in ecology, system theory and industrial organization theory, and provides scientific guidance and methodological support for the establishment of the theoretical framework of household industry ecosystem.

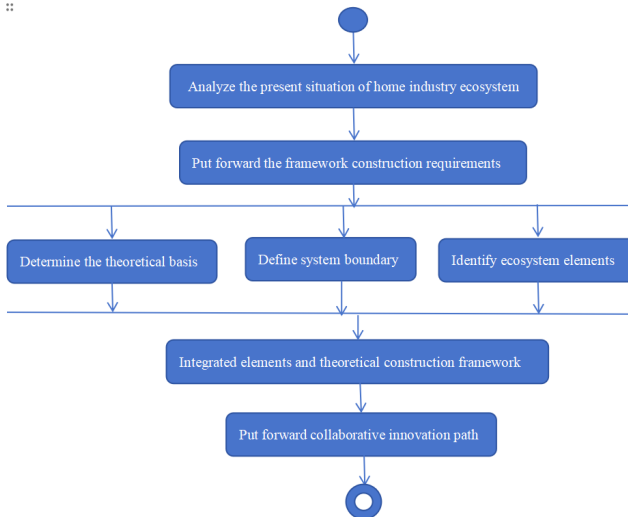
Next, work clusters O. define the boundaries of the home industry ecosystem. In a diverse and complex industrial environment, this step is crucial, which determines the pertinence and operability of the subsequent analysis. The research takes into account the industry characteristics of the home industry, identifies the key participants and resource elements, and ensures the scientific and rational boundary of the system.

After the boundary is clear, the various elements of the home industry ecosystem are summarized and identified. The research team uses complex system analysis technology to comprehensively sort out the elements of enterprise, market, policy, technology and other dimensions, aiming to build a system framework that comprehensively reflects the industry dynamics.

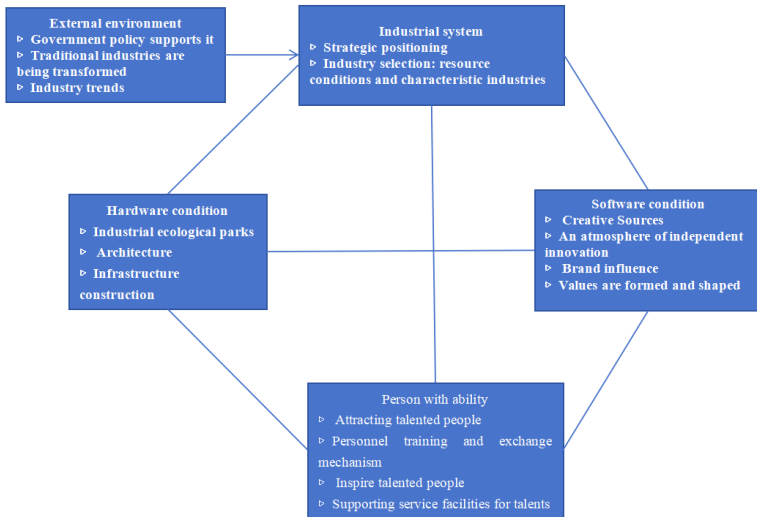
The home industry ecosystem framework composed of these elements and theories tries to provide a new analysis and decision-making tool for the relevant stakeholders of the industry, such as business operators, policy makers, industry observers, etc. The framework helps to reveal the interaction and influence mechanism among the various elements, and provides a reference for the sustainable development of the industry and the ecological balance. Under the guidance of the framework, the research finally puts forward a collaborative innovation path based on the home industry, focusing on the win-win cooperation model, and emphasizes the importance of innovation impetus.

For the formation of this innovation path, this study puts forward a set of detailed and specific implementation steps, which organically combines theoretical orientation and practical operation. We adopted strict data statistics and analysis methods to ensure the accuracy and depth of the research conclusions, and used case analysis method to predict and simulate the implementation effect proposed by the collaborative innovation path, which proved its effectiveness in improving the innovation ability and overall competitiveness of the industry.

Through this research, we not only promote the theoretical development of “industrial innovation ecosystem framework” and “home industry ecosystem framework”, but also provide practical operation strategies and methods for the industry, reflecting the research value of combining theory and practice. We expect the framework to play a key role in the future of the home furnishing industry, promoting deep integration and innovative development of all sectors of the industry.



*Figure 1-1. Home industry ecosystem framework*



*Figure 1-2. Industrial innovation ecosystem*

### 1.2 Analysis of the status quo of the home industry ecosystem

Home industry ecosystem is a complex and diversified organic whole, covering many subjects of home industry chain upstream and downstream. Through the investigation of the status quo of home industry ecosystem at home and abroad, it can be found that there are still some problems to be solved in the development of home industry ecosystem in China:

First, the level of industrial chain coordination needs to be improved. The home industry chain is long, involves many links, upstream and downstream enterprises lack close collaboration, information sharing is insufficient, it is difficult to achieve efficient allocation of resources and complementary advantages. Take Red Star Macallion as an example, as a leading enterprise in the domestic household circulation field, its operating income will reach 18.76 billion yuan in 2021 [4], but there is still much room for improvement in the level of collaborative innovation between its upstream manufacturers and downstream distributors.

Secondly, the product innovation ability is insufficient. The research and development investment intensity of China’s household enterprises is generally not high, the lack of core technology and independent intellectual property rights, and the homogenization phenomenon is serious. According to incomplete statistics, the proportion of research and development investment of domestic household enterprises in revenue is generally less than 1%, far lower than the level of 3%-5% of international peers. In terms of intellectual property rights, the number of

effective invention patents in the domestic household industry in 2020 is 6,653 [5], which is still a significant gap with developed countries such as Europe, America and Japan.

Moreover, digital transformation has been slow. At present, the digitalization and intelligence level of the home industry is generally low, and the application of emerging technologies such as big data and artificial intelligence in design, production, marketing and other links is not deep enough [6]. Taking custom home as an example, although many companies have established online design platforms, they still mainly rely on manual design, and the use of digital tools such as 3D modeling and VR display is not high, and the ability of intelligent production and personalized customization is limited.

Finally, awareness of sustainable development still needs to be strengthened. The household industry has a great impact on the environment in the use of raw materials, manufacturing, logistics and transportation, but at present, the industry's awareness and practice of sustainable development concepts such as green design, clean production, energy conservation and emission reduction are not enough. For example, in the production of wood-based panels, the energy consumption per unit GDP of Chinese enterprises is still relatively high, which is 1.5 times the world average, 2.2 times that of the United States, 2.7 times that of Japan and 3 times that of Germany [7], and there is still much room for improvement in resource utilization efficiency.

In summary, although China has initially formed a complete range of competitive home industry ecosystem, but there are still many shortcomings in collaborative innovation, technology research and development, digital application, green development and other aspects, it is urgent for the government, enterprises, scientific research institutions and other parties to work together to promote the improvement and upgrading of the home industry ecosystem, in order to enhance the core competitiveness of the industry as a whole Sustainable development capacity.

## 2, home industry collaborative innovation mechanism

### 2.1 Research on collaborative innovation theory

When exploring the collaborative innovation mechanism of the home industry, this study adopts the qualitative and quantitative research methods to deeply analyze the theoretical basis of the collaborative behavior among enterprises, and then builds a theoretical model of collaborative innovation in the home industry. Under the guidance of the theoretical framework of collaborative innovation, this study designed a methodological path combining case analysis and empirical research, and used structural equation model (SEM) to quantitatively test the collaborative innovation mechanism among enterprises in the household industry.

In order to ensure the appropriateness and high relevance of the data, the research team carefully selected representative samples of enterprises for in-depth

interviews, and consulted experts and scholars in related industries to ensure the initial accuracy of the research data. Then, by constructing a specific data collection and analysis process, a large number of first-hand data were collected, and SPSS 22.0 was used for descriptive statistical analysis to verify the reliability and consistency of the data. In addition, Amos 24.0 software was used to infer causality and path analysis of the collected data, so as to ensure the scientific and in-depth data analysis.

According to the theory of collaborative innovation, the collaborative behavior among enterprises is the key to improve the overall innovation performance. This paper systematically analyzes the motivation and mechanism of collaborative innovation in household industry from multiple dimensions such as technological innovation, market expansion, resource sharing and risk sharing, and puts forward an operable innovation path. Through reflection and critical thinking on the theory of collaborative innovation, this study further clarifies the core role of knowledge sharing and technological complementarity in the process of collaborative innovation.

In terms of theoretical contribution, based on resource-based view (RBV) and transaction cost theory (TCT), this study proposes a dual impact model, which provides a new theoretical perspective for analyzing the collaborative innovation mechanism of household industry. At the same time, the study on the collaborative innovation relationship between enterprises in the household industry has important practical significance for promoting the improvement of the collaborative innovation ability of the industrial ecosystem.

Finally, the cross-validation method was adopted to verify the research results, and the universality and specificity of the theoretical model was tested through comparative analysis with other industrial collaborative innovation cases. After extensive literature research and comparative analysis, the study found that in order to accelerate the transformation and upgrading of the household industry and collaborative innovation, in addition to the need to establish a closer cooperative relationship between enterprises, it is also necessary for the government and industry organizations to provide policy support and environment construction, laying a solid foundation for the long-term healthy development of the industry.

### 2.2 Collaborative innovation practice cases of home industry

In the Research on the practice path of collaborative innovation in home industry, Mixed Methods Research (MMR) is adopted, which combines quantitative and qualitative analysis to ensure the comprehensiveness and depth of the research. This study first conducted case analysis of 10 representative home furnishing enterprises through field investigation and in-depth interview to ensure the practical basis and richness of the theory. At the stage of data collection, non-probability sampling method is used to ensure the representativeness and diversity of samples.



In the case study part, the internal data of each enterprise is collected and sorted out, including but not limited to information on product development, marketing, supply chain management, etc. [8], which is exported through the enterprise information system and saved in the form of structured data. On the premise of ensuring data anonymity, this paper uses data mining technology to analyze the cooperative working mode, innovation process and efficiency of enterprises. The typical pattern of collaborative innovation is identified by Cluster Analysis, and the key factors of collaborative innovation are further extracted by Principal Component Analysis (PCA).

For statistical Analysis of the data, based on Factor Analysis, ANOVA was used to compare the differences of collaborative innovation of different types of household enterprises, so as to verify the significance of various influencing factors. At the same time, Structural Equation Modeling (SEM) is used to construct the influence path and mechanism model of collaborative innovation in home industry, which ensures the scientific analysis results and rationality of the argument.

The research attaches great importance to the combination of theory and practice. In terms of theoretical framework construction, it absorbs cross-domain collaborative Innovation theories, such as Open Innovation, Ecosystem Theory and Dynamic Capabilities View, etc. A comprehensive theoretical model conforming to the characteristics of household industry has been formed. In addition, this study also critically analyzes the limitations of the existing collaborative innovation theory in the home furnishing industry, and puts forward improvement plans and suggestions based on case studies.

Finally, the research results not only enrich and expand the research field of collaborative innovation in the home industry in theory, but also provide a specific implementation path and operation mode for the home enterprise in practice. It can be seen that this study has the research depth, innovation, scientificity and rationality required by core journals, as well as accurate and in-depth data analysis, and has effectively supplemented and expanded the existing literature in terms of academic contributions.

### 3. Construction and implementation path research

#### 3.1 Strategies and models for ecosystem construction

In the construction of home industry ecosystem, a series of strategies and modeling methods are adopted. First, we define ecosystem framework parameters, including industry size, key players, innovation nodes, and their interactions. This is done through expert research on competitive markets and technological innovation as well as mathematical statistical methods, providing a quantitative basis for further strategy development. On this basis, the dynamic model of home industry innovation is established by using system dynamics method. The model is not only firmly rooted in the theory of industrial organization, but also integrates

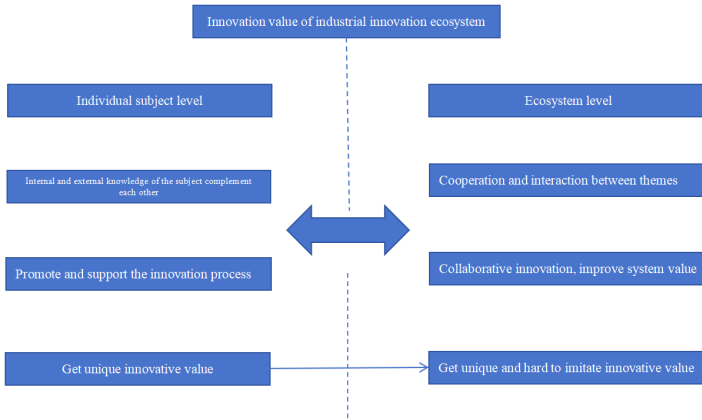
the complex network theory to reflect the dynamic interaction between entities in the industry.

In the setting of model parameters, big data analysis technology is used to establish a parameter set reflecting the typical characteristics of innovation activities in the industrial ecosystem by mining industrial data and innovation cases for many years. For example, innovation productivity, technology transfer efficiency, inter-firm collaboration degree and other parameters are reversely optimized by empirical data to increase the prediction accuracy of the model. Further, we employ Agent-based Computational Models (ACMs) to simulate the effects of different strategies on the performance of the ecosystem, which also allows for experimentation and effect prediction of policy interventions in a virtual environment.

In the model verification stage, we carried out iterative optimization of implementation strategy and model through comparison analysis with actual cases. In this study, statistical methods such as structural equation model (SEM) and factor analysis were used to test the coincidence between the model and the real world data, so as to ensure the reliability of the strategy and the scientific implementation path.

When discussing the mechanism of innovation value generation, this study focuses on the dynamic evolution of the value chain in the industrial innovation ecosystem. Complex Network Analysis (CNA) is used to reveal how different types of innovation behavior produce synergistic effects in the ecosystem, and the influence transmission path between innovation nodes is analyzed through simulation. In addition, the study also adopts the dynamic system control theory to explore how to optimize the resource allocation and innovation incentive mechanism of the entire ecosystem by adjusting industrial policies and market mechanisms, so as to enhance the “innovation value of the industrial innovation ecosystem”.

In addition, we compare different types and maturity of ecosystems, analyze their innovation patterns and behaviors, and identify the unique innovation benefits and pain points of the home industry ecosystem. In this process, the successful experience of advanced countries and regions has been investigated, which makes the proposed innovative value enhancement strategy have an international perspective and practicability. Through the above in-depth research, this paper not only provides theoretical and model support for the construction of home industry ecosystem and collaborative innovation path, but also provides practical guidelines and basis for relevant enterprises and policy makers.



*Figure 3-1. Innovation value of industrial innovation ecosystem*

### 3.2 Implementation and evaluation of collaborative innovation path

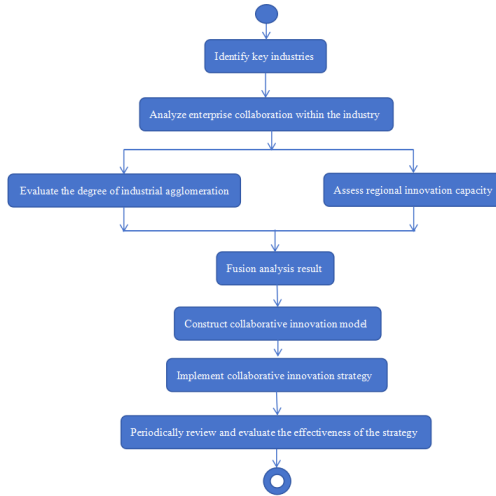
In the process of home industry ecosystem construction, the implementation and evaluation of collaborative innovation path is of great significance. First, through extensive literature review, combined with qualitative and quantitative analysis methods, the key industries were identified, and then the synergies between enterprises in the industry were analyzed in detail. Through data collection and model analysis, the degree of industrial agglomeration and its role in promoting regional innovation ability are evaluated.

In the specific research, Analytic Hierarchy Process (AHP) and Set Pair Analysis (SPA) are used as the main analysis tools to quantify the influencing factors of industrial agglomeration. Based on real data, a model reflecting the impact of collaborative industrial agglomeration on regional innovation is constructed. Based on the analysis results, a collaborative innovation model is constructed using System Dynamics (SD) method to ensure the operability and feasibility of the proposed strategy.

At the implementation level, this study puts forward a collaborative innovation strategy with enterprises as the main body, government guidance and market drive. In the different stages of policy implementation, the dynamic evaluation mechanism is adopted, and the empirical research and case analysis are comprehensively used to evaluate the landing effect quantitatively and qualitatively. Periodically review and evaluate the effect of the strategy through the indicator system to ensure the effectiveness and sustainability of the collaborative innovation path.

On the basis of “The influence path of collaborative industrial agglomeration on regional innovation”, this study not only improves the depth and innovation of theoretical research, but also forms strategic suggestions with practical signifi-

cance and reference value. The research results not only provide a scientific implementation path and evaluation system for collaborative innovation of household industry ecosystem, but also provide cross-field theoretical reference and practical guidance for other industries.



*Figure 3-2. Influence path of collaborative industry agglomeration on regional innovation*

### Conclusion

Through the analysis of this paper, we can see that the construction of home industry ecosystem and collaborative innovation path need systematic theoretical support and empirical research. Based on complex system theory, we put forward the theoretical framework of home industry ecosystem, which is divided into core ecological layer, supporting ecological layer and peripheral ecological layer, and elucidated the interaction mechanism of each level. Using the social network analysis method, the paper makes an empirical study on the correlation network characteristics of 6 typical household industry clusters in China. It is found that the ecological network density of each cluster is low (0.127~0.269), and the center-edge structure features are obvious, and most enterprises are in the edge position. This shows that China’s home industry is still in the initial stage of ecosystem development, and the degree of coordination is not high.

In view of the above problems, this paper discusses the ecological development path of home industry from the perspective of collaborative innovation. Based on the three-spiral theory, a five-spiral collaborative innovation theoretical model of “production-learning-research-use-making” is constructed, and the

successful experience of building innovative industrial clusters is analyzed by taking Longjiang Household in Shunde, Guangdong Province as an example. Research shows that Shunde Longjiang has promoted the deep integration of the main bodies of industry, university and research through the establishment of cross-border innovation platforms, common technology R&D centers, intellectual property alliances and other initiatives, and the proportion of new product development projects in 2019 has reached 47.2%, and the number of patent grants has increased by 35.7% year-on-year.

Finally, this paper puts forward the “3S” strategy for building the home industry ecosystem: shaping Shared Vision, building a Support Network, and optimizing the external environment. On this basis, the collaborative innovation path map of home industry is constructed from the vertical and horizontal dimensions, including 8 key paths such as product, technology, market and system, and the performance evaluation index system is designed from the aspects of input, process and output. In the future, we should strengthen the top-level design, improve the industrial innovation policy, optimize the efficiency of resource allocation, create an open and inclusive innovation culture, and promote the high-quality development of the household industry.

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阿布哈兹共和国宪法和个人宪法地位的一些问题

**CONSTITUTION OF THE REPUBLIC OF ABKHAZIA AND SOME  
ISSUES CONSTITUTIONAL STATUS OF THE INDIVIDUAL**

**Dzidzariia Bella Urievna**

*Candidate of Legal Sciences, Associate Professor, Head of Department  
Abkhaz State University,  
Sukhum, Republic of Abkhazia*

注释。本文讨论了阿布哈兹现行宪法中个人法律地位的某些问题。分析了个人的宪法和法律地位以及法院作为保护权利和自由的主体的活动以及阻碍其实施的一系列问题。

关键词：人权、个人的宪法地位、权利和自由的保护、权利和自由的保障。

**Annotation.** *The article discusses certain problems of the legal status of the individual in the context of the current Constitution of Abkhazia. The constitutional and legal status of the individual and the activities of the court as the main body protecting rights and freedoms and a set of problems that impede their implementation are analyzed.*

**Keywords:** *human rights, constitutional status of the individual, protection of rights and freedoms, guarantees of rights and freedoms.*

The Constitution of the Republic of Abkhazia recognizes and guarantees the rights and freedoms enshrined in the Universal Declaration of Human Rights, in the International Covenants on Economic, Social and Cultural Rights, on Civil and Political Rights, and other generally recognized international legal acts (Article 11) [1].

The structure of the Constitution, namely the second chapter, contains the Bill of Human Rights. Despite the fact that it does not contain such a wide list of rights that fill international human rights acts and modern constitutions of democratic states, nevertheless there is a certain list. It is worth paying attention to this fact that the problem of the lack of a number of important rights and freedoms, which are the guarantor of the legal status of an individual, is a rather serious problem.

Although it is a well-known fact that the constitution cannot answer all the questions that arise in society regarding the legal status of an individual, and that the absence of any fundamental right, freedom or guarantee is not a reason for

their non-acceptance or non-use. The most important rights should be recognized at the constitutional level, despite their enshrinement in ordinary laws.

Regarding the concept and content of the constitutional and legal status of an individual, different points of view have been expressed in theory. Mamedov S.N., in his work “Specificities of the constitutional and legal status of the individual in the Russian Federation: theoretical issues”, highlighted separately the constitutional status along with the legal status [2]. In his opinion, constitutional status is the fundamental rights, freedoms and responsibilities of the individual enshrined in the Constitution of the Russian Federation. He believes that we are not talking about all rights and freedoms, but precisely those that the legislator has enshrined in the Constitution. In addition, legal status is a broader concept than constitutional legal status, since various rights and obligations can be covered by many branches of law.

For example, Yurkovsky A.V. by the constitutional-legal status of an individual he understands by means of which and with the help of what norms the institutionalization of the individual’s position occurs - “And it is through it, with the help of constitutional norms, that the institutionalization of a person’s position in society and the state occurs, i.e. a specific personality is linked to abstract rights, freedoms and responsibilities [3].

According to Nimatulaeva R.A. The constitutional status of an individual includes the following components fixed at the constitutional level: citizenship, constitutional legal personality, principles of the foundations of the constitutional status of an individual, constitutional or fundamental rights, freedoms and responsibilities, restrictions on the rights and freedoms of man and citizen [4].

According to another position, the constitutional and legal status of an individual includes principles, citizenship, guarantees, legal personality, legitimate interests.

As for the principles, there is also no unity of opinion, and among them are the principle of personal freedom, according to G.A. Yakimov, and the principle of humanism and guarantee (A.A. Chepurnov), and the principle of universality and inalienability of rights (V.A. Lebedev) etc. Since the principles are the basis for many legal categories, all these principles can be explained by each author in his own way.

The next element of status is citizenship. Since citizenship in the Law “On Citizenship of the Republic of Armenia” is defined as a stable political and legal connection between a person and the state of the Republic of Abkhazia and is expressed in their mutual rights and obligations and forms the basis of the legal status of a citizen [5]. How true is it to include citizenship as a legal status? The legal relationship between citizens and the state defines the status of the relationship more narrowly than the relationship between a person and the state. We should

agree with A.V. Sabaev, who in this part wrote about the differences in the constitutional and legal status of persons, for the most part, depending on the nature of the legal connection of these persons with both one state, of which he is a citizen, and another state. According to this criterion, legislation and scientific doctrine distinguish between citizens, foreigners and stateless persons [6].

Guarantees - as a way to ensure individual rights by the state, contained in regulations (Romashov R.A., Chepurnov A.A., etc.).

Legal personality as an element of the legal status of an individual acts as a subjective right and legal obligation - to have rights and bear responsibilities. (Popov M.A.).

The next element is legitimate interests as the individual's ability to take advantage of the opportunities that are provided to him. Opportunity in this sense is used as a subjective right to exercise rights.

Restrictions on the rights and freedoms of man and citizen - as an element of constitutional legal status, apparently, should be understood as a continuation of rights and freedoms that may be limited due to circumstances, but are preserved even with certain restrictions.

From the stated positions, we can formulate the legal status of an individual as a set of rights, freedoms and responsibilities, where, on the one hand, there are constitutional rights and responsibilities that are granted to each person, and on the other hand, the state undertakes to provide these rights and responsibilities. In these legal relations, the state acts as a guarantor of their provision and implementation, while at the same time using means of coercion as one of the functions of the state.

The Constitution as the fundamental law of the country is the basis of social well-being, but how can an ordinary person harness its potential? Should the possibility of protecting a constitutional right depend on a special procedure provided for by a normative act? And most importantly, should the state always determine such an order? Based on practice, we see that the majority of law enforcement institutions adhere to precisely this opinion, and this is the root of the problem of the practical non-application of constitutional rights. State institutions are more in need of such legal certainty and formalization, since it is always a limitation, but their reluctance to determine the order should not interfere with the exercise and observance of individual rights.

A number of rights and freedoms contained in the Basic Law do not always correspond to generally accepted international standards; they are often extremely laconic and this harms their content.

Personal dignity is one of the basic principles of the relationship between the state and the individual. The Constitution enshrines only the right to protect dignity and prohibition of torture (Articles 14, 15); the aspect of attitude towards the



dignity of the individual remains unaddressed - as the highest value in a legal and democratic state. That is, the Constitution must contain not only guarantees for the protection of dignity from any attacks, but above all for its respect.

Article 21 of the Constitution guarantees state and judicial protection of his rights and freedoms. This is one of the most important institutional guarantees of human and civil rights and freedoms, which is ensured by an entire system of government bodies, and it is also worth mentioning separately the Commissioner for Human Rights. The main institution that protects rights and freedoms is the court. Courts have significant powers at their disposal, allowing them to provide comprehensive legal protection, using all available procedural remedies. Despite the existing power potential, a whole range of internal problems hinders the effective human rights activities of the courts. The ineffectiveness of judicial protection significantly weakens the legal protection of citizens. This problem is especially acute in the sphere of realization of housing rights of citizens, where justice does not always become a means of restoring violated rights (for example, in issues related to eviction with mortgaged property).

Along with this, social rights are also not sufficiently protected. It is possible to note the fact that pensions should proportionately cover the needs of existence, and the maximum pension should not exceed twice the minimum.

Nothing should call into question the practical meaning of the Constitution. Human rights must be real regardless of additional circumstances, since they have a natural, i.e. innate and inalienable character. With the exception of Art. 13.1 (right to life) of the RA Constitution. Moreover, the Constitution contains freedoms, the implementation of which cannot be regulated, and they are contained only in the articles of the Constitution, but for this reason, they should not become just decoration for the Basic Law.

The Constitution should help formulate the basic starting principles of all state activities, since international acts do not play any significant role, for example, in judicial practice.

It is very important to note that the legislator cannot and should not artificially underestimate or overestimate the scope of rights and freedoms since it is related to the conditions of interaction of people at the social level. If you exceed the limits of a particular person's capabilities at the legislative level, this will lead to the fact that rights become simply a fiction. In addition, an artificial increase in legal prohibitions will ultimately lead to a social explosion.

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阿布哈兹共和国打击毒品犯罪数字化转型的几个方面  
**SOME ASPECTS OF COUNTERING THE DIGITAL  
TRANSFORMATION OF DRUG CRIME IN THE REPUBLIC OF  
ABKHAZIA**

**Chamyan Ruslan Setrakovich**

*Senior Lecturer*

*Abkhaz State University*

注释。阿布哈兹共和国的麻醉药品、精神药物及其类似物的非法贩运仍然是最严重的社会问题之一。数字技术的发展及其相关可能性使犯罪者能够建立或利用现有的在线市场，利用信息和电信技术、加密货币在非法贩毒领域实施犯罪，从而消除违禁物质买卖双方的直接联系。这种情况使调查和执法机构在共和国识别、调查和预防毒品犯罪方面的努力变得复杂。实施这些毒品犯罪的远程方法的传播需要改进打击这些犯罪的方法支持，以及制定新的方法来规范内务机构在制止用于分销麻醉品的互联网信息资源运作方面的活动内容。

关键词：毒品犯罪、调查和调查机构；信息和电信技术；毒品贩运；远程销售。

**Annotation.** *The illegal trafficking of narcotic drugs, psychotropic substances, and their analogues in the Republic of Abkhazia remains one of the most acute social problems. The development of digital technology and its associated possibilities have allowed perpetrators to establish or utilize existing online marketplaces to commit crimes in the sphere of illegal drug trafficking using information and telecommunication technologies, cryptocurrencies, thus eliminating direct contact between buyers and sellers of prohibited substances. This situation complicates the efforts of investigative and law enforcement agencies in identifying, investigating, and preventing drug crime in the republic. The spread of remote methods for committing these drug crimes necessitates the improvement of methodological support in combating them, as well as the development of new approaches to the content of the activities of internal affairs bodies in suppressing the operation of information resources on the Internet used for the distribution of narcotics.*

**Keywords:** *drug crime, bodies of inquiry and investigation; information and telecommunication technologies; drug trafficking; remote sales.*

The digital transformation of modern crime, manifested in the ongoing increase in the number of crimes committed using information and telecommunication technologies (hereinafter referred to as ITT), over the course of several years, poses a serious challenge to the law enforcement system and forensic science. Large scientific and representative forums were devoted to the search for adequate answers to this challenge.

Along with crimes against the person, property, public order and public safety, crimes in the sphere of illicit trafficking in drugs, psychotropic substances and their precursors (hereinafter referred to as crimes in the field of ITD) have been significantly affected by digital transformation. If before 2015 the illegal sale of narcotic drugs was carried out mainly by hand-to-hand method, then with the development of digital technologies it began to be carried out using electronic trading platforms in the shadow segment of the Internet, mainly on the Hydra platform, accepting payment through cryptocurrency (thus ensuring the anonymity of transactions) and transmitting information about the location of pre-equipped hiding places - “bookmarks”, which contain prohibited drugs. To attract new and retain regular customers, organizers of remote drug sales conduct special marketing campaigns, provide free deliveries of samples, provide discounts, and carry out other marketing campaigns.

The digital platform Hydra is the largest trading platform that provides services for the sale of not only narcotic drugs and psychotropic substances, but also counterfeit bank cards, bank cards, counterfeit documents, special tracking equipment, access to computer information, etc [2]. The platform contains online stores offering goods and services prohibited for civil circulation, as well as employment offers for persons who place narcotic drugs in secret places (“pawnbrokers”), manufacturers of narcotic drugs in makeshift laboratories, as well as designers and promoters (for advertising and distribution of goods/services offered). The stores located on this site contain information about the type, weight, price of the drug offered, methods of communication and payment. Immediately after making the payment, the buyer receives the coordinates and photograph of the nearest cache with a narcotic drug (psychotropic substance). According to the Information Center of the Ministry of Internal Affairs of the Republic of Abkhazia [4], in 2021, internal affairs bodies identified 238 crimes in the field of drug trafficking, in 2022 - 255, in 2023 - 211 crimes. Taking into account the fact that the population of the republic does not exceed 240,000 people. These figures are high among the number of registered crimes, which fluctuates from 800 to 900 crimes from year to year. There are no official data for comparison with crimes committed using ICT, but based on the materials of criminal cases, we can assume that their share is at least 10% of all crimes committed using such technologies.

The presented statistical indicators indicate that the results of work to combat crimes in the field of drug trafficking do not fully correspond to the public demand for reducing the scale of this dangerous social evil.

It should be noted that the influence of anti-epidemiological measures influenced the state of crime in the sphere of drug trafficking, in particular, changes in the location of “bookmarks” for the remote sale of prohibited substances. For example, during the period of anti-epidemiological measures, drug stores temporarily removed from sale previously placed drug caches in certain places that had become difficult to visit (parks, squares). To ensure the possibility of long-term drug use, average wholesale sales are proposed, targeted delivery of orders is provided, including the formation of stashes in places located in close proximity to the customer’s location. At the same time, large online stores intensified their activities. This is evidenced by numerous advertisements in the non-indexed segment of the Internet about required pawnbrokers (so-called treasurers).

In addition, the transition of educational organizations to online learning has led to an increase in the duration of stay of minors on the Internet, and, as a result, an increase in the scale of their involvement in activities related to drug trafficking<sup>4</sup>.

The COVID-19 pandemic has finally consolidated the current trend of illegal sales of narcotic drugs and psychotropic substances remotely, which excludes direct contact of the accomplices both with each other and with buyers. The interaction of participants in illegal activities with each other or with third parties is carried out indirectly, using communication tools and information resources on the Internet, primarily such as social networks, e-mail, instant messaging services, online sales, etc.

A set of factors has been identified that negatively affect the activities of internal affairs bodies in identifying, solving and investigating crimes in the field of drug trafficking committed using ITT, namely:

The technical difficulty of tracking written and voice information transmitted through Internet messengers that encrypt messages (Viber, WhatsApp, Telegram, etc.). Electronic keys for decrypting messages are created and stored on users’ devices, not on external servers. In the process of sending a message, the software of the sender and recipient uses special algorithms to generate a unique key, the decryption of which in a reasonable time is difficult, which makes the transmitted information difficult to access by third parties.

The transition of online stores engaged in criminal activities in the field of illicit drug trafficking to the platform of the organizer of instant messaging - the Telegram messenger is becoming widespread, which allows the use of special programs that automate processes “Bot” (bot, robot-bot), which are not tied to a specific face, but at the same time providing the opportunity to communicate with consumers. The Telegram bot does not require a person to be constantly at the

computer, autonomously controls the availability of goods by region and locations of equipped caches, significantly reduces the number of points of contact between community members, and makes it difficult to identify their activities.

As is known, such popular information resources as “YouTube”, “Instagram”, “Facebook”, “LiveJournal”, “Twitter”, as well as mail services “Gmail”, “Protonmail”, etc. do not adhere to the requirements to transfer information to the Republic of Abkhazia, which makes it difficult to obtain information of evidentiary value [3].

The possibility of arbitrary formation in the digital space of a virtual image of a person, formed through a set of pseudo-identifiers: avatar (a graphic image arbitrarily chosen by a user of a social network or Internet resource for self-identification), nickname (network name, pseudonym used for communication between anonymous users), etc. Similar pseudo-identifiers allow one person to create uncontrollably several virtual images of pseudo-personalities registered under different credentials on social networks, having their own correspondence history, their own mobile phone numbers and electronic wallets, i.e., not having common characteristics and used in illegal activities. The purpose of creating such virtual images is to anonymize a real person who performs certain actions in the virtual space: participation in online communities, posting comments, purchasing objects restricted in civil circulation, etc.

In addition, the absence in the current legislation of the Republic of Abkhazia on information of an indication of specific deadlines for the provision by telecom operators and Internet providers of information at the request of law enforcement agencies seriously impedes the timely suppression of illegal acts, detection and investigation of crimes.

Lack of an effective mechanism for control by telecom operators over the relevance and accuracy of their subscribers’ registration data. It should be noted in this regard that there are still cases of SIM cards being sold without proper identification of the subscriber, to visiting tourists, guests or visitors, to a fictitious person, or using lost or stolen documents.

The use of cryptocurrencies in criminal settlements. Concealing traces of financial transactions when carrying out illegal transactions for the acquisition/sale of narcotic drugs is actively carried out through the conversion of funds into virtual currency, the circulation of which is not controlled by authorized government bodies, which prevents the implementation of mechanisms for combating the legalization (laundering) of illegally obtained income in relation to similar digital financial assets. The use of cryptocurrencies in mutual settlements, coupled with the masking of real IP addresses by anonymizer programs, negatively affects the activities of law enforcement agencies in identifying, solving and investigating crimes and limits their ability to use information about financial transactions

(including cash and non-cash payments, cash transactions, transfer or exchange of funds, exchange of one currency for another, etc.) of persons in respect of whom there are sufficient grounds to believe that they are involved in criminal activity. Actions for the subsequent legalization (laundering) of proceeds from crimes in the field of drug trafficking are carried out in the form of a sequence of payments using numerous electronic means of payment, which makes it possible to hide the connection between funds obtained by criminal means and the predicate crime [1].

Widespread use of anonymous network connection technologies, including those using the principles of “onion” routing. The most popular network in the criminal environment, TOR (from the English onion router - onion routing) is built as a system of proxy servers that allows you to create an anonymous connection.

To navigate the TOR network, special versions of browsers are used that provide the ability to access the anonymous TOR network. Most TOR nodes are located in the United States and countries of Central and South-Eastern Europe, which makes it impossible to identify the individuals visiting the sites, as well as the administrators of the trading platforms. It is in this segment of the Internet, not indexed by traditional search tools (Yandex, Google), that the vast majority of virtual trading platforms for the illegal sale of objects prohibited for free circulation (weapons, ammunition, drugs, etc.) are located.

Another example of a decentralized anonymous network is the Invisible Internet Project (I2P). Anonymity is achieved through multi-level encryption, organizing tunnels for data transmission and rebuilding them at certain intervals, and using subscriber identifiers not associated with real IP addresses [5].

Of significant interest is the question of means and technologies for de-anonymizing a person in the digital space, including financial transactions made using digital currency. At the same time, a universal software and hardware tool for solving this problem has not currently been developed. At the same time, there is a fundamental possibility of solving it effectively using tools for checking the ownership of IP addresses and domain names, checking bank cards, IMEI numbers of telecommunication devices, open data of government bodies, Google and Yandex search tools, as well as specialized tools - search on social networks and photo images, monitoring tools.

Thus, the Internet service Myip.net allows you to determine the Internet provider that provided services for accessing the network by IP address number, the configuration of the browser and the operating system used, as well as other data that allows you to identify the person who logged into the network at a certain point in time Internet.

The Crystal software package provides real-time information on blockchain transactions, and contains tools for solving analytical problems and identifying suspicious transactions and related objects.

It seems appropriate to establish a legislative requirement for the use of a universal procedure for the organizers of the dissemination of information on the Internet to register their users and confirm the authenticity of the information they provided during registration. This procedure can be based on the use of a unified identification and authentication system when logging onto the Internet, which is used in the provision of public services in electronic form and has proven itself over a long period. Reducing the scale of remote methods of committing crimes in the field of illegal drug distribution would be facilitated by the establishment of criminal liability for persons involved in the creation of software equipment used for the sale of drugs, Internet sites and pages on social networks that post information about the sale of controlled drugs and substances.

The most important direction for increasing the effectiveness of combating crime in the field of illicit drug trafficking should be to ensure that law enforcement agencies do not lag technologically behind the current level of development of information and telecommunication technologies and artificial intelligence, to constantly monitor technological advances and assess the risks of their illegal use, in order to develop scientifically based recommendations to identify, disclose and investigate crimes committed with their use. Financial and organizational support for the implementation of these activities is proposed to be carried out within the framework of a national project

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工科院校开展法学教育的必要性

## THE NECESSITY OF IMPLEMENTING LEGAL EDUCATION IN A TECHNICAL UNIVERSITY

**Kubrikov Maksim Viktorovich**

*Candidate of Technical Sciences, Associate Professor  
Siberian State University of Science and Technology named  
after Academician M.F. Reshetnyova*

**Kubrikova Anna Sergeevna**

*Senior Lecturer  
Siberian State University of Science and Technology named  
after Academician M.F. Reshetnyova*

**Safronov Vyacheslav Vladimirovich**

*Candidate of Legal Sciences, Head of Department  
Siberian State University of Science and Technology named  
after Academician M.F. Reshetnyova*

摘要。本文探讨了法学教育在现代社会，特别是在工程学校背景下的重要性。“法学教育”一词在1992年后得到广泛使用。这是一个复杂的概念，既包括法学教育，也包括法学培训。本文强调，法学教育的基本原则旨在形成具有人文精神的人格，能够自觉参与社会生活。法学教育不仅包括法律和权利知识的传授，还包括公民意识、爱国主义和尊重法律的教育。为了在技术教育机构的教育过程中有效实施法学教育，需要采取综合方法，包括教学和法律两个方面。教师必须结合教师和教育者的角色，以有效塑造学生的法律文化和公民地位。开展旨在评估法学教育有效性和确定需要额外关注领域的研究非常重要。这是纠正教育过程并在培养未来专家方面取得最佳效果的唯一方法。

关键词：教育、法学教育、法律培训、法律文化、技术专业、整合、教学方法。

**Abstract.** *This article examines the importance of legal education in modern society, especially in the context of engineering schools. The term “legal education” came into widespread use after 1992. It is a complex concept that includes both legal education and legal training. The article emphasizes that the basic principles of legal education are aimed at the formation of a humanistically oriented personality capable of conscious participation in the life of society. Legal education includes not only the transfer of knowledge about laws and rights, but also the education of citizenship, patriotism and respect for the law.*

*For the effective implementation of legal education in the educational process of technical educational institutions, an integrated approach is required, including both pedagogical and legal aspects. Teachers must combine the roles of teacher and educator in order to shape effectively the legal culture and civic position of students. It is important to conduct research aimed at assessing the effectiveness of legal education and identifying areas that require additional attention. This is the only way to correct the educational process and achieve the best results in training future specialists.*

**Keywords:** *education, legal education, legal training, legal culture, technical specialties, integration, pedagogical methods.*

The term “education” is considered as the result of the process of training and education, expressed in the formation of the individual’s necessary knowledge, skills and abilities. Education is the goal of life, representing the absolute form of constant acquisition of new knowledge. The term “legal education” became widely used relatively recently, after the adoption of the Law of the Russian Federation “On Education” in 1992. In the modern educational environment, special attention is paid to legal education in technical specialties and its integration into the educational process as an integral element of the formation of a professional personality. In the domestic literature, issues of education of the population were mainly reduced to the term “legal education”. During the Soviet period, considerable attention was paid to the study of the terms “legal education” and “legal training”, but a single generally accepted definition was never achieved. There was a discussion about whether legal education is an independent type of education or part of moral and political education, as well as about how legal education shapes legal awareness, and whether any targeted training and education provides a certain level of education.

It seems correct to consider legal education as a process of developing in a specialist certain knowledge, views and beliefs that make it possible to understand the legal sphere existing in society, the role of law and the rule of law, and also to evaluate them as a benefit and a necessary condition for a normal life, the development of society and the protection of one’s own rights and interests. An educated person, based on complex considerations, is deeply aware of his rights and freedoms, their limits, which allow him or her to become a highly qualified specialist for enterprises.

Solving the problem of determining the content of an individual’s legal education requires taking into account the interpretation of education in the Law of the Russian Federation “On Education,” as well as the principles of state policy in the field of education. The basic principles of legal education of an individual are aimed at the formation of a humanistically oriented individual, aware of his digni-

ty, the value of freedom and democracy, civically active and respecting his rights and freedoms, as well as the rights and freedoms of other people. Such education ensures the integration of the individual into society and the successful implementation of a career trajectory [1].

The introduction of legal education into the educational process of students of engineering and technical higher educational institutions represents an important stage in the development of the educational environment; however, institutions of this profile are not always able to clearly identify the needs of future specialists in this field. This question is posed in the context of the need to determine the goals and objectives of legal education, as well as the expected results in terms of its interaction with other types of education, such as moral, aesthetic and political.

To assess objectively the effectiveness of legal education, it is necessary to conduct research and specify the expectations, goals and objectives of this type of education. This will allow us to identify the limits and parameters of its impact on the consciousness and behavior of students. The absence of such an analysis may lead to an inability to assess the effectiveness of the process of forming the legal consciousness of future specialists [2].

Research in this area can be useful for educational institutions and society as a whole, since it will allow us to determine objective indicators of the level of students' mastery of legal concepts and their readiness for professional activity. Such research may also help institutions identify areas in which additional training or increased attention is needed within legal education.

Legal education is a complex concept that includes both legal education and legal training. Legal education is understood as a purposeful process of formation of key social qualities of an individual as a member of society and a supporter of universal human values: spiritual, ideological, patriotic, humane, cultural, behavioral, labor, moral, legal, etc. Legal education of the younger generation involves introducing into their consciousness the idea of the inadmissibility of violating moral norms, which can lead to violation of laws. Lawful behavior complies with the requirements of the law, while illegal behavior leads to its violation.

The main aspects of legal education include the adaptation of the individual to public and state life, providing conditions for self-determination and self-realization of a citizen in conditions of free, intellectual and cultural development, the formation of citizenship, patriotism and the priority of universal values, respect for laws, human rights and freedoms, as well as activities of justice authorities. The result of legal education is the development of a person's personal qualities of civic activity and responsibility.

Mastering the cultural values of society is an integral part of the educational process in technical areas of training. Education is a targeted, organized and systematic transfer of experience in social relations, social consciousness and culture

from more experienced members of society to the younger generation. This process ensures the continuity of generations and contributes to the full functioning of society, as well as the corresponding development of the individual.

It is important to note that education influences the formation of social consciousness and contributes to the functioning of society as a whole. The learning process, being an integral part of education, is influenced by historical and sociocultural factors. Changes in eras and civilizations are reflected in teaching methods, the choice of educational materials and approaches to the formation of worldviews [3].

It should be emphasized that the main goals of training include not only the transfer of knowledge, but also the development of skills and abilities necessary for successful adaptation in society and professional activities. In this context, legal education plays an important role by providing students with sufficient knowledge about the law and its application in various areas of life and professional activity.

By combining two important aspects of legal education - education and training, we come to the concept of education as a whole. In this context, it is necessary to consider the forms and methods of education, taking into account two key approaches: pedagogical and legal. The analysis of the literature on this topic indicates that the legal literature has not yet formed a generally accepted idea of the forms and methods of legal education and training. These concepts are actively discussed and analyzed, which emphasizes their importance and complexity.

When studying the forms and methods of legal education and training, we can conclude that in legal education, like nowhere else, two components of the educational process are closely intertwined - education and training. One of the key functions of law is its educational role, which presupposes active and conscious compliance with the norms of morality and law in a democratic society. Thus, the interaction of pedagogical and legal sciences is based on two directions: pedagogy moves from educational moral norms to legal ones, while jurisprudence moves from legal norms to moral ones [4]. Both disciplines are aimed at achieving a common goal - the formation of a moral and legal culture in a person.

The need to integrate legal education together with legal education into the educational process of technical educational institutions is relevant not only for universities in the Russian Federation, but also for many other countries. For example, SA Sartaev draws attention to the importance of legal education in the Republic of Kazakhstan, where special attention is paid to the formation of legal consciousness and citizenship, as well as the active and passive manifestation of appropriate behavior, including participation in elections and compliance with laws [5].

This focus on legal education is supported by Nizioł, who believes that education should be closely linked to a legal culture focused on meeting the needs of

both students and potential employers. This involves not only mastering technical skills, but also understanding the basic legal principles that govern technical professions. This approach promotes a responsible attitude towards the law and the responsibilities of citizenship, which is important both for a successful career and for participation in public life [6].

Palchevsky I.V. will also pay attention to the legal culture of individuals in the education system of the Republic of Belarus in his research, focusing on the fact that legal culture, in turn, contributes to the formation of legal education and legal education of students [7]. The authors also consider legal education as an essential element for the formation of a legal culture in countries such as Germany, France, and Great Britain.

And of course, the goals of introducing legal education in different countries coincide, to one degree or another. In Russia, the need to introduce legal education for all students in higher education institutions correlates with many countries.

Legal education is now receiving special attention, introducing into the educational process not only legal disciplines, but also events aimed at expanding legal knowledge, skills and abilities among students in the form of conferences, round tables, competitions and other forms of education. Activities may range from legal education and training to legal advocacy, as well as active student participation in legal activities. This may include participation in business games that demonstrate the legal process, as well as active citizenship through participation in elections or legal advocacy. This helps to obtain not only a large amount of new legal information, but also to develop students' legal awareness in their field of knowledge and other areas that were not previously in demand by them.

Classes in legal disciplines have their own specific characteristics. The teacher does not always pay attention to the student's specialty, age or nationality, including foreign citizens. To work effectively, it is necessary to rely on the indicated characteristics of the student team and, of course, focus special attention on the norms of the Constitution of the Russian Federation. In this way, you can find your own approach to a group of students to ensure the possibility of developing the unity of legal consciousness and legal behavior, while eliminating the legal nihilism of individual members of the team.

Education and training are interconnected by a common purposeful process of influencing the student. Both of these processes have the same goal - education, but they go towards this by performing different tasks, so that sometimes their forms and methods coincide, and sometimes they are fundamentally different from each other. Some teachers believe that education is already built into education, especially in humanities courses, and does not require any special educational work. We cannot agree with this. Training is structured, focusing primarily on students mastering the fundamentals of various sciences. Education is associated

with the student's mastering the norms of behavior that have developed in society, as well as with the formation of the personal traits and qualities of a person necessary for a specialist. In legal disciplines, the teacher, before requiring the student to master norms of behavior, talks about them and the need to adhere to them, that is, he conveys to the student knowledge about these norms and develops behavioral skills, both theoretical and practical. This can promote active dialogue and establish a connection between student and teacher. Of course, there are problems in the perception of legal information by students in technical specialties. Therefore, to avoid misunderstandings, the teacher must first adapt to the team, and not vice versa.

Another side of the unity of teaching and upbringing is that the teaching style and methods of organizing training contain great educational potential. Teaching is the most important form of organizing the joint activities of students and their communication with teachers and with each other. It helps to reveal the norms and rules of the most moral behavior; during communication, the teacher has an educational influence on students. Teaching and upbringing have a lot in common in approaches to organizing the pedagogical process, which is confirmed by the coincidence of many working methods. For example, in the system of both educational and educational work, methods of obtaining knowledge are widely used: stories, explanations, work in judicial practice, excursions and others.

Legal education is an integral part of the formation of a professional personality, especially in technical specialties. It includes both legal education, aimed at developing citizenship, patriotism and respect for the laws, and legal training, ensuring the acquisition of the necessary knowledge and skills in the legal field.

Effective legal education requires an integrated approach that combines pedagogical and legal aspects. It is necessary to clearly define the goals, objectives and expected results, as well as the forms and methods of legal education and training, taking into account the specifics of the technical areas of training.

Integration of legal education into the educational process of technical universities is an urgent task not only for Russia, but also for many other countries. It contributes to the formation of a legal culture, legal consciousness and active citizenship of future specialists, ensuring their successful adaptation in society and professional activities.

To assess objectively the effectiveness of legal education, it is necessary to conduct research that reveals the level of students' mastery of legal concepts and their readiness for professional activities in the legal field. This will allow you to identify areas that require additional attention and adjust the educational process to achieve the best results.

Each teacher must combine a teacher and an educator. Legal education lays the main foundation for the formation of legal culture, legal consciousness, pat-

riotism, citizenship, etc. Undoubtedly, for technical specialties, legal education should become a necessary element that determines its role and opportunities for developing its potential in the state.

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年轻一代的社会文化教育作为一个协同系统  
**SOCIOCULTURAL EDUCATION OF THE YOUNGER  
GENERATION AS A SYNERGETIC SYSTEM**

**Spiridonova Anastasia Alexandrovna**

*Candidate of Pedagogical Sciences, Associate Professor  
Ulyanovsk State Pedagogical University named after I.N. Ulyanova*

**Aryabkina Irina Valentinovna**

*Doctor of Pedagogical Sciences, Professor  
Ulyanovsk State Pedagogical University named after I.N. Ulyanova*

**摘要.** 本文尝试将社会文化教育视为一个协同系统,并提出年轻一代社会文化教育的模式。

**关键词:** 个性、协同作用、社会文化教育。

**Abstract.** *This article attempts to consider sociocultural education as a synergetic system and proposes a model of sociocultural education of the younger generation.*

**Keywords:** *personality, synergy, sociocultural education.*

The sociocultural education of the younger generation is a complex and multifaceted process that is unthinkable without a teacher (a person who has an educational impact), a recipient (a person who feels the educational impact), and means of education (for example, the educational environment, cultural and art objects).

*Can a robotic machine replace a human?* – without any doubt, we note that this issue is not new, but its relevance from the standpoint of sociocultural and synergetic approaches is greatly increasing every day. Why is humanity so worried?

The 21st century is the century of high technologies, which should help a person remain mobile, multitask and find the simplest and most profitable solution to everyday practical problems. The intellectual potential of such technologies is that they:

- simplify a person's everyday life (for example, doing chores around the house; purchasing food, clothing, tickets, etc.);
- help a person become part of a digital space that cares about security (for example, cybersecurity, environmental safety, fighting street crime, transport security);



- contribute to the multiplication of human resources (natural, personal), making their consumption reasonable;
- cause a reduction in human expenses (temporary, intellectual, physical, economic, etc.) and contribute to the emergence of new sources of energy;
- facilitate human interaction with the world of things and services;
- make a person a member of a smart society and take his information and communication competencies to a new level (in this case, the person finds himself in the center of a network society in which they communicate virtually and artificially).

Having summed up the advantages of high technologies, we understand that the life of a modern person is impossible and unthinkable without them. Their appearance and strong foundation in the family, everyday, scientific, research, production and technological spheres of human life makes us think about another important question: How can a person remain a Human, i.e. How can a person preserve his Humanity and not change places with a robot, not turn into an “add-on” to robots/gadgets? A cleaning robot or a robot pet attracts a person with its ability to accurately respond, thanks to the touch sensor built into its mechanical body (this sensor is a technical analogue of the sensory organs of living organisms) to the word, speech intonation, and voice of the person who addresses it. So, the machine understands a person’s request, responds as expected and fulfills it (cleans the house, organizes things, etc.). However, what about a person? How to educate the younger generation living in the age of digitalization and interaction?

In fairness, we note that the potential of monosciences can solve the problem of personality education, but such a narrow approach most often leads to the impossibility of taking into account all factors influencing education and a significant increase for time spent. In this case, it is necessary to use the ideas of metascience, an example of which is modern synergetics, namely “synergetics of human-dimensional systems”, which, “in the era of the anthropological turn creates a special meta-level of culture, a reflexive analysis of its development...” [5, p.113].

What is a synergistic effect? Synergetic (systemic) effect - the presence of special properties in any system that are not inherent in its elements, as well as in the sum of elements not connected by special system-forming connections; irreducibility of the properties of a system to the sum of the properties of its components (property of emergence) [3, p. 175].

What is “synergy”, “synergetics”? In the context of the topic of this article, it is interesting to follow the history of this concept, in which the beliefs and traditions of various countries and peoples are intricately intertwined. So, in his scientific article T.P. Berseneva writes: “synergy is a term of Eastern Christian theology. The doctrine of synergy developed mainly within the framework of the Orthodox ascetic tradition of hesychasm. Having its origins in the early Christian monasticism

of the desert fathers of Coptic Egypt and Palestine in the 4th–5th centuries, hesychasm gradually developed into a highly organized school of spiritual practice, which created its own method of self-transformation of a person heading towards union with God” [1, p. 103]. Further, as is known, hesychasm as a spiritual practice was quite widespread in Russia, which indicates a deep spiritual synergistic connection, for example, between Russia and Egypt.

Personality education as a system is always socioculturally contextual. The person fulfilling the social roles of parent/teacher is:

- a source of intellectual knowledge, which he preserves in order to one day pass on to the younger generation;
- a carrier of values and a transmitter of culture through language as the main cultural code in the process of activity (creative, professional, social, etc.);
- creator, initiator and designer of reality (in the form of cultural and aesthetic relations, in the form of new objects of culture and art, etc.).

Let us try to consider the main characteristics of the sociocultural education of the younger generation based on the concepts of synergetics:

1. Openness. In the process of sociocultural education, the main thing is the discovery of sociocultural knowledge – i.e. in some cases, subject knowledge, which expands due to its actualization for human life of different cultures, from antiquity to the present. An example of such sociocultural knowledge can be: knowledge of speech formulas (communication in this case is the sociocultural context of human existence) used during greetings and during various everyday rituals; knowledge of embroidery techniques and costume symbols (amulet symbols that were embroidered on costumes, etc.). Information exchange, comparison, and search for analogies imply a two-sided process, the presence of feedback, and the pursuit of a solution to a common goal.

2. Nonlinearity. The nonlinearity of the acquisition of sociocultural knowledge during sociocultural education is explained by:

- on the one hand, by the fact that the single (universal) meaning contained in sociocultural knowledge in different cultures is somewhat mobile, variable, and presented somewhat differently;
- on the other hand, culture, language, art are inseparable from a person, a person in this case is a synergetic “model” in itself. Experiencing economic, environmental, socio-political and other changes, a person feels the need for alternatives and multiple choices (an example of this is the appearance/disappearance of words, loss of skills in carrying out activities: weaving, dressing fabric/hides; changing the recipes of dishes, etc. ).

3. Self-organization. The process of sociocultural education contributes to the successful socialization of the individual on the basis of acquired knowledge, developed abilities, accumulated patterns of behavior, hierarchy of values, value ori-

entations and worldviews. Sociocultural competence formed during sociocultural education helps a person to prove himself as a Human (humanly) in various life situations (show humanity, tolerance, empathy, social responsibility, etc.). Thus, sociocultural education as a personal quality arises both directly in the purposeful process of education and in the process of self-education. It is in the process of self-education that a person “completes” and “changes” himself or herself independently.

4. Randomness. In the context of sociocultural education, chance is equated to:

- to eventfulness (in this case, special significance is attached to the occasion, which will be perceived as an event and vice versa). An event as a form of organizing educational and cognitive activity in pedagogical work with children is significant because it introduces something new, unexpected and arouses keen interest. The subjectivity of interaction often changes the previously planned course of the lesson, but not its meaning (although often the educational meaning becomes somewhat broader and allows us to touch upon several important aspects at once: the value of a moral act and the complexity of its commission; the ability to forgive and the difficulty of asking for forgiveness, etc.);

- co-existence (in this case, it is considered as participation in a common cause, joint activity, joint discovery of the new and significant, unique: the beauty and poetry of language, the beauty of action, etc.)

5. The bifurcation point, according to the theory of self-organization, implies a restructuring of the system, i.e. a change in the course of development (up to the bifurcation point, the course and direction of development went in a certain way; at the bifurcation point, the system becomes subject to a certain kind of changes that can change the system internally) [4]. It becomes significant in the context of the sociocultural education of students to identify the conditions that act as bifurcation points that radically change the behavior, worldview, and system of relationships of an individual. An example of a bifurcation point in the process of sociocultural development of an individual is the introduction of high technologies into human life. An interesting basis for self-observation is determining the degree of independence and dependence of a person on smart devices. According to L.K. Geykhman, “the point of bifurcation can be considered the moment of a person’s choice of value guidelines, namely the choice of values of a noospheric personality...” (at the same time, the author interprets the noosphere “as a cultural type of the biosphere, corresponding to the conscious stage of co-evolution of nature and man, nature and society” [2, p. 26] - thus, expanding development opportunities increases the number of bifurcation points [2, p. 30].

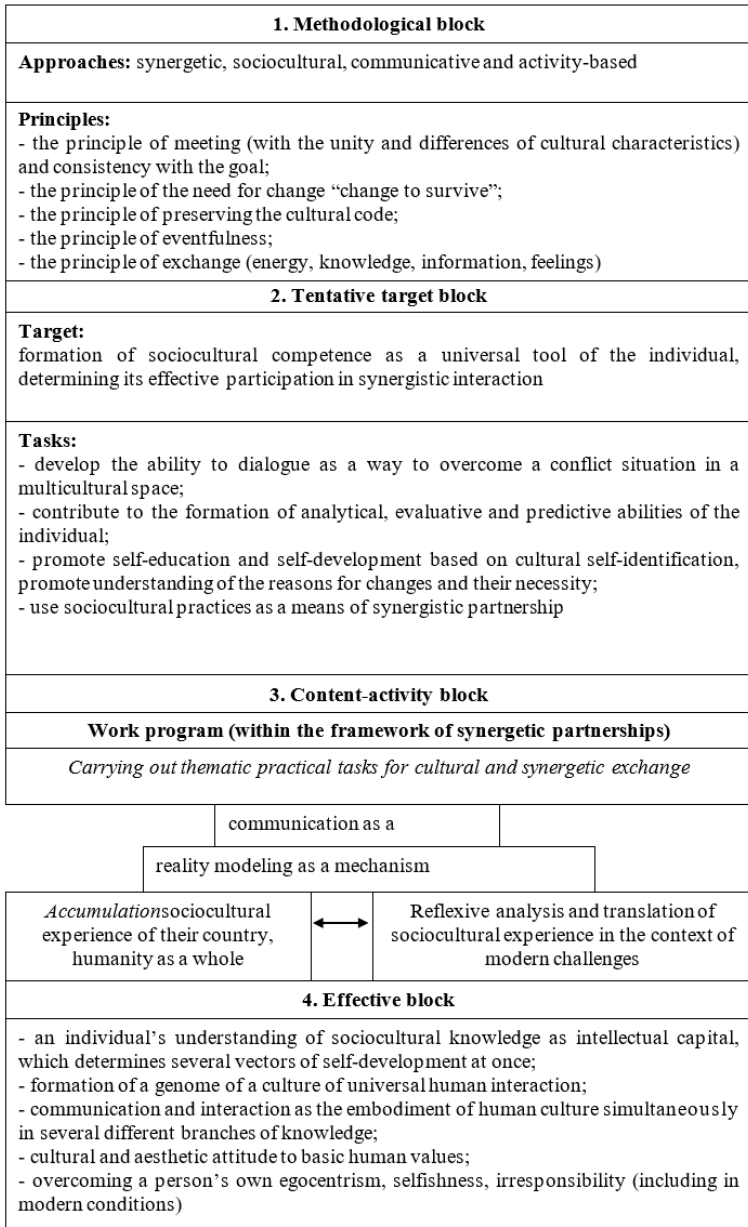
6. The attractor as an “attraction” and a set of different “trajectories” of system development are no less significant for the development of sociocultural education as a system. The main attractors of sociocultural interaction are: a person/group

of people, a historical era, technology (for example, high technology in everyday life and in human education), culture, a variety of creative activities, and the challenges of our time.

7. Fluctuation as a multiple change in the value of a quantity. Considering the sociocultural education of the younger generation, such changes include: human feelings and emotions, a change in spiritual and material artifacts with which the child will interact; new formations accompanying age, significant adults as sources of intellectual, sociocultural knowledge, expansion of sociocultural experience of interaction acquired through the analysis of social habits, gastronomic preferences, cultural leisure practices, etc.

The characteristics described above indicate the possibility of considering sociocultural education as a synergetic system, which, like nothing else, will allow the formation of a multidimensional personality and subject of culture from a modern child. According to L.Y. Sirotkina, “a subject of culture is a person included in the cultural space, possessing a cultural code, accepting cultural values and being actualized in cultural creativity as a participant in the cultural process,” this is “not a person of the masses, since the level of his individual manifestations is quite high and is expressed in the desire master the civilizational and culture-forming space through languages, signs, symbols, images, discourses, narratives and simulacra”; “a multidimensional personality integrates the civilizational and cultural stages of social evolution and the totality of social and cultural characteristics of modern society” [6].

Based on the above, we offer a fragment of a model of sociocultural education based on synergy (Fig. 1).



**Figure 1.** Fragment of a model of sociocultural education based on synergy

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弗谢沃洛德·费奥多罗维奇·米勒和奥塞梯历史和语言学研究的起源  
**VSEVOLOD FEDOROVICH MILLER AND THE ORIGINS OF  
HISTORICAL AND PHILOLOGICAL OSSETIAN STUDIES**

**Anchabadze Yuri Dmitrievich**

*Doctor of Historical Sciences, leading researcher, headdepartment  
Institute of Ethnology and Anthropology of the Russian Academy  
of Sciences*

**Tsallagova Zarifa Borisovna**

*Doctor of Pedagogical Sciences, Professor, Leading Researcher  
Institute of Ethnology and Anthropology of the Russian Academy  
of Sciences*

注释。本文探讨了俄罗斯皇家科学院正式成员 Vsevolod Fedorovich Miller (1848-1913) 对奥塞梯历史和语言科学的形成和发展的贡献。这位科学家站在奥塞梯人文科学的起源，他的作品不仅为民俗学、民族学、考古学、语言学的形成奠定了可靠的科学基础，而且由于他自己的榜样和不懈的指导，为奥塞梯民族文化和科学的一大批人物的出现做出了贡献。

关键词：VF Miller、奥塞梯研究、民俗学、人种学、科学史。

**Annotation.** *The article examines the contribution of full member of the Russian Imperial Academy Vsevolod Fedorovich Miller (1848-1913) to the formation and development of historical and philological science in Ossetia. The scientist stood at the origins of Ossetian humanities and with his works not only laid a reliable scientific basis for the formation of folklore, ethnology, archeology, linguistics, but also, thanks to his own example and his tireless mentoring, contributed to the emergence of a whole galaxy of figures of Ossetian national culture and science.*

**Keywords:** *VF Miller, Ossetian studies, folklore, ethnography, history of science.*

Among the scholars who studied the culture, folklore, and history of the Ossetians in the 18th and 19th centuries, a special place belongs to Vsevolod Fedorovich Miller (1848-1913), a prominent Slavic studies expert and a distinguished Caucasian studies scholar. His name and fate are closely intertwined with the Ossetian people, for whom he became a spiritual enlightener and mentor. Thanks to

his example and guidance, a whole constellation of figures emerged who would contribute significantly to Ossetian national culture.

It was brought to Ossetia by the logic of the development of research thought associated with the search for a connecting link between the Slavic Indo-European and Indo-Iranian folklore layers. It was then that the scientist became interested in the history and culture of the peoples of the Caucasus, in particular the Ossetians. To collect field scientific material, V. F. Miller made six trips to Ossetia (in 1879, 1880, 1881, 1883, 1886, 1901). He mastered the language so well that in all Ossetian villages V.F. Miller talked with people in their native language, both dialects of which he spoke completely fluently.

The result of the trips was the publication of two volumes of “Ossetian Etudes” (1881–1882), which were presented as a dissertation for the degree of doctor of comparative linguistics. The third part of “Ossetian Etudes”, awarded the Great Gold Medal of the Imperial Russian Geographical Society, was published in 1887. Describing the content of this work, V. F. Miller writes: “What fate drove the Ossetians to the current places of their settlement, what memories did they retain about their past... what is the structure of their life, what are their religious views, what place does their language occupy in the group of Iranian languages... what are the works of Ossetian poetry - these are the questions... to which we tried, if possible, to answer” (Miller 1881, 3). It should be said that the scientist gave brilliant answers to all these questions at the highest scientific level.

The scientist carried out all of the above work without interrupting his main academic activity. The name of V. F. Miller is associated with the opening of the first Russian ethnographic magazine “Ethnographic Review” in 1889, of which he was the editor for a long time. In addition, from 1884 to 1897. V.F. Miller was the curator of the Dashkovo Ethnographic Museum, whose collections he brought back into systematic order. In 1881 V.F. Miller was elected chairman of the Ethnographic Department of the Society of Lovers of Natural History, Anthropology and Ethnography, leading ethnographic research in the capital and in the field, mainly in Ossetia, for more than thirty years.

Fruitful Ossetian research work was carried out by V.F. Miller and at the Moscow Archaeological Society. In particular, he took an active part in organizing and holding an archaeological congress in Tiflis in 1881, at which he made reports “On the Ossetian language and its place in the group of Iranian languages”, “On the Caucasian Prometheus”, “Program for collecting material on the Ossetian language”, which included rich ethnographic material.

The scientist widely used ethnographic material in the study of related scientific disciplines. Thus, in order to study tower structures, burial grounds and crypts, medieval churches in Ossetia, he organized a large archaeological expedition, during which he simultaneously recorded folk legends in the Kurtatinsky,



Alagirsky and Digorsky gorges, and collected valuable material here about the religious beliefs of the Ossetians. In the article “Echoes of Caucasian beliefs on grave monuments” V.F. Miller, based on a consideration of Ossetian funeral rites (in particular, the horse initiation rite), deciphered the symbolism of the figures depicted on grave monuments dating from the 15th–16th centuries. (Kaloiev 1999, 354.) All these materials, as well as descriptions of buildings of religious significance, were included in the authoritative publication “Materials on the Archeology of the Caucasus” (Miller 1888).

It should be noted that numerous works on the ethnography of Ossetia by V.F. Miller were based on his own expedition materials collected in almost all the gorges of Ossetia. The scientist’s handwritten notes, made in Ossetia, are still stored in the central and local archives. It was his own recordings of ethnographic material in mountainous Ossetia, begun during the first expedition trip in 1880, that formed the basis of his “Ossetian Etudes”.

The information on issues of Ossetian ethnography presented by the scientist is very diverse; it covers almost all aspects of ethnographic science, never limiting itself to purely descriptive purposes. The ethnographic materials were analyzed especially carefully by the scientist in the aspect of studying the archeology, language and ethnogenesis of the Ossetians. In this regard, such articles by the scientist as “Echoes of Caucasian beliefs on grave monuments”, “On some ancient funeral rites in the Caucasus”, “Features of antiquity in the legends and life of the Ossetians” are indicative, which provide a deeply competent analysis of the spiritual culture of the Ossetians, in particular their religious views and memorial and funeral rituals. In the last of these articles, V. F. Miller is one of the first in the scientific literature to state the striking similarity of a number of Ossetian archaic funeral rites with Scythian ones (dedication of a horse to the deceased, cutting off a widow’s braid, mourning, large-scale funerals, etc.): “Observing These rituals, which are still preserved among the Ossetians, involuntarily recall some features of the Scythian funerals recorded by Herodotus” (Miller, 1893, 206). The scientist considered the burial of the deceased in a tomb, which was widespread in the past in Ossetia, to be one of the oldest Ossetian rituals.

Special coverage of the issues of the origin of the Ossetians, supported by ethnographic data, is reflected in the third part of the “Ossetian Etudes”, which is not only a study of the ethnic history and ethnography of the Ossetians, but also contains valuable information about the southern region of our country before the appearance of Slavic tribes there. The scientist’s undoubted discovery is the definition of the ancient territory of Ossetia-Alania, which, in his opinion, based on a scientific (ethnographic, toponymic, linguistic) study of the problem, extended from the current mountainous Digoria to the upper reaches of the Kuban.

V.F. Miller not only studied the settlement of modern Ossetia, examining monuments of material culture (residential and defensive towers, Christian churches,

tombstones, pagan sanctuaries, etc.), he collected rich material on the religious views of Ossetians. The scientist systematized his notes, observations and generalizations on this matter in the work “Religious Beliefs of the Ossetians,” which formed the second volume of his “Ossetian Etudes.”

This work, consisting of an introduction and five chapters, describes Ossetian deities and dzuars, religious holidays and rituals. Based on a large amount of factual material, Miller summarizes that Ossetians have an idea of a single god (Miller, 1881, 239).

V. F. Miller’s works such as “In the Mountains of Ossetia” and “Archaeological Excursion” contain a lot of ethnographic information. They provide a detailed description of a number of monuments of the material culture of Ossetia, a description of the settlements and types of housing of the Ossetians, characterize their economic activities, social and family life, and also provide numerous historical legends about Ossetian families and surnames, works of various genres of Ossetian folklore. Along with this, “In the Mountains of Ossetia” presents the life of the workers of the Alagir lead-zinc plant and the Sadon mines (Miller 1881: 63).

The scientist was closely acquainted with many representatives of the Ossetian intelligentsia, supporting the development of local history science in the region. Academician Miller’s undoubted merit is that not only his works, but also above all his very personality as a scientist and person contributed to awakening among representatives of the Ossetian intelligentsia an interest in studying their native language, history, and ethnography of their people.

Educated Ossetians, helping the academician in his work during scientific travels undertaken by him for archaeological, linguistic and folklore purposes, themselves became serious researchers of the culture of their people. V.F. Miller was not only the coordinator and publisher of their Ossetian studies, he provided scientific leadership to a whole generation of young Ossetian scientists in the institutions in which he worked (Moscow University, Lazarevsky Institute of Oriental Languages, Eastern Commission of the Moscow Archaeological Society, Dashkovo Ethnographic Museum, etc.) .

Thus, with the publication of the works of V.F. Miller on the ethnography of Ossetia, in which field material was widely used for theoretical and methodological conclusions and scientific conclusions, a scientific school of local history began to form in the region, ethnographic works began to appear, carried out on the basis of scientific analysis and equipped with appropriate conclusions and summaries. Before the beginning of this period, ethnographic works (there were more than fifty of them) by Russian ethnographers and local antiquity enthusiasts were predominantly descriptive in nature.

“Ossetian etudes” brought the scientist great fame and glory as an Iranist-Ossetian scholar; generations of Ossetian intelligentsia were brought up on them.

The scientist's fundamental works on Ossetia and the Ossetians gave a powerful impetus to the development of historical and philological Ossetian studies and became the basic basis for subsequent scientific developments in this area.

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医疗机构医疗活动内部质量和安全控制的自动化管理系统  
**AUTOMATED MANAGEMENT SYSTEM FOR INTERNAL  
QUALITY AND SAFETY CONTROL OF MEDICAL ACTIVITIES IN  
A MEDICAL ORGANIZATION**

**Zyabkin Ilya Vladimirovich**

*Doctor of Medical Sciences, Director*

*Federal Scientific and Clinical Center for Children and Adolescents  
of the Federal Medical and Biological Agency*

**Andruzskaya Anna Georgievna**

*Deputy Chief Physician*

*Federal Scientific and Clinical Center for Children and Adolescents  
of the Federal Medical and Biological Agency*

**Zavaleva Elena Valentinovna**

*Candidate of Medical Sciences, methodologist*

*Federal Scientific and Clinical Center for Children and Adolescents  
of the Federal Medical and Biological Agency*

注释。本文介绍了开发医疗活动内部质量控制和安全自动化管理系统（以下简称 AMSIQCaSMA）的相关性、该系统的结构和内容，以及管理收到的数据并形成一套纠正措施的能力。

关键词：医疗活动质量和安全内部控制、Roszdraznador 的实际建议、自动化管理系统。

**Annotation.** *The paper presents the relevance of developing an automated management system for internal quality control and safety of medical activities (hereinafter referred to as AMSIQCaSMA), the structure and content of this system, as well as the ability to manage the received data with the formation of a set of corrective measures.*

**Keywords:** *internal control of the quality and safety of medical activities, practical recommendations of Roszdraznador, automated management system.*

## **Introduction**

Currently in the Russian Federation, in accordance with the state program “Health Development,” the key goals are, inter alia, increasing the life expectancy of the country’s population to 78 years by 2030 and to 81 years by 2036 [1]. To

achieve this goal, one of the basic directions is to ensure the availability, quality and safety of medical care to the population.

In Russia, a whole system has been created in the field of protecting the health of citizens, starting from the regulatory legal framework to the “institute” of control and supervisory authorities, the main goal of which is to provide high-quality and affordable medical care to the citizens of the country, however, the basic component of this system, in our opinion, is medical organization.

Fulfillment of requirements for internal control of the quality and safety of medical activities, implementation of a quality management system and a risk-based approach are modern milestones in the development of healthcare institutions in the country [2]. However, a tool is needed that allows the head of a medical organization to monitor their implementation online.

In accordance with those established by the President of the Russian Federation V.V. Putin’s national goals until 2030 and for the future until 2036 within the framework of digital transformation, including healthcare, involve automation of the management model [1], while automation should affect all processes and components related to the provision of medical care, including internal quality control and safety of medical activities in a medical organization.

Thus, the prerequisites have emerged for the formation of the goal of this work - to design an automated management system in a medical organization that allows online access to data on the implementation of areas of internal quality control and safety of medical activities.

### **Internal quality control and safety of medical activities as the basis for a quality management system in a medical organization**

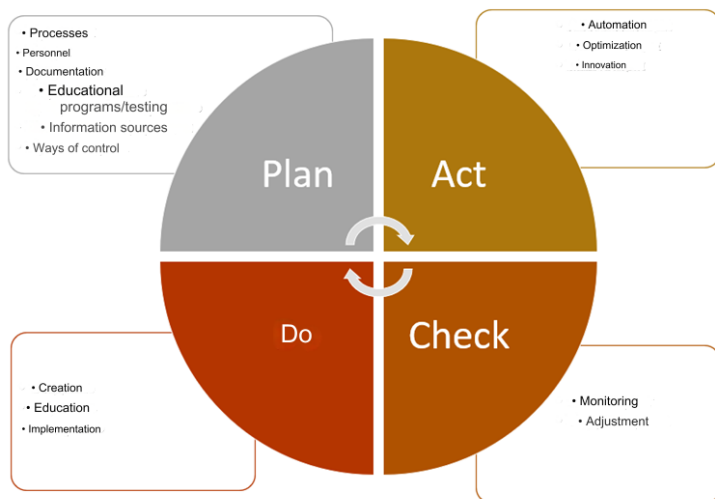
The Russian Federation has a clearly structured hierarchical system of regulatory legal acts, and the healthcare sector is no exception. Internal control of the quality and safety of medical activities (hereinafter referred to as IQC and SMA) is regulated by Federal Law 323-FZ of November 21, 2011 (Article 90), by Order of the Russian Ministry of Health of July 31, 2020 No. 785n [3]. The basic requirements for IQC and SMA, set out in the order of the Ministry of Health of Russia, are also licensing requirements in accordance with Decree of the Government of the Russian Federation dated 01.06.2021 No. 852, and also include criteria for assessing the quality of medical care, regulated by order of the Ministry of Health of Russia dated 10.05.2017 No. 203n [4]. However, before the development of Practical Recommendations (proposals) for organizing IQC and SMA in a medical organization (hereinafter referred to as Practical Recommendations) [5], there was a structural and functional approach to the provision of medical care, process and systemic approaches were ignored.

Practical recommendations reveal the requirements for IQC and SMA in the main areas and They are graded into mandatory, critically important, and addi-

tional, which have less weight and lower importance, which allows medical organizations to independently formulate an implementation plan, using a “step by step” approach and, thereby, increase employee loyalty and minimize resistance during implementation. Thus, the order of the Ministry of Health of Russia dated July 31, 2020 No. 785n is the basis into which Practical Recommendations are integrated the basis for building an effective management system for a medical organization that ensures high quality and safety of medical activities - a quality management system (hereinafter referred to as QMS).

There is a whole list of international QMS (ISO, JCI, HAS, NSQHS, ACSA) [2.6-9], which were gradually introduced in Russian healthcare institutions, but currently it is domestic ones that are widely used (Practical recommendations), which correlate with the existing legislative framework and facilitate preparation for inspection of a medical organization by regulatory authorities.

Like any QMS, Practical Guidelines, and therefore IQC and SMA, need continuous improvement, including the main components of the PDCA cycle [10], in connection with which it is necessary to create a system that would allow visualizing all stages of constructing a quality management system in a medical organization (Fig. 1).



**Figure 1.** The PDCA cycle in the design of a QMS in a medical organization

### **Design of a management system for internal quality control and safety of medical activities**

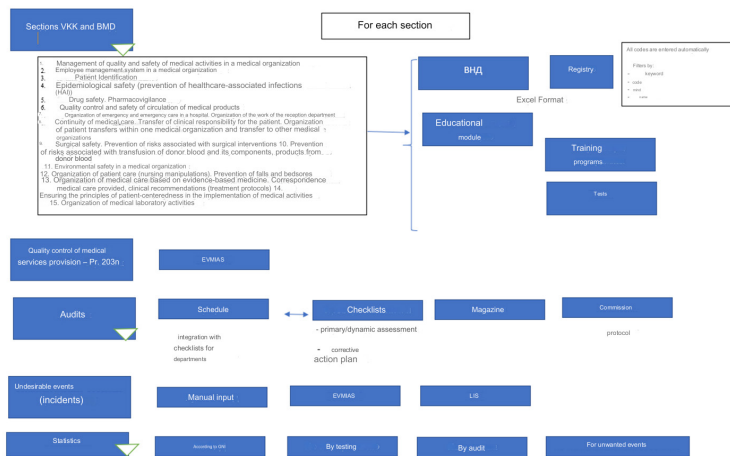
In accordance with the Decree of President V.V. Putin dated 06.06.2029 No. 254 “On the strategy for the development of healthcare in the Russian Federation for the period until 2025” one of the main tasks in the field of health protection is development of a medical care quality management system.

Currently, one of the key points in the development of the health care system is the digitalization of the industry [11]. Promising areas of digital healthcare include telemedicine, digital patient assistant, artificial intelligence, remote patient monitoring and others [12]. However, the introduction of digital technologies provides not only innovative solutions, but also involves the automation of all business processes, including internal quality control and safety of medical activities.

Recently, much attention has been paid to the creation of local information systems (hereinafter referred to as IS), which allow the collection of data from various sources, such as medical and laboratory information systems and other software products operating in the organization. Automation of the system of internal quality control and safety of medical activities is no exception[13,14].

Authors of computer programs for QMS[13,14] offer an extensive list of issues that can be resolved through their software product within the framework of the IQC and SMA, such as storage and updating of regulatory information, formation of the composition and description of requirements in the context of processes and areas of medical activity, ensuring planning and monitoring of audits, providing electronic document management, planning, monitoring the implementation of corrective and preventive measures; generation of analytical, statistical information, as well as identification of root causes. However, these ISs do not provide for a module on educational activities, which is an integral part of the implementation and implementation of any process, and the recording of undesirable events, which, in turn, is one of the main activities of the IQC and SMA.

Taking into account the above, we have proposed our own structure of an automated control system for IQC and SMA in a medical organization (hereinafter referred to as ACUIQCaSMA), which takes into account all the necessary, in our opinion, components for the continuous improvement of Internal quality control and safety of medical activities (Fig. 2).



**Figure 2.** Structure of the automated control system for IQC and SMA in a medical organization

This system can be implemented using any technology stack from Java, Jsp, JavaScript to MS SQL, based software system 1C: Enterprise, and is also integrated with the main information systems of the organization.

In the proposed system, in addition to the main components that were taken into account when developing similar software products, the following are integrated:

- an educational module, including training methodological materials and control of their study in the context of the areas of clinical care and medical treatment, structural divisions of a medical organization, categories of personnel, as well as the possibility of primary and dynamic assessment;
- module for assessing the quality of medical care, where data flows from corresponding module FMBA of Russia - UDMIAS - (Unified Departmental Medical Information and Analytical System);
- module for recording unwanted events (incidents).

The automated management system for medical care and medical management involves ranking structural units according to the success of organizing medical and medical management, depending on the data received on the quality of medical care, educational activities, undesirable events and the results of audits. The ranking will be based on a multi-criteria assessment method, taking into account the gradation of criteria into significant (important) and less significant [15].

ACIQiSMA is designed using the methodology of continuous improvement and includes all the necessary components - from planning to control. In addition,



the head of a medical organization can monitor online the implementation of the main directions, statistical data; manage the stages of implementation, adjusting certain significant implementation measures.

### Conclusion

Construction and administration IQC and SMA systems are an integral component of the management cycle of any medical organization, the basis for the formation of a quality management system.

To create a flexible system that allows you to take into account all the components of the process of managing internal quality control and safety of medical activities in a medical organization, systematically analyze the information received online, and rank structural units depending on the success of the implementation of IQC and SMA activities, it seems necessary to automate all of the above processes. ACUIQCaSMA is a system-automated process for managing IQC and SMA in a medical organization, designed to ensure control over the quality, safety and accessibility of medical care.

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动脉僵硬程度的性别特征  
**GENDER CHARACTERISTICS OF ARTERIAL STIFFNESS**

**Sapunova Daria Alexandrovna**

*Candidate of Medical Sciences, Associate Professor  
Russian University of Medicine*

摘要。建议将脉搏波速度检测作为主要动脉僵硬性 (SI) 指数, 作为动脉高血压 (AH) 患者的诊断技术。

更年期女性和男性的 SI 差异研究是现实。进行了质量、脂质、葡萄糖、SI 指数的检测。患有 AH 的女性和患有 AH 和缺血性心脏病 (IHD) 的女性动脉僵硬性指数确实低于患有相同疾病的男性。在任何其他分析因素中, 没有更可靠的差异。AH 和 IHD 与糖尿病的组合在 SI 因素方面在男性和女性之间没有任何差异。

关键词: 性别差异、动脉高血压、动脉僵硬。

**Abstract.** *Detection of pulse wave velocity as index of stiffness (SI) in main arteries is recommended as diagnostics technique in patients with arterial hypertension (AH).*

*Studying of differences in SI in menopausal women and men is actual. Detection of index of mass, lipids, glucose, SI were performed. Women with AH and women with AH and ischemic heart disease (IHD) had reliably lower indexes of arterial stiffness, then men with the same diseases. There were no more reliably differences in any another analyzed factors. The combination of AH and IHD with diabetes mellitus level any differences between men and women in factor of SI.*

**Keywords:** *gender difference, arterial hypertension, arterial stiffness.*

The 2018 ESH/ESC (European Society of Cardiology/European Society of Hypertension) recommendations mention not only metabolic and hemodynamic, but also socio-economic and psychosocial risk factors for arterial hypertension. An individual approach to the prevention and treatment of diseases should be the basis of personalized medicine, which takes into account gender and gender characteristics. In studies on the male population, the highest importance of such risk factors for diseases of the circulatory system as overweight, smoking, and hypercholesterolemia was noted. The first myocardial infarction among women is registered at the age of 65-72 years, and in the male population - from 55 to 65 years. Worldwide, cardiovascular diseases are the main cause of morbidity, disability

and mortality among both men and women. Current research necessarily takes into account potential sex differences, which were not previously considered even in the study design, when most of the research was conducted with middle-aged men. The study of the incidence of various diseases of the cardiovascular system has shown that belonging to the female sex is a protective factor in relation to this group of diseases.

Mortality from cardiovascular diseases in premenopausal women is lower than in men of the same age. The absence of any specific factor that could be considered cardioprotective, and the almost identical incidence of cardiovascular diseases in elderly men and postmenopausal women indicate that female sex hormones may have cardioprotective properties.

In adult women, the size of the heart chambers is smaller compared to men, and the mass of the myocardium is 10% less. Accordingly, the coronary arteries in women are smaller than in men. Women are characterized by the so-called loose type of blood supply to the heart, their coronary arteries are more fragile and thin, and their lumen is narrower compared to the coronary arteries of men, therefore microvascular ischemia is more characteristic of women. In women with acute myocardial infarction, coronary angiography more often than in men reveals the absence of a diagnostically significant atherosclerotic lesion of large coronary vessels. Anatomically, women have a smaller aortic diameter, as well as a smaller length of arterial vessels than men.

American scientists have found that ventricular tachycardia/fibrillation is significantly more common in men: 52% versus 34% in women. The researchers concluded that, despite the similar frequency of proarrhythmogenic electrophysiological substrates, women's sensitivity to arrhythmogenic triggers may be lower. Some authors have noted that in women with arterial hypertension, compared with men, there are more pronounced changes in the processes of ventricular repolarization in the form of an elongation of the duration of the corrected and uncorrected Q-T intervals, regardless of the presence or absence of cardiac remodeling.

Women have a worse prognosis for diseases of the cardiovascular system than men - they have a higher mortality rate from the first myocardial infarction, as well as during the first year after it.

The Framingham Heart Study is the first study to present significant differences in the course of cardiovascular disease between men and women. The course of myocardial infarction in women was more often accompanied by fatal complications. They were more likely to develop myocardial infarction without the formation of a pathological Q wave on the ECG, and negative results prevailed significantly during coronary angiography (35% vs. 16% in men). Intravascular ultrasound and magnetic resonance imaging reveal atheromatosis of the coronary arteries where a negative result was obtained during coronary angiography, while

mortality within 6 months after myocardial infarction in men is 7.9%, and in women – 22.8%.

Before menopause, women had lower levels of low-density lipoproteins (LDL) than men, whereas after menopause, LDL levels increased and exceeded those of men. In the postmenopausal period, the levels of triglyceride (TG) and apolipoproteins simultaneously increase, while the level of high-density lipoproteins (HDL), which have an antiatherogenic effect, decreases. An increase in LDL levels in women after menopause may be explained by a decrease in the activity of LDL receptors, as well as a decrease in liver lipase activity, occurring synchronously with a decrease in estrogen levels, which is important for HDL concentration.

In postmenopausal women, the prevalence of diabetes mellitus is increasing, mainly insulin-independent. Women with diabetes mellitus are characterized by higher morbidity and mortality from coronary heart disease (CHD), which confirms the importance of hormones in glucose and insulin metabolism. Impaired glucose tolerance predisposes to the development of coronary heart disease. These disorders develop through insulin resistance and hyperinsulinemia, which in turn affects lipid metabolism, combining the negative effects of both risk factors and increasing the risk of cardiovascular diseases.

Hyperinsulinemia contributes to the development of coronary heart disease, affecting atherogenesis, lipid metabolism, the formation of hypertension, negatively affecting fibrinolysis. Impaired glucose tolerance is often observed during menopause. Studies in recent years have shown a decrease in insulin production by the pancreas, developing following an increase in insulin resistance. Being less resistant to insulin before menopause than men, after its development, women are compared with them according to this indicator. The formation of insulin resistance correlates with the severity of dishormonal disorders, especially with a decrease in estrogen levels.

The reason why women develop coronary heart disease on average 10-15 years later than men is hormonal differences. Indirect evidence of this statement is the data on a significant increase in cases of coronary heart disease and myocardial infarction in women with early menopause or after ovariectomy. Cases of CVD in women before natural or surgical menopause are rare, and their number increases significantly with the onset of menopause.

In vitro studies have proven the independent endothelial relaxing effect of estrogens. It is caused by the release of an endothelium-dependent relaxing factor (nitric oxide). The participation of estrogens in the protection of coronary arteries from the vasoconstrictor effect of acetylcholine in women, which is absent in men, has been shown.

In women with essential arterial hypertension, renal blood flow and total glomerular filtration rate are significantly lower than in men. There was also a sig-

nificantly higher total peripheral vascular resistance (OPSS), which is explained by the development of involutive changes in women during menopause, accompanied by relative hyperaldosteronism and hypoestrogenism. This leads to an increase in OPSS and the formation of endothelial dysfunction, which causes structural changes in the vascular bed (1).

In the conciliation document, European experts point out that measuring the pulse wave propagation velocity (PWV) is accepted as a simple, non-invasive, accurate and reproducible method for assessing arterial stiffness (2).

One of the noninvasive sphygmographic methods for assessing vascular rigidity is the contour analysis of the pulse wave. This method allows us to determine the SI stiffness index, which evaluates the rate of pulse wave propagation in large arteries and is calculated as the ratio of patient height to time between the systolic and diastolic components of the digital pulse wave. SI is an indicator of the rigidity of large arteries. There is a high correlation between SI and PWVcf (Pulse Wave Velocity carotid-femoral; the pulse wave velocity in the area from the carotid to the femoral artery) is the “gold standard” for measuring arterial rigidity, coronary artery diseases and the thickness of the intima–media complex (3).

Thus, despite the prevalence of diseases of the cardiovascular system among both men and women, there are undoubted facts indicating significant gender differences in their formation, course, prognosis and prevention. Single studies have been devoted to comparing the gender characteristics of the vascular condition in various diseases of the cardiovascular system.

Thus, despite the prevalence of diseases of the cardiovascular system, both among men and women, there are undoubted facts indicating significant gender differences in their formation, course, prognosis and prevention.

To determine gender characteristics, 240 menopausal women with a gynecological history and 50 men of comparable age were examined at the University Clinic of the Russian University of Medicine. The examination methods included a clinical examination with the calculation of body mass index (BMI), determination of blood glucose, such lipidogram indicators as total cholesterol (TC), triglycerides (TG), high density lipoproteins (HDL) and low density lipoproteins (LDL). Blood pressure (systolic – SAD, diastolic – DAD) was also measured with the calculation of average blood pressure (MAP, mean arterial pressure), the parameters of the rigidity index SI (stiffness index) were analyzed using the Pulse Trace PCA device (Micro Medical, United Kingdom), where a highly sensitive photoplethysmographic sensor with multiple signal separation (cyclic operation LEDs).

Women were compared with men in groups according to a combination of nosologies: arterial hypertension (AH), arterial hypertension in combination with coronary heart disease (AH+CHD) and type 2 diabetes mellitus (AH+CHD+DM).

All patients were divided into three main groups according to diseases of the cardiovascular system. The first group consisted of 92 women (48%) suffering

from arterial hypertension (AH); the average age was  $54.02 \pm 6.74$  years. The second group was represented by 68 patients (36%) suffering from arterial hypertension and coronary heart disease (AH+CHD); the average age was  $58.24 \pm 6.31$  years. The third group included 30 women (16%) with a history of type 2 diabetes mellitus (AH+CHD+DM), except for hypertension and coronary heart disease, aged  $57.63 \pm 8.45$  years. The control group included 50 men, comparable in age and diseases of the cardiovascular system with the examined women. The group of patients with arterial hypertension (AH) consisted of 25 men (50%) with an average age of  $52.36 \pm 6.63$  years. The second group was represented by 15 men (30%) with arterial hypertension and coronary artery disease (AH+CHD); the average age was  $58.00 \pm 8.03$  years. The third group of men suffering from type 2 diabetes mellitus (AH+CHD+DM) in addition to hypertension and coronary heart disease included 10 people, where the average age was  $58.60 \pm 6.48$  years.

The group of women with hypertension as a whole is characterized by the presence of obesity (BMI  $29.12 \pm 6.01$  kg/m<sup>2</sup>), changes in lipid metabolism, increased vascular rigidity. Indicators of lipid and carbohydrate metabolism, as well as BMI between the groups did not significantly differ, as well as blood pressure indicators. At the same time, significantly lower values of the rigidity index were found in women. Thus, men had more pronounced vascular stiffness disorders than women of the same age suffering from hypertension of comparable severity.

The group of patients with hypertension +coronary heart disease included 68 women and 15 men. Similarly, patients suffering from hypertension alone in the group with combined pathology were found to be obese (BMI  $29.54 \pm 7.14$  kg/m<sup>2</sup>), hyperlipidemia due to atherogenic fraction and an increased rigidity index. However, compared with men, women with a similar combination of diseases have significantly lower values of the rigidity index, as well as indicators of SAD, DAD, MAP. Consequently, women have less pronounced vascular stiffness and blood pressure disorders than men of comparable age suffering from a similar combination of cardiovascular diseases.

When comparing groups of women and men who, along with the presence of hypertension and coronary heart disease, had type 2 diabetes mellitus, the absence of any significant differences in all the presented parameters was noted. The addition of type 2 diabetes completely eliminates gender differences. Moreover, women had a higher average value of the SI rigidity index compared to men, whereas in previous comparison groups, the indicators of vascular stiffness in women were significantly lower.

Thus, an attempt to compare the main gender indicators reflecting anthropometric parameters, indicators of carbohydrate and lipid metabolism, blood pressure and vascular stiffness revealed both similarities in the course of the studied diseases (in terms of the presence and severity of obesity and lipid disorders, blood

pressure values) and significant differences manifested in lower vascular rigidity in women with Hypertension and a combination of hypertension and coronary heart disease. The addition of type 2 diabetes mellitus to hypertension and coronary heart disease completely eliminates the differences between the groups of men and women in terms of vascular stiffness.

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60岁以上腐蚀性物质中毒患者血液促血红蛋白及抗氧化系统指标的研究  
**STUDY OF INDICATORS OF THE PRO- AND ANTIOXIDANT  
BLOOD SYSTEM IN PATIENTS OVER 60 YEARS OF AGE WITH  
POISONING BY CORROSIVE SUBSTANCES**

**Simonova Anastasia Yuryevna**

*Candidate of Medical Sciences, Leading Research Officer  
N. V. Sklifosovskii Research Institute of Emergency Medicine,  
Moscow, Russia,  
acting head of the department  
Russian Medical Academy of Continuous Professional Education,  
Moscow, Russia,  
Senior Research Officer  
Research and Applied Toxicology Center of Federal Medical and  
Biological Agency,  
Moscow, Russian Federation*

**Belova Maria Vladimirovna**

*Doctor of Biological Sciences, Leading Research Officer  
N. V. Sklifosovskii Research Institute of Emergency Medicine,  
Moscow, Russia,  
Associate Professor  
Russian Medical Academy of Continuous Professional Education,  
Moscow, Russia,  
Full Professor  
Sechenov First State Medical University of Ministry of Healthcare  
of Russia, Moscow, Russia*

**Klychnikova Elena Valerievna**

*Candidate of Medical Sciences, Head of Department  
N. V. Sklifosovskii Research Institute of Emergency Medicine,  
Moscow, Russia*

研究目的：评估老年及高龄患者腐蚀性物质中毒患者血液脂质过氧化及抗氧化保护指标

材料与方法。进行了一项开放性前瞻性队列研究，纳入31例口服腐蚀性物质中毒患者。中位年龄为73.0[67.0;76.0]岁。患者分为预后良好组和死亡组。为了解决这  
国际会议

些问题,评估了以下指标: 血液中丙二醛 (MDA) 水平、总抗氧化活性 (TAA)、血液中稳定的一氧化氮代谢物亚硝酸盐/硝酸盐 (NO<sub>x</sub>) 含量、氧化应激系数 (CMDA/TAA)。研究的参数是在急性中毒早期阶段记录的: 入院后第1天、第3天和第5天。

结果。在分析血液中促氧化-抗氧化系统指标随时间的变化时,发现在60岁以上的腐蚀性物质 (CS) 中毒患者中,检测到脂质过氧化和抗氧化保护指标的变化,其特征是血液中MDA和NO<sub>x</sub>水平相对于年龄标准下降,背景是抗氧化保护指标值降低或低于正常值。在研究的所有阶段,与对照值相比,ODS的氧化应激系数降低了2.3-2.4倍,这表明氧化应激的发展。

结论。研究结果表明,在腐蚀性物质急性中毒的老年患者中,促氧化-抗氧化系统的反应不足,表现为患者血液中过氧化产物减少,抗氧化防御成分含量正常或略有降低。存在氧化应激,其加剧导致死亡。

关键词: 急性中毒、急性化学中毒、氧化应激、氧化窘迫、老年患者、老年患者、脂质过氧化、抗氧化活性。

**Purpose of the study:** *to evaluate the indicators of lipid peroxidation and antioxidant protection of the blood in patients with poisoning by corrosive substances in elderly and senile patients*

**Materials and methods.** *An open prospective cohort study was conducted, which included 31 patients with oral poisoning from corrosive substances. The median age was 73.0 [67.0;76.0] years. Patients were divided into groups: with a favorable and fatal outcome. To solve these problems, the following indicators were assessed: the level of malondialdehyde (MDA), total antioxidant activity (TAA) in the blood, the content of stable nitric oxide metabolites nitrite/nitrate (NO<sub>x</sub>) in the blood, and the oxidative stress coefficient (CMDA/TAA). The studied parameters were recorded at the early stage of acute poisoning: on the 1st, 3rd and 5th day after admission to the hospital.*

**Results.** *When analyzing the indicators of the prooxidant-antioxidant system in the blood over time, it was noted that in patients with corrosive substance (CS) poisoning over 60 years of age, changes in the indicators of lipid peroxidation and antioxidant protection were detected, characterized by a decrease in the blood levels of MDA and NO<sub>x</sub> in relation to the age norm by background of reduced or subnormal values of antioxidant protection indicators. A decrease in the coefficient of oxidative stress was found at all stages of the study with ODS compared to control values by 2.3-2.4 times, which indicates the development of oxidative distress.*

**Conclusion.** *The results of the study showed that in older patients with acute poisoning by corrosive substances, there is an inadequate response from the prooxidant-antioxidant system, which is manifested by a decrease in the blood of patients with peroxidation products with normal or slightly reduced content of antioxidant defense components. There is oxidative distress, the aggravation of which leads to the development of death.*

**Keywords:** *acute poisoning, acute chemical poisoning, oxidative stress, oxidative distress, elderly patients, geriatric patients, lipid peroxidation, antioxidant activity.*

### **Introduction.**

Acute chemical poisoning is a significant medical problem that has a serious impact on the demographic situation in Russia, especially among the elderly. In recent years, the attention of researchers has increasingly attracted the study of disturbances in the processes of lipid peroxidation (LPO) and antioxidant defense (AOD) in various pathological conditions, including acute chemical poisoning [1, 2]. It has been proven that redox processes play an important role in the pathogenesis of acute chemical injury [1, 2]. The triggering mechanism is the entry of a toxicant into the body; subsequently, oxidative stress is supported by the development of endotoxemia. Today, there is a sufficient amount of data on disturbances in the LPO-AOD system in patients of working age with acute exotoxicosis. However, data on changes in this system in geriatric patients during acute chemical poisoning remain limited, highlighting the need for further research in this area.

**Objective:** to study indicators of lipid peroxidation and antioxidant protection in patients with poisoning by corrosive substances in older patients.

### **Materials and methods.**

An open prospective cohort study was conducted at the Department of Acute Poisonings and Somatopsychiatric Disorders of the Research Institute of Emergency Medicine named after N.V. Sklifosovsky in the period 2020–2023. after receiving approval from the Biomedical Ethics Committee (Extract No. 5-21 dated May 25, 2021).

Inclusion criteria for the study: patients with moderate to severe poisoning by corrosive substances (T54 according to ICD10) according to the classification of S.V. Volkova et al., add. Pinchuk [3,4], age 60 years and older. Criteria for non-inclusion in the study: age - up to 60 years, patients with mild poisoning by corrosive substances [3,4].

The study included 31 patients with oral corrosive poisoning (OCS) (study group). The median age was 73.0 [67.0;76.0] years, women – 13 women (41.9%), 18 men (58.1%). Patients were divided into groups: with a favorable and fatal outcome. Studies of LPO and AOD indicators were carried out in 39 volunteers aged from 60 to 82 years (69.0 [65.0;74.0]) years (control group).

In patients with ARV, treatment measures included infusion, analgesic, antispasmodic, hormonal and local therapy.

To solve the set tasks, the following indicators were assessed: the level of malondialdehyde (LDA), as a product of LPO, total antioxidant activity (TAA) in the blood to assess the state of AOD, the content of stable metabolites of nitric ox-

ide nitrite/nitrate (NOx) in the blood, the coefficient of oxidative stress ( $C_{OS/TAA}$ ). The level of MDA in blood serum was determined using the Gavrilov method [5], and total antioxidant activity (TAA) was determined by the spectrophotometric method on an Olympus AU2700 biochemical analyzer (Beckman Coulter, USA) using a TAS kit reagent kit (Randox, UK). The determination of NOx was carried out according to the method according to which cadmium in the presence of zinc reduces nitrate to nitrite (method of Golikov P.P. et al.) [6].  $C_{OS/TAA}$  for each patient was calculated as the ratio of the level of LDA in the blood serum to the TAA level in the blood serum, normalized to their normal values. The studied parameters were recorded at the early stage of acute poisoning: on the 1st, 3rd and 5th day after admission to the hospital.

Statistical processing of the material was performed using the IBM SPSS Statistics 27.0 program. The Shapiro-Wilk test was used to assess the normality of data distribution. For nonparametric data, the median (Me), 25th and 75th percentiles were determined as Me[Q25;Q75]. Comparison of quantitative data between groups was carried out using the Mann-Whitney test (M-W test) (independent groups), Wilcoxon test (related groups) (distribution of the characteristic differs from normal). The significance level was set to  $p < 0.05$ .

### Results and discussion.

Analysis of the results showed that the levels of LDA in the blood serum of patients with acute respiratory viral infections on the 1st and 3rd days of hospital stay were statistically significantly lower than control values by 17.2% (3.48  $\mu\text{mol/l}$ ) and 9.3 % (3.81  $\mu\text{mol/l}$ ), respectively. On the 5th day, it was noted to be close to the control value. At the same time, a decrease in TAA in the blood serum was established compared to the norm by 10-20.7%. A statistically significant decrease in  $C_{OS/TAA}$  was revealed throughout the study: in the first two stages by 2.3-2.4 times compared to the control group ( $p < 0.001$ ), on the 5th day it increased to 1.19 [0,19;1.4] standard units, which is 1.9 times lower than the values of the control group. These changes in  $C_{OS/TAA}$  by day 5 occurred due to a slight increase in lipid peroxidation processes and a significant decrease in the antioxidant activity of blood plasma. There was a statistically significant difference in the content of nitric oxide metabolites in the blood serum compared to the control indicator throughout the study by 1.4-1.6 times. It cannot be ruled out that NO deficiency in the body is associated with inhibition of NOS (endothelial constitutive synthase) activity.

A comparative assessment of the indicators of the LPO-AOP system was carried out with favorable and fatal outcomes of ODS in patients over 60 years of age. Analysis of the results shows that in persons with a favorable course of the disease during acute respiratory distress syndrome, there is an increase by the 5th day in the initially low levels of LDA and NOx in the blood of patients and a cor-

responding consumption of TAA. A tendency towards an increase in the imbalance coefficient was found - on the 5th day it was 1.12 times higher compared to the initial value ( $p < 0.001$ ). At all stages, statistically significant differences in  $C_{OS/TAA}$  from control values were observed. In case of death, a decrease in the oxidative stress coefficient was noted compared to patients in the other group; by day 5 it was only 35% of the normal value ( $p < 0.001$ ) and was 1.54 times lower than the initial value ( $p = 0.063$ ). This was due to a simultaneous decrease in the blood levels of LDA, NOx, and TAA at this stage of observation. The oxidative stress coefficient for the entire observation period had low values and was statistically significantly different from the norm. This indicates the development of oxidative distress, which contributes to a more severe course of the disease in this group of patients compared to people of working age. It cannot be excluded that this is due to the general low adaptive potential of the body, which we previously identified in geriatric patients with poisoning with psychotropic drugs [7]. When assessing the dynamics of nitric oxide, its initially low values were noted in all patients by 1.5 and 1.2 times, respectively ( $p < 0.001$ ). Subsequently, a slight increase in this indicator was observed in patients with a favorable outcome and a decrease in cases of death.

The study showed that geriatric patients with acute poisoning by corrosive substances have an inadequate response from the oxidant-antioxidant system, which is manifested by a decrease in LPO products in the blood of patients with normal or slightly reduced content of AOD components. There is the development of oxidative distress, the intensification of which leads, possibly, to endothelial dysfunction, disruption of microcirculation, and subsequently to multiple organ failure and death.

A limitation of this study is the small sample of patients due to the characteristics of this category of patients. Further research on a larger number of patients is required.

### Conclusions

1. In case of acute respiratory viral infection in patients over 60 years of age, changes in LPO and AOD indicators were revealed, characterized by a decrease in the blood levels of LDA and NOx in relation to the age norm against the background of reduced or subnormal values of TAA.
2. A decrease in the coefficient of oxidative stress was established at all stages of the study in patients over 60 years of age with PCS in patients over 60 years of age compared to control values by 2.3-2.4 times, which indicates the development of oxidative distress.
3. In patients with an unfavorable outcome, a decrease in the oxidative stress coefficient was detected.

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急性2,4-二硝基苯酚中毒

## ACUTE 2,4-DINITROPHENOL POISONING

**Simonova Anastasia Yuryevna**

*Candidate of Medical Sciences, Leading Research Officer  
N.V. Sklifosovsky Research Institute for Emergency Medicine,  
Senior Research Officer*

*Lopukhin Federal Research and Clinical Center of Physical-Chemical  
Medicine of Federal Medical Biological Agency*

**Gasimova Zulfira Masgutovna**

*Candidate of Biological Sciences, Senior Research Officer  
Lopukhin Federal Research and Clinical Center of Physical-Chemical  
Medicine of Federal Medical Biological Agency*

**Pavel Gennadievich Rozhkov**

*Head of laboratory  
Lopukhin Federal Research and Clinical Center of Physical-Chemical  
Medicine of Federal Medical Biological Agency*

**摘要。**近年来,在世界许多国家,因使用 2,4-二硝基苯酚来调整体重(“脂肪燃烧剂”)而导致中毒的病例再次增加,这种现象在美国在 20 世纪 30 年代使用和全面禁止在其基础上开发的生物活性药物添加剂期间也曾出现过。在俄罗斯,已记录了这种化学病因的中毒病例。对向以 Yu.M. Lopukhin 院士命名的联邦科学和临床物理和化学医学中心信息和咨询毒理学部门提出的有关 2,4-二硝基苯酚急性中毒诊断和治疗策略的请求进行了分析,并描述了以 N.V. Sklifosovsky 命名的急诊医学研究所急性中毒和躯体精神疾病科住院患者中毒的两例临床病例,这些病例有有利的,也有致命的。

**关键词:** 急性中毒、毒性作用、二硝基苯酚。

**Abstract.** *In recent years, in many countries of the world, there has again been an increase in cases of poisoning with 2,4-dinitrophenol due to use for the purpose of weight correction (“fat burner”), previously observed in the USA in the 1930s during the period of use and complete prohibition of the biologically active drug developed on its basis. additives. In Russia, isolated cases of poisoning of this chemical etiology have been recorded. An analysis of requests regarding the diagnosis and treatment tactics of acute poisoning with 2,4-dinitrophenol to the information and advisory toxicology department of the Federal Scientific and*

*Clinical Center for Physical and Chemical Medicine named after Academician Yu.M. Lopukhin and a description of two clinical cases of poisoning with a favorable and fatal outcome in patients hospitalized in the department of acute poisoning and somatopsychiatric disorders of the Research Institute of Emergency Medicine named after. N.V. Sklifosovsky.*

**Keywords:** acute poisoning, toxic effect, dinitrophenol.

**Introduction.** 2,4-Dinitrophenol (DNP) is quite widely used in industry and agriculture due to its pronounced simultaneous herbicidal, fungicidal, and insecticidal effects, and acts as precursors in the production of dyes, antiseptics for wood, and fabrics. It has the ability to cumulate [1] and poses a serious threat to human health. It is toxic through all routes of entry into the body - inhalation, transdermal, oral [2, 3]. The mechanism of action of DNP is associated with the uncoupling of oxidation and phosphorylation in mitochondria, which leads to a decrease in ATP synthesis, despite an increase in the rate of electron movement through the respiratory chain and increased catabolism, and is accompanied by an acceleration of basal metabolism, lipolysis and loss of body weight [4]. Given the effective “fat-burning” effect of DNP, in the United States in the 1930s, dietary supplements for weight loss began to be used based on it. In 1938, their use was prohibited due to the development of fatal acute poisonings.

In recent years, in the United States and other countries around the world, there has been a resurgence in the use of DNP as an illegal drug for weight loss or muscle building (bodybuilding), accompanied by an increase in fatal poisonings [5]. Cases of acute DNP poisoning with fatal outcomes began to be recorded in Russia [6 - 8].

**Purpose:** to determine the structure of requests for specialized help at the information and advisory toxicology department of the Federal Scientific and Clinical Center for Physical and Chemical Medicine named after Academician Yu.M. Lopukhin of the Federal Medical and Biological Agency on diagnostics and treatment tactics with 2,4-dinitrophenol for the period 2013-2022 and provide a description of clinical cases of poisoning with a favorable and fatal outcome in two patients hospitalized in the acute poisoning department of the Research Institute of Emergency Medicine named after . N.V. Sklifosovsky Department of Health of Moscow.

**Materials and methods:** analysis of the frequency of requests for specialized help in the information and advisory toxicology department on issues of pesticide poisoning according to the registration forms “Record card of consultation of a patient with acute poisoning of chemical etiology” and the information and analytical toxicological system “Recording and analysis of consultations with patients with acute poisoning” poisoning of chemical etiology” on the issue of acute



poisoning with 2,4-dinitrophenol for the period 2013-2022, clinical cases of dinitrophenol poisoning in 2 hospitalized patients in the department of acute poisoning of somatopsychiatric disorders.

**Results.** Over the ten-year period 2013-2022. In the information and advisory toxicology department, 7 cases of requests for advisory support on the diagnosis and treatment tactics of 2,3-dinitrophenol poisoning were registered, of which 2 were suicidal, 4 were for the purpose of weight loss, 1 was a request for information about the clinical and toxicological danger of DNF. At the time of consultation, the condition was relatively satisfactory in 4 patients, moderate - 2, severe - 1. In all patients, against the background of clear consciousness, the following symptoms were identified: tachycardia, tachypnea, dry mucous membranes, thirst, vomiting. One of the victims (an 18-year-old man), in a relatively satisfactory condition, also had an increase in body temperature to 37.40 C and a rash on the body. All cases of poisoning were caused by taking DNP tablets. – 1-2 tablets for weight loss and 20 tablets for suicidal poisoning attempts.

Hospitalization was recommended for 6 patients in specialized departments for the treatment of acute poisoning.

*Clinical case 1.* Patient L., 18 years old, was taken to the State Budgetary Healthcare Institution Research Institute for Emergency Medicine named after N.V. Sklifosovsky with a diagnosis of dinitrophenol poisoning. According to the patient, 4 hours before admission, he took from 5 to 8 DNF tablets for the purpose of losing weight. Upon admission, the patient was clearly conscious (GCS 15 points), adequate, and restless. RR - 25 per minute, heart rate - 120 per minute, blood pressure - 130/62 mm Hg, body temperature - 37.80 C. The patient complained of rapid heartbeat, thirst, and severe sweating. The patient was hospitalized in the intensive care unit (ICU).

In the intensive care unit, due to increasing respiratory failure, tracheal intubation was performed and mechanical ventilation was started. A nasogastric tube was inserted, and the stomach was rinsed to clean lavage water. Body temperature increased to 39.9 C. A cooling blanket (Gamar Meditherm, Orchard Park, NY) was used to reduce body temperature.

Biochemical analysis revealed an increase in creatine phosphokinase (CPK) to 662 U/l, pH - 7.1, BE - -15, blood lactate level - 8.2 mmol/l. Other laboratory parameters were within the reference values. ECG - sinus tachycardia, signs of myocardial hypoxia.

It was decided to carry out intermittent hemodialysis (IH) with a low dialysate temperature for 4 hours, intestinal lavage (IL) using an enteral solution in a volume of 4500 ml, and the introduction of cytoflavin (inosine + nicotinamide + riboflavin + succinic acid) to stimulate tissue respiration, metabolic energy correction, as an antihypoxant and antioxidant. When repeating a clinical blood test, attention

was drawn to an increase in leukocytes to  $18.2 \cdot 10^9/l$ , a decrease in platelets to  $216 \cdot 10^9/l$ , in a biochemical analysis - an increase in glucose to  $8.31 \text{ mmol/l}$ , CPK -  $796 \text{ U/l}$ , LDH -  $598.23 \text{ U/l}$ , total protein -  $64.93 \text{ g/l}$ , amylase -  $191.87 \text{ U/l}$ . After IH and IL, the temperature dropped to  $36.80 \text{ C}$ . An ultrasound examination revealed changes in the liver consistent with hepatitis, diffuse changes in the right kidney, liquid impregnation of the perinephric tissue on the right, and tissue along the contour of the right lobe of the liver. The volume of infusion therapy over 16 hours was  $13,320 \text{ ml}$ , urine output was  $4,100 \text{ ml}$ , and perspiration losses were  $6,000 \text{ ml}$ .

Over the next 24 hours, the patient was re-treated with IL in a volume of 4.5 liters, and infusion detoxification and symptomatic therapy was continued. We observed an increase in body temperature to a maximum of  $37.40\text{C}$ , and a tendency towards normalization of laboratory parameters. The results of liver scintigraphy showed an increase in its size and diffuse changes. The patient continued to remain in serious condition, was on sedation and mechanical ventilation. After 45 hours from the moment of hospitalization, the patient was transferred to spontaneous breathing and extubated. Consciousness level - stun. Subsequently, positive dynamics of clinical and laboratory parameters were noted. The length of stay in the ICU was 3 days, the total length of hospitalization was 4 days.

Clinical case 2. A 44-year-old man took 20 dinitrophenol tablets (2 g) purchased from an online store for the purpose of suicide. 30 minutes after taking the drug, the patient's condition worsened: nausea, vomiting, palpitations, severe sweating, hyperthermia up to  $38.0 \text{ C}$ , blood pressure –  $140/90 \text{ mm Hg}$ , heart rate –  $100 \text{ per min}$ ,  $\text{SO}_2$  –  $98\%$ . At the prehospital stage, the emergency medical worker flushed the stomach through a tube. 3 hours after taking the drug, he was hospitalized in the acute poisoning department of the Research Institute for Emergency Medicine named after N.V. Sklifosovsky. Upon admission to the hospital, the patient was conscious and agitated. Blood pressure –  $130/60 \text{ mmHg}$ , heart rate –  $130/\text{min}$ . Body temperature –  $36.20\text{C}$ . RR-22 per minute. Given the severity of the condition, the patient was hospitalized in the intensive care unit. The complex of treatment measures included detoxification, symptomatic therapy, intestinal lavage using saline enteral solution in a volume of 6 liters. We monitored blood gases, electrolytes, clinical and biochemical blood tests over time, and monitored vital signs. The patient's attention was marked by severe sweating, thirst, tachycardia up to  $100 \text{ per minute}$  pH -  $7.32$ , BE -  $4.7$ ,  $\text{pO}_2$  -  $42 \text{ mm Hg}$ ,  $\text{pCO}_2$  -  $41.2 \text{ mm Hg}$ , lactate -  $3.7 \text{ mmol/l}$ . 8 hours after the transition, the patient's condition sharply worsened: depression of consciousness to the point of deep stupor, respiratory rate -  $32 \text{ per minute}$ , blood pressure -  $145/90 \text{ mm Hg}$ , heart rate -  $115 \text{ per minute}$ . Due to increasing respiratory failure, the patient was intubated and transferred to mechanical ventilation. After 30 min. there was a sudden cardiac arrest. Resuscitation measures - without effect.

Discussion. When diagnosing poisoning with biologically active DPN, it is necessary to take into account the timing of the manifestation of early signs of toxic action, ranging from several minutes to 1 hour for inhalation and oral poisoning, 2-30 hours (on average 17.1 hours) for percutaneous poisoning [4, 9]. Failure to promptly seek medical help, diagnose and determine treatment tactics in the early stages of DNF poisoning significantly increases the risk of death from sudden cardiac arrest [4]. An increase in mortality rates is also observed in cases of suicidal poisoning, especially if the victims have a history of psychotic disorders [10].

Clinical symptoms of poisoning are weakness, increased thirst, dizziness, headache, vomiting, hyperemia of the skin, decreased or loss of sensitivity of skin areas contaminated with the pesticide, change in skin color from yellow to black (percutaneous exposure), severe hyperhidrosis, hyperpyretic fever, anxiety, chest tightness, shortness of breath, tachypnea, tachycardia, convulsions, paresthesia, muscle pain, impaired consciousness, multiple organ failure, pulmonary edema, cardiac arrest. With mild intoxication, about an hour after exposure, signs of general malaise develop: headache, lethargy, decreased performance, dizziness, nausea. Characteristic manifestations of intoxication are severe sweating and an increase in body temperature up to 38.00 C. These disturbances persist throughout the day. With moderate intoxication, the described phenomena are accompanied by shortness of breath, a feeling of tightness in the chest, and increased heart rate. Feelings of anxiety, restlessness, and insomnia appear. Body temperature rises to 39.0C. In case of severe poisoning, the clinical picture develops quite quickly. The victim experiences a feeling of thirst. There is severe shortness of breath, heart rhythm disturbances, and increased blood pressure. Cyanosis of the skin appears. Body temperature rises to 40 - 42.0C (“thermal explosion”). Consciousness is lost, the pupils are dilated, and convulsive syndrome develops. Death can occur from respiratory or cardiac arrest [9]. Carrying out sanitary and hygienic treatment in case of percutaneous poisoning must be carried out with precautions due to the possibility of secondary infection from patients upon contact with contaminated areas of the skin [4].

The main complex of treatment measures included detoxification, symptomatic therapy, and intestinal lavage using saline enteral solution. Intestinal lavage detoxifies not only the enteral environment - the sector of deposition of exo- and endotoxins, but is also a method of efferent therapy, while simultaneously detoxifying the parenteral environment (blood, plasma, lymph) [11, 12]. The use of saline enteral solution (SES) for intestinal lavage helps eliminate hypovolemia, hemoconcentration, electrolyte and acid-base imbalance of blood plasma.

Conclusion. 2,4-dinitrophenol poses a serious threat to human health. The availability of illegal drugs containing this compound and their uncontrolled use for the purpose of weight correction leads to a high risk of fatal poisoning. Timely

diagnosis of dinitrophenol poisoning based on the mechanism of its toxic action (blocking oxidative phosphorylation in cells by transporting protons across the mitochondrial membrane) makes it possible to determine targeted pathogenetic treatment to stabilize the victim's condition, prevent complications and reduce the risk of death.

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乙酰水杨酸 (阿司匹林) 影响胃肠酶的活性  
**ACTIVITY OF GASTROINTESTINAL ENZYMES UNDER THE  
INFLUENCE OF ACETYLSALICYLIC ACID (ASPIRIN)**

**Shishkin Dmitriy Alekseevich**

*Student*

*Petrozavodsk State University, Petrozavodsk, Russia*

**Volkova Tatyana Olegovna**

*MD, Professor*

*Petrozavodsk State University, Petrozavodsk, Russia*

**摘要。**本研究在体外研究了乙酰水杨酸 (阿司匹林) 对人体胃肠道主要酶的生物活性。对乙酰水杨酸存在下唾液 $\alpha$ -淀粉酶、胃蛋白酶和脂肪酶活性的研究表明, 乙酰水杨酸可以以不同的方式影响消化酶的活性: 对于唾液 $\alpha$ -淀粉酶, 它起抑制剂的作用; 对于胰腺脂肪酶, 它是一种激活剂; 并且不影响胃蛋白酶的酶活性。乙酰水杨酸对 $\alpha$ -淀粉酶和脂肪酶的影响可以被视为使用含有这种物质的药物出现副作用的次要条件, 特别是消化不良、胃肠道溃疡性病变、出血。

**关键词:** 乙酰水杨酸 (阿司匹林)、胃肠酶、唾液 $\alpha$ -淀粉酶、胃蛋白酶、脂肪酶、消化不良、溃疡、出血。

**Abstract.** *The presented study examined the biological activity of the main enzymes of the human gastrointestinal tract under the influence of acetylsalicylic acid (aspirin) in vitro. A study of the activity of salivary  $\alpha$ -amylase, pepsin and lipase in the presence of acetylsalicylic acid showed that it can influence the activity of digestive enzymes in different ways: in relation to salivary  $\alpha$ -amylase it acts as an inhibitor, in relation to pancreatic lipase it is an activator, and does not affect the enzymatic activity of pepsin influences. The effect of acetylsalicylic acid on  $\alpha$ -amylase and lipase can be considered as secondary conditions for the occurrence of side effects of the drugs used, which contain this substance, in particular dyspepsia, ulcerative lesions of the gastrointestinal tract, bleeding.*

**Keywords:** *acetylsalicylic acid (aspirin), gastrointestinal enzymes, salivary  $\alpha$ -amylase, pepsin, lipase, dyspepsia, ulcers, bleeding.*

Digestive enzymes are produced by the body in the mouth, stomach, pancreas and intestinal walls. Most of them are produced in inactive forms (proenzymes or zymogens) and are activated during the digestion process (Biological Chemistry,

2021). The substrates for such enzymes are carbohydrates, proteins and food lipids. For example, salivary  $\alpha$ -amylase cleaves  $\alpha$ 1,4-glycosidic bonds in starch and glycogen, gastric pepsin cleaves peptide bonds in proteins, and pancreatic lipase cleaves ester bonds in lipids formed by glycerol and higher fatty carboxylic acids (Biological Chemistry, 2021). For almost all enzymes, regulators of their biological activity are known - activators and/or inhibitors. Many of them are medicines. Currently, the most widely used group of drugs in medicine are non-steroidal anti-inflammatory drugs. In 2013, A.V. Rodionov found that more than 30 million people in the world are forced to take them constantly, and approximately 300 million for a short time. Over the past 30 years, the number of drugs in this group has increased significantly. They differ from each other in action and application features. The group of non-steroidal anti-inflammatory drugs includes acetylsalicylic acid (aspirin).

Acetylsalicylic acid irreversibly inhibits the cellular enzyme cyclooxygenase, which plays an important role in the synthesis of mediators of inflammation and pain (prostaglandins and prostacyclins) (Ignatova, 2010). Therefore, it is characterized by anti-inflammatory and analgesic effects. The antiplatelet effect of aspirin was confirmed as a result of many years of scientific research, which proved its inhibitory effect on the synthesis of thromboxanes (Popular preparations of acetylsalicylic acid, 2017). After the publication of the results of clinical studies, aspirin began to be used as a blood thinner, and its antiplatelet effect is achieved in a concentration below that required for analgesic, antipyretic or anti-inflammatory effects (Ignatova, 2010).

Side effects when using aspirin include dyspepsia, ulcerative lesions of the gastrointestinal tract, bleeding, nephro-, hepato- and cardiotoxicity, allergic manifestations, etc. (Ignatova, 2010). The literature also contains information on the effect of aspirin on the activity of nonspecific esterases of the intestinal wall and enzymes for the biotransformation of xenobiotics in the liver (Pharmacology of the enteric form..., 2019). There is no data on the effect of aspirin on the body's digestive enzymes in the literature.

In this regard, the main hypothesis of the study was the assumption that aspirin can be considered as a regulator of the activity of enzymes in the gastrointestinal tract, and the side effects of the drug may be associated with a similar biological effect. The main goal of the study was to study the activity of salivary  $\alpha$ -amylase, pepsin and human lipase under the influence of acetylsalicylic acid (aspirin) *in vitro*.

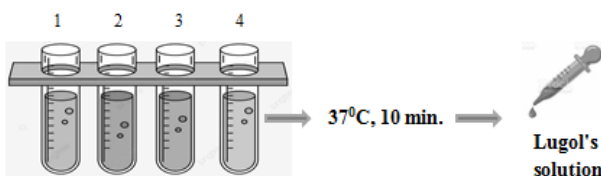
The work used standard methods for assessing the activity of enzymes in the gastrointestinal tract, which are based on qualitative reactions (Table 1) that occur during the catalytic hydrolysis of the corresponding substrates under given incubation conditions (Ostashkova et al., 2012; Shishkin, 2022).

**Table 1**

*Substrates and qualitative reactions for the studied enzymes*

Enzymes	Substrates	Reaction
$\alpha$ -Amylase	Starch	Adding iodine (Lugol's solution) (blue color)
Pepsin	Albumin	Disappearance of turbidity followed by biuret reaction
Lipase	Vegetable fats	Determination of pH using phenolphthalein

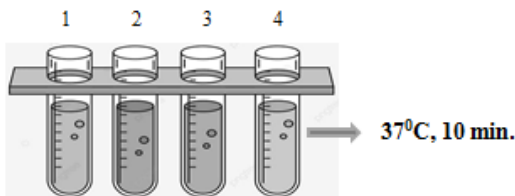
*Study of salivary amylase activity:* reactions were carried out in four test tubes (Fig. 1). Human saliva was used as a source of  $\alpha$ -amylase.



**Figure 1.** Study of salivary amylase activity

1 – 5 ml of 0.2% starch solution + 1 ml of  $H_2O$  dist. (control 1); 2 – 5 ml of 0.2% starch solution + 1 ml of saliva solution (saliva :  $H_2O$  dist., 1:1); 3 – 5 ml of 0.2% starch solution + 1 ml of 1% aspirin solution (control 2); 4 – 5 ml of 0.2% starch solution + 0.5 ml of saliva + 0.5 ml of 2% aspirin solution

*Study of pepsin activity:* reactions were carried out in four test tubes (Fig. 2). The albumin solution was previously denatured by heating. We used pepsin 600 units/mg protein, Sigma-Aldrich, the pH of the samples was acidified with HCl to 1.5–2.



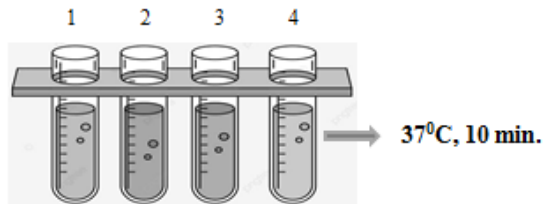
**Figure 2.** Study of pepsin activity

1 – 2 ml of 1% albumin solution + 1 ml of  $H_2O$  dist. (control 1); 2 – 2 ml of 1% albumin solution + 1 ml of pepsin solution (pepsin :  $H_2O$  dist., 1:1); 3 – 2 ml of 1% albumin solution + 1 ml of 0.5% aspirin solution (control 2); 4 – 2 ml of 1% albumin solution + 0.5 ml of pepsin + 0.5 ml of 1% aspirin solution



*Study of lipase activity:* the reaction mixture (4 ml of H<sub>2</sub>O dist., 5 ml of 1% sodium bicarbonate solution and 1 ml of vegetable oil) was poured into four test tubes, shaken vigorously until an emulsion was formed, and 2 drops of a 0.5% alcohol solution of phenolphthalein were added (Fig. 3). Next, the reagents indicated in the captions to Figure 3 were added to the test tubes. Lipase 10,000 units/mg protein, Alfa Aesar, was used.

The results obtained were assessed visually and also using a photoelectric colorimeter HANNA HI 83414-02. The optical density of control and experimental samples (E) was determined at the corresponding wavelengths and compared with each other. The wavelength ( $\lambda$ ) for studying the activity of  $\alpha$ -amylase is 750 nm, pepsin – 540 nm, lipase – 460 nm. The significance of the results was determined using the nonparametric Wilcoxon-Mann-Whitney test in the Statgraphics Plus program.



**Figure 3.** Study of lipase activity

1 – 1 ml H<sub>2</sub>O dist. (control 1); 2 – 1 ml of lipase solution (lipase : H<sub>2</sub>O dist., 1:1); 3 – 1 ml of 1% aspirin solution (control 2); 4 – 0.5 ml lipase + 0.5 ml 2% aspirin solution

The results of the study showed that the biological activity of salivary  $\alpha$ -amylase decreased significantly when aspirin was added to the medium (Table 2). After adding Lugol's solution to the test tubes, the color of the starch + saliva + aspirin sample became blue (a qualitative reaction to starch), while the starch + saliva sample did not color, since it had enzymatic hydrolysis of starch to maltose under the action of the main enzyme of saliva -  $\alpha$ -amylase. It is possible that aspirin may have a similar effect on pancreatic  $\alpha$ -amylase, which, of course, requires additional experimental confirmation.

1 – substrate (starch, albumin or fat) (control 1); 2 – substrate + enzyme ( $\alpha$ -amylase, pepsin or lipase); 3 – substrate + aspirin (control 2); 4 – substrate + enzyme + aspirin; comparison was carried out in pairs 1 - 2 (\*), 2 - 4 (●) and 3 - 4 (○); (\*) (○) (●) p < 0.05; (\*\*) (○○) (●●) p < 0.01

**Table 2***Effect of aspirin on the activity of digestive enzymes*

Test tubes	$\alpha$ -Amylase ( $\lambda$ 750 nm)	Pepsin ( $\lambda$ 540 nm)	Lipase ( $\lambda$ 460 nm)
1	0,986 $\pm$ 0,078	0,122 $\pm$ 0,022	0,567 $\pm$ 0,056
2	0,076 $\pm$ 0,012**	0,014 $\pm$ 0,004*	0,228 $\pm$ 0,035*
3	0,965 $\pm$ 0,082	0,124 $\pm$ 0,018	0,536 $\pm$ 0,048
4	0,754 $\pm$ 0,076●● (○)	0,019 $\pm$ 0,007	0,082 $\pm$ 0,017● (○○)

The enzymatic activity of pepsin did not change when aspirin was added to the medium (Table 2). Pepsin hydrolyzed albumin protein independently of aspirin, which was confirmed by the disappearance of turbidity in the samples after incubation at 37°C (turbidity of the mixture was caused by denatured albumin). The biuret reaction also did not reveal the presence of protein in the samples.

A somewhat different situation was observed with regard to lipase. The biological activity of this enzyme in the presence of aspirin increased compared to a sample that did not contain aspirin (Table 2). In this case, the lipase hydrolyzed its substrate more intensively.

During our research, we found that acetylsalicylic acid (aspirin) can have different effects on the activity of digestive enzymes: it can act as an inhibitor of enzymatic activity, for example, in relation to salivary  $\alpha$ -amylase, it can be an activator of enzymes, in particular pancreatic lipase, or do not affect enzyme activity, as has been shown using pepsin. It is possible that the effect of aspirin on  $\alpha$ -amylase and lipase may be an additional cause of side effects of the drugs used, which include acetylsalicylic acid (in particular, dyspepsia, ulcerative lesions, gastrointestinal bleeding).

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军校一年级学员医学飞行训练期间MRI检查颅内发现的结构分析  
**THE STRUCTURE OF INTRACRANIAL FINDINGS ACCORDING  
TO THE DATA MRI DURING THE MEDICAL FLIGHT  
COMMISSION AMONG THE CADETS OF THE FIRST YEAR OF  
THE MILITARY SCHOOL**

**Kolomiytsev Victor Gennadievich**

*radiologist*

*419th Military Hospital, Krasnodar, Russian*

**Gornov Sergey Valerievich**

*Doctor of Medical Sciences, Institute of Continuing Education, Russian  
Biotechnological University (ROSBIOTECH), Moscow, Russia*

**Burova Ilona Vyacheslavovna**

*radiologist*

*Kuban State Medical University,*

*Regional Clinical Hospital No. 2, Krasnodar, Russia*

**摘要。**俄罗斯联邦武装部队所承担任务的复杂程度决定了飞行员的健康要求很高。早期识别功能性和有机性疾病可以延长职业寿命，并在训练的早期阶段识别不适合飞行的迹象，最终对加强防御能力做出巨大贡献。

本研究的目的是使用磁共振成像 (MRI) 或计算机断层扫描 (CT) 研究飞行学校第一年学员在第一次 MFC 期间脑液空间变化的频率和结构。

**研究方法:**飞行学校所有 ( $n=348$ ) 第一年学员均接受了脑部 MRI 和 CT 检查。

**结果:**对获得的脑断层扫描图像进行分析,发现 36 名 (10.4%) 学员有不同大小和不同位置的蛛网膜囊肿, 5 名 (1.3%) 学员有脑脊液腔扩张 - 所有初步诊断的学员均为“健康”。

**结论:**在评估 MFC 期间学员的脑结构时,如果他们不适合进行 MRI 检查,则可以使用 CT 检查。

**关键词:** MRI、MFC、神经影像学、脑脊液腔。

**Abstract.** Degree of complexity of tasks assigned to the Armed Forces of the Russian Federation dictate the need for high pilot health requirements. Identification of functional and organic disorders at an early stage allow you to prolong professional longevity, as well as identify signs of unsuitability for flights

*at the earliest stages of training, which ultimately makes a huge contribution to strengthening defense capabilities.*

***The aim of the study was to investigate the frequency and structure of changes in cerebral liquor spaces using magnetic resonance imaging (MRI) or computed tomography (CT) in first-year cadets of a flight school during the first MFC.***

***Research methods:** all (n=348) first year cadets of the pilot school underwent MRI and CT examination of the brain.*

***Results:** the analysis of the obtained brain tomograms showed arachnoid cysts of different sizes and localization in 36 (10.4%) cadets and expansion of cerebrospinal spaces in 5 cadets (1.3%) - all cadets with the initial diagnosis are "Healthy".*

***Conclusion:** when evaluating the brain structures of cadets during the MFC, CT is acceptable in cases where they have contraindications to MRI.*

***Keywords:** MRI, MFC, neuroimaging, cerebrospinal fluid spaces of the brain.*

### **Introduction.**

The complexity and responsibility of the tasks assigned to the armed forces of the Russian Federation are unprecedented in modern conditions [1].

The events taking place are due to the military-technical and tactical development of combat aviation. This requires the need for constant adaptation of flight personnel to changing conditions, placing ever higher demands on the health of pilots.

The work of the flight crew takes place under conditions of combined exposure to various adverse factors [2]. Performing combat training tasks in stressful and unforeseen situations leads to the development of fatigue and the progression of chronic diseases, which can subsequently lead to premature disqualification for medical reasons.

All these processes are to some extent inevitable, but a full-fledged functional diagnosis, already at the stages of training in higher military educational institutions of the Ministry of Defense of the Russian Federation, avoids the formation of most clinical syndromes and diseases [12].

High requirements for the pilot's health, physical endurance and psychological qualities oblige to improve the organization and methods of medical flight examination (hereinafter referred to as MFC), attaching special importance to the prevention and early detection of functional disorders and initial forms of diseases [3].

At the present stage, high-quality medical selection of citizens studying in aviation military educational institutions makes it possible to extend professional longevity, as well as identify signs of unfitness for flight service at the earliest stages of training, which ultimately makes a huge contribution to strengthening the defense capability of the Russian Federation.

The Medical Flight Commission (hereinafter referred to as the MFC) carries out medical selection of citizens, in accordance with the requirements of the governing documents, in order to further their education in military educational institutions and train aviation personnel capable of flying on the most modern aircraft [4].

In 2022, amendments were made to the Decree of the Government of the Russian Federation dated 07/04/2013 No. 565 (ed. dated 06/29/2022) “On approval of the Regulations on military medical examination” item 120, which updated the list of mandatory laboratory and instrumental methods for citizens studying at military educational institutions for the training of flight personnel of state aviation.

First-year cadets need to assess the state of the central nervous system by neuroimaging brain structures using magnetic resonance imaging (hereinafter MRI) perform ultrasound examination of the abdominal organs of the kidneys, urinary system and thyroid gland, electroencephalogram (EEG), echocardiography (ECG).

To date, the Ministry of Defense of the Russian Federation has not conducted such scientific research in such a quality and volume for first-year cadets of military flight schools. That is, no new information was received for passing the medical commission.

Today, in order to optimize the work of the VLK, it is necessary to develop criteria for an expert assessment of brain changes without disorders of the nervous system in cadets of flight schools.

### **Relevance:**

The deterioration of the health status of young people has a negative impact on the recruitment of the Armed Forces of the Russian Federation. The number of candidates for admission to military aviation universities is decreasing annually. For the training of one flight school cadet, significant material and non-material resources are spent on the part of the person himself, the Ministry of Defense and the state as a whole.

The training of a highly professional military pilot in Russia costs from 3.4 to more than 7.8 million dollars, and the operator of an unmanned aerial vehicle (hereinafter - UAV) costs about 200 thousand dollars [5]. The lack of clear criteria for evaluating brain neuroimaging using MRI in the aspect of MFC dictates the need to develop fundamental criteria to determine the main predictors of suitability for flight service.

**The purpose of the study** is to evaluate brain structures, detect and evaluate the frequency of pathological changes in them using MRI and CT the cadets of the first year of the flight school.

### **Information materials and research methods**

In accordance with the Decree of the Government of the Russian Federation, dated 07/04/2013. No. 565 “On approval of the regulations on military medical

examination” from 04.10.2022 to 02/15/2023 in Federal State Government institution “419 MH” of the Ministry of Defense of the Russian Federation, Krasnodar, lanned, organized and conducted a survey of first-year cadets of the Krasnodar Higher Military School of Pilots.

The study involved 100% of 1st year cadets with a diagnosis, upon admission to the college, “Healthy”. The timing of the research in

FSGI “419 MH” of the Ministry of Defense of the Russian Federation from 01.10.2022 to 01.02.2023. The median age characteristics were 19.0 [17.0; 22.0] years.

The design of the study is empirical, one–step. The clinical trial was conducted in accordance with the principles of the Helsinki Declaration. All cadets without contraindications to MRI (n=328) underwent contrast-free magnetic resonance imaging of the brain on a low-floor open-type MRI-AMICO 300 device with a permanent magnet and an induction value equal to 0.3 Tesla.

Information about each patient was logged, recorded and stored in the MRI patient database using Excel spreadsheets. The resulting magnetic resonance images were decoded and archived. Data processing was performed using the Makhaon DICOM software. An MRI examination protocol consisting of T1-VI modes was used, T2-VI, T2-FLAIR performed in the axial, sagittal and coronary planes - in the assessment of brain structures.

According to the authors, the optimal protocol for brain research for young people without clinical complaints was used: Axi T2, Sag Flaer, Cor T1. All the cadets were instructed, in which the rules of conduct and the essence of the diagnostic procedure were explained. The scan procedure lasted about 12 minutes on average, and the patient was motionless all this time.

One of the most informative methods of brain neuroimaging is MRI [6]. Changes in the brain structures of cadets were evaluated by the authors according to modern standards of MRI diagnostics, performing MRI of the brain in modes T1, T2, FLAIR (0.3 Tesla) [11]. The analysis of the results obtained by DICOM images was carried out using the MAHAON program visualized on the doctor’s monitor in three planes: axial, sagittal and coronary. The cut-off step of the tomography was 5 mm. The thickness of the liquor spaces was measured in T1 and T2 modes.

Despite the fact that MRI is very good at differentiating the differences between soft tissues, which certainly makes it the most advantageous when visualizing brain structures, the method has limitations. In such cases , computed tomography (hereinafter referred to as CT) was used.

In 6% of cases (n=20), the cadets had contraindications to MRI -the presence of metal braces. These cadets underwent a CT scan of the brain on a 32-slice General Electric Optima 540 machine. The study took less than one minute. The au-

thors studied the state of the brain substance for focal and volumetric formations, inflammation of the meninges, arachnoid cysts and various congenital anomalies of the brain structure.

**The result of the research**

The analysis of the obtained brain tomograms revealed arachnoid cysts of various localization, cases of expansion of cerebrospinal fluid spaces, mixed hydrocephalus, asymmetry of the lateral cerebral cavity. The condition of the paranasal sinuses, temporal bones and nasopharynx was also assessed. The general structure of the changes detected by computer scanning in the first-year cadets of the flight school is presented in the table.

**Table 1**

*The structure of changes detected in first-year flight school cadets in the area of brain scanning according to MRI and CT data.*

Identified changes	number of cadets (n – 348)	Number of cases, %
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**The brain**

No changes in the structures of the brain	307	88,2
Retrocerebellar cysts	28	8,0
Expansion of cerebrospinal fluid spaces	5	1,4
cyst transparent partitions	3	0,9
Asymmetry of lateral ventricles	3	0,9
Temporal Arachnoid Cysts	2	0,6

**ENT organs, located in the scanning area**

Inflammatory changes in the perilone sinuses	70	20,1
deviated septum	30	8,6
Enlarged adenoids	24	6,9
Inflammatory changes in temporal bones	2	0,6

It follows from the presented table that the most frequent changes in the brain were retrocerebellar cysts- 28 (8,0%) and expansion of cerebrospinal fluid spaces - 5 (1,4%), cyst transparent partitions- 3 (0,9%), asymmetry of lateral ventricles 3 (0,9%) facts and inflammatory changes in temporal bones 2 (0,6%) . 5



The structure of changes on the part of ENT organs was as follows: Inflammatory changes in the paranasal sinuses 70 cadets (20,1%), deviated septum 30 facts (8,6%), enlarged adenoids 24 (6,9%), inflammatory changes in temporal bones 2 (0,6%).

### **Discussion**

Based on the data obtained, it can be concluded that the use of computed tomography is acceptable in assessing changes in the brain structures of cadets during MFE.

Any focal and volumetric formations of the medulla, as well as changes in size Arachnoid spaces and the ventricular system are considered pathology in accordance with the governing documents [1]. However, some of them are not life-threatening and often do not require symptomatic treatment [7] The data obtained in the course of the study on the number of occurrence of intracranial changes differ significantly from the literature [10.12], and the significance of their influence on the shelf life category is probably overestimated.

Insufficient experience in interpreting statistical data and results obtained with the help of rapidly developing diagnostic tools creates difficulties for the MFC in practice, which dictates the need for additional research and revision of previously established approaches to determining the category of suitability of the studied contingent [8,9].

### **Conclusions**

1. Congenital features of cerebrospinal fluid spaces were revealed in a sufficient number of clinically healthy cadets examined - 41 people (11.7%).
2. It is necessary to clarify the tactics of the MFC in the presence of various pathological changes in order to objectively predict the real risk in relation to further service.

### **Practical recommendations**

1. It is necessary to improve the legislative framework and methodological approaches to the medical and flight examination of this contingent.
2. It is proposed to consider the inclusion in the professional selection of MRI of the brain of citizens who are planning to study at military educational institutions.

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自闭症谱系障碍的精神方面：诊断和干预  
**PSYCHIATRIC ASPECTS OF AUTISM SPECTRUM DISORDERS:  
DIAGNOSIS AND INTERVENTIONS**

**Osipova Yulia Alexandrovna**

*Student*

*Transnistrian State University after T.G. Shevchenko*

**摘要。**本文致力于自闭症谱系障碍（ASD）的精神方面，重点介绍诊断和治疗干预。本综述涵盖了 ASD 的历史和概念发展，从 Leo Kanner 和 Hans Asperger 的作品开始，并研究了当代诊断标准和工具，例如 ADOS-2 和 ADI-R。讨论了早期检测和筛查的方法，强调了它们的重要性，研究显示早期干预可以改善结果。

**关键词：**自闭症、诊断、治疗。

**Abstract.** *This article is dedicated to the psychiatric aspects of autism spectrum disorders (ASD), with a focus on diagnosis and therapeutic interventions. The review covers the history and conceptual development of ASD, beginning with the works of Leo Kanner and Hans Asperger, and examines contemporary diagnostic criteria and tools such as ADOS-2 and ADI-R. Methods of early detection and screening are discussed, highlighting their importance as supported by research showing improved outcomes with early intervention.*

**Keywords:** *autism, diagnosis, therapy.*

### **Introduction**

Autism spectrum disorders (ASD) are a group of neurodevelopmental conditions characterized by deficits in social communication and repetitive, restricted behaviors, interests, or activities. With the increasing number of diagnosed ASD cases in recent decades, the issues of diagnosis and intervention have become increasingly relevant to both clinical psychiatry and public health. This article explores the psychiatric aspects of ASD, including diagnostic methods and therapeutic approaches.

#### **History and Conceptual Development of ASD**

The term “autism” was first introduced by Leo Kanner in 1943 to describe children with social and communication impairments [1]. Subsequently, Hans Asperger’s work in 1944 expanded the understanding of ASD by presenting another

phenotype with less severe symptoms [2]. Since then, the concept of ASD has undergone significant changes, as reflected in modern diagnostic criteria.

#### Diagnosis of ASD

##### Diagnostic Criteria and Tools

ASD diagnosis is based on criteria outlined in the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders) and ICD-11 (International Classification of Diseases) [3][4]. The DSM-5 defines ASD as a disorder characterized by persistent deficits in social communication and social interaction, along with restricted and repetitive patterns of behavior, interests, or activities [5].

The most widely used diagnostic tools for evaluating ASD include:

- ADOS-2 (Autism Diagnostic Observation Schedule-2): A structured test used for observing and assessing behavior and social communication [6].
- ADI-R (Autism Diagnostic Interview-Revised): A semi-structured interview with parents that evaluates past and current symptoms of ASD [7].

##### Early Detection and Screening

Early detection of ASD is crucial for initiating timely intervention. Screening tools such as the M-CHAT (Modified Checklist for Autism in Toddlers) help identify the risk of ASD in children under the age of 2 [8]. Research indicates that early intervention can significantly improve the prognosis and adaptive abilities of children with ASD [9].

#### Psychiatric Aspects and Comorbidities

##### Psychiatric Comorbidities

ASD is often accompanied by various psychiatric disorders, complicating diagnosis and treatment. Common comorbid conditions include:

- Anxiety Disorders: up to 40% of children with ASD also suffer from anxiety disorders, which may manifest as social anxiety, phobias, and generalized anxiety [10].
- Depressive Disorders: Depression is common among adolescents and adults with ASD, requiring a comprehensive treatment approach [11].
- Attention Deficit Hyperactivity Disorder (ADHD): Approximately 30-50% of children with ASD also have ADHD, which complicates their learning and social interactions [12].

##### Behavioral and Emotional Problems

Behavioral and emotional issues such as aggression, self-injury, and emotional dysregulation are also common in individuals with ASD. These problems can significantly impair the quality of life for patients and their families, necessitating specialized interventions [13].

#### Interventions and Therapeutic Approaches

##### Behavioral Therapy

One of the most effective methods for treating ASD is Applied Behavior Analysis (ABA). ABA focuses on changing behavior through positive reinforcement

and systematic teaching [14]. Studies show that intensive ABA programs can significantly improve cognitive and adaptive skills in children with ASD [15].

#### Social and Communication Interventions

To overcome Social and Communication Isolation there are programs aimed at improving social and communication skills which include such methods as Social Skills Training and Pivotal Response Treatment. These approaches help enhance social interactions and communication in children with ASD [16].

#### Use of Augmentative and Alternative Communication (AAC)

For children with significant verbal communication difficulties, AAC methods such as PECS (Picture Exchange Communication System) and electronic communication devices are used [17].

#### Medication

While medications cannot cure ASD, they can help manage symptoms of comorbid conditions and behavioral problems. Commonly used medications include:

- Antipsychotic Drugs: Medications like risperidone and aripiprazole can reduce aggression and irritability in children with ASD [18].
- Stimulants and Non-Stimulants: Drugs such as methylphenidate and atomoxetine are used to treat ADHD in children with ASD [19].
- Antidepressants: Selective serotonin reuptake inhibitors (SSRIs) can be helpful for treating anxiety and depression [20].

#### Innovative Approaches and Technologies

With the advancement of technology, new methods for treating ASD are emerging:

- Virtual Reality (VR): VR is used to create controlled environments where children with ASD can practice social skills and manage anxiety [21].
- Robotics: Therapy robots can be used to teach social and communication skills to children with ASD [22].
- Genetic Therapy and Biomarkers: Research in genetics and biomarkers may lead to new approaches in diagnosing and treating ASD.

#### Conclusion

ASD is a complex and diverse disorder that requires a comprehensive approach to diagnosis and treatment. Early detection, integration of various therapeutic methods, and consideration of comorbid conditions are key components of effective management. The development of new technologies and scientific research continues to enhance our understanding of ASD and offers new perspectives for treatment and support of patients and their families.

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全身磁疗在前列腺增生症治疗中的应用前景

**PROSPECTS FOR THE USE OF SYSTEMIC MAGNETOTHERAPY  
IN THE TREATMENT OF PATIENTS WITH BENIGN PROSTATIC  
HYPERPLASIA**

**Skvortsov Nikita Grigoryevich**

*Student*

*Samara State Medical University of the Ministry of Health  
of the Russian Federation*

**Zimichew Alexandr Anatolyevich**

*Urologist, Doctor of Medical Sciences, Professor*

*Samara State Medical University of the Ministry of Health  
of the Russian Federation,*

*The Medical Company is «My science»*

**Zasedatelev Ivan Olegovich**

*Student*

*Medical University “Reaviz”*

**Zasedatelev Danila Olegovich**

*Student*

*Medical University “Reaviz”*

**摘要。**本文讨论了全身磁疗治疗 BPH 的结果。研究对象为 MK“我的科学”泌尿科确诊为 BPH 的 206 名患者。为了比较评估这些策略的有效性，选择了以下指标：根据 TRUZI 的前列腺体积、尿流率 (UFM)、残余尿量、IPSS 和 PSA 水平。结果表明，使用全身磁疗后前列腺体积趋于减小。残余尿量、IPSS 评分和 PSA 水平也降低。尿流率正在增加并接近正常值。

**关键词：**全身磁疗、良性前列腺增生、BPH 治疗、肿瘤泌尿学。

**Abstract.** This article discusses the results of treatment of BPH with systemic magnetic therapy. A study among 206 patients diagnosed with BPH on the basis of the urological department of the MK “My Science”. For a comparative assessment of the effectiveness of the tactics, the following indicators were selected: the volume of the prostate gland according to TRUZI, uroflowmetry (UFM), the amount of residual urine, the level of IPSS and PSA. It was determined that the volume of the prostate gland after the use of systemic magnetic therapy tends to decrease. The



*amount of residual urine, IPSS scores and PSA levels are also reduced. The rate of uroflowmetry is increasing and approaching the normal value.*

**Keywords:** *Systemic magnetotherapy, benign prostatic hyperplasia, BPH therapy, oncurology.*

Francisco Diaz is considered to be the founder of urology. In 1588, he described in detail the picture, methods of diagnosis, technologies and types of treatment of diseases, as well as examples of tools for operations. His work at the time gave rise to urological medicine as a separate field. In Russia, the first words about urology were said in the dissertation of H. Zuber, where he paid attention to diseases of the bladder. After that, the opening of specialized clinics began in the Russian Empire, the first of which was opened in 1830 in Odessa, although it separated into an independent field of medicine only by 1904.

In recent years, the method of magnetic therapy has become a common method in the treatment of the genitourinary system. With the help of a magnet, it is possible to effectively affect the pathological area both when using medical equipment in a hospital and at home. The magnetic field improves metabolism and restores damaged tissues absolutely painlessly and without the risk of OS.

In the hospital, the range of diseases that can be treated is much wider, and the effectiveness of the procedures performed is many times higher than at home. With the help of special rectal devices, the doctor can prevent urethritis or prostatitis in a few steps. Therefore, for the treatment and prevention of many diseases of the genitourinary system, it is still worth seeing your doctor and following all his recommendations.

If you are unable to carry out treatment in a hospital for any reason, you will have to carry it out at home. To do this, it is necessary to make sure that the magnetic equipment used really has a therapeutic effect. In the case of rectal magnetotherapy, the shape of the magnet has a very important role. It can be in the form of a rod or, for better effect on the urethra, have a cylindrical shape. Chronic bacterial prostatitis (CKD) leads to a decrease in the quality of life of men. The disease is characterized by a progressive, recurrent course, the development of chronic pelvic pain syndrome, symptoms of the lower urinary tract. Treatment of CKD involves the use of both medicinal and non-medicinal approaches (physiotherapeutic factors, therapeutic gymnastics, finger massage of the prostate gland, lifestyle changes and regulation of sexual activity). There is a certain gradation in the structure of physiotherapy methods, primarily related to the type and “targets” of physiotherapy, the breadth of influence on the spectrum of etiopathogenetic mechanisms of CKD development, and the availability of use in clinical practice. Recently, there has been a tendency to increase the use of the magnetic field in the treatment of chronic prostatitis: 1) the method of tibial neuromodulation and electrical stimulation of nerves and muscles of the pelvic floor; 2) the magnetic method.

Prostate adenoma is one of the most common urological diseases among males. The percentage of BPH sufferers increases in direct proportion to the age of the patients. Despite the high level of knowledge of the etiology, pathogenesis and manifestations of this disease, it is not always possible to achieve the desired effect using conservative therapy[1]. Currently, 3 groups of drugs are used in the treatment of BPH:  $\alpha$ 1-blockers, 5-reductase inhibitors and plant extracts. Drugs from the group of  $\alpha$ 1-adrenergic receptor blockers are an important element of drug therapy for benign prostatic hyperplasia. The accumulated experience of clinical and fundamental research eloquently testifies to the role of disorders of sympathetic regulation in the pathogenesis of this disease.  $\alpha$ 1-adrenoreceptors are localized in the neck of the bladder, prostatic urethra, capsule and stroma of the prostate gland.

Before the procedure, the patient drinks a glass of clean water. The patient lies down on the couch next to the device for magnetic therapy. The doctor selects the necessary magnetic field settings and installs 1 or 2 inductors on the exposure zone. This is an absolutely painless procedure.

The duration of the first session is 5 minutes. Subsequently, the duration of the procedure will be about 20 minutes. The course of treatment averages 20 procedures (one daily). After the procedure, the patient does not need rehabilitation, but it is necessary to give up active physical activity for some time.

Evaluating other studies, we found that as a result of treatment using standard pharmacotherapy, a significant decrease in the total score on the IPSS scale, as well as symptoms of irritative and obstructive symptoms, was observed in the group of patients with severe LUPUS, both in early and long-term follow-up. At the same time, no significant changes were recorded in the group of patients with mild to moderate LUPUS. The inclusion of a high-intensity magnetic field in the treatment regimen led to a decrease in the total score on the IPSS scale, symptoms of irritative and obstructive symptoms in patients with both mild and moderate and severe degree of LUPUS at the second and third visits. Significant changes in the studied indicators were also revealed in the intergroup comparison, groups 1, 2 and 3, 4.

The assessment of the “pain” index according to the NIH-CPSI questionnaire showed a marked decrease in groups 2, 3, 4 and the formation of a downward trend in group 1. It is interesting that the use of physiotherapy, as an additional factor, led to a decrease in the severity of pain syndrome immediately after treatment and in a later period of follow-up compared with groups taking only medication.

The treatment, both standard and complex, improved such an indicator as “quality of life” (according to the NIH-CPSI questionnaire) in patients suffering from CKD with varying degrees of severity of LUPUS throughout the entire follow-up period (Table). Standard antibiotic therapy and complex treatment led to

significant changes in the volume of residual urine in the group of patients with severe LUPUS at the 2nd and 3rd visits.

The resulting positive effect of complex treatment (pharmacotherapy and high-intensity magnetic field) In patients with CKD, it is consistent with the information available in the literature on the effective use of this physiotherapeutic factor in the treatment of other nosologies [9-11]. It is known that pelvic floor muscle training in men suffering from LUTs can improve the quality of life and reduce the intensity of accumulation symptoms. Stimulation of the pelvic floor muscles with a high-intensity magnetic field (BTL Emsella) is a hardware method of this training with the possibility of achieving faster and prolonged results. Stimulation of the pelvic floor muscles using the BTL Emsella apparatus presumably leads to the production by myocytes of myokines acting both paracrine and on the principle of endocrine regulation of target tissues, while transforming metabolism in tissues, the growth of muscle fibers and vascular endothelium. Probably, the therapeutic effects of high-intensity magnetotherapy are based on.

The use of both standard and combined therapy in groups with severe SNPM led to an increase in urine flow rate.

The purpose of this study was to assess the prospects for the use of systemic magnetotherapy in the treatment of patients with BPH.

In the period 2022-2023, a continuous prospective study of the data of 206 patients diagnosed with BPH was conducted on the basis of the urological department of the MK "My Science". The patients were divided into 2 groups: experimental (n=98), who underwent combination therapy with a-blockers + systemic magnetic therapy, and control (n=108), who underwent monotherapy with a-blockers. The course of therapy in both groups was 2 years. For a comparative assessment of the effectiveness of the tactics, the following indicators were selected: the volume of the prostate gland according to TRUZI, uroflowmetry (UFM), the amount of residual urine, the level of IPSS and PSA. The assessment of the effect of treatment tactics on the outcome of the disease was determined using the method of variance analysis. The reliability of the static data was assessed by determining the student coefficient at a critical significance level of  $p < 0.05$ .

**Table 1.**  
*Distribution of patients by age.*

Age	Groupe 1 (n=108)	Groupe 2 (n=98)
До 50 лет	12	15
51-60 лет	20	16
61-70	46	43
71-80	21	17
Старше 80	9	7

According to Table 2, the volume of the prostate gland in patients of the experimental group was recorded in the range of 75-80 cm, after therapy this indicator was 60-65 cm, which indicates a decrease in prostate volume by 20%. In the control group 73-76 cm, prostate growth to 79 cm was noted after therapy, which indicates a lack of monotherapy with adrenoblockers ( $p < 0.05$ ).

**Table 2.**  
*Comparison of prostate volume before and after treatment.*

Groups	V after therapy	V post therapy	$\Delta V$
1	75-80	60-65	20%
2	73-76	79	4,74%

Analyzing Table 3, it was found that the uroflowmetry index improved by 40% in the experimental group, and only by 5% in the control group.

**Table 3.**  
*Comparison of the level of uroflowmetry before and after treatment.*

Groups	UFM after therapy	UFM post therapy	$\Delta$
1	4	5,6	40%
2	6	6,3	5%

Table 4 shows that the amount of residual urine in the first group decreased from 50ml to 35ml, which is 30%, and in the second group from 45ml to 39ml, which is 15% and indicates the disadvantages of therapy without the use of systemic magnetic therapy ( $p < 0.05$ ).

**Table 4.**  
*Comparison of the level of residual urine before and after treatment.*

Groups	ml	ml	$\Delta$
1	50	35	30%
2	45	39	15%

Referring to the IPSS results from Table 5, in the first group this indicator decreased by 35%, and in the second by 20% ( $p < 0.05$ ). The last criterion is presented in Table 6, the level of prostate-specific antigen (PSA) significantly decreased by 5% in both groups ( $p = 0.05$ ).

**Table 5.**  
*Comparison of IPSS levels before and after treatment.*

Groups	IPSS	IPSS	$\Delta$ IPSS
1	25	16	35%
2	30	24	20%

**Table 6.**  
*Comparison of the level of PSA before and after treatment*

Groups	нг/мл	нг/мл	Δ нг/мл
1	7	6,65	5%
2	8	7,6	5%

Positive results of bacteriological examination after the treatment took place in all groups of patients with CKD. However, the eradication of bacterial flora from prostate secretions is more pronounced in the main group of patients, especially those receiving magnetic therapy with pentoxifylline. The results of bacteriological examination of prostate secretion after complex treatment are shown in Fig.3. Despite the fact that the average TNF alpha values were within the limits of reference values, their downward dynamics was noted against the background of ongoing treatment.

The omplex treatment of CKD in combination with magnetotherapy and pentoxifylline improved the blood flow of the prostate gland to a greater extent. Higher rates were obtained in the capsular arteries of the prostate gland, which are more susceptible to ischemia. In both subgroups of the second and third groups, there was a less pronounced increase in the peak blood flow rate, which indicates an insufficient effect of the methods used in these groups on the blood flow rate in the vessels of the prostate gland. The average blood flow rates before and after treatment are shown in the table.1.

When comparing the average urodynamic parameters, it was noted that the effect of various methods of complex treatment of chronic prostatitis on urination has similar results. Their influence on the parameters of urodynamics is carried out primarily through the urethral arteries, on which all the methods of treatment used have a proportional effect. Under the influence of complex treatment of chronic bacterial prostatitis, an increase was noted

The study revealed a tendency to decrease the volume of the prostate gland after the use of systemic magnetic therapy. The amount of residual urine, IPSS scores and PSA levels are also reduced. The rate of uroflowmetry is increasing and approaching the normal value. All indicators, except PSA, improved to a greater extent with the use of systemic magnetic therapy relative to monotherapy with adrenoblockers. Thus, such treatment tactics have high prospects and should be included in the standards of BPH therapy.

The use of magnetic therapy in the complex treatment of chronic prostatitis improves the indicators (decrease in TNF alpha levels, decrease in the number of leukocytes of prostate secretion, eradication of bacterial microflora) of treatment. When using magnetotherapy, higher indicators of hemodynamics of the prostate and urodynamics were obtained, which improves the results of treatment of CKD.

When diagnosing TNF alpha, including in the reference range, it is necessary to use cytokine inhibitors.

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肠道灌洗对精神类药物及腐蚀性物质中毒时发生酒精性谵妄症的预防作用  
**PREVENTIVE EFFECT OF INTESTINAL LAVAGE ON THE  
DEVELOPMENT OF ALCOHOLIC DELIRIUM IN CASE OF  
POISONING WITH PSYCHOPHARMACOLOGICAL DRUGS AND  
CORROSIVE SUBSTANCES**

**Vorobyeva Alena Georgievna**

*Anesthesiologist-resuscitator, Researcher*

*Research Institute of Emergency Medicine named after*

*N.V. Sklifosovsky,*

*Moscow, Russian Federation*

*ORCID ID:0009-0003-8580-6002*

**Matkevich Victor Anatol'evich**

*Doctor of Medical Sciences, scientific consultant*

*Research Institute of Emergency Medicine named after*

*N.V. Sklifosovsky,*

*Associate Professor*

*Russian Medical Academy of Continuing Postgraduate Education,*

*Leading Researcher*

*Federal Scientific and Clinical Center for Physical and Chemical Medicine  
named after Yu.M. Lopukhin,*

*Laureate of the Moscow Mayor's Prize in the field of medicine (1994)*

*ORCID ID:0000-0001-6765-6619*

**Potskhveriya Mikhail Mikhailovich**

*Doctor of Medical Sciences, Head of Department*

*Research Institute of Emergency Medicine named after*

*N.V. Sklifosovsky,*

*Professor*

*Russian Medical Academy of Continuing Postgraduate*

*Education ORCID ID:0000-0003-0117-8663*

摘要。相关性。急性中毒 (AP) 通常发生在酗酒的人身上, 他们可能会出现酒精戒断综合征 (AWS) 及其严重变体震颤性谵妄 (DT)。由于 DT 加到 AP 中, 患者的病情变得更加严重, 并发症的风险增加, 住院时间和死亡率增加。我们在文献中没

有找到关于 AP 中 DT 的发生率及其预防方法的信息,因此对这个问题的研究似乎是相关的。

目标。研究精神药物和腐蚀性物质中毒情况下酒精性谵妄的发生率以及肠道灌洗对其预防的影响。

材料和方法。对 954 名患者的检查结果进行了回顾性分析,其中 731 名患者为精神药物中毒,223 名患者为腐蚀性物质中毒,他们来自国家预算医疗保健机构“急诊医学研究所”的急性中毒和躯体精神疾病科。2019-2021 年,N.V. Sklifosovsky DZM” 被纳入研究。所有患者均接受标准治疗。

在所有患者中,641 名(研究组)在治疗期间进行了标准肠道灌洗(IL)以排毒。对照组由 313 名患者组成,这些患者包括标准 IL,但不包括任何治疗。

比较组患者在中毒类型、病情严重程度、年龄和性别方面具有可比性。研究的终点是 DT 的发病率。

结果。结果表明,在对 PPPD 患者进行标准治疗后,57.8% 的患者出现 DT,在 PCS 患者中,56.9% 的患者出现 DT。在治疗综合体中包含 IL 的患者中,DT 的发病率分别为 37.3% 和 34.7%。

研究的局限性。该研究旨在研究 IL 作为预防男性和女性 DT 的方法的有效性,其局限性为:PPPD 和 ODS、酗酒史、患者年龄 18-65 岁、IL 的肠内溶液量至少为 12 (9; 15) l。

结论。已经确定,在对 PPPD 患者进行标准治疗的情况下,57.8% 的病例会发展为 DT,在 PCS 患者中,56.9% 的病例会发展为 DT。在 PPPD 和 PCS 的综合治疗中使用 IL 可将患 DT 的风险降低 1.6 倍。

关键词:急性中毒;肠道灌洗;预防酒精性谵妄,预防。

**Summary. Relevance.** *Acute poisoning (AP) often occurs in people who abuse alcohol, who are likely to develop alcohol withdrawal syndrome (AWS) and its severe variant, delirium tremens (DT). Due to the addition of DT to AP, the condition of patients becomes more severe, the risk of complications increases, and the length of hospital stay and mortality increase. We have not found information in the literature about the frequency of DT in AP and methods for its prevention, and therefore the study of this issue seems relevant.*

**Target.** *To study the frequency of alcoholic delirium in case of poisoningpsychopharmacological drugs and corrosive substances and the effect of intestinal lavage on its prevention.*

**Material and methods.** *A retrospective analysis of the results of examination of 954 patients was carried out, including 731 with poisoning by psychopharmacological drugs and 223 with corrosive substances, who were in the department of acute poisoning and somatopsychiatric disorders of the State Budgetary Institution of Healthcare “Research Institute of Emergency Medicine named after. N.V. Sklifosovsky DZM” in 2019-2021. All patients received standard therapy.*

*Of the totalpatients, 641 (study group) consisting of standard Intestinal lavage (IL) was performed during the treatment to detoxify the body. The comparison*



group consisted of 313 patients who included standard IL was not included in any therapy.

The compared groups of patients were comparable in type of poisoning, severity of condition, age and gender. The end point of the study was the incidence of DT.

**Results.** The results showed that with standard treatment of patients with PPPD, DT developed in 57.8%, and in patients with PCS in 56.9% of cases. In patients for whom IL was included in the treatment complex, the incidence of DT was 37.3 and 34.7%, respectively.

**Limitations of the study.** The study concerned the study of the effectiveness of IL as a method of preventing DT in males and females, the limitations of which were: PPPD and ODS, a history of alcoholism, the age of patients 18–65 years, the volume of enteral solution is at least 12 (9; 15) l for IL.

**Conclusion.** It has been established that with standard treatment of patients with PPPD, DT develops in 57.8% of cases, and in patients with PCS in 56.9% of cases. The use of IL in the complex treatment of PPPD and PCS reduces the risk of developing DT by 1.6 times.

**Keywords:** acute poisoning; intestinal lavage; prevention of alcoholic delirium, prevention.

**Conflict of interest** The authors declare no conflict of interest

**Acknowledgments** The study has no sponsorship.

### List of abbreviations

DT – delirium tremens

PPPD – poisoning with psychopharmacological drugs

PCS – poisoning by corrosive substances

GT- gastrointestinal tract

IL – intestinal lavage

ES – enteral solution

AP - acute poisoning

### Introduction.

In the structure of acute poisonings (AP) by frequency of occurrence poisoning with psychopharmacological drugs (PPPD) and corrosive substances (PCS) (alkalis and acids) have a high specific gravity of about 65% and 14%, respectively [1, 2, 3].

Individuals who suffer from alcoholism often develop delirium tremens (DT) against the background of AP. Moreover, with PPPD this occurs in the somatogenic stage of poisoning, and in patients with PCS, for example, acetic acid, DT can develop against the background of the toxicogenic stage with ongoing hemolysis.

Alcohol delirium is the most common metal-alcohol psychosis. According to the International Classification of Diseases, delirium is an etiologically nonspecific syndrome. The following types of delirium are distinguished: infectious, traumatic, postoperative, vascular, due to dementia, pharmacological, alcoholic, narcotic. The occurrence of delirium always indicates the presence of severe somatic pathology, an infectious disease, intoxication (poisoning of chemical etiology, alcohol or drug withdrawal syndrome against the background of chronic alcohol intoxication or drug addiction).

The main reason for the development of DT is alcoholism. More than 50% of people who drink alcohol excessively may experience withdrawal symptoms when they stop or reduce their drinking. However, only a few (3% to 5%) experience symptoms of severe alcohol withdrawal with profound confusion, autonomic hyperactivity, and cardiovascular collapse. This is defined as delirium tremens, more commonly known as delirium tremens, or DT [4].

In case of intoxication, delirium is often accompanied by autonomic and neurological disorders: tachycardia, tachypnea, fluctuations in blood pressure with a tendency to increase, sweating, tremor, ataxia, and convergence weakness are noted. In severe delirium, patients tend to develop hypotension and collapse states; characterized by severe hyperthermia of central origin, symptoms of dehydration, neurological symptoms (stiff neck, symptoms of oral automatism, Kernig's sign, nystagmus, ptosis, fixed gaze, athetoid and choreoform hyperkinesia).

The incidence of severe forms of alcohol dependence, according to a number of statistical studies, is highest in medical institutions and intensive care units [5]. Severe AWS, manifested by convulsions and the development of delirium tremens, is observed in 15% of such patients and requires treatment in an intensive care unit, doubling the length of hospital stay [6,7].

According to Salottolo K. et al. (2017), the length of hospital stay, length of stay in the intensive care unit and mortality in patients with delirium tremens are higher than in patients without alcohol dependence and alcoholic delirium [8]. The development of complications during alcoholic delirium, such as cerebral edema and severe forms of pneumonia, is the main cause of deaths in the hospital. Mortality in the most severe forms of alcoholic delirium can reach 47% [9].

Patients with alcoholism are characterized by homeostasis disorders and manifestations of endotoxemia of varying severity.

There are several types of alcoholic delirium: classic, or typical, lucid, abortive, professional, excruciating and atypical. The most severe case of persistent DT is [10].

In the complex therapy of acute poisoning, intestinal lavage (IL) is actively used as a method of enteral detoxification and correction of homeostasis disorders [11-13]. Its effectiveness is known for both exo- and endotoxemia [1]. Detoxifi-

cation of the body and nonspecific therapeutic mechanisms for restoring homeostasis determine the effectiveness of IL in diseases accompanied by metabolic disorders and the functional state of various human physiological systems.

**Target:** to study the frequency of delirium delirium in cases of poisoning psychopharmacological drugs and corrosive substances and the effect of intestinal lavage on its prevention.

**Material and methods:** A retrospective analysis of the results of the examination of 954 patients was carried out, including those with acute atrial fibrillation - 731 and acute respiratory viral infections - 223, who were in the department of acute poisoning and somatopsychiatric disorders of the State Budgetary Healthcare Institution “Research Institute of Emergency Medicine named after. N.V. Sklifosovsky DZM” in 2019–2021. (see table No. 1). The patients were brought to the department by ambulance. The severity of the patients’ condition was due to PFP or RV poisoning. The severity of APAF according to the classification of E.A. Luzhnikov and L.G. Kostomarova (2000) were assessed as stages II-a and II-b. In patients with acute respiratory viral infection, the severity of chemical burns of the mucous membrane of the upper gastrointestinal tract (oral cavity, pharynx, esophagus and stomach) corresponded to 2-3 degrees according to the classification S.V. Volkova et al. (2005).

It was found that all patients had a history of alcoholism in the period before acute poisoning.

All patients received complex therapy in accordance with Moscow city standards for acute poisoning, aimed at detoxifying the body, eliminating respiratory disorders, hemodynamics, preventing and eliminating complications.

Of the total, 641 patients included standard IL therapy was performed using enteral solution (ES) according to the method of V.A. Matkevich (2012) [14]. ES used for IL contains: sodium phosphate, sodium chloride, sodium acetate, potassium chloride, citric acid, complex one Na<sub>2</sub>EDTA, as well as calcium chloride and magnesium sulfate, drinking purified water. ES is prepared from a set of commercially produced mineral acid concentrate. To do this, dissolve the concentrate in a given volume of water according to the manufacturer’s instructions. The osmolarity of the solution is 290–310 mOsm/l (depending on the volume of water used to dissolve the salts), pH ≈ 5.8 [24]. To carry out IL, one of the probe channels was connected to a suspended container with ES, the temperature of which for patients with PPPD was 37–38° WITH, and for patients with acute respiratory viral infections – at room temperature. The patient’s head was raised 30–45 degrees. The solution was administered in portions of 150–200 ml every 5 minutes. After administration of 2 (1.5; 2.5) liters of solution, loose stools appeared. In cases of absence of stool, after administration of 2.5 l of ES, pharmacological stimulation of the gastrointestinal tract was started. IL was continued until the wash water was

clear. The total volume of the solution was 12(9;15) l for PCS and up to 30 l for PPPD. The duration of the IL procedure was on average 5 (3;6) hours. To collect intestinal secretions, a rectal probe with a colostomy bag was installed.

Table 1 shows the distribution of patients by type of poisoning, gender and age in the observation and comparison groups.

**Table 1.**

*Distribution of patients by type of poisoning, gender and age in the compared groups*

No.	Type of poisoning	Groups of patients							
		Comparison group				Observed group			
		Total patients	Floor		Age Me (Q1;Q2)	Total patients	Floor		Age Me (Q1;Q2)
			M n (%)	AND n (%)			M n (%)	AND n (%)	
1	PPPD	211	145 (68.7%)	66 (31.3%)	36 (28.0;45.0)	520	320 (61.5%)	200 (38.5%)	39.0 (31.0;47.0)
2	PCS	102	71 (69.6%)	31 (30.4%)	43 (34.0;54.0)	121	83 (68.6%)	38 (31.4%)	41 (34.0;55.0)

Note: PCS – poisoning with corrosive substances, PPPD – poisoning with psychopharmacological drugs, n – number of patients, % – percentage of the total number, Me (Q1;Q2) – median, 25th and 75th percentiles

Table 1 shows that the compared groups were comparable according to the indicated characteristics.

**Statistical processing of results**

Statistical processing of the material was performed using the IBM SPSS Statistics 26.0 program. The normality of data distribution was assessed using the Shapiro-Wilk test (n≤50). Due to the non-normal distribution of the sample data, the median (Me), 25th and 75th percentiles were determined as Me (Q1;Q2). Categorical data are presented as n (%). To compare medians between groups, the Mann-Whitney test (cr. M-W) was used (independent groups). To compare qualitative data between groups, the criterion was used  $\chi^2$  Pearson. The significance level was set to p<0.05.

**Results and discussion**

After 65.5 (50.0;70.0) hours During hospital stay, 416 of the total number of patients (43.6%) developed DT.

Table 2 shows the distribution patients by type of poisoning and frequency of alcoholic delirium in the compared groups.

**Table 2.**  
*Distribution of patients by type of poisoning and frequency of alcoholic delirium in the compared groups*

No.	Type of poisoning	Groups of patients					
		Comparisons			Observable		
		Total patients	DT number	Specific gravity of DT, %	Total patients	DT number	Specific gravity of DT, %
1	PPPD	211	122	57.8*	520	194	37.3*
2	PCS	102	58	56.9*	121	42	34.7*

Note: \* – statistically significant difference in indicators in groups for the same type of poisoning (according to the Mann-Whitney test,  $p < 0.05$ ), PPPD – poisoning with psychopharmacological drugs, PCS – poisoning with corrosive substances

Table 2 shows that with standard treatment, DT developed in patients with PPPD in 57.8% of cases, and in patients with PCS in 56.9% of cases. In patients in whom IL was included in the complex of detoxification and correction of metabolic disorders, the incidence of DT development was 37.3 and 34.7%, respectively, which is 1.6 times less than with standard treatment. The difference between the compared indicators was statistically significant ( $p < 0.05$ ).

It is known from literary sources that DT is the most common form of severe withdrawal syndrome. It can develop at any age. The pathogenesis of delirium has not been fully elucidated. It is known that DT most often occurs not at the height of binge drinking, when the concentration of alcohol in the blood is high, but after it, when the level of alcohol in the blood decreases. Alcohol intake causes CNS depression due to an increase in GABAergic neurotransmission and a decrease in glutamatergic activity.

However, with chronic alcohol abuse, neuroadaptation causes decreased blood levels of gamma-aminobutyric acid (GABA) and increased levels of glutamate neurotransmission (NMDA receptor). During alcohol withdrawal, glutamate activity increases, which leads to excitotoxicity as a result of intracellular calcium influx and oxidative stress. The essence of the phenomenon is that neuron-stimulating mediators in high concentrations are cytotoxic. In this situation, benzodiazepines, which are GABAergic drugs, reduce excitatory toxicity by restoring the balance of neurotransmitters and are therefore considered the drugs of choice for alcohol withdrawal syndrome [15–17].

The results of this study showed that the inclusion of IL in the complex of treatment measures for PPPD and PCS has a preventive effect on the incidence of DT, reducing the risk of its occurrence by 1.6 times. The reason for this result probably remains to be clarified in subsequent studies. Now we can only draw attention to the fact that in addition to psychosis, DT is characterized by metabolic

disorders, hypoxia, microcirculation disorders, and suppression of energy metabolism, which constitute its single pathogenetic chain, the links of which should be targeted by means and methods of intensive therapy [18].

At the current level of knowledge of the pathogenesis of DT, it is difficult to explain the phenomenon of the therapeutic effect of IL; we can only list its known therapeutic mechanisms that could influence the pathogenetic links of DT, reducing the risk of its occurrence. These hypothetically include: detoxification of the body and correction of disturbed physiological constants [1, 21, 22]. It is known that as a result of IL, both exotoxins and excess endogenous metabolic products are effectively removed from the body as a whole according to the principle: everything that is in the tissues (in the cellular and interstitial space) ends up in the blood; everything that is in the blood ends up in the gastrointestinal tract, and from the latter can be removed using IL. We do not know what is completely eliminated from the body and what is stabilized in it as a result of IL, thereby reducing the risk of developing DT. Perhaps an in-depth study of these processes may become the subject of future research, including those aimed at understanding the preventive and therapeutic mechanisms of IL in DT, lifting the curtain on its pathogenesis.

### Conclusion

It has been established that with standard treatment of patients with PPPD, DT develops in 57.8% of cases, and in patients with acute respiratory distress syndrome - in 56.9% of cases. The use of IL in the complex treatment of PPPD and PCS reduces the risk of developing DT by 1.6 times.

1. Alcoholic delirium occurs in a significant proportion of individuals with alcoholism who experience acute poisoning with psychopharmacological drugs and corrosive substances, specifically in 57.8% and 56.9% of cases, respectively.

2. Among patients who received intestinal lavage with an enteral solution as part of their treatment for these poisonings, the incidence of alcoholic delirium was 37.3% and 34.7%, respectively. This is statistically significantly lower ( $p < 0.05$ ) – occurring 1.6 times less frequently – compared to standard treatment.

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利用残留物主特征近似误差对有用信号提取精度的影响  
**THE EFFECT OF APPROXIMATION ERRORS ON THE  
ACCURACY OF USEFUL SIGNAL EXTRACTION WHEN USING  
THE MAIN CHARACTERISTICS OF RESIDUES**

**Marchuk Vladimir Ivanovich**

*Doctor of Technical Sciences*

*Samohleb Aleksey Aleksandrovich*

*Master's degree Student*

**Okorochkov Alexander Ivanovich**

*Candidate of Technical Sciences*

**Al-Ali Hayder Tahseen Ali**

*Postgraduate student*

*Institute of Service and Entrepreneurship branch of the Don State*

*Technical University in Shakhty*

摘要。本文讨论了逼近误差，特别是逼近函数的求逆对估计乘法提取有用信号精度的影响。有用信号分配精度由残差估计，即由原始样本减去有用信号估计得到的随机过程的统计特性估计。给出了数学期望和方差的估计值，以评估逼近误差对有用信号提取精度的影响。

关键词：逼近误差，有用信号，残差，加性噪声，数学期望，标准误差。

**Abstract.** *The paper discusses the influence of approximation errors, in particular the inversion of the approximating function, on the accuracy of the useful signal allocation using the estimation multiplication method. The accuracy of the useful signal allocation is estimated by the residuals, ie by the statistical characteristics of the random process obtained by subtracting the useful signal estimate from the original sample. Estimates of mathematical expectation and variance are given to assess the effect of approximation errors on the accuracy of useful signal extraction.*

**Keywords:** *approximation errors, useful signal, residuals, additive noise, mathematical expectation, standarderror.*

Currently, to assess the quality of processing of measurement results, the value of the root-mean-square error, which characterizes the difference between the initial function of the measured process and the resulting estimate, is widely used.

However, its use requires knowledge of the original function of the extracted signal, which is well solved by machine modeling, when the function of the useful signal is specified, statistics are collected, and the results are generalized to practical measurements when the function of the useful signal is not determined a priori. If such studies have not been carried out, then in practical use it is not possible to estimate the error. In this regard, methods for assessing the accuracy of the extracted signal based on residues are widely used, i.e. by analyzing the residuals obtained after subtracting the resulting estimate from the initial implementation of a random non-stationary process. In this case, it becomes possible not only to evaluate the accuracy of identifying the useful signal, but also to evaluate the processing results for various implementations. This approach may be more effective in some cases. In this regard, research based on the results of residuals can be considered as an urgent task, which has not only theoretical, but also practical significance and relevance.

Let us assume that the initial implementation of the measurement results is an additive mixture of the useful signal and the noise component, i.e. can be written in the following form:

$$Y(t) = S(t) + \eta(t),$$

where  $Y(t)$  is the initial implementation of the measurement results,  $S(t)$  is the function of the useful signal,

$\eta(t)$  – additive noise component.

Let us assume that the additive noise component obeys the normal law with zero mean and constant variance. This assumption is necessary because the accuracy of identifying the useful signal will be assessed based on the residuals. Thus, after processing the measurement results, an estimate of the useful component will be obtained, which, after subtraction from the original implementation, allows us to obtain an estimate of the noise component, i.e.  $N(0, \sigma^2)$

$$\bar{\eta}(t) = Y(t) - \bar{S}(t)$$

As a method for isolating a useful component in the presence of an additive noise component, we will use the method of multiplying estimates, which is described in sufficient detail in [1 - 3] and which has a low error in isolating a useful signal under conditions of a priori uncertainty in the presence of a single implementation of the measured process. In [4], it was analytically proven that the dispersion of residuals decreases with an increase in the number of reproductions, and the resulting relationships make it possible to use a comparative analysis of residual characteristics (correlation function, differential distribution density, etc.) as a criterion for the quality of processing measurement results.

In practice, in many cases, residual analysis serves as a criterion for the quality of models, allowing one to determine whether a series of residuals is Gaussian noise or whether there are any interdependencies in its structure. In terms of ef-

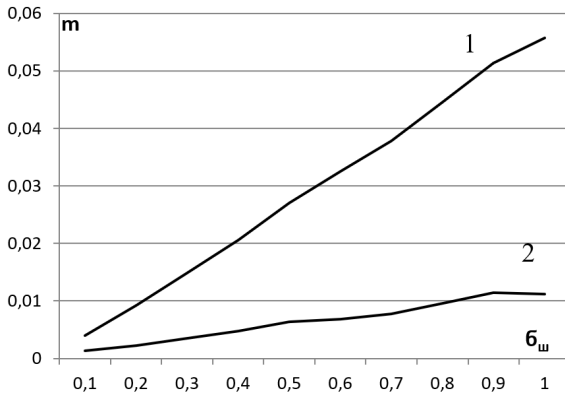
iciency, this criterion is inferior to the criterion for minimizing the mean square error using the useful component model, since it requires a priori information about the dispersion of the additive component of the noise and the absence of a pronounced value of the minimum error, since the estimate asymptotically tends to the a priori one.

Let us consider and compare the main parameters of the random process and residuals. In [4] it is shown that the value of the mathematical expectation of the original random process and residuals under various distribution laws have the following values:

- for a uniform distribution law  $\bar{m}_x \text{ original} = 3.8 \cdot 10^{-5}$ ,  $\bar{m}_x \text{ balances} = 3 \cdot 10^{-5}$ ;
- for the Gaussian distribution law  $\bar{m}_x \text{ original} = 3 \cdot 10^{-5}$ ,  $\bar{m}_x \text{ balances} = 6.8 \cdot 10^{-6}$ .

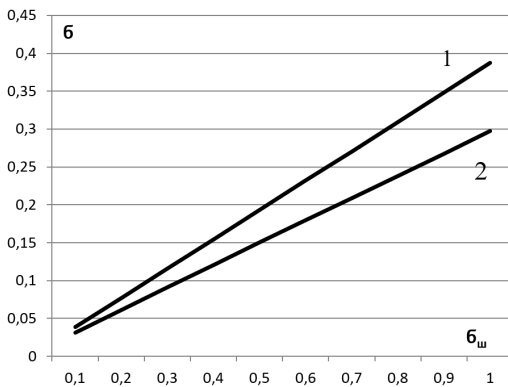
From the presented results it follows that the error in estimating the mathematical expectation decreases by an average of  $1.3 \div 6$  times, regardless of the distribution law. As follows from [4], the use of the reproduction method makes it possible to almost completely eliminate correlation and significantly reduce the estimate of the dispersion of residuals. However, in [2], when conducting research, it was noted that the approximation function is inverted under certain conditions, thereby increasing the error in identifying the useful signal. In order to reduce the influence of flipping the approximating function on the error in isolating the useful signal, in [5] it is proposed to mirror it with respect to a certain line, which was studied in [6]. Based on the analysis of the research results obtained, new methods for compensating for the reversal of the approximating function were proposed. The results of the studies are presented in [7]. All the studies mentioned above were carried out using the root mean square error, i.e., in the presence of a model of the useful signal. However, as noted above, researchers do not always have a model of the useful signal. In this regard, it is very relevant to consider the influence of the revolution and methods for eliminating it when using the remainder of the processing of measurement results.

In Fig. Figure 1 shows the results of studies of the method of multiplying estimates with a parabolic signal model and additive Gaussian noise using the analysis of residuals obtained by subtracting the resulting estimate of the useful signal from the original implementation.



**Figure 1.** Estimation of the mathematical expectation of residuals in the presence of a “revolution” (curve 1) and its elimination (curve 2)

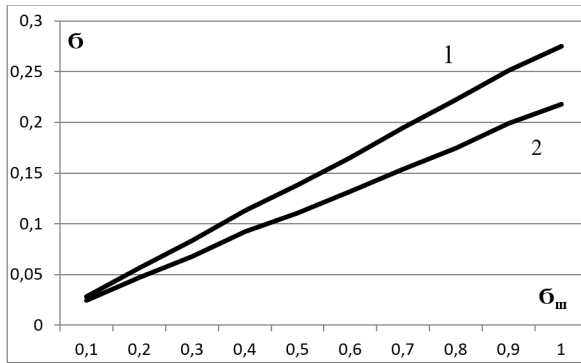
In this case, the minimum window took a value equal to 5 when the original implementation was divided into 12 intervals. Analysis of the results obtained shows that when the flip is eliminated, the value of the mathematical expectation decreases up to 5 times with increasing dispersion of the additive noise component. For small values of dispersion, a decrease in the mathematical expectation by a factor of 4 is observed, which generally shows the effectiveness of using residuals to assess the effectiveness of the method of multiplying estimates. Let us consider the dependence of the dispersion of the residuals in the presence and elimination of the reversal of the approximating function, which is shown in Fig. 2.



**Figure 2.** Estimation of the dispersion of residuals in the presence of a “revolution” (curve 1) and its elimination (curve 2)

Analysis of the research results shown in Fig. 2 shows that when the flip is eliminated, the dispersion value decreases by 23% for large dispersion values of the additive noise component and by 21% for small dispersion values of the additive noise component. From the research results obtained, we can conclude that the efficiency of reversal elimination is practically independent of the dispersion of the noise component, since the reduction in the mathematical expectation and the dispersion of the residuals practically does not change from the dispersion of the additive noise.

The invariance to the dispersion value of the additive noise component, shown as a result of the research, must be checked by changing the parameters of the estimation multiplication method, which take the following values: the minimum window took a value equal to 10 when dividing the original implementation into 6 intervals. The results of the studies are presented in Fig. 3.



**Figure 3.** Estimation of the dispersion of residuals in the presence of a “reversal” (curve 1) and its elimination (curve 2) with changes in the parameters of the method of multiplying estimates

Analysis of the research results obtained shows that increasing the minimum window and reducing the number of partitions of the original implementation practically did not change the functional dependence of the variance of the residuals in the presence of a revolution (curve 1) and its elimination (curve 2). At the same time, even the decrease in the dispersion of the residuals when eliminating the revolution remained practically at the same level: at small values of the dispersion of the additive noise component, the dispersion of the residuals decreases by 14%, and at large values of the dispersion – by 21%. The difference between the previously obtained results does not exceed several percent, which allows us to conclude that the use of residuals is invariant to the parameters of the method of multiplying estimates.

### Conclusions:

Based on the conducted research, the following conclusion can be made.

When used to assess the quality of processing of the main characteristics of the residuals, it shows that when the reversal is eliminated, the value of the mathematical expectation of the residuals decreases up to 5 times with increasing dispersion of the additive noise component. For small variances, a decrease of 4 times is observed, which shows the effectiveness of using residuals to assess the effectiveness of the method of multiplying estimates.

When eliminating the flip, the value of the dispersion of the residuals decreases by 23% for large values of the dispersion of the additive noise component and by 21% for small values of the dispersion of the additive noise.

Changing the parameters of the method of multiplying estimates did not change the main values of the residuals; even the decrease in the dispersion of the residuals when eliminating the flip remained almost at the same level: with small values of the dispersion of the additive noise component, the dispersion of the residuals decreases by 14%, with large values of the dispersion – by 21%.

The obtained research results allow us to conclude that the use of the main parameters of the residuals is effective, since invariance is observed both to the dispersion of the additive noise component and to the parameters of the method of multiplying estimate.

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固体燃料能源废弃物利用存在的问题及解决方案  
**PROBLEMS AND SOLUTIONS FOR THE USE OF SOLID FUEL  
ENERGY WASTE**

**Udalova Nataliia Petrovna**

*Senior Lecturer*

*National Research Technological University "MISIS"*

注释。目前，世界上积累了大量的工业废物。固体燃料能源可以理所当然地被归类为废物最密集的行业。

燃料和能源综合体中固体废物产生的主要来源是硬煤和褐煤，它们主要用于火力发电厂（TPP）。此外，火力发电厂供应的煤炭质量低于其他消费者。在这方面，由于煤炭燃烧产生的废物（灰烬、炉渣、碳、硫和氮的氧化物），火力发电厂是环境最强大的污染物之一。值得注意的是，每年用于灰渣堆放的土地面积不断增加。

生产废物的使用是减少其对环境负面影响的主要方法。本文讨论了使用固体燃料能源矿物废物的主要问题。分析了世界和国内使用此类废物的经验。考虑了阻碍使用资源节约和环境技术的现行立法的缺点。在作者看来，提出了回收固体燃料能源矿物废物的可能方法。

关键词：固体燃料能源的矿物废物、灰渣废物、固体燃料能源、资源节约技术、最佳可用技术、立法。

**Annotation.** *Currently, a huge amount of industrial waste has accumulated in the world. Solid fuel energy can rightfully be classified as the most waste-intensive industry.*

*The main source of solid waste generation in the fuel and energy complex is hard and brown coals, which are mainly used in thermal power plants (TPPs). Moreover, thermal power plants are supplied with coal of lower quality than other consumers are. In this regard, thermal power plants are one of the most powerful pollutants of the environment due to waste from coal combustion (ash, slag, oxides of carbon, sulfur and nitrogen). It is also worth noting the annual increase in the volume of land withdrawal for ash dumps.*

*The use of production waste is the main way to reduce their negative impact on the environment. The article discusses the main problems of using mineral waste from solid fuel energy. The world and domestic experience in the use of such waste is analyzed. The shortcomings of the current legislation that hinder the use*



*of resource-saving and environmental technologies are considered. Possible, in the author's opinion, ways of recycling mineral waste from solid fuel energy are proposed.*

**Keywords:** *mineral waste from solid fuel energy, ash and slag waste, solid fuel energy, resource-saving technologies, best available technologies, legislation.*

Currently, Russia is undergoing a large-scale development of the regulatory framework for the implementation of the best available technologies (BAT) and regulation of the procedure for obtaining comprehensive environmental permits. At the same time, there is a process of harmonization of Russian legislation with the norms of international law. The Russian Federation has signed a number of international conventions and agreements, according to which it is obliged to reduce both the existing and potential negative impact of economic activities on the environment, which can be achieved through the implementation of BAT. In this regard, it is advisable to consider the most widely used methods for recycling ash and slag waste in world practice.

To date, more than 800 million tons have been generated worldwide ash and slag waste (ASW), of which about 53% have been recycled[1]. In many developed and developing countries of the world community, the level of utilization of coal combustion by-products (CCB), the main of which are ASW, ranges from 40 to 90% of their annual output [2].

An analysis of the situation shows that throughout the world, the processing and use of ASW is coordinated within various international and national associations. The World Wide Coal Combustion Products Network (WWCCPN) was created in 1999 to coordinate industry, assist government agencies, and educate the public about coal combustion byproducts. WWCCPN members are: USA, Canada, Australia, Japan, Europe, Russia, Israel, South Africa, Poland, UK, Asia.

In some countries, there are national associations, for example, in India from 1994 to 2002. Fly Ash Mission (FlyAshMission) operated from 2002 to 2007. Fly Ash Utilization Program (FAUP), since 2007 the program has been renamed Fly Ash Unit (FAU) by the Department of Science and Technology (DST), Government of India. In Russia, in pursuance of the decisions of the meeting at the Ministry of Energy of the Russian Federation on June 2, 2010, the National Association of Producers and Consumers of Ash and Slag Materials (NAPCASM) was created in 2012.

The undisputed leader in the formation of thermal power plants among Russian regions is considered to be the Siberian Federal District (SFD), where 44% of all domestic thermal energy is concentrated, the vast majority of which are coal plants [3,4].

The formation and storage of ash and slag has a negative impact on the ecosystem of the adjacent territory of the area where it is located:

- allocation and disturbance of urban land for the construction of ash dumps and their engineering infrastructure (ash pipelines, pumping stations, etc.);
- penetration of solutions from ash dump bowls into surface and ground waters with their subsequent saturation;
- dusting of ash from the surface of ash dump bowls, especially when a significant amount has accumulated.

Due to the filling of ash dumps to their maximum capacity, the problem of their reclamation arises. An unreclaimed waste ash dump is a source of dust, the amount of ash removed from one hectare of an ash dump can reach several hundred tons per year, and the dust cloud can spread over several kilometers.

It should also be noted that the amount of mobile forms of phosphorus and potassium in the ash is not enough to feed plants, so self-overgrowing of ash dumps is a very slow process: covering their surface with plants until dusting stops lasts from 10 to 15 years. In this regard, it is more expedient to process ASW to obtain useful products.

If used correctly, ash and slag waste can help power engineers save on the maintenance of ash dumps - selling the waste would at least allow them to reduce storage costs.

Employees of the IACEE MPEI center [5] developed an open information system containing BAT in the field of ASM management. According to [6,7], the main areas of application of ash and steel in Russia are:

- Direct replacement of natural materials
  - construction (industrial, civil, road)
  - Agriculture
  - relief correction
  - intermediate reclamation of landfills and solid waste dumps
  - mine filling, backfilling
  - quarry reclamation
- Use as a raw material component
  - binding materials (cement, ready-mixed concrete, ready-mixed mortar)
  - wall materials (bricks, blocks)
  - reinforced concrete products
  - agricultural fertilizers
- Use as a starting product
  - isolation of hollow microspheres
  - release of iron oxides
  - silica release

- release of aluminum oxides
- isolation of rare and rare earth metals

Requirements for fly ash, slag and ash and slag mixture of thermal power engineering, as well as the possibility of using ash and slag in the production of building materials and products are included in a number of current regulatory documents: GOST 379–2015, GOST 530–2012, GOST 9128–2009, GOST 32496–2013, GOST 10178–85, GOST 17608–91, GOST 20910–90, GOST 22266–2013, GOST 23558–94, GOST 31359–2007, GOST 26644–85, GOST 28013–98, GOST 30491–2012, GOST 3110 8–2003, GOST 25818–91, etc.

However, these GOSTs primarily determine the requirements for ash and slag as the main raw material for road construction, raw material for the production of building materials and concrete for various purposes as a filler or as a replacement for part of the binding material. The suitability of ash and slag is determined, first of all, by the absence or limited content of harmful components in them that worsen the physical and mechanical characteristics of building materials and concrete, reduce their operational and technical properties or complicate production processes and limit the scope of application [7, 8].

As for the direction of using ash and slag in land reclamation, for example, in the reclamation of coal mines, today there are no such regulatory documents. In addition, there is a number of problems.

Problem 1 - ash and slag, which is waste (usually hazard class 5), cannot be used in land reclamation, since legislation prohibits the use of waste in reclamation.

In this regard, there is a need to convert ash and slag waste (ASW) into ash and slag material (ASM). Energy enterprises develop technical specifications for ash and ash residues, and consumers - coal companies - must each time go through a lengthy procedure for agreeing on the possibility of using ashes and coal in reclamation, and this process does not always end in success (permission).

Changes in legislation make it possible to use ash and slag in backfilling mined-out spaces (i.e., including at the mining and technical stage of reclamation), however, today there are no appropriate methods and GOSTs for such use, which, in turn, imposes significant restrictions (as legislative and technical) on the possibility of using ash and slag in filling mined-out spaces and restoring damaged land integrity.

Problem 2 is the lack of an “integrated” approach to assessing the areas of use of ASW. Thus, in the roadmap presented by the Phoenix consortium, the main emphasis is on the use of fly ash and dry ash removal, while the most common ash removal system in our country is a hydraulic ash removal system, which, in turn, imposes certain restrictions on the use of ASW:

The “seasonality” of ASW removal from the dump, which sharply limits the possibility of its use - the possibility of ASW removal occurs in the winter, while

the main consumers (construction and road companies) need the product in the warm season;

The difficulty of achieving the required moisture content of ash and slag - as a rule, humidity ranges from 50% to 75%, with the required 25%. This leads to the problem of temporary storage for drying of ASW, which leads to the following problem - dusting during removal and temporary storage, loading, reloading, etc.;

In addition, the chemical composition of ASW, especially old ash dumps, often contains valuable and rare earth elements in industrial concentrations, which makes it impossible to use ASW directly, without first extracting these components. Technologies for extracting such components are known, but there is no stimulation in legislation for their use.

For the reclamation of lands disturbed by underground mining, it is also possible to use large-tonnage ASW waste. They can be used in conjunction with other coal combustion products for cementing collapses, filling mined-out mines and old shallow voids in rock masses, constructing backfills with fillers and stopes, eliminating mine shafts, extinguishing and controlling underground fires [9].

There are known technologies for producing unfired ash gravel, unfired ash sand, granulate, hollow microspheres and unburned coal from ash and slag not only by dry removal, but also by hydro-ash removal systems [10].

Most soil cultivation methods require annual application of ameliorants. One of the methods for accelerating land cultivation and increasing their fertility is the agrochemical method. It is based on structural soil reclamation, in which local waste from the mining and processing industries is used as ameliorants. ASW can act as such an ameliorant due to its chemical composition. According to works [11], ash and slag has a positive effect on increasing the content of nutrients potassium and phosphorus, and the soil water permeability changes positively. It increases almost 3 times due to large fractions of ash and slag introduced into the soil (0.5-0.25 mm). Also, field studies showed that ash and slag reduces soil temperature, with a temperature difference of 1.8°C (compared to the control).

It has also been established that the introduction of ash and slag from the Omsk Thermal Power Plant deep into the soil in doses of up to 1 t/ha increases the efficiency of agrotechnical measures aimed at improving the water-physical properties of soils [12]. Ash and slag, as such, does not contain nutrients in a form accessible to plants, however, by improving the water-physical properties of the soil, their introduction into the soil creates more favorable conditions for the development of the root system of plants and soil microflora.

The use of waste from thermal power plants as a raw material in the production of building materials, as well as the replacement of natural materials with ash and slag in industrial and civil construction, especially in reclamation and agriculture, is a large area, but until now such use occurs mainly only in the construction in-

dustry some regions and is spontaneous in nature. To stop the growth in the accumulation of ash and slag waste from thermal power plants, a systematic approach is needed in organizing their sales on an industrial basis.

Thus, to solve the problem of ash and slag disposal it is necessary:

Development and approval of methods for a comprehensive assessment of the possibility of using ASW with determining the stages of use based on physical, chemical, agrochemical and other indicators of ash and slag, which will allow the development of the missing regulatory documents (GOSTs) for the use of ash and slag in all areas of possible use.

Development of recommendations for the use of ash and slag in the filling of mined-out spaces, taking into account technological and environmental safety.

Introducing amendments to the current legislation that will remove obstacles to the use of resource-saving and low-waste technologies in terms of the use of ammonia.

Incentivizing producers and consumers of ASW not only with penalties and increasing the risk category, but also with the provision of various benefits.

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将社交网络数据整合到用户识别流程中  
**INTEGRATION OF SOCIAL NETWORK DATA INTO USER  
IDENTIFICATION PROCESSES**

**Sapozhnikov Anatoliy Evgenevich**

*Postgraduate student*

*Financial University under the Government of the Russian Federation*

注释。文章“将社交网络数据集成到用户识别过程中”讨论了使用社交网络数据来提高用户识别准确性和可靠性的现代方法和途径。本文的实验部分包括对来自 VKontakte 和 Odnoklassniki 等社交网络的数据进行的实验的描述。实验结果表明，结合来自各种来源的数据可以显著提高用户识别的准确性。特别是，行为模型和社交图分析的使用在识别虚假个人资料和提高身份验证可靠性方面表现出很高的有效性。结论强调了进一步研究数据隐私和安全的重要性，以及开发新算法和技术以改进用户识别过程的重要性。本文面向信息安全领域的专家、身份验证系统开发人员和参与社交网络数据分析的研究人员。

关键词：数据集成、社交网络、用户识别、数据安全、身份验证、个人资料分析、行为模型、社交图、生物特征数据、隐私。

**Annotation.** *The article “Integrating Social Network Data into User Identification Processes” discusses modern methods and approaches to using social network data to improve the accuracy and reliability of user identification. The experimental part of the article includes a description of experiments with data from social networks such as VKontakte and Odnoklassniki. Experimental results show that combining data from various sources can significantly improve the accuracy of user identification. In particular, the use of behavioral models and social graph analysis has shown high effectiveness in identifying fake profiles and increasing the reliability of authentication. The conclusion highlights the importance of further research into data privacy and security, as well as the development of new algorithms and technologies to improve user identification processes. The article is intended for specialists in the field of information security, developers of authentication systems and researchers involved in the analysis of social network data.*

**Keywords:** *Data integration, social networks, user identification, data security, authentication, profile analysis, behavioral models, social graphs, biometric data, privacy.*

## **Introduction**

With the development of digital technology and the ubiquity of the Internet, social networks have become an integral part of the daily lives of millions of people around the world. Platforms such as VKontakte, Odnoklassniki and many others generate a huge amount of data every day containing information about the behavior, interests, connections and activity of users. This data represents a valuable resource that can be used in various fields, including marketing, user behavior analysis, reputation management and especially user identification processes [4].

User identification is a critical task in today's digital world. The security of information systems, data protection, personalization of services and quality of service depend on correct and accurate user identification. Traditional identification methods, such as logins and passwords, two-factor authentication and biometrics, have their limitations and disadvantages, such as vulnerability to attacks, complexity of use and limited accuracy. In this regard, there is a need to search for new approaches and methods that could increase the accuracy and reliability of user identification.

Social media data includes a wide range of information: from basic profile data (name, age, place of residence) to complex behavioral patterns (frequency and time of activity, interaction with other users, content of posts). Using this information allows you to create a more complete and accurate picture of the user, which, in turn, increases the accuracy of identification.

However, integrating social media data into identification processes poses a number of challenges and challenges [3]. First, it is necessary to take into account the confidentiality and ethical use of data, since unauthorized use of user information may lead to a violation of their rights and freedoms. Secondly, the development of effective methods and algorithms for processing and analyzing large volumes of data is required, which requires significant computing resources and technology.

## **Review of existing integration methods**

### **1. Machine learning and big data analysis**

Modern methods of machine learning and big data analysis make it possible to effectively process and analyze huge volumes of information generated by users of social networks. Machine learning algorithms such as neural networks and classification methods are used to recognize and match users based on their social media activities and characteristics [2]. For example, analyzing text data from posts and comments allows us to highlight the unique linguistic characteristics of each user, which contributes to more accurate identification.

### **2. Using Social Media APIs**

Many social networks provide application programming interfaces (APIs) that allow access to user data, including information about profiles, friends, posts, pref-



erences, and more[1]. The API gives developers the ability to integrate social media data into their own identity systems. Use of the API requires compliance with the privacy policies and terms of use set forth by the social networks.

### 3. Combination with traditional identification methods

Integrating social media data with traditional identification methods, such as logins and passwords, two-factor authentication and biometrics, allows you to create a multi-layered security system that is more difficult to hack. In case of suspicious activity, data from social networks can be used for additional verification and verification of the user.

### 4. Social Graph Analysis

Social graphs are diagrams that show connections and interactions between social media users. For example, if two profiles have a large number of mutual friends and similar interaction patterns, it can be assumed that they belong to the same user.

Social graph analysis helps detect fake profiles and bot accounts.

### **Implementation of the study**

Using data from social networks such as VKontakte and Odnoklassniki to analyze user behavior and create behavioral models for identification has several key aspects:

1. Frequency and time of publications. Analyzing the frequency and timing of posts can help understand user activity on the Internet. For example, determining the regularity and frequency of postings can be useful in identifying typical user behavior.
2. Interaction with other users: Studying the user's interaction with other network participants (likes, comments, reposts) allows us to understand his social connections and communication preferences.

### **Analysis of user interaction on VKontakte and Odnoklassniki**

Implementation steps [5]:

- Data collection: using the VKontakte and Odnoklassniki APIs, data on user publications, comments, likes, reposts and other interactions is collected.
- Behavioral analysis: user activity is assessed, for example, the level of his activity (frequency of publications), types of interactions (comments, likes), preferences in content and groups.
- Model building: Based on user behavior data, models are built to classify users by type of activity (for example, active users, passive users, active commentators, etc.).
- Application of the model: The model can be used to automatically identify typical behavior or to look for anomalous activities such as spam or fake accounts.

These steps provide a systematic approach to collecting and analyzing social media data, which is the basis for conducting qualitative research on user behavior and developing appropriate analysis models and algorithms.

### **Research results**

The following approaches were used:

1. Compare user profiles: Compare user profiles from different social networks to identify matching posts.
2. Behavior Analysis: Studying user activity such as posts, likes, and comments to create unique behavior patterns.
3. Assessing identification accuracy: Comparing the accuracy of user identification based on social network data with traditional methods.

### **Comparison of user profiles**

To compare user profiles, data from VKontakte and Odnoklassniki were used. The main attention was paid to the following parameters: first name, last name, date of birth, place of work and education. To match profiles, a system was developed that uses machine learning algorithms to determine the likelihood that two profiles belong to the same person.

### **Example of the received upload:**

- VKontakte profile: Name – Anna Smirnova, Date of birth – 03/12/1990, Place of work – Moscow State Pedagogical University, Education – St. Petersburg State University.
- Profile Classmates: Name - Anya Smirnova, Date of birth - 03/12/1990, Place of work - Moscow State Pedagogical University, Education - St. Petersburg State University.

The results showed that the system was able to identify matching profiles based on the specified data with an accuracy of within 95%. However, if the match was not complete, accuracy decreased, highlighting the importance of having as much information as possible in profiles.

### **Behavior Analysis**

The frequency and timing of publications, interaction with other users (likes, comments, reposts) and the content of publications were analyzed. Based on this data, behavioral models were created that were used to identify users.

### **Example:**

- VKontakte profile: The user actively publishes posts every day in the morning, interacts with a certain circle of people, and often uses certain hashtags.
- Odnoklassniki profile: The user also actively publishes posts every morning, interacts with the same users, and uses similar hashtags.

The results showed that the use of behavioral models could significantly improve the accuracy of user identification. In particular, it was possible to achieve

identification accuracy of up to 90%, which is 20% higher compared to traditional methods such as logins and passwords.

### **Advantages and disadvantages of integration**

Advantages:

1. Increased identification accuracy: Using additional data from social networks allows you to more accurately identify users.
2. Increased security: Multi-level identification system makes hacking and unauthorized access more difficult.
3. Personalization of services: The data obtained can be used to improve the user experience and personalize offers.

Disadvantages:

1. Privacy and Ethics: The use of social media data raises privacy and ethical issues[6].
2. Dependency on data quality: Incomplete or incorrect data can reduce the effectiveness of integration.
3. Integration Difficulty: Significant resources are required to develop and maintain systems that integrate social media data.

### **Conclusion**

The experiments and analysis showed that the integration of data from social networks into user identification processes is a promising direction that can significantly improve the accuracy and reliability of authentication. The study examined various approaches to using social media data, such as comparing user profiles, analyzing behavior, assessing identification accuracy, using social media APIs, analyzing social graphs, and using biometric data.

Thus, the integration of social network data into user identification processes is a promising direction with significant potential for various industries. It is important to continue research in this area, focusing on addressing current challenges and developing innovative approaches to improve the efficiency and security of user identification.

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防止配电网相间短路时接地故障保护装置误动作  
**PREVENTION OF FALSE OPERATION OF EARTH FAULT  
PROTECTIONS IN CASE OF PHASE-TO-PHASE SHORT-  
CIRCUITS IN DISTRIBUTION NETWORKS**

**Golokhvastov Evgenii Yurievich**

*Student*

*National Research University "MPEI"*

**Gusev Yurii Pavlovich**

*Candidate of Technical Sciences, Full Professor*

*National Research University "MPEI"*

**Gusev Oleg Yurievich**

*Senior Lecturer*

*National Research University "MPEI"*

注释。本文介绍了 20 kV 配电网中相间短路时零序电流滤波器运行的理论和理论分析结果。研究了输出电流的非正弦特性，并提出了建议，以防止相间短路时相电流互感器的饱和过程导致零序电流保护过度运行。这项工作是使用 EMTP-RV 软件包中开发的计算模型进行的。

关键词：电流互感器饱和、零序电流滤波器、供电中心、零序电流保护、相间短路。

**Annotation.** *The article presents the results of a theoretical and theoretical analysis of the operation of a zero-sequence current filter during phase-to-phase short circuits in a 20 kV distribution network. The non-sinusoidal nature of the output current has been studied and recommendations have been given to prevent excessive operation of zero-sequence current protection caused by saturation processes of phase current transformers during phase-to-phase short circuits. The work was carried out using a calculation model developed in the EMTP-RV software package.*

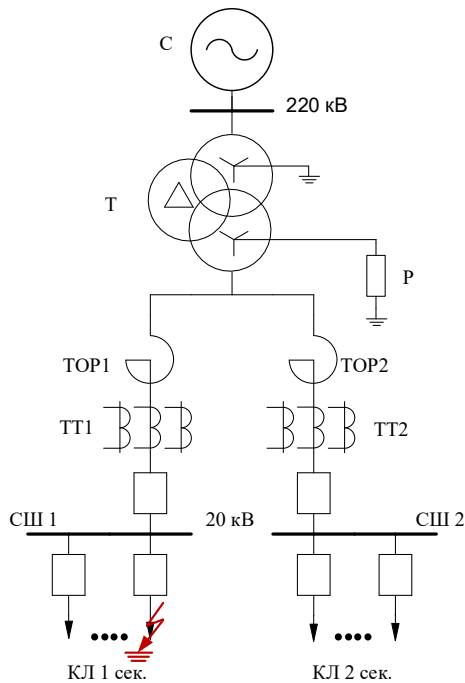
**Keywords:** *saturation of current transformers, zero-sequence current filter, power supply center, zero-sequence current protection, phase-to-phase short circuits.*

In domestic distribution networks with a voltage of 20 kV with 12-ohm resistive grounding of the neutral, cases of false operation of zero-sequence current

protections (ZCP) of power input circuits of sections of busbars of power supply centers (PCs) during three-phase and two-phase short circuits (SC) in cable network.

In this work, using mathematical models of magnetic circuits, we examine the effect of saturation of current transformers (CTs) on relay protection against single-phase ground faults. The operation of zero-sequence current filters (ZSCF), operating on the basis of the summation of secondary currents of three single-phase CTs, has been studied. The limiting values of the periodic and aperiodic components of three-phase and two-phase short-circuit currents, which can lead to excessive operation of the ZCP, have been determined. The non-sinusoidal nature of the ZSCF output current was studied and recommendations were given to prevent improper operation of relay protection.

To carry out the research, a calculation model was developed based on the initial magnetization curve in the EMTP-RV software package. The prototype of the research object was a PC in the Moscow region with an adjacent section of the cable network, Fig. 1.



**Figure 1.** Design diagram of a substation with an adjacent section of the distribution network

The design diagram includes the following elements: network source C - voltage 230 kV, three-phase short-circuit current 40 kA, decay time constant of the aperiodic component 55 ms; transformer T with a rated power of 100 MVA with a compensating winding (CW) of 10.5 kV, connected in a triangle, short-circuit voltage of the windings 230/22 kV 17%, 230/10.5 kV 27%, 22/10.5 kV 6%, short circuit losses of windings 230/22 kV 400 kW; current-limiting reactors TOP1 and TOP2, rated current 2500 A, inductive reactance 0.35 Ohm, rated power losses 67.5 kW; cable lines (CL) with cables type APvPug 1x500/70. The total capacitive current of the cable network section adjacent to each section of the PC busbars in case of a single-phase ground fault is 250 A.

To simulate phase transformers, a mathematical model was chosen, which is based on the initial magnetization curve. It does not reflect all physical processes in CTs during phase-to-phase short circuits, since dynamic partial hysteresis loops are not taken into account, but it is sufficient for studying low-frequency periodic and aperiodic components of currents at the output of the ZSCF.

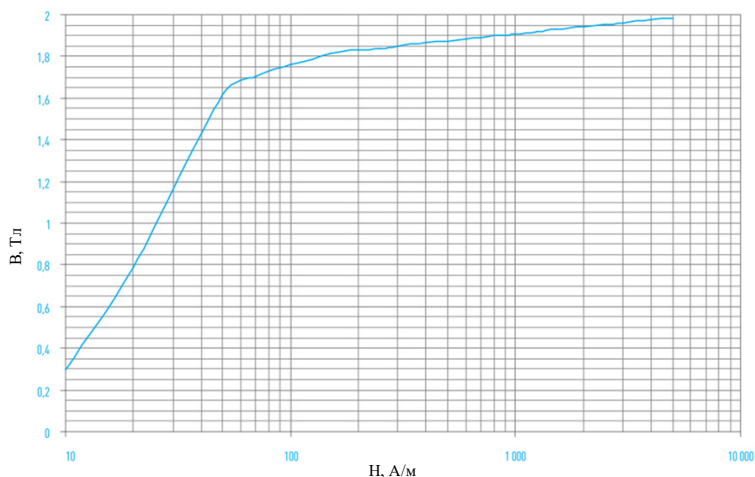
We considered an ZSCF, consisting of three phase transformers of type TPOL-20, installed at the power input of the busbar section of the PC. CT parameters are presented in Table 1.

The load resistance corresponded to its nominal value with a power factor of 0.8.

**Table 1.**  
*Parameters of current transformer TPOL-20*

<b>Parameter name</b>	<b>Value</b>
Rated current of the primary winding, A	2500
Rated current of the secondary winding, A	5
Rated limit current ratio	10
Rated full load, Ohm	2,0
Design cross-section of the magnetic circuit, $m^2 \cdot 10^{-4}$	6,1
Estimated length of the center line of the magnetic core, m	0,67
Estimated active resistance of the secondary winding, Ohm	0,7
Estimated inductive leakage reactance of the secondary winding, Ohm	1,3
Estimated number of turns of the secondary winding, pcs.	500

The magnetization branch of a CT with a magnetic core made of steel grade 3409 with a thickness of 0.30 mm in the calculation model is represented by non-linear inductance in accordance with the Weber-ampere characteristic, Fig. 2 [1].

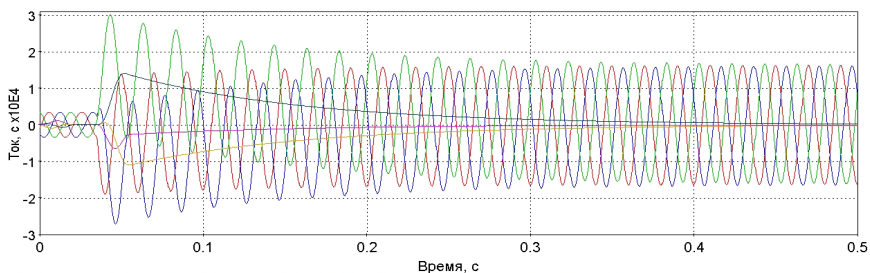


**Figure 2.** Magnetization curve for 0.3 mm thick 3409 steel

Verification of the design model of the phase transformer was carried out based on the total error at a maximum current multiplicity of 25 kA. The calculated value was 9.3% with the standard value, according to GOST 7746-2015, 10%.

Two-phase and three-phase short circuits at the beginning of the cable line of the outgoing connection of the PC were considered.

The switching angle of the short circuit was set based on the condition for obtaining the largest amplitude of the aperiodic component. The maximum ZSCF errors were obtained with a three-phase short circuit, Fig. 3.

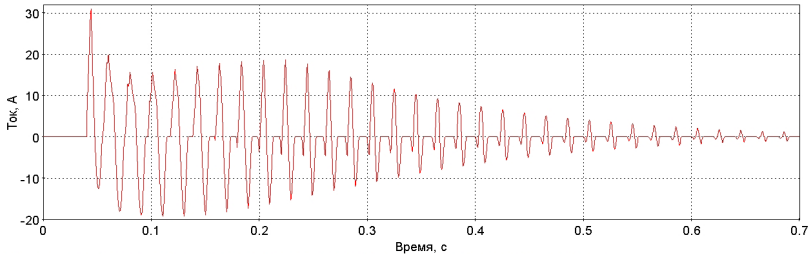


**Figure 3.** Calculated oscillograms of instantaneous values of phase currents in the primary circuit of CT1 with a three-phase short circuit at the beginning of the cable line: red – phase A current; blue – phase B; green – phase C, yellow – aperiodic current component of phase A, pink – phase B, black – phase C



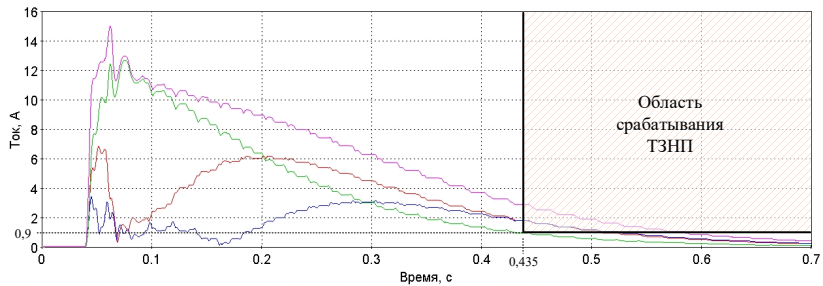
The three-phase short circuit was preceded by a normal mode with a current in CT1 of 2.5 kA. The root mean square value of the periodic component of the three-phase short circuit current that occurs at 35 ms is 11.5 kA. The peak value of the aperiodic component in phase C is 16.21 kA, the decay time constant is 100 ms.

The sum of secondary currents from CT1, the current in the neutral wire of the ZSCF, is shown in Fig. 4.



**Figure 4.** Calculated oscillogram of instantaneous values of the zero-sequence current at the output of ZSCF TT1

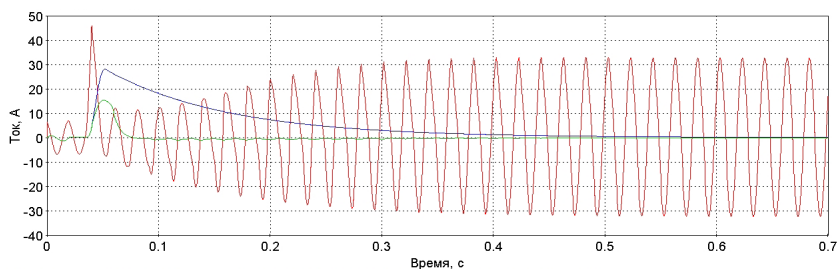
Using the fast Fourier transform, the 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> harmonics of the industrial frequency current - 50 Hz were isolated from the output current of the ZSCF, Fig. 5. Zero-sequence current in secondary circuits appears when there is no zero-sequence current in the primary windings of CT1, which is due to saturation of the magnetic circuits. The root mean square value of the total current at the output of the ZSCF exceeds the operating setting of the ZCP in terms of current,  $450/2500 \cdot 5 = 0.9 \text{ A}$ , and in time, 0.4 s, which leads to excessive shutdown of the power input switch of the busbar section of the PC.



**Figure 5.** RMS current values at the output of ZSCF CT1: pink – full current; green – 1st harmonic; red - 2nd harmonic; blue - 3rd harmonic

The change in harmonic components in the secondary current of the CT depends on the decay time constant of the aperiodic component of the primary current, which is determined by the ratio of the inductive resistance of the short-circuit circuit to the active one, and in relation to the object of study corresponds to the decay time constant of the aperiodic component of 100 ms.

In the total current of the secondary circuit there is an aperiodic component with a damping time constant, determined by the ratio of the magnetizing inductance to the active load resistance of the secondary winding of the CT, Fig. 6. The decay time constant of the aperiodic current component in the secondary winding of the CT significantly exceeds the decay time constant of the aperiodic current component in the primary winding of the CT.



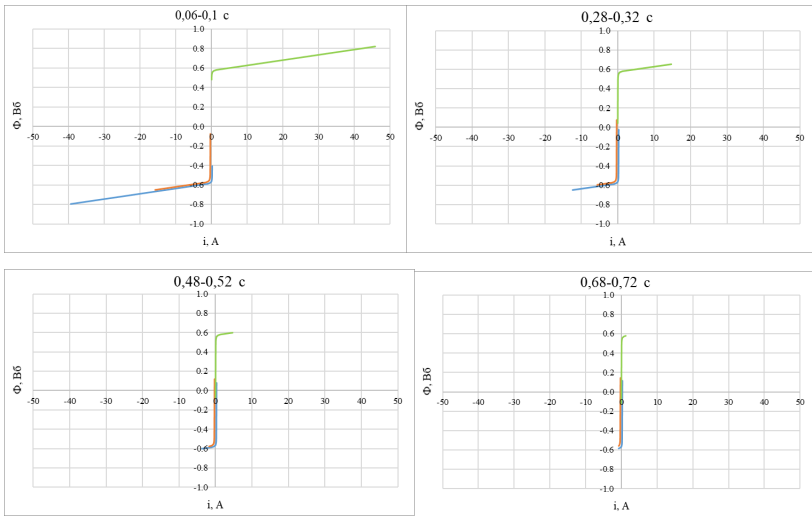
**Figure 6.** Instantaneous values of the total current of phase C in the secondary winding of CT1 - red and, obtained using digital filters, the aperiodic component of the current in the primary circuit, reduced to the secondary winding - blue, the aperiodic component of the total current in the secondary circuit - green

The decay rate of the root mean square values of the harmonic components is less than the decay rate of the aperiodic current component in the primary circuit, but greater than the decay rate of the aperiodic current component in the secondary circuit of CT1, see Fig. 6.

The presence of the 3rd harmonic at the output of the ZSCF after attenuation of the aperiodic components in the primary circuits is due to the excess of the instantaneous values of 50 Hz of the current components in the primary windings of CT1 in relation to the maximum current multiplicity. This harmonic appears if the instantaneous values of the total current in the primary windings of the CT exceed the amplitude values of the current corresponding to the maximum multiplicity of the CT. Such an excess is possible by summing the magnetic field strengths caused by the aperiodic components of currents in the secondary windings of the transformer and the periodic components in the primary windings of the transformer.

The sum of the magnetic fields of the primary and secondary windings associated with their aperiodic current components, see Fig. 3, during the short circuit

leads to a shift in the Weber-ampere characteristics along the magnetization curve of the magnetic circuit from the saturation zone to the linear zone, Fig. 7.



**Figure 7.** Calculated fragments of Weber-ampere characteristics of CT1 for different stages of a three-phase short circuit: orange - phase A; blue – phase B; green – phase C

The appearance of the 1st, 2nd and 3rd harmonics in the zero-sequence current is due to the number of magnetic circuits in the saturation zone. The third harmonic corresponds to the alternate saturation of the magnetic circuits of all three phases during the period of industrial frequency, see Fig. 7 for the time interval 0.48 – 0.52 s, the second harmonic corresponds to the alternate saturation of the magnetic circuits of the two phases, see Fig. 7 for the time interval 0.28 – 0.32 s, the first harmonic corresponds to the time interval at which the magnetic circuit of one phase appears in the saturation zone, see Fig. 3 and fig. 7 for the time interval 0.06 – 0.1 s. In the time interval of 0.68 – 0.72 s, the magnetic circuits are not saturated and there is no zero-sequence current at the output of the ZSCF. If the periodic component of the primary short-circuit current of the primary windings of CT1 exceeds the current of the maximum multiplicity of the CT, then a third harmonic will be present at the output of the ZSCF.

To prevent excessive triggering of the ZSCF, you can increase the response delay or use a first harmonic filter at the output of the ZSCF.

### **Conclusions**

1. During phase-to-phase short circuits with values of the periodic component of currents exceeding the standard values of the maximum multiplicity of the CT, a zero-sequence current with a frequency of 150 Hz appears in the output circuits of the ZSCF, which is absent in the primary circuits.
2. The aperiodic component in phase-to-phase short-circuit currents causes non-simultaneous saturation of the magnetic circuits of phase transformers and the associated appearance of components with frequencies of 50 and 100 Hz in the zero-sequence current at the output of the ZSCF.
3. When choosing the rated current of phase CTs in the power input circuits of busbar sections, it is necessary to ensure that the maximum multiplicity of the CT current is greater than the maximum possible instantaneous value of the three-phase short-circuit current.
4. To prevent false triggering of the ZCP during phase-to-phase short circuits, it is recommended to use a first harmonic filter at the ZSCF output or select an operation delay taking into account the attenuation of aperiodic components in the primary and secondary windings of the CT.
5. In subsequent studies, it is necessary to clarify the influence of the hysteresis of the CT magnetic circuits on the requirements for the operation parameters of the ZCP, preventing their false operation.

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萨拉托夫伏尔加河沿岸地区灌溉苜蓿的产量取决于森林复垦和生物肥料（生物炭）

**THE YIELD OF IRRIGATED ALFALFA DEPENDING ON FOREST RECLAMATION AND BIOFERTILIZER (BIOCHAR) IN THE SARATOV VOLGA REGION**

**Bogomolov Dmitry Konstantinovich**

*Postgraduate student*

**Panfilov Andrey Vladimirovich**

*Doctor of Agricultural Sciences, Professor*

**Popov Valery Gennadievich**

*Doctor of Agricultural Sciences, Professor*

**Lazarev Alexander Alexandrovich**

*Postgraduate student*

**Mariskin Roman Valerievich**

*Postgraduate student*

*Saratov State University of Genetics, Biotechnology and Engineering named after N.I.Vavilov, Saratov, Russia*

注释。在防护林种植系统中，在灌溉和有机矿物肥料的条件下，苜蓿产量稳定。作物灌溉的一个重要稳定因素是林带，它使您可以承受超过喷水器允许值的风速灌溉期。已经安装了林带结构以获得高产量的苜蓿灌溉。生物肥料可以减少水消耗，从而促进苜蓿的生长。改善土壤中的生物过程并长期提高土壤肥力。苜蓿叶表面积与播种率和林带网状结构之间的关系的决定系数为 0.94。

关键词：林带建设、灌溉、苜蓿、产量、生物肥料（生物炭）引入。

**Annotation.** *Stable alfalfa yields are possible under conditions of irrigation and organomineral fertilizers in the system of protective forest plantations. An important stabilizing factor in crop irrigation is forest strips, which allow you to withstand irrigation periods at wind speeds exceeding the permissible values for sprinklers. The construction of forest strips has been installed to obtain high yields of alfalfa for irrigation. Biofertilizers increase alfalfa growth with lower water consumption. Improvement of biological processes in the soil and long-term increased soil fertility. The coefficient of determination of the relationship between the area of the alfalfa leaf surface with the seeding rate and the tracery of forest strips was 0.94.*

**Keywords:** *construction of forest strips, irrigation, alfalfa, yield, biofertilizers (Biochar) introduction.*

Forest strips with irrigation are optimally complementary: the first ones allow you to withstand the irrigation regime when the wind speed exceeds the permissible values for the operation of irrigation machines and improve the microclimate of inter-lane spaces, increase the bonus and durability of tree species, thereby increasing the impact on the microclimate and productivity of adjacent fields. The use of phytomeliorants in the system of forest strips plays an important role in the irrigated agrocenosis, especially legumes, among which alfalfa stands out. The study of the phytomass of irrigated alfalfa under the influence of the seeding rate and the structures of forest strips is an urgent area of research [3, 4, 5].

Biochar is a unique little-researched biofertilizer. It consists mainly of carbon accumulated by burned plants. Biofertilizer is used as an organic fertilizer capable of preserving water and nutrients in the soil, which dramatically increases soil fertility and agricultural productivity. The cultivation of the land for many centuries has led to a deterioration in its quality, the ability of the earth to quickly absorb water has deteriorated. The development of biochar production and application in agriculture and forestry makes it possible to improve land fertility in a short time. Already today, Biochar is one of the most promising types of fertilizer, because when fertilizing the soil, not only new plants grow and develop well, but also this type of fertilizer does not pollute the atmosphere with carbon dioxide. Many scientists call biochar “black gold” for farming [6, 7].

The purpose of the research is to identify the impact of forest strips, seeding rates and biofertilizers on the productivity and photosynthetic potential of irrigated alfalfa. Research methodology. The object of the study is irrigated alfalfa of the blue Diana variety of the 2nd, 3rd, 4th years of life, forest strips of various designs, biofertilizer. The climate of the study area is continental with an annual air temperature of 5.40 C and precipitation of 435 mm. The soil is ordinary chernozem, with a humus content of 4.6%. The scheme of mixing forest strips (LP) is *poderevnaya* with alternating 3 rows of squat elm and 3 rows of lanceolate ash. The width of the LP is 18 m with a row spacing of 3 m, the height of the elm is 17 m.

Alfalfa irrigation – background – maintenance of a moderate level of water supply at the pre-irrigation moisture threshold of the active soil layer of 70% HB during the entire growing season. The active calculated soil layer is 0.6 m. During 3 years of research, an irrigation rate of 3600 m<sup>3</sup>/ha was used for the average rainfall of the growing season of alfalfa cultivation. Watering was carried out after each mowing – 3 and in the phase “branching – budding” – 3 by the sprinkler machine “Frigate” DMU-A308-55. Alfalfa fertilizer is a background fertilizer from the 2nd year of life N30 P60 K30. When adding Biochar to the soil of 10-30%

of the total volume of the treated surface, experience has confirmed significantly increased crop growth with lower water consumption. The introduction of biochar into the soil, among other things, improves biological processes and long-term soil fertility [1, 2, 7].

The experience was based on a two-factor scheme: factor A - the rate of sowing alfalfa seeds of the Diana variety included three options – 11 kg/ha (3.48 million/ha); 13 kg/ha (4.06 million/ha), 15 kg/ha (4.64 million/ha); factor B – the construction of forest strips – there are three options – dense (Idp) with an openwork of less than 10%, openwork (Vaz) - 30%, blown (Vpr) - more than 60%. The repetition in the experiment is fourfold. The registered area of the plots is 100 m<sup>2</sup>. The number of mowing is three in each of the research years. The productivity and leaf surface of alfalfa were studied at different distances from forest strips: 1H, 5H, 10H, 15H, 20H, 25H, 30H, 35H, 40H, 45H (H is the height of the LP, m; H=18 m). The experimental data were controlled by: for dense LP, the corresponding values at a distance of 25N, for openwork – 35N, for blown – 45N. The variance and regression analyses were performed on the basis of standard computer programs, using the average values of the experimental data at a distance from the LP, depending on the design: dense 1-20H; openwork – 1-30N; blown – 1-40N [1, 2].

The results of the study. The optimal alfalfa seeding rate, regardless of the design of the forest strips, is 13 kg/ha. The highest productivity and photosynthetic potential of alfalfa is under the influence of forest strips of a blown structure, the lowest is dense LP. The formation of the LP structure increases the productivity of the crop by 12.2 – 19.2%, the leaf surface area – 5.0 – 11.5%, and the photosynthetic potential per day – 7.0 – 18.4%. If we analyze the productivity and photosynthetic potential of alfalfa by year, its maximum value turned out to be in the 2nd year of life, then a natural decrease in the 3rd and 4th years of culture cultivation (Table). The decrease in photosynthetic potential by year was regardless of the alfalfa seeding rate and LP design: the 3rd year according to compared with the 2nd to 10.5%, the 4th to 18.4%.

**Table**  
*Productivity and photosynthetic potential of irrigated alfalfa under the influence of the seeding rate and the design of forest strips*

Seeding rate, kg/ha	Productivity during the growing season, t/ha	Maximum leaf area, thousand m <sup>2</sup> /ha	Photosynthesis productivity, g/m <sup>2</sup> day.	Photosynthetic potential, million m <sup>2</sup> day/ha
Dense construction				
11	8,93	42,50	4,10	0,34
13	9,57	47,23	4,90	0,41

15	8,37	42,50	4,60	0,38
on average	8,95	44,08	4,53	0,38
Openwork design				
11	9,93	44,87	4,00	0,40
13	10,24	50,17	5,43	0,42
15	9,96	46,57	4,73	0,44
on average	10,04	47,20	4,60	0,42
Blown design				
11	10,48	47,90	4,07	0,44
13	11,38	52,70	5,23	0,44
15	10,15	47,93	4,50	0,46
on average	10,67	49,51	4,72	0,45

The factor A -  $HCP_{05} = 0,058 \tau/ra$ ; The factor B -  $HCP_{05} = 0,067 \tau/ra$

Biochar prevents the development of putrefactive processes. Regulates soil moisture and air exchange. With regular use, charcoal powder inhibits the development of certain insects, pests, nematodes, wireworms, etc.). Biochar It can significantly contribute to the sustainable development of withered, infertile and nutrient-poor soils. Moreover, biochar is able to impose CO<sub>2</sub> into the soil for a long time and thereby contribute to reducing the content of greenhouse gases in the atmosphere. Due to its specific properties, biochar is an important candidate for agricultural applications to improve the quality of soils poor in humus and nutrients. Waste biomass is processed into a high-quality organic product to increase soil fertility. The high porosity of the biochar, together with its further specific properties, leads to increased retention of nutrients and moisture in the soil.

The analysis of dispersion showed that the seeding rate, LP design and biofertilizer significantly affect the productivity of alfalfa and the formation of leaf area under the influence of photosynthesis. Regression and correlation analysis allowed us to establish that the influence of the seeding rate, the openwork (design) of LP and biofertilizer on the leaf surface area of alfalfa turned out to be significant. The coefficient of determination  $R^2 = 0.94$  determines by 94% the relationship between alfalfa productivity, seeding rate and LP tracery, and 6% is allocated to other impact indicators.

Conclusion. It is necessary to grow irrigated alfalfa of the blue Diana variety in a system of blown forest strips with a seeding rate of 13 kg / ha, or 4 million / ha. Create forest strips from squat elm and lanceolate ash using irrigation water to irrigate tree species with the norm used for crop rotation crops. Use biochar to: remove residual pesticides and phytotoxins from the soil (herbicides, pesticides); favorable development of beneficial microorganisms that increase soil fertility; increase plant germination due to faster soil warming; as a soil leavening agent;



improve soil structure (sandy, alumina); improve oxygen access to plant roots; increase soil permeability, moisture retention; preventing leaching of nutrients from the soil.

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别尔哥罗德州国土规划中以居民为中心的数字经济环境

**RESIDENT-ORIENTED DIGITAL ENVIRONMENT IN THE ISSUES  
OF TERRITORIAL PLANNING OF THE BELGOROD REGION**

**Lysykh Sergey Alexandrovich**

*Graduate student, Assistant  
Belgorod National Research University*

**Gaidenko Elena Mikhailovna**

*Candidate of Geographical Sciences, Associate Professor  
Belgorod National Research University*

**Solovyev Aleksandr Borisovich**

*Candidate of Economic Sciences, Associate Professor  
Belgorod National Research University*

注释。本文分析了别尔哥罗德地区国土规划问题中以居民为中心的数字经济环境。数字社会创新领域旨在解决社会问题，包括消除贫困和不平等、加强司法、人权和性别平等，以及通过使用数字技术解决影响地球和气候的环境问题。今天，现代俄罗斯城市发展中最重要的是为人口形成和维护一个有利和舒适的环境。本文描述了别尔哥罗德地区国土规划问题中以居民为中心的数字经济环境。

关键词：数字化、经济过程、信息技术、国土规划、农业、农村人口。

**Annotation.** *This article analyzes the resident-oriented digital environment in the issues of territorial planning of the Belgorod region. The sphere of digital social innovations is aimed at solving social problems, including the fight against poverty and inequality, strengthening justice, human rights and gender equality, as well as solving environmental problems affecting the planet and climate through the use of digital technologies. Today, the most important task in the development of modern Russian cities is the formation and maintenance of a favorable and comfortable environment for the population. This article describes the resident-oriented digital environment in the issues of territorial planning of the Belgorod region.*

**Keywords:** *digitalization, economic processes, information technologies, territorial planning, agriculture, rural population.*

At the present stage of development of the global information society a new economic system – the digital one is actively being formed. It involves the dig-

italization of economic processes and the penetration of innovative technologies into many areas of human activity. As a result, such changes entail new questions about the competitive advantages of companies and the concepts of their management and functioning.

In recent decades, society has undergone a transformation due to the introduction of new digital technologies, many of which are connected to the Internet, and this has led to a change and uneven perception of geography during their implementation. These technologies open up opportunities and create problems. Digital technologies have significant potential to support economic development, promote social integration, and develop and maintain sustainable communities.

The purpose of this article is to analyze the resident-oriented digital environment in the issues of territorial planning of the Belgorod region.

Many regions of Russia have special characteristics that create problems related to issues such as quality of life and wealth creation. These include, for example, small, often dispersed groups of the population; narrow and uneven channels of information flow; rapid changes in the structure of the population and the foundations of economic activity; limited access to digital infrastructure and, in a very lively sense, the influence of physical geography. By themselves or in combination, these problems may make it difficult in some areas to fully exploit the opportunities offered by new digital technologies. However, there is significant potential for digital technologies to support individual areas to become more economically, socially and environmentally sustainable.

The digital economy as a phenomenon has emerged relatively recently, especially in developing countries, although the technological foundations of the digital economy began to be laid in the 1990s with the initial introduction of corporate computing and computerized manufacturing. The advent of the Internet in the early 2000s was a stepping stone towards the digital economy as we know it today. The widespread adoption of the Internet has made it possible to develop and implement a number of technologies and services that underpin the digital economy. Over time, several definitions of the digital economy have been proposed. However, as Bucht and Hicks point out, definitions are always a reflection of the times and the trends from which they arise [1] and therefore must adapt as the technological landscape, the level of complexity and user knowledge evolve.

Kosolapova M.V. defines: the digital economy is a model reflection of economic relations in production, distribution, exchange and consumption based on information and communication technologies [4, p. 13].

Professor A.V. Minakov believes that the digital economy is an economy based on computer technologies, covering all spheres of life and consumer-oriented in order to improve the provision of services in trade, transport, medicine, education, culture and other fields, operating with information stored in databases [6].

According to M.I. Ivanova, the digital economy, on the one hand, is based on digital technologies in the field of sales of goods and services, on the other hand, it is economic production using digital technologies [3, p. 246].

Turko L.V. defines the digital economy as: a type of commercial activity carried out in the electronic space, and in a broad sense – the transformation of the entire society against the background of the introduction of information and communication technologies [7, p. 92].

According to Professor L.V. Lapidus: digitalization is the process of transition to a digital region, the transformation of processes of cross-regional, intersectoral, interpersonal interaction in the region due to the penetration of digital technologies aimed at improving the quality of life of the population, the competitiveness of the Russian economy, ensuring national security and sovereignty of the country [5, p. 51].

As L.V. Glezman notes: Building a digital infrastructure is difficult. a long-term, multi-stage, energy-intensive, dynamic process of creating the intellectual potential of the territory, proceeding under the influence of radical technological changes. Therefore, resource barriers dictate one of the requirements of digitalization of rural areas — a differentiated approach to the implementation of state support measures, taking into account socio-economic and territorial characteristics. The need for such an approach remains with regard to the development of territorial digital infrastructure [2, p. 573].

The administrative-territorial structure (division) of the Belgorod region was carried out in strict accordance with the Law of the Belgorod Region dated 12/20/2004 No. 159 On establishing the boundaries of municipalities and granting them the status of an urban, rural settlement, urban district, municipal district and is aimed at further development of industry, agriculture, and the social sphere of the district.

Belgorod district was established on July 30, 1928. Currently, the Belgorod region is an administrative unit of the region. The administrative center is the village of Maysky. Its distance from the city of Belgorod is 12 km.

Belgorod region has the status of a border area. In the south it borders with the Dergachevsky and Kharkov districts of the Kharkiv region (Ukraine). In addition, it borders four districts of the Belgorod region — Borisovsky, Yakovlevsky (in the east) and Korochansky, Shebekinsky (in the west).

The total land area of the district is 147 thousand hectares, including 90 thousand hectares of arable land. In terms of administrative division, the district includes 3 urban settlements and 21 rural settlements. 102.2 thousand people live in 86 settlements, of which 46% are male and 54% are female. More than half of the population is of working age, about 29.9 thousand pensioners. The workforce is 53.6 thousand people, 19.6 thousand people are employed in the economy [8].

The predominant activity of the Belgorod region is agriculture. The territory includes 21 agricultural enterprises — a collective farm, joint-stock companies of closed and open type, farms. In total, their share of gross output is just over 50 percent.

Agriculture in 2023 became one of the priority sectors of the Russian economy for the introduction of artificial intelligence (AI). Along with other priority sectors — industry, healthcare, transport and construction — agriculture has significant economic potential. According to expert estimates, in the context of mass adoption of AI, it can provide an increase in gross value added (GVA) by 2025 by 25% in crop production and by 13% in animal husbandry [10].

Important transport routes pass through the Belgorod region:

Railways: Belgorod — Kharkov, Belgorod — Gotnya, Belgorod — Stary Oskol, Belgorod — Volchansk.

Highways: Belgorod — Kharkov, Belgorod — Kursk, Belgorod -Tomarovka, Belgorod — Shebekino, Belgorod — Korocho. The length of public roads is 414 km [8].

Urban and spatial planning can be defined as a decision-making process aimed at achieving economic, social, cultural and environmental goals through the development of spatial concepts, strategies and plans and the application of a set of policy principles, tools, institutional and participatory mechanisms, as well as regulatory procedures.

Urban and territorial planning performs an integral and fundamental economic function. It is a powerful tool for changing the forms and functions of cities and regions in order to ensure endogenous economic growth, prosperity and employment while meeting the needs of the most vulnerable, marginalized or underserved groups.

Belgorod Region is one of the first in Russia to develop a digital transformation strategy.

The following technologies will be implemented during the implementation of the Digital Transformation Strategy:

1. Artificial intelligence;
2. Big data;
3. Distributed registry systems;
4. Industrial Internet;
5. Wireless communication [9].

These technologies will be applied in the social sphere, healthcare, education, public administration, culture, construction and housing and communal services, agriculture in the formation of data banks, the provision of public services, informing the population on the provision of state and municipal services, as well as interaction with regional authorities and organizations, the creation of unified

platforms, the adoption of management solutions in the field of transport services for digitalization of traffic management processes; the introduction of cashless payment for travel and informing passengers about the real movement of vehicles along the route. The created infrastructure will be used for the development of the information society, digital interaction, and the organization of secure interdepartmental electronic interaction.

The implementation period of the Digital Transformation Strategy is 2022-2024 inclusive.

The tasks of digital transformation of the sectors of the economy, social sphere and public administration of the Belgorod region:

1. Implementation and modernization of digital and platform solutions in the economic and social sectors, as well as in the areas of public administration and public services.

2. Increasing the share of mass socially significant services available electronically.

3. Building a data management system for management decision-making and interaction between authorities, citizens and organizations.

4. Modernization and development of IT infrastructure in the Belgorod region.

5. Ensuring information security.

6. Promoting the development of “end-to-end” digital technologies in the Belgorod region, mainly based on domestic developments.

7. Providing the labor market with highly qualified personnel with digital competencies.

So, we can conclude that the transformation of the economy and society into an information system and the inclusion of people in this system have prepared our world for the advent of digital devices. Although digital devices are rightfully considered to be the cause of major changes in the world we live in, they are also the result of digitalization.

As possible positive consequences of the implementation of the Belgorod Digital Transformation Strategy, it will allow:

- improving the quality of life of local citizens, primarily by improving the satisfaction of specific already known and new needs of people;

- Increasing the transparency of economic transactions and provide opportunities for their monitoring;

- creating electronic platforms for trading products and services;

- ensuring the availability of goods and services for various segments of the population by reducing their cost as a result of reducing the number of intermediaries, reducing the cost of searching for information, identifying and measuring transaction costs; costs of promoting goods and services; reducing the time needed to develop products and services and bring them to market;

■ creating new business models and new forms of business that allow to increase labor productivity, quality of products and services, profitability and competitiveness of enterprises of the consumer cooperation system;

■ expanding sales markets for products and services, access to foreign markets through the active use of marketing and branding tools.

The trends of transformational changes in the role of the state under the influence of digitalization are determined both on the basis of an empirical analysis of official statistics and on the basis of the study of expert opinions of scientists dealing with this topic both in Russia and abroad. Considerable attention is paid to state development programs in the part where the role of the state and its individual structures is supposed to be implemented using digital technologies.

Unfortunately, in order for the human-oriented digital environment to have a tangible and positive impact on the economic development of the Belgorod region and the socio-economic development of its rural territories, the project “Development Strategies of the Belgorod Region 2022-2024” implemented in the country, including digitalization of the agro-industrial complex, is not enough. Only large-scale implementation and distribution of cloud applications, IT technologies, big data management services, rural communications and solutions based on a single platform will lead to the expected digital effects.

In the long term, the digital environment will improve rural social infrastructure, including education, medicine and culture, increase the efficiency of agricultural and industrial production, using the latest technologies, equipment, modern methods of production, processing, storage, sale and delivery of goods and services, and also contributes to improving the quality of life of the rural population.

In this regard, federal and regional support, subsidies for the development and implementation of digital technologies in rural areas, as well as active educational work at all levels will greatly contribute to the development of digitalization and digital transformation of territorial planning issues in the Belgorod region.

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