



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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中观经济层面商业医药市场的潜力：以俄罗斯各地区为例
**POTENTIAL OF THE COMMERCIAL MEDICINE MARKET AT
THE MESOECONOMIC LEVEL: ON THE EXAMPLE OF
RUSSIAN REGIONS**

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注释。本文提出了私人医疗服务市场发展潜力的概念，并在此框架内识别和构建了15个因素，这些因素在系统结构分析的基础上统一为区域层面的三个结构模块：医疗保健行业状况、区域社会经济状况以及其对商业医疗发展的商业吸引力。开发并测试了评估商业医疗市场潜力的方法，其中考虑了每个具体因素的重要性，在此基础上计算了俄罗斯各地区私人医疗服务市场发展潜力的综合评级。从而可以确定其容量及其在各个地区的改进方向。同时，提出并测试了私人医疗服务市场潜力与有偿医疗服务市场规模和商业医疗市场容量之间的相互关联和相互依赖的假设，该假设是通过计算潜在容量并考虑2023年至2025年期间有偿医疗市场的预测增长率来确定的。

关键词：私人医疗服务市场潜力、商业医疗区域市场、本地市场。

Annotation. The article proposes the concept of the development potential of the private medical services market, within the framework of which 15 factors are identified and structured, united on the basis of system-structural analysis into 3 structural blocks of the regional level: the state of the healthcare industry, the socio-economic situation of the region and its business attractiveness for the development of commercial medicine. The method of assessing the potential of the commercial medicine market was developed and tested, taking into account the significance of each specific factor, on the basis of which an integrated rating of the development potential of the private medical services market of Russian regions was calculated. Thus, it becomes possible to determine its capacity and the direction of its improvement in each region. At the same time, the hypothesis of interrelation and interdependence of the private medical services market potential

with the volume of the paid medical services market and with the capacity of the commercial medicine market, determined by calculating the potential capacity taking into account the forecast growth rates of the paid medicine market for the period of 2023 - 2025, was put forward and tested.

Keywords: private medical services market potential, regional market of commercial medicine, local markets.

The health of citizens is an important part of the economic, political and social security of the country, independence and normal human life; therefore, the goal of the health protection system is to create the necessary conditions for preserving and improving the health of the population and for leading a healthy lifestyle. Improving the state of health is one of the most urgent issues for many people in our country.

As a result of the impact of external political pressure, the implementation of sanctions policy and accumulated internal problems, the activation of managerial, financial and organizational resources to achieve the national development goals of the country, in particular - improving public health, increasing life expectancy (up to 80 years by 2030) and the duration of active working life, improving the quality of life by reducing the level of morbidity comes to the forefront [1].

In the study of the issues of the designated problematics it is possible to distinguish several aspects that attract the attention of scientists and specialists.

The main theoretical provisions in the field of health economics are presented in the works of: Gabueva L.A., Kolosnitskaya M.G., Kudrina V.G., Kucherenko V.Z., Pachin M.V., Reshetnikov A.V., Semyonov V.Y., Starodubov V.I., Shamshurina N.G., Shamshurin V.I., Sheiman I.M., Yudanov A.Y. and others.

The issues of functioning of the Russian medical services market are studied in the works of I. Nikolaev, J. Buribaeva, E. Likhtarovich, V. Seleznev, S. Volkov, I. Fedorova, D. Reshetov. Competitive behavior of medical institutions in the market is studied in the works of P. Rivers, S. Glo-vera. The analysis of factors that exert market pressure on the competitive situation in the market is presented in the article by G. Tron [2,3].

At the same time, a number of theoretical and practical issues related to the functioning of the market of private medical services and ways of development within the framework of regional economic policy realization, as well as the assessment of the potential of the market of commercial medicine in individual subjects are not sufficiently developed.

In this regard, it is important to clearly understand the trend of commercial medicine, its place in the Russian healthcare system, the mechanism of its interrelation with the state (budgetary) medicine and the factors of its growth as an independent sphere of economic management. This will allow to further determine

the potential of private medicine to provide timely, affordable and quality medical services to the general population, in accordance with the state program “Health Care Development”.

It should be noted that currently the concept of “potential of the regional market of private medical services” is not a defined category according to regulatory legal acts and scientific literature.

The article attempts to address this gap

Thus, the authors propose to understand the potential of the regional private medical market as an integral expression of the totality of socio-economic, financial and sectoral factors that determine the possibility of development and capacity of the HMM market in a particular region.

The diversity of factors determining the level and potential of development of the private medical services market, unstable geopolitical situation, the dynamics of the situation in the market of medical equipment and drugs, limited resources, the need for proper placement of emphasis creates the need for structuring and formation of an approach to assessing the potential for the development of private medicine.

Based on the study of positive and negative trends of the environment of functioning of the private medical services market of a particular region - Kostroma region allowed to determine the prospects and directions of its development (Fig. 1).

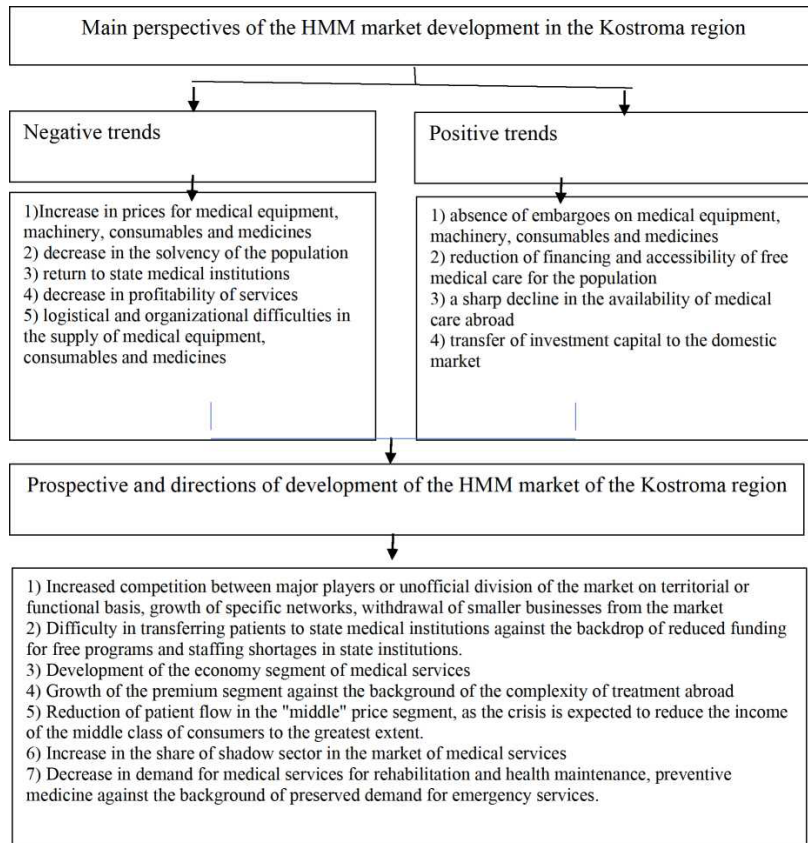


Figure 1. Prospects for the development of the PMU KO market. Source: compiled by the authors

As can be seen from Figure 1, the functioning of private medical organizations will largely depend on the effectiveness of the commercial policy of medical organizations and, mainly, the ability to respond quickly to changing market conditions.

At the same time, changes in the foreign policy situation, the introduction of new sanctions, and possible measures to support the economy in crisis conditions will continue to influence, including dramatically, the market of medical services in the Russian Federation, as well as the market as a whole. This makes the level of management, efficiency of commercial and marketing policy of clinics a particularly important factor.

To this end, the research has developed an author's approach to the application of system- structural analysis level of private medical services market potential taking into account the factors affecting the flow of patients and the average check (market capacity) at the regional level.

In order to assess the level of potential of the market of private medical services, taking into account the factors affecting the flow of patients and the average check (market capacity) at the regional level, it seems appropriate to analyze their level of influence on the formation and development of the market of private medical services at the meso-economic level.

At the same time, in order to assess these factors, it is necessary not only to assess their level of influence in the regional context, but also to assess each factor in correlation with other factors, dividing them into appropriate categories

- indicators characterizing the state of the healthcare industry at the meso-level;
- indicators of the socio-economic situation of the region;
- indicators of business attractiveness of the region for private medicine.

The above approach allowed not only to assess the factors influencing the potential for the formation and development of the private medical services market at the meso-economic level, but also to compare the level of this influence.

For this purpose, an expert method of evaluating the factors affecting the potential of the private healthcare services market has been utilized, wherein a rating has been assigned to various factors.

In accordance with the proposed methodology, the potential of formation and development of the market of private medical services will be formed on the basis of the sum of the weighting coefficients of the ranks of the corresponding methods of factors of influence on it...:

The obtained results clearly demonstrate the level of potential for the formation and development of the market of private medical services in the context of regions. Thus, the maximum score for the indicators of socio-economic status of the region is 0.248, for the indicators of business attractiveness of the region for private medicine - 0.565, in terms of indicators characterizing the state of the health sector at the meso-economic level - 0.187.

According to the results of comparing the potential of the private medical services market in a number of Russian regions, it was found that the highest potential for the formation and development of the private medical services market at the meso-economic level was found in Moscow, the Moscow region, St. Petersburg, the Republic of Tatarstan and the Republic of Bashkortostan [4-23].

There is a certain interest in assessing the relationship between the potential of the private medical services market and the volume of the market of paid medical services and the capacity of the market of commercial medicine, determined by

calculating the potential capacity taking into account forecast growth rates of the market of paid medicine for the period 2023 - 2025 [5]

The above analysis will give an idea about the impact of the regional private medical services market potential on its capacity.

Based on the results of the assessment of the relationship between the potential of the private medical services market in a number of Russian regions and its capacity by calculating the Pearson coefficient for the period from 2023 to 2025 on the basis of the data presented in Table 3, it was found that there is a direct noticeable (from 0.56 to 0.59) relationship between these indicators. Such a relationship indicates that the author's proposed integral numerical expression of a set of socio-economic and sectoral factors as a way to determine the potential of the regional market of private medical services can predict the rate of development and potential capacity of the market of private medical services in a particular region.

At the same time, evaluating the regional market of private medical services in the Kostroma region, it is necessary to emphasize the low indicators both in the presence of market development mechanisms and in its condition. In this regard, nowadays it is necessary to create a complex system of management of the regional market of private medical services on the territory of the region, including both standard subjects of the market and mechanisms of state support, as well as working bodies for monitoring and elaboration of new mechanisms for the development of market relations in the sphere of commercial medicine.

The analysis of the state, problems and trends in the development of the regional market of commercial medicine allowed us to formulate several generalizations:

- The author's interpretation of the concept of "potential of the regional market of private medical services" as an integral expression of a set of socio-economic and sectoral factors that determine the possibility of development and capacity of the HSMI market in a particular region.
- based on the systematization of theoretical, methodological and empirical data, 15 factors that comprehensively influence the development potential of the private medical services market at the meso-level, including the market capacity in different subjects of the Russian Federation, were identified and structured into 3 structural blocks: the state of the health care industry at the meso- economic level, the socio-economic situation of the region, the business attractiveness of the region for the development of commercial medicine.
- The method of assessing the potential of the commercial medicine market, which takes into account the importance of each specific factor, has been proposed and tested, on the basis of which an integrated rating of the potential of the private medical services market development has been calculated on the example of Russian regions, which determines its capacity and sets the direction of its improvement in each region.

- The assumption about the existence of interrelation between the potential of the private medical services market and the volume of the market of paid medical services and the capacity of the commercial medicine market, determined by calculating the potential capacity taking into account the forecast growth rates of the market of paid medicine for the period 2023 - 2025, was put forward, tested and proved.

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综合发展战略下缓解社会经济体系差距的途径

PATHWAYS TO MITIGATING DISPARITIES IN SOCIO-ECONOMIC SYSTEMS UNDER INTEGRATED DEVELOPMENT STRATEGIES

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摘要: 本文探讨了在数字化和向知识密集型经济转型过程中克服社会经济体系 (SES) 失衡的途径。作者分析了实施综合发展战略对经济安全构成的主要威胁, 包括数字化的双重效应、人力资本的异化以及区域差异。作者特别关注人力资本作为平衡SES的关键要素所发挥的作用, 以及根据技术变革改革其培训体系的必要性。研究提出了协调国家、区域和企业层面战略的措施, 包括定制再培训项目、建立区域集群以及实施风险监测系统。在批判性分析当代挑战的基础上, 提出了将经济安全措施与人力资本发展同步的建议。

关键词: 社会经济体系 (SES)、经济安全、失衡、经济数字化、人力资本、综合发展战略、区域差异、知识密集型经济、风险与威胁。

Abstract. *The article explores ways to overcome imbalances in the socio-economic system (SES) amid digitalization and the transition to a knowledge-intensive economy. The author analyzes key threats to economic security arising from the implementation of an integrated development strategy, including the dual effects of digitalization, the alienation of human capital, and regional disparities. Special attention is paid to the role of human capital as a key element in balancing the SES, as well as the need to reform its training system in line with technological changes. The study proposes measures to harmonize strategies at the national, regional, and corporate levels, including the customization of retraining programs, the establishment of regional clusters, and the implementation of risk monitoring systems. Based on a critical analysis of contemporary challenges, recommendations are formulated to synchronize economic security measures with human capital development.*

Keywords: *socio-economic system (SES), economic security, imbalance, digitalization of the economy, human capital, integrated development strategy, regional disparities, knowledge-intensive economy, risks and threats.*

Modern socio-economic systems (hereinafter referred to as SES) operate under conditions of high uncertainty, ambiguity, and complexity, which creates threats to their stability and provokes systemic imbalances. In the context of market economy transformation, digitalization, and the increasing knowledge intensity of processes, ensuring economic security has become a key state priority.

The relevance of this study stems from the need to develop an integrated strategy capable of neutralizing threats, reducing the likelihood of risk events, and minimizing SES imbalances, particularly in the context of digital transformation [3].

The purpose of this article is to identify ways to overcome SES imbalances by analyzing threats, methods of their mitigation, and defining the role of human capital in implementing an integrated development strategy.

The study employs system analysis to examine SES structure and imbalance factors, comparative analysis of economic security strategies at different levels (national, regional, micro-level), and content analysis of scientific publications and regulatory documents (including Russian Presidential Decree No. 208 of May 13, 2017).

The research is based on an analytical literature review, which highlights the following key issues:

- digitalization has a dual impact: while it enhances efficiency, it also leads to the alienation of human capital [1–8; 10, 12];
- a mismatch exists between technological advancement and human capital quality, reducing enterprise competitiveness [2, 9, 11, 14];
- there is an urgent need to reform workforce training systems for knowledge-intensive industries [5, 7, 14].

The analysis of regulatory frameworks – particularly Russia’s Economic Security Strategy until 2030 [11] – emphasizes that it sets the framework for integrating measures at all governance levels.

As noted, a key state function (both in Russia and abroad) remains ensuring the economic security of SES, encompassing all sectors of the national economy. Given Russia’s ongoing market economy transformation – requiring SES modernization, digitalization, and increased knowledge intensity [3] – it must account for new factors influencing economic security risks [2]. Thus, an integrated development strategy must be formulated and implemented, aimed at regulating, controlling, and stimulating economic growth in line with national objectives and economic security goals at all levels (national, regional, micro-level, individual).

However, implementing this strategy may not only neutralize new threats but also generate them, making risks more latent and introducing ambiguity – particularly in digitalization and the alienation of human capital from direct participation in production processes [2–7].

To overcome imbalances, specific strategic objectives must be considered, fostering a coherent integrated strategy for economic security that addresses SES imbalances amid the transition to a digital knowledge-based economy.

The foundation of this strategy lies in staging digitalization and enhancing knowledge intensity, based on the evolving needs of the economic structure. These changes require investments, technological upgrades, and innovations supported by adequate human capital. Human capital – possessing the necessary knowledge, skills, and competencies – is central to implementing this strategy and resolving SES imbalances through material balance equations.

Traditionally, economic security strategies are structured at three levels: national, regional, and local [11]. Accordingly, threat analysis, mitigation measures, and imbalance resolution must be addressed at all levels.

Currently, Russia is continuously refining its economic security strategies, seeking the most effective approaches to neutralize threats in dynamic conditions [2–8, 10, 13]. Human capital remains the unifying factor across disparate initiatives, necessitating reforms in its development.

However, shortcomings in workforce training hinder modernization, digitalization, and economic security, exacerbating SES imbalances—particularly the gap between technological advancement and human capital quality, undermining the competitiveness of Russian enterprises both globally and domestically.

A clear, coherent, and adaptive integrated strategy for mitigating SES imbalances in economic security will enhance human capital development and deployment. Such a strategy allows for regional customization, enabling localities to optimize workforce utilization based on SES-specific human capital availability.

Thus, it is undeniable that human capital is the cornerstone of SES material balance. Optimizing its use requires tailored training programs aligned with regional needs and synchronizing digitalization with workforce upskilling. Supporting data [12]:

- 48% of Russian enterprises face a shortage of digitally skilled workers;
- only 27% of employees undergo regular retraining.

Customized retraining programs (e.g., Germany’s dual education system, which reduced industrial skill gaps by 34% in 5 years) could mitigate workforce imbalances.

Further optimization requires a three-tier strategy model (national, regional, local), incorporating flexible digitalization scenarios adapted to industries and regions. Significant regional disparities exist – Moscow and St. Petersburg concentrate 68% of IT specialists [1], while 40% of Russian regions lack training centers for high-tech industries [9].

At the micro-level (enterprises), mechanisms to stimulate innovation, R&D, and real-time threat monitoring are essential (67% of Russian firms lack predictive risk analytics [14]).

An integrated SES development strategy must prioritize human capital and adaptive governance, harmonizing technological and workforce development while strengthening regional roles in strategy implementation.

Future research should assess the effectiveness of proposed measures under sanction pressures.

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北方地区农业工业综合体经济增长的一些特点
**SOME FEATURES OF ECONOMIC GROWTH OF THE AGRO-
INDUSTRIAL COMPLEX OF THE REGIONS OF THE NORTH**

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注释。提出了一种科学的方法来解决北方地区农业工业综合体经济增长特征这一紧迫问题。特别关注了农业工业综合体经济增长的来源和功能特征、部门和地域因素的优化组合、加速其领域和企业的社会经济转型进程。确定了为确保北方地区农业工业综合体经济的可持续增长，尤为重要是恢复农业工业领域与国家结构之间的有效联系，以获得国家的全面财政、经济和其他支持。揭示了农业工业综合体经济活动方式的不断改进演变了经济增长的概念。

关键词：经济增长、稳定性、投资、概念、模型、地域因素、生产力、资本集中度、集约化。

Annotation. *A scientific approach to solving urgent problems to identify the features of economic growth of the agro-industrial complex of the regions of the North is presented. Particular attention is paid to the sources and functional characteristics of the economic growth of the agro-industrial complex, the optimal combination of sectoral and territorial aspects, the acceleration of the processes of socio-economic transformation of its spheres and enterprises. It is determined that in order to ensure sustainable economic growth of the agro-industrial complex of the regions of the North, it is of particular importance to restore effective ties between the agro-industrial spheres and the state structure - to achieve comprehensive financial, economic and other support from the state. It is revealed that the regular improvement of the methods of conducting economic activities of the agro-industrial complex evolves the concept of economic growth.*

Keywords: *economic growth, stability, investment, concept, model, territorial aspects, productive forces, capital intensity, intensive.*

The problems of ensuring the economic growth of the agro-industrial complex of the regions of the North are the most important area of economic science and a priority task of agro-industrial policy. This is a reliable source for the development of theoretical and practical foundations of intersectoral management of the agro-industrial complex of these regions. The study shows that the existing variety of concepts and models (rates, forms, differences and similarities) of economic growth are based on peculiar regional features and their different functional characteristics. Based on the above statements, it should be noted that the economic growth of the agro-industrial complex of the regions of the North requires a more detailed analysis of economic activity using modern theories of the economic cycle, and most importantly, the study of the main technological chain “finance - science - production - market” in each specific type of activity.

Based on theoretical and practical considerations, the economic growth of the agro-industrial complex of the regions of the North is the result of a reasonably organized, steadily managed and effectively functioning inter-sectoral economy. Expansion of the scale of intensive investment activities of economic entities of the agro-industrial complex is a reliable guarantee of achieving an actively reproducing regime, renewal of production spheres. Stable economic growth of the agro-industrial complex of the regions of the North is possible only on the basis of periodic development and implementation of progressive principles, perfect mechanisms and the necessary conditions for real economic activity.

A reliable source of long-term economic growth of the agro-industrial complex of the regions of the North is the creation of such favorable conditions that can be provided with the right combination of sectoral and territorial aspects of various regional and intersectoral tasks. In fact, the economic growth of the agro-industrial complex of the regions of the North is closely related to the development of a long-term program of socio-economic, environmental, infrastructural, demographic and other transformation of their spheres and enterprises. Based on this, on behalf of the president of the country, the government updated the Strategy for the development of the agro-industrial complex until 2030. The need to revise the Strategy is caused, among other things, by qualitative changes in the external and internal conditions of functioning both in the economy as a whole and in the agro-industrial complex in particular [1, p. 7].

This category is closely related to the effective conduct of agro-industrial management both within the country and in its individual economic regions (regions, regions) and territorial-production complexes, as well as in specific (local) economic coordinates and production fragments. Therefore, the development of long-term comprehensive programs for the growth of agricultural production in the regions of the North involves a comprehensive analysis and assessment of the achieved level of their productive forces, the implementation of production

activities and meeting the needs of the population in the necessary volumes and quality of food.

The study shows that during the years of reform in the agro-industrial complex in the northern regions, a low level of investment in agricultural production has developed, the principles of steady growth of budget funds allocated for capital investments have been destroyed. The lack of intensive development of agriculture in the regions of the North ended not only with a sharp drop in production growth rates, but also with a reduction in the area of developed northern territories for the production of agricultural products. The imbalanced state of the territorial and production aspects of the agro-industrial complex of the regions of the North accelerated the processes of reducing the local population and labor resources, reducing the volume and range of local food and deteriorating its quality. The negative dynamics of financing agricultural production in the regions of the North was the main source of the decline in the rate of development of their productive forces, the destruction of integration ties, and the slowdown in the development of many industrial spheres and enterprises for the processing of agricultural raw materials.

With a decrease in the scale of production and a change in the territorial location of agriculture, there have been changes in the scale and structure of production in the processing industry, especially in the food industry. Consequently, the negative rates of functioning of agricultural production are closely related to the results of the influence of natural and climatic conditions and a number of other regional factors that often affect the processes of reproduction. This suggests that, taking into account many negative factors, there is a need to differentiate interest rates in the economy and change the taxation system of the agro-industrial complex as a whole [2, p. 78].

Harsh climatic conditions, including the presence of permafrost covering most of the territory of the northern regions, as well as a high degree of swampiness, have a significant impact on the capital intensity of production, on the timing and efficiency of the use of fixed production assets, on the rate and structure of spent working capital. Increased wear and tear of machinery and equipment, a relatively higher share of unproductive (for heating and heating) consumption of fuel, heat and electricity contribute to an increase in the cost of production results, an increase in prices for agri-food products.

The study determines that a significant impact on the growth of the economy of the agro-industrial complex of the regions of the North is exerted by such factors as: relatively low population density, territorial disunity of processing industry and agricultural facilities, the presence of a large number of isolated, low-power, and therefore economically inefficient cultural and household facilities, boiler houses, power plants, agricultural machinery repair shops, etc. The remoteness of

agricultural production from industrial cities and regions narrows the possibilities of organizing large agricultural enterprises that could have a high degree of integration. The failure to achieve a synergistic effect of the agro-industrial complex of the regions of the North does not make it possible to use the results of the latest achievements of scientific and technological progress in a timely manner.

Regional features of the functioning of the agro-industrial complex of the regions of the North indicate that when determining the main directions of their economic growth, it is necessary to develop a long-term economic policy for each region, taking into account their specific specifics and functional significance. It is this policy that is able to take into account the main parameters of economic growth in the agro-industrial complex of the regions of the North, determine their integration parameters and ensure the development of conditions for the sale of marketable products, and solve the problems of food security in the future.

A characteristic feature of the reproduction process of the agro-industrial complex of the regions of the North is that the increased tendency to increase the consumed resources does not correspond to the volume and quality of the gross and net products created. These ratios of a reproduction nature are due to the increased material intensity of production, the increased share of material values in the gross product. Naturally, the increase in costs per ruble of products is associated not only with the increase in the cost of the material values used, but also with the regional (northern) features of production, the upward trend in the physical volume of consumption of fixed and circulating assets, which indicates “expensive” and complex production.

Hence the conclusion: today it is necessary to take into account those features and trends in the growth of the economy of the agro-industrial complex of the regions of the North, which are characteristic of the modern development of their productive forces. The agro-industrial policy of the regions of the North should be aimed at accelerating the processes of capital accumulation, ensuring positive technological changes in the production sectors of the agro-industrial complex, which lead to sustainable economic growth. It is necessary to diversify the measures of state support, expressed in the formation of a toolkit of measures that allow taking into account the factors that determine the regional and sectoral specifics of agricultural production. This requires improving the mechanism for distributing the regulatory powers of the state between the federal and local levels of government [3, p. 44].

A relatively low level of economic development, the existing inter-sectoral structure and the distribution of productive forces of the agro-industrial complex of the regions of the North give grounds for the conclusion that it is necessary to strengthen the processes of formation of the production and territorial structure in the regional economic complexes. Increasing the intensity of scientific, production

and territorial developments makes it possible to identify potential opportunities for the development of a number of specialized new types of agricultural and processing enterprises. In the context of increased dynamism in the formation of inter-regional and intra-regional economic relations, improved inter-sectoral and intra-sectoral resource proportions, the need to optimize territorial-industrial complexes is of paramount importance.

Particular attention should be paid to eliminating disproportions between the potential for agricultural production and its processing. To eliminate the existing discrepancy, it is necessary to significantly accelerate the pace of financing the agro-industrial complex of the regions of the North, to ensure equal investment in their spheres and enterprises. In the future, it is necessary to ensure the growth of the agricultural economy due to intensive factors, and first of all, the transition to a new level of agricultural development, increasing labor productivity based on the use of the latest achievements of scientific and technological progress.

Of no small importance is the development of systems of progressive principles and forms of stimulating the economic activity of the agro-industrial complex of the regions of the North. This makes it possible to secure more land and labor resources in production, and mainly lands with improved fertility and highly qualified workers. It is important to improve the system of material and moral incentives: to establish additional payments and corresponding benefits for the regions of the North. This will strengthen the processes of using labor, land and capital resources, rationalize the structure of the agro-industrial complex of the regions of the North as a whole.

Suffice it to say that the further development of agricultural production in the regions of the North, the creation of their new sub-sectors and types of activity presupposes significant changes in the sectoral structure of the processing industry. In the future, in the sectoral structure of agriculture in the northern regions, a high share will belong to animal husbandry, especially the development of cattle, pig breeding, reindeer husbandry and poultry farming, and the smallest to crop production, including the production of fodder crops, perennial and annual grasses, vegetables and potatoes. It should be emphasized that the scale of development of the northern territories for the production of agri-food products should increase from year to year. Suffice it to say that the agro-industrial complex of Russia successfully resists Western sanctions and is the most important element of global food security, occupies a worthy place in the system of national and food security [4, p. 5671].

Judging by the existing features, the growing needs of the population for the necessary agri-food products, we note that the growth of the economy of the agro-industrial complex of the regions of the North is directly proportional to the upward trend in their investment. The analysis of the capital intensity of agricul-

tural production shows that if in many regions of the North the costs per ruble of production tend to grow actively, it is too early to talk about a positive growth rate of production. Almost 80% of agricultural organizations in the regions of the North have a decrease in the profitability of the production of manufactured and sold products, there is no necessary profit both in animal husbandry and in crop production. In general, with a low rate of investment, there is a drop in yield per hectare of cultivated land, a decrease in capital efficiency, and an increase in the cost of living and embodied labor.

Today, most regions of the North suffer from the destructuring of agricultural production: there is a significant decrease in the share of crop production in general economic activity. The most relative growth in production is observed in dairy cattle breeding, reindeer herding and pig breeding. The share in the food industry of the agro-industrial complex of the regions of the North, which operates at the expense of local agricultural raw materials, is also decreasing. The highest industrial specialization is observed in those regions that have traditionally been engaged in reindeer herding, fur farming, poultry farming and beekeeping.

The main reason for restraining the growth of the economy of the agro-industrial complex of the regions of the North is the periodic decrease in the share of capital investments in their spheres and enterprises. According to statistics, on average for 1995-2023, the share of investments in agriculture and the food industry from all investments in the economy of the regions of the North decreased from 12,0 and 2,1% to 0,4 and 0,3%, respectively, which was a decrease of 30,1 and 7,0 times. A paradoxical point is that with a downward trend in investments in fixed assets, there is an increase in the value of fixed production assets. The latter is closely related to the periodic revaluation of capital resources, the “artificial” increase in the value of fixed production assets in accordance with the growth of market prices. This method of revaluation contributes to an “artificial” increase in the amount of depreciation deductions at the standard operating rate of “old” machinery and equipment. This, in turn, leads to a decrease in labor productivity, a drop in the efficiency of exploited assets as a whole.

There are some factors that limit the growth of agricultural production. One of these factors is the following: a) uneven functioning of individual elements in the structure of the main technological cycle of production; b) discrepancy in time between the allocated financial resources and the acquired production resources (machinery, equipment, production technologies, etc.); c) slow pace of transition to a new level of development – restraining the processes of using industrial and intellectual components; d) poor development of production and social infrastructures; e) deterioration of the integration foundations between agriculture and the processing sector; f) lack of favorable conditions for transition and adaptation to interregional and foreign food markets; g) weakening of ties with state organiza-

tional, managerial and legal structures, as well as foreign financial markets; h) a significant decrease in the effectiveness of organizational and management mechanisms in specific types of activities of the agro-industrial complex.

It should be noted that the North is not homogeneous in terms of nature: the tundra zone differs sharply from the zone of forest-tundra and, especially, taiga; Stable permafrost in one of its areas has its own specifics in comparison with the “sluggish” permafrost of another area. There are local features that greatly affect the processes of functioning of agricultural production. From this point of view, the development of the northern territory for food production requires a special approach: taking into account specific natural and climatic conditions, determining the possibilities of inter-sectoral (integration) relations and conditions for participation in interregional and foreign markets. The analysis shows that for a long period of time in the sectoral institutes of the agro-industrial complex there were insufficient experimental and production bases that could substantiate and ensure the effectiveness of repair bases (workshops) of agricultural machinery and equipment, maintain the consistency of the necessary production infrastructures, implement environmental cleanliness, a set of recreational (restoration) measures in the northern regions.

A characteristic feature is that increasing the importance of the territorial aspect, improving integration processes, deepening specialization and increasing the concentration of production spheres of the agro-industrial complex of the regions of the North requires constant improvement of their management system. The implementation of a number of measures to improve management and eliminate many negative factors in management will make it possible to carry out intersectoral structural shifts in the agro-industrial complex of the regions of the North, to strengthen their integration interaction with other enterprises capable of achieving a synergistic effect. The law of synergy, as the theoretical basis of the structural determinant, determines the sources of economic growth in the agro-industrial complex by increasing the level of organization of its internal and external relations [5, p. 1129].

Summing up, it should be noted that the sustainable economic growth of the agro-industrial complex depends not only on territorial aspects and a rational combination of inter-sectoral interaction, but also on the increase in comprehensive requirements for periodic developments with more advanced systems and methods of managing the agro-industrial complex. Only a long-term program for the development of the agro-industrial complex of the regions of the North can ensure the optimization of territorial and production characteristics, accelerate the processes of transition to a new level of development of their spheres and enterprises. The above circumstances make it possible to ensure a large-scale organization of intersectoral integrations, to have large enterprises with an optimal structure and

high efficiency. The creation of new large agro-industrial enterprises, the rational combination of their sectoral and territorial principles in production management, as well as the widespread introduction of scientific and technological progress are important factors in the growth of the economy of the agro-industrial complex of the regions of the North.

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信息技术在企业经济犯罪侦查中的应用

THE APPLICATION OF INFORMATION TECHNOLOGY IN THE INVESTIGATION OF CORPORATE ECONOMIC CRIMES

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摘要：本文认为企业法证是打击企业经济犯罪最有效的方法。本文还对企业犯罪进行了分类，探讨了法证的主要阶段，并研究了现代认知信息技术在经济犯罪调查中的应用。

关键词：法证、经济犯罪、企业欺诈、信息技术、人工智能。

Abstract. *The article considers corporate forensic as the most effective method of combating economic crimes at the enterprise. The article also classifies corporate crimes, examines the main stages of forensic and studied modern cognitive information technologies used in the investigation of economic crimes.*

Keywords: *forensic, economic crimes, corporate fraud, information technology, artificial intelligence.*

Every company in the course of its financial and economic activities faces with corporate crimes. They can cause tangible and intangible damage and worsen the economic position of the company. The risks of committing economic crimes are inevitably increasing every year. According to the Global Economic Crime Survey 2024, conducted by the auditing organization PwC, the main types of economic crimes remain procurement crimes, cybercrimes and corruption [3].

Forensic is a set of measures to prevent economic crime, to investigation of crimes that have already been committed, and to prevent their recurrence in the future. Economic crimes can be committed against a specific organization, as well as against the State, private individuals and business entities of all forms of ownership.

In the case of a successful forensic procedure, the client receives a tangible benefit, rather than a conditional one, which is expressed in monetary terms. A positive outcome of forensic analysis is either the avoidance of financial losses through the timely prevention of an incident or the compensation for material and moral damages resulting from the investigation. In both cases, the harm caused is

compensated by assets that have value (property and finances). Even if the client incurs intangible losses (such as lost profits, reputational risks, or goodwill depreciation), financial claims are also made against the guilty party.

Usually forensic services are provided by audit organizations on a paid basis. However, investigations can also be carried out by the internal services of the organization if competent staff are available.

Let's take a closer look at corporate forensic. It is an investigation into crimes committed against a particular organisation.

This service includes: corporate intelligence (preventive measures against economic crimes at the enterprise), the investigation itself (assessment of damage caused, expert analytical procedures, and evidence collection), development of follow-up measures to prevent the recurrence of crimes, and assistance in obtaining compensation for damages incurred.

Corporate economic crimes can be classified as follows (Figure 1).

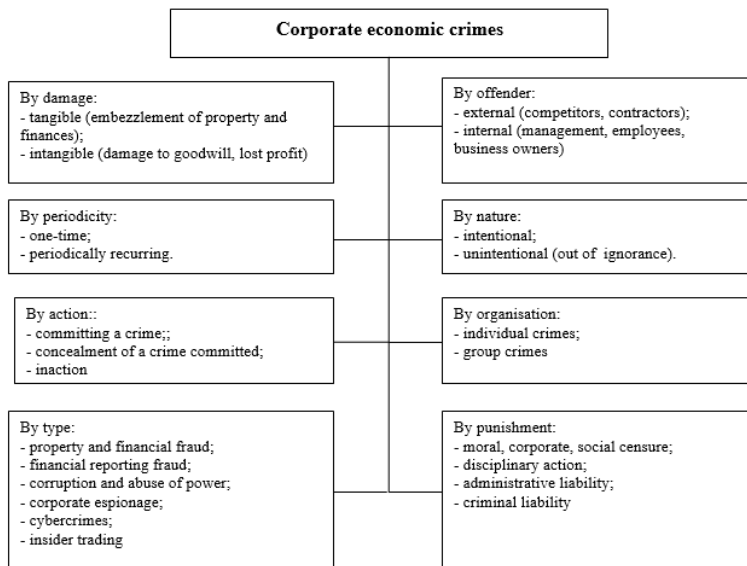


Figure 1. Classification of corporate economic crimes / developed by the author

In our opinion, the main areas of combating economic crimes at an enterprise are the following:

1. The management of the organization and business owners need to be sure that at every enterprise, regardless of its size and form of ownership, economic crimes de facto take place. This implies the need for corporate

intelligence, even if there are no obvious signs of planning or committing a crime. After all, as we know, it is better to prevent a crime than to investigate it.

2. If a crime has already been committed, it must be investigated, even if the damage to the enterprise is minor. This will increase the chances of preventing the recurrence of this crime in the future.
3. It is better to investigate economic crimes with the involvement of outside specialists. To do this, you need to contact an audit organization that provides forensic services. The undeniable advantages of this are as follows:
 - The objectivity and independence of outside experts and their impartiality in the investigation;
 - The absence of a conflict of interest that may arise between internal specialists conducting the investigation and the management of the organization in case of its involvement in a crime;
 - The capabilities and resources of the audit organization are much greater: it has a wider staff of specialists, the time for the investigation is limited only by the terms of the contract, and it uses innovative information technologies, including its own IT developments;
 - The interdisciplinarity of external forensic specialists compared to the limited competencies of the internal specialists of the firm. In audit organizations, a wide range of narrow specialists can be involved in forensic investigations, including auditors, economists, criminologists, psychologists, IT specialists, etc.

However, before turning to an audit organization for forensic services, a company must calculate the expected economic effect of these services and determine whether the incurred costs are economically justified, i.e., lower than the losses from the committed crime. [4].

In an era of global digitalization, forensic specialists use the latest cutting-edge technology in investigating economic crimes

Let's take a closer look at the main stages of the investigation and the cognitive information technologies used in it.

The first stage: determining the motive. Economic crimes may be committed because of personal grudges (revenge, envy, competition). However, the majority of economic crimes are committed for the illegal enrichment of one person at the expense of another.

To identify the motive behind an economic crime, it is necessary to determine the extent of the damage caused: whether it involved reputational or financial losses, a decrease in the firm's investment attractiveness, the leakage of insider information, or the theft of intellectual property. For instance, it is unlikely that business owners would intentionally contribute to a decrease in their investment attractiveness. Therefore, they can be excluded from the circle of suspects in the

investigation of investment crimes. Another example is that the company has suffered reputational damage. In this case, it can be assumed with a higher degree of probability that this occurred due to the competitors' actions.

The second stage: search for suspects. The precise determination of the motive of the crime helps narrow down the circle of suspects. They are usually individuals connected to the client through business or personal relationships. At the same time the existing as well as past relationships need to be taken into account. Modern information technologies, such as Big Data and artificial intelligence, allow for a thorough analysis of the customer's environment and the identification of anomalies and behavioral patterns in this environment. Thus, artificial intelligence can study and analyze the behavior of suspects on social networks and messengers and apps, determine their financial status and social standing, and identify hidden ties to the client. For example, a former partner, an unsuccessful investor, etc.

The largest Russian audit organizations utilize their own digital platforms to verify the reliability and affiliations of third parties (employees, contractors, managers) based on numerous risk indicators. These programs establish biographical facts, the presence of legal disputes, compliance violations that have led to directives from government regulators, and determine the likelihood of a conflict of interest. For example, the audit organization "Tekhnologii doveriya" evaluates the reliability of counterparties based on more than seventy risk indicators. [1].

The third stage: investigation. Modern information technologies enable the effective execution of various expert-analytical procedures (such as the search for suspicious operations and transactions, monitoring of suspicious network activity, document examination, and recovery of deleted information, among others). However, a necessary condition for the successful conduct of an investigation is the provision of full access to information by the client, including insider information. This task is simplified by the presence of a complete digital twin within the company. A digital twin is an accurate virtual copy of the firm, its identical digital counterpart, in which all ongoing processes can be tracked in real time, and it includes electronic document management and a digital archive. By analyzing this data, the program can identify all deviations and anomalies.

The fourth stage: formation of the evidence base. The most popular platform for collecting digital evidence, which is subsequently used in legal proceedings, is the eDiscovery system. This system filters and analyzes large volumes of data and then visualizes the results obtained. Digital evidence can include any electronic information obtained from cloud storage, databases, electronic media (including mobile phones), social networks and messengers, websites, emails, and other digital sources. [2].

The fifth stage: legal proceedings. Not all investigations of economic crimes result in legal proceedings, as bringing a case to court can cause significant reputa-

tional damage not only to the guilty party but also to the injured party. Therefore, in some cases, the parties reach a settlement. However, if the case does proceed to court, forensic specialists will provide the necessary legal support to the client and may act as independent experts during the legal proceedings if needed.

Thus, corporate forensic analysis is of strategic importance for the financial and economic activities of any organization. If an economic crime has been committed against a company, it is essential to investigate it, preferably with the involvement of external forensic specialists.

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物流系统中运输成本的形成与降低研究——以PJSC “Magnet” 为例
**STUDY OF FORMATION AND REDUCTION OF TRANSPORT
COSTS IN THE LOGISTICS SYSTEM - ON THE EXAMPLE OF
PJSC MAGNIT**

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摘要.文章通过理论分析与具体实例,揭示了零售企业物流系统中运输成本的发生机理,并针对俄罗斯最大的零售企业——马格尼特公司提出了基于技术现代化和管理优化的成本管理方案。研究显示,通过智能路线规划、激励措施改革和使用新能源技术,运输成本可降低12-15%。

关键词: 物流成本; 供应链管理; 供应链管理; 激励措施; 成本控制

Annotation. *Based on theoretical analysis and specific examples, the article reveals the mechanism of occurrence of transport costs in the logistics system of retail enterprises and proposes a cost management scheme based on technological modernization and optimization of management for the largest retail enterprise in Russia - the company “Magnet”. The study shows that transport costs can be reduced by 12-15% due to intelligent route planning, reform of the incentive system and the use of new energy technologies.*

Keywords: *Logistics costs; supply chain management; supply chain management; incentives; cost control.*

1. Theoretical foundations of logistics costs

Logistics costs, as a key element of enterprise operations, include multidimensional costs such as purchasing, inventory, transportation and management. Transportation costs account for 30-50% of the total logistics costs, which are mainly affected by distance (cost increase per 100 km by 8-12%), load (cost decrease by 5% with a 10% increase in the full load factor) and time interval (3-7% of costs

due to overtime penalties). According to INCOTERMS 2020 rules, the distribution of transportation responsibilities directly affects the cost structure, with the seller responsible for all costs up to the designated delivery point.

The optimization model shows that the Vehicle Routing Problem with Time Windows (VRPTW) algorithm is effective in reducing costs. The model reduces overall costs by 18-22% due to dynamic planning that balances vehicle load (≤ 20 tons), time constraints (± 30 minutes), and route length (optimal routes are 15-20% shorter).

2. Analysis of transportation costs in PJSC Magnit

Expenses from transportation of products amounted to 879 billion rubles.

A comparison of the rates of change in the absolute values of revenue and cost price indicates that cost price growth is outpacing revenue growth.

Table 2.2.1
Production Cost Structure in 2021

Cost items	billion rubles.	Specific gravity, %
- depreciation of fixed assets	26	3
- remuneration	272	31
- payroll accruals	44	5

Continuation of table 2.2.1

- fuel consumption	202	23
- operational repair of vehicles	149	17
- transport insurance	0	0
- maintenance of bus stations	97	11
- lease payments	35	4
- travel expenses	9	1
- building maintenance costs	26	3
-others	9	1
Total:	879	100

Source: Compiled by the author based on: Annual report of the Magnit chain of stores for 2021 [Electronic resource]. – Access mode: <https://www.magnit.com/ru/shareholders-and-investors/results-and-reports/#tabs-results-2021> (date of access 11/21/2022)

Other expenses for the reporting year amounted to 15.0 billion rubles.

Table 2.2.2*Structure of other expenses for 2021*

Type of operating expense	Amount (billion rubles)
Payment for services of credit institutions	7.46
Write-off of accounts receivable	0.98
Taxes and fees (property tax)	0.24
Others	0.41
Compensation for damages	1.43
Write-off of damage from fuel theft	4.48
Total:	15.0

Source: Compiled by the author based on: Annual report of the Magnit chain of stores for 2021 [Electronic resource]. – Access mode: <https://www.magnit.com/ru/shareholders-and-investors/results-and-reports/#tabs-results-2021> (date of access 11/21/2022)

Taking into account road transport, climatic and other operational factors is carried out using correction factors (allowances), regulated in the form of percentage increases or decreases in the initial value of the standard (their values are established by decision of the legal entity or individual entrepreneur operating the vehicle).

Operation of motor vehicles in winter, depending on the climatic regions of the country - from 5% to 20% (inclusive - and further in the text for all upper limit values of the coefficients).

Operation of motor vehicles on public roads (I, II and III categories) in mountainous areas, including cities, towns and suburban areas, at an altitude of: from 300 to 800 m - up to 5% (low mountains); from 801 to 2000 m - up to 10% (mid mountains); from 2001 to 3000 m - up to 15% (high mountains); over 3000 m - up to 20% (high mountains).

Operation of motor vehicles on public roads of categories I, II and III with a complex plan (outside cities and suburban areas), where on average per 1 km of road there are more than five curves (turns) with a radius of less than 40 m (or based on 100 km of road - about 500) - up to 10%, on public roads of categories IV and V - up to 30%.

When operating motor vehicles in populated areas with a population of: over 5 million people - up to 35%; from 1 to 5 million people - up to 25%; from 250 thousand to 1 million people - up to 15%; from 100 to 250 thousand people - up to 10%; up to 100 thousand people (in the presence of regulated intersections, traffic lights or other road signs) - up to 5%.

Operation of motor transport requiring frequent technological stops related to loading and unloading, boarding and disembarking passengers, including route

taxi buses, cargo-passenger and small-class trucks, pickup trucks, station wagons, etc., including transportation of food and small cargo, servicing mailboxes, cash collection, servicing pensioners, disabled people, the sick, etc. (with an average of more than one stop per 1 km of travel; stops at traffic lights, intersections and crossings are not taken into account) - up to 10%.

When vehicles are moving at a reduced average speed (when transporting non-standard, large-sized, heavy, dangerous goods, goods in glass and other similar goods, when moving in columns accompanied by vehicles with cover) in the range of 20 - 40 km/h - up to 15%, the same with an average speed below 20 km/h - up to 35%.

The main share of the rolling stock is made up of freight vehicles and special vehicles; passenger vehicles are predominantly passenger vehicles, the share of which decreases at the end of the analyzed period; the share of special vehicles and mechanisms increases. There is a reduction in the average fleet of vehicles with a significant increase in the share of technically sound vehicles at the end of the analyzed period.

At the same time, an increase in the technical readiness of rolling stock is observed for all types of motor transport: both for freight and special vehicles and mechanisms, as well as for passenger transport.

That is, we can talk about an increase in the working fleet of vehicles at the disposal of the enterprise. It should be noted that at the end of the analyzed period, the lowest degree of technical readiness pertains to special vehicles and mechanisms and passenger vehicles.

In the structure of the enterprise's operating time, the largest share is occupied by the productive operating time of vehicles. However, it should be noted that vehicles are idle for a significant amount of time; there is also an increase in the share of time spent on vehicle repairs, which is an unfavorable characteristic of the operation of the motor transport service.

There is an unfavorable trend of decreasing the intensity of vehicle fleet operation during one vehicle day of the enterprise's work, as evidenced by the reduction in the time spent by vehicles on duty. The dynamics of the average operating speed of the enterprise's vehicles is quite stable and is within 22.5-23.2 km/h.

The operation of the vehicle fleet is characterized by unstable dynamics of both the total mileage and the average daily mileage of the rolling stock. At the end of the analyzed period, a reduction in both the total and average daily mileage of the enterprise's vehicles is observed.

The analysis of the technical readiness coefficient showed that the degree of technical readiness of the fleet of rolling stock of a motor transport enterprise varies within 96-97%, which is a positive characteristic of the technical condition of vehicles and their suitability for operation.

The dynamics of the fleet utilization rate indicate that the degree of vehicle utilization is fairly stable and varies within the range of 63-65%.

At the same time, it can be said that the degree of exploitation of the fleet of vehicles is not fully realized, as there are additional time reserves, which at the end of the period amount to 36%.

Comparing the dynamics of the technical readiness coefficient and the fleet utilization coefficient, we can say that during the analyzed period, there was a downtime of technically sound vehicles.

Thus, in order to increase the productive operating time of the vehicle fleet (i.e. the time of cargo transportation), it is necessary to develop measures to reduce unproductive downtime and improve rolling stock repair methods, which helps to reduce the downtime of transport during repairs by reducing the time of repairs and improving the quality of repair work. That is, measures to improve the technical and operational performance of the rolling stock.

3. Measures to reduce transportation costs at PJSC Magnit

We propose to introduce into the activities of the enterprise under study a piecework direct system of payment for labor based on rates per ton and ton-kilometer.

It should be noted that the employment contract and the regulations on remuneration of PJSC Magnit may stipulate that when operating vehicles with loading in both directions, as well as when transporting returnable containers (boxes, trays, cans, containers) in the opposite direction, correction factors from 0.5 to 1.0 per ton-kilometers completed in the opposite direction may be applied to the rates for 1 tkm.

Below we will provide the calculation of the accrual of wages for the driver of PJSC Magnit at piece rates per ton and tkm.

Let's look at an example: a car driver (2nd class) works on a car with a lifting capacity of 3.5 tons.

According to the waybill and consignment notes, the driver transported 3.5 tons of cargo along the route and 2 tons of cargo in the opposite direction.

The driver's working time is 22 hours. The length of the route is 314 km, including 290 km on Group I roads with an estimated mileage of 50 km/h and 24 km on city roads with an estimated mileage of 25 km/h.

The driver is entitled to additional payment for combining the position of freight forwarder in the amount of 30% of the freight forwarder's tariff rate.

The salary established in PJSC Magnit is 17,000 rubles.

The wage system is piecework direct. The driver works with a summarized accounting of working time.

Let's calculate the driver's salary. Based on the average monthly calculated standard of working hours for the 1st quarter of 2022 for a 5-day work week -

151.2 hours - the driver's hourly wage rate for a 5-day work week will be 112 rubles/hour.

The driver's per-minute rate for a 5-day work week is 1.87 rubles/min.

Let us determine the piece rate (Pm) for the downtime during loading and unloading of 1 ton of cargo: the standard downtime for vans during manual loading and unloading of packed and unpackaged cargo with a vehicle load capacity of over 3 to 4 tons is 13.9 minutes per 1 ton.

Then the piece rate per 1 ton of loading and unloading (Pt) will be 26 rubles (1.87 rubles x 13.9 min).

Let's calculate piece rates for 1 tkm:

a) when driving in the city: $R_{tkm} = 1.87 \text{ rubles} \times 60 / (25 \text{ km/h} \times 3.5 \text{ t} \times 0.5) = 2.6 \text{ rubles};$

b) when driving outside the city on roads of group I: $R_{tkm} = 1.87 \text{ rubles} \times 60 / (50 \text{ km/h} \times 3.5 \text{ t} \times 0.5) = 1.3 \text{ rubles};$

The amount of piecework wages will be:

Total accrued at piece rates – 3581.27 rubles.

The salary for the preparatory and final time of 20 minutes and the pre-trip medical examination time of 5 minutes per shift will be 46.75 rubles (25 minutes x 1.87 rubles).

Additional payment for the 2nd qualification class in the amount of 10% of the tariff rate (salary) for the time worked as a driver - 246.4 rubles (112 rubles x 22 hours x 10% / 100%).

Let's calculate the additional payment for combining the position of freight forwarder in the amount of 30% of the freight forwarder's tariff rate.

The forwarder's salary is 15,000 rubles.

The hourly rate of the forwarder will be 99 rubles.

The additional payment will be 653.4 rubles (22 hours x 99 rubles x 30% / 100%). Total accrued wages – 21,528 rubles.

As noted above, the company's losses due to the lack of a material motivation system and, as a consequence, the ineffective work of drivers led to significant financial losses in 2021.

In conclusion, it should be noted that the motivation system will improve the quality of transportation of PJSC Magnit products and reduce the enterprise's transportation costs.

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法律规制的算法方法

ALGORITHMIC METHOD OF LEGAL REGULATION

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摘要：本文探讨了算法法律规制方法的问题，并探讨了算法方法的一些实际应用领域。分析了国外关于该主题的最新研究成果，并对算法方法在立法中的潜在应用提出了假设。作者运用了逻辑和辩证法。研究结果表明，向算法规制的转变是不可避免的，而且实际上已经开始。研究结果有望用于进一步的研究和教育领域。

关键词：算法、数字化、法律、命令式、手动、方法、可选、规制。

Abstract. *The paper examines the issue of algorithmic legal regulation method. Some practical areas of application of the algorithmic method are considered. The most advanced foreign works on this topic are analyzed. An assumption (hypothesis) is made about the possible application of the algorithmic method in lawmaking. The author used logical and dialectical methods. As a result of the study, it was established that the transition to algorithmic regulation is inevitable and has actually begun. The obtained results are proposed to be used for further research and in the educational sphere.*

Keywords: *algorithm, digital, law, imperative, manual, method, optional, regulation.*

Introduction. The method of legal regulation is the main feature of the branch of law, together with the subject of law. Methods of legal regulation are a set of techniques and methods by which public relations are influenced. Methods may vary depending on the goals, objectives and characteristics of the legislation in each specific country. In Russia, as a rule, methods are divided into imperative and optional. The imperative method assumes mandatory compliance with legal norms. The state establishes clear rules of conduct that are subject to strict observance. In this case, no deviations from the norm are allowed, and sanctions are provided for its violation. An example of such a method is criminal legislation regulating crimes and penalties. The optional method provides participants in legal

relations with more freedom in choosing their behavior. The norms of this method contain a framework within which the parties can independently regulate their obligations. This is typical for civil, family, and business law, where contracts and agreements between the parties are of central importance. Methods of legal regulation play a key role in ensuring law and order and justice in society. Each of the presented methods has its own characteristics and is applied depending on specific conditions and goals, which allows the state to effectively manage public relations.

1. However, due to the accelerated development of technologies and digitalization of society, it is necessary to adapt existing legal norms and develop new approaches and methods of legal regulation. Information and digital relations require: flexibility from legislation; interdisciplinary approach; cooperation between countries; new forms of dispute resolution; digital literacy of the parties and other aspects. Let's give some examples. Passenger service in public transport has changed. Now many vehicles are equipped with terminals for selling travel documents (tickets), and some already operate without selling tickets at all. How in the latter case will the passenger prove to the inspector that he purchased a ticket. In parallel, in the same ticketless option, payment for travel is made using a QR-code. Electronic queues in banks and hospitals initially functioned with the issuance of a paper ticket. Later, everyone switched to the option without issuing a ticket (the client must remember the queue number). In addition to the inconvenience, a lot of questions arise about how this queue is arranged. Who and how monitors the correctness of customer (consumer) accounting? How are payments recorded? All this is not obvious, but all this is controlled by algorithms, which are the basis of programs that control terminals (in transport and other institutions). We believe that traditional methods of legal regulation are useless to apply in these conditions. Alternatively, they should be adapted, i.e. undergo a deep transformation and supplementation with other new methods. Adaptation is possible under the condition of deep, detailed formalization of regulation. Conventionally speaking, all moves should be clearly spelled out. It is proposed to include the algorithmic method of legal regulation among the new methods of legal regulation. An algorithm, as a mathematical tool, is closely related to computer programs. The algorithmic method of legal regulation involves detailed formalization of the process of influencing public relations not only in the form of a text description. First of all, such a method assumes that all relations in the digital environment or in digital format should be divided into block diagrams. Each diagram should have an exit to a clear result and a control point. And only after this, the flow chart can be transferred for program compilation. Algorithms can be used to automate various stages of legal work, including document processing, contract analysis and claim drafting. This allows you to reduce the time spent on routine tasks and reduce the risk of errors. Algorithmic methods in law are approaches where legal processes and decisions

are systematized and structured using algorithms. These methods are used to automate legal actions, improve law enforcement and increase the efficiency of the legal profession.

2. Let's consider what international researchers say about Algorithmic regulation and method. Lawrence Lessig, the founder of the Creative Commons organization and the ideological inspirer of the free information movement, known as a fighter for changing copyright legislation, especially on the Internet. The author's main idea and warning can be designated as a transition from text-based regulation to code-based regulation [Lessig 1999]. The monograph, which has gone through two editions, is more popular (and available for downloading on information networks) in the second version (in the author's version Code version 2.0 [Lessig 2006]). The subject of legal regulation, as follows from many theoretical works, can be social relations. Accordingly, the algorithm, as part of another object, provided as the subject of regulated relations, can be an object of regulatory impact. Comparison of the algorithm with a computer program, as well as a means of information processing allows us to consider it as a certain program (or a component part of a program) for a computer. Mankind has discovered them, learned about them, described them and uses them. And the other part of algorithms is «“man-made”, the result of human activity (for example: processes in metallurgy, in the chemical industry), primarily in the field of information technology» [Skiena 2012]. This is a basic, in a sense, primitive approach. Probably, the classification will not be limited to this: there will be another variety of mixed-type algorithms relations and algorithms methods. Several practical ideas for the transition to level regulation were proposed by the authors under the leadership of Karen Yeung, Martin Lodge. As result they are recommend «using a four-layer model to think about regulation of AI. The foundational layer consists of existing liability, property, and contract law <...> second layer consists of corporate governance measures, <...> third layer consists of sector-specific regulation to deal with risks arising in particular AI use cases, for example in medical devices or bank trading platforms <...> last layer consists of a high-level monitoring body to watch for broader social harms that may emerge from AI-related applications, and ring alarm bells» [Yeung 2019 : 246]. In fact, the design and creation of algorithms is a very complex sphere. It can be probating also for the algorithms methods and for the algorithms methodics.

2.2. Mireille Hildebrandt is a legal scholar and philosopher, professor at the Free University Brussels, who has been studying the interpenetration of law and information technology for a long time. She directly formulates that she is «interested in what code-based law “does” in comparison with text-based law» [Hildebrandt 2020 : 68]. Another study that needs to be paid attention to is Digisprudence by Laurence Diver. The author himself notes as an example of the transition

to algorithmic regulation that «while we are considering theoretical models, some [of them] have already been implemented in New Zealand» [Diver. 2022: 241]. Then he gives a diagram of the parallel adoption of the law in the text document (*.pdf) and program code. At the same time Silvia Crafa, associate professor at the Italian University of Padua, presents some legal contracts in blocs-design view. She resumed, that «Using dedicated software to represent or enact legislation or regulation has the advantage of solving the inherent ambiguity of legal texts and enabling the automation of compliance with legal norms» [Crafa 2022 : 23]. In 2024 she presented the article «Algorithmic Thinking for Writing Laws: The Case of Italian Electoral Law» [Crafa 2024]. In that article: a logical algorithm for a legal situation based on the law; a mathematical formula that describes situational relationships; a description of all this using program code in the high-level programming language Python.

3. As a result, a transitional situation takes place. Rules and laws written in text are gradually replaced by program code. At present, the transition is illustrated by block diagrams. But in the future, perhaps, block diagrams will also become an anomaly. And laws will be written directly in program code. In this case, traditional methods of regulation are simply not applicable. Legislators will need to use methods similar, at present, to the methods used by programmers. These are sets of “tools” that we call algorithmic methods. They include such methods of influencing relations that lead to a pre-programmed result. Unlike the technological method, the algorithmic method is based on mathematical formulas and program code. The idea of an algorithmic method can currently be considered a hypothesis.

Conclusion. Traditional methods of legal regulation (imperative and optional) continue to be important instruments of legal regulation. However, in modern conditions, they need to be adapted and supplemented with new methods. Adaptation is possible provided that regulation is deeply and thoroughly formalized. It is proposed to include the algorithmic method of legal regulation among the new methods of legal regulation. An algorithm, as a mathematical tool, is closely related to computer programs. The algorithmic method of legal regulation involves detailed formalization of the process of influencing public relations not only in the form of a text description, but also in the form of block diagrams and program code. This proposal should be considered as a hypothesis. It is necessary to continue a comprehensive study of algorithmic regulation with the involvement of a wide range of specialists.

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航行危险: 马六甲海峡海盗活动的兴起

NAVIGATING DANGER: THE RISE OF PIRACY IN THE STRAITS OF MALACCA

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摘要: 马六甲海峡的海上犯罪问题严重危及海上安全和国际贸易, 国际贸易约占全球贸易的三分之一, 其中包括重要的能源供应。本文从机遇理论和全球化理论的视角审视马六甲海峡的海盗和海上恐怖主义, 并探究其持续存在的根本原因。本文对当代国际法律框架进行了批判性分析, 并提出了全面的预防性解决方案, 包括加强海上监测、制定先进的法律文书以及旨在维护区域稳定的高科技方法。本文呼吁开展区域合作并采用最佳管理实践, 以确保关键海上航线的安全, 并促进国际贸易的畅通无阻。

关键词: 海盗、海上恐怖主义、马六甲海峡、跨国安全威胁、东南亚。

Abstract. *The issue of maritime crime in the Strait of Malacca is a serious concern for maritime security and international trade, which accounts for approximately one-third of global commerce, including essential energy supplies. Piracy and maritime terrorism in the Strait are examined in this paper through the lenses of opportunity theory and globalization theory, and the root causes that contribute to their persistence are explored. This paper critiques contemporary international legal frameworks and proposes comprehensive preventative solutions, including strengthened maritime monitoring, advanced legal instruments, and high-technology approaches aimed at regional stability. The paper urges regional collaboration and the best management practices, to secure critical maritime lanes, and facilitate the unimpeded flow of international trade.*

Keywords: *maritime piracy, maritime terrorism, Strait of Malacca, transnational security threats, Southeast Asia.*

The Strait of Malacca, a critical global waterway, faces increasing vulnerability to criminal activities such as piracy, armed robbery, and maritime terrorism, which threaten both regional stability and international trade. This narrow passage, located between the Malay Peninsula and Sumatra, accommodates around 80,000 ship transits annually and is essential for transporting about one-third of the world's trade, including significant energy supplies [1.P.45]. Its strategic importance has made it a hotspot for criminal activities, necessitating enhanced maritime security measures [2.P. 67].

Piracy is thus defined by the United Nations Convention on the Law of the Sea (UNCLOS) as any act of violence or depredation contrary to international law for private purposes on the high seas [3.P.31]. Bueger and Edmunds highlight that piracy often thrives in areas with poor surveillance and law enforcement, with the Strait's geographical features creating ideal conditions for such crimes [4.P.3]. The lack of effective maritime governance further exacerbates security vulnerabilities.

Globalization has also increased opportunities for crime by facilitating the movement of goods and people, making the Strait an attractive target for criminal organizations [5.P.102]. Additionally, the rise of piracy as a tactic for terrorist groups, motivated by ideological and political goals, poses significant risks to global markets, particularly as vital commodities transit through these waters [6. P. 88].

The growing prevalence of piracy and maritime terrorism has heightened security concerns among coastal states, disrupting global shipping industries [7.P.45]. Given the evolving nature of these threats, a thorough review of international legal frameworks is essential to effectively address them [5.P.105]. Southeast Asia's extensive network of ports and vital shipping lanes makes it a key hub for international commerce. However, the region's heavy reliance on maritime trade also leaves it vulnerable to piracy and other criminal activities at sea [8.P.45].

The article's structure is the following: the first part separates piracy and maritime terrorism from one another, explaining their characteristics and reasons. The second part examines the current situation with these threats in Southeast Asian waters. The third part criticizes Article 101 of UNCLOS regarding its effectiveness in the fight against piracy and maritime terrorism [3.P.15]. Finally, the article offers recommendations on strengthening legal frameworks, regional cooperation, and enforcement mechanisms to counteract maritime security threats [5.P.106].

The 19th century piracy on the decline, re-emerged in the late 20th century as modern hijackings of aircraft and ships. Piracy under international law is acts of

violence for private purposes on the high seas. Piracy usually entails criminal attacks by boat-borne pirates on ships or coastal areas [9.P.45]. Mejia et al. [10.P.45] argue that piracy must be defined precisely as theft, which helps minimize legal ambiguity regarding sovereignty and jurisdiction.

Historically, piracy can be traced to the 14th century BCE when Sea Peoples attacked Aegean civilizations [11.P.15]. UNCLOS criminalizes piracy by legislating illegal acts conducted for private purposes on the high seas and differentiating them from “armed robbery against ships” within territorial waters [3.P.101]. UNCLOS regulations, like earlier conventions, have been acknowledged as customary international law [3. P. 1].

Throughout history, piracy has thrived in various regions. The Barbary States of North Africa, for instance, operated as pirate states from the 16th to the 18th century until suppressed by military campaigns in the early 19th century [7. P. 12]. Maritime terrorism, encompassing assaults on both civilian and military vessels, suffers from a lack of robust international regulations. This regulatory gap can be attributed, in part, to the perception that maritime terrorism was a lower priority compared to piracy during the 1990s [8. P. 92]. The Achille Lauro hijacking in 1985 was a defining moment that led the international community to implement the Suppression of Unlawful Acts Against the Safety of Maritime Navigation (SUA) Convention. The SUA Convention represents the first holistic international legal regime intended to address the risk of maritime terrorism. It established important procedures for the prevention and response to illegal acts endangering the safety of maritime navigation [7.P.150].

The relationship between piracy and terrorism became increasingly evident following significant events such as the hijacking of the Achille Lauro and the September 11 attacks. These incidents highlighted how maritime crime could intersect with terrorist activities, prompting a reevaluation of security measures in maritime environments [4.P.15]. In the late 20th century, piracy re-emerged in East and Southeast Asia and East Africa, often linked to organized crime and, at times, state complicity [8.P.30]. The Law of the Sea, primarily governed by UNCLOS, establishes a legal framework for maritime order, defining territorial waters and exclusive economic zones while allowing for innocent passage [3.P.18-22]. This framework is essential for maintaining international maritime security and promoting cooperation among states [8, P. 58].

Piracy is primarily driven by economic motivations, while terrorism is often rooted in political objectives. This distinction has led to the emergence of a piracy-terrorism spectrum, complicating security efforts in regions like the Strait of Malacca. The evolving nature of these threats necessitates a nuanced understanding of their interconnections, as both forms of crime can exploit similar environments and vulnerabilities [7.P.175]. Examples include incidents in 1992 when

there was a hijacking of the Malaysian-flagged cargo vessel MV Sinar Mas and in 2000 the assault on bulk carrier Seaspan, indicating such hotspots continue to pose risk [7.P.45].

Malacca piracy has been a source of challenge for sailors and ship owners traversing its 900 km (550 miles) sea lane for many years. Collective efforts by Thailand, Indonesia, Malaysia, and Singapore in recent times have improved maritime security, and reported instances of piracy have declined substantially [6.P.150]. The geography of the Strait, which is narrow and studded with islets, is hard to police and conducive to pirates' working conditions.

Under the International Maritime Bureau (IMB), pirate attacks declined for a third consecutive year in 2006, and attacks in the Strait dropped from 79 in 2005 to 50 in 2006 [18.P.10]. Notwithstanding these improvements, the area was responsible for 40% of piracy attacks worldwide in 2004 [6. P.152]. In October 2007, Indonesia was still the world's most vulnerable country to piracy, although the situation was better than in the preceding year [7. P.35]. The Malacca Strait is strategically significant to global trade as it sees the passage of more than 120,000 ships annually, which is roughly one-third of global maritime trade [8.P.64]. During 1995-2013, Southeast Asia accounted for 41% of the world's pirate attacks with considerable loss among seafarers [4. P.8].

In recent years, piracy incidents in Southeast Asia have declined sharply. In Q1 2022, the IMB recorded a total of 34 boarded vessels globally, with no crew kidnappings reported for the first time since 2010 [12.P. 15]. However, concerns remain, as the ReCAAP Information Sharing Centre reported 25 incidents in Asian waters in Q1 2023, primarily classified as armed robbery [13.P.2]. The Malacca Straits Patrol, established in response to high piracy rates in 2004, has been effective in reducing incidents, achieving a "close-to-zero incident level" by 2011 through enhanced regional cooperation and information sharing [4. P. 12].

Maritime criminality, including instances of piracy and maritime terrorism, pose serious threats in the Gulf of Aden, Gulf of Guinea, and Southeast Asia. These illegal practices disrupt shipping and commercial operations, with far-reaching economic implications, including added insurance charges that are later borne by consumers, as well as deterring foreign direct investment [7.P.45]. Such economic repercussions can further entrench poverty and instability in the affected areas [4.P.25]. International legal frameworks, such as the United Nations Convention on the Law of the Sea (UNCLOS) and the Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation (SUA), emphasize the imperative requirement for cooperative action on the part of the member states in the effective suppression of maritime crimes [3.P.12]. Existing legal regimes constitute a basis for the collaborative efforts of nations to suppress piracy and maritime terrorism, as well as to ensure the safety and security of maritime navigation [14.P.1].

The United Nations Convention on the Law of the Sea (UNCLOS) specifies in Article 101 that piracy is any criminal act carried out by means of force or intimidation on the high seas or in locations outside the jurisdiction of a state, for private gain of individuals using a privately owned ship or aircraft [3.P.70]. This legal precedent provides grounds through which acts of piracy can be dealt with and emphasizes the need for international cooperation in fight against such criminal acts. [3.P.19]. This definition includes a “two-ship” requirement, excluding acts of mutiny or internal hijacking from its scope. Anti-piracy efforts are often undermined by corruption and resource limitations in law enforcement, particularly in Southeast Asia, where officials may collude with pirates due to low salaries [6.P.158].

The ‘right of hot pursuit,’ as outlined in Article 111 of UNCLOS, allows a coastal state to pursue a foreign vessel violating its laws within its territorial waters, provided the pursuit is continuous [3.P.21]. This provision is crucial in regions like the Strait of Malacca, where pirates frequently evade capture by crossing into neighboring territorial waters, complicating enforcement and response efforts [4. P. 6].

These cooperative international efforts have resulted in the formation of several treaties and conventions, as well as regional agreements, with the lead being the United Nations Convention on the Law of the Sea (UNCLOS) and the Djibouti Code of Conduct [3.P.12]. These frameworks promote international cooperation to tackle maritime security challenges; however, enforcement remains a significant hurdle. Many nations lack adequate naval resources to effectively patrol vast maritime areas, and jurisdictional complexities often impede the prosecution of apprehended pirates and criminals. Without a cohesive approach and sufficient resources, effectively combating high-seas criminality remains a daunting challenge [15.P.50].

To respond effectively to threats posed by high-seas criminality capacity in regional maritime law enforcement must be developed. Training courses, intelligence-sharing mechanisms, and advanced surveillance technology can develop the ability of regional forces to respond more effectively to emerging threats. Regional security institutions are normally constrained by differing national priorities and the different capacities of member states [15.P.55].

The private sector also plays a vital role in enhancing maritime security. Shipping companies are increasingly adopting best management practices, such as deploying armed security personnel aboard vessels and utilizing technologies like Automatic Identification Systems (AIS) and satellite tracking to monitor ship movements and detect suspicious activities [4.P.15]. The involvement of international bodies, like the United Nations and the International Maritime Organization, can catalyze discussions, provide funding, and promote the sharing of technology to enhance regional maritime security capabilities [16.P.10].

A comprehensive strategy is required to effectively counter the piracy and maritime terrorism threats in the Strait of Malacca and Southeast Asia [17.P.22]. Strengthening maritime surveillance and patrols in the Strait and surrounding waters is vital to prevent and respond to incidents [15.P.65]. Regional countries can enhance cooperation by establishing joint patrols and information-sharing agreements [7.P.95]. Mechanisms like the Regional Cooperation Agreement on Combating Piracy and Armed Robbery (ReCAAP) can increase responsiveness and collaboration. International legal frameworks need to be reinforced in prosecuting the pirates and sea terrorists in order to advance the maritime security significantly [4.P.394]. An examination of the governing institutions and actions taken by organizations such as the International Maritime Organization (IMO) would promote legal coordination and operational effectiveness in piracy counteraction. All the efforts at modernizing have the potential for greater international coordination and the creation of a more streamlined legal system in tackling such challenges [4.P.42].

International shipping companies should adopt Best Management Practices (BMP) to effectively mitigate the risks associated with piracy. These practices include deploying armed security personnel aboard vessels, utilizing satellite tracking and Automatic Identification Systems (AIS) for real-time monitoring of movements, and providing crew training in emergency response procedures. Implementing such measures can significantly enhance safety and promote information sharing and coordination with the navies and police of neighboring countries in port and coastal security efforts [4.P.55]. Furthermore, developing robust cybersecurity measures is critical to protecting ship infrastructure from cyber threats associated with maritime terrorism. Regional cooperation among Southeast Asian nations is crucial for effectively addressing piracy in the Strait of Malacca. Initiatives such as the ASEAN Maritime Forum play a significant role in fostering dialogue, collaboration, and a unified approach to maritime security. By bringing together member states to share intelligence and best practices, these initiatives enhance collective efforts to combat piracy and ensure the safety of vital shipping lanes [4.P. 65].

International shipping companies should implement Best Management Practices (BMP) to mitigate piracy risks. This includes deploying armed security personnel on ships, utilizing satellite tracking and AIS for monitoring movements, and training crews in emergency response procedures [4.P.10]. The enforcement of comprehensive maritime security measures can have the potential to greatly enhance security and enable effective information sharing and coordination with the naval authorities and law enforcement agencies of neighboring countries on port and coastal security programs. By promoting cooperation among regional stakeholders, these measures can lead to a more unified response to maritime threats,

ultimately enhancing overall security in vulnerable areas [7.P.240]. Furthermore, developing robust cybersecurity measures is critical to protect ship infrastructure from cyber threats associated with maritime terrorism [8.P.50]. Regional cooperation among Southeast Asian countries is also essential for addressing piracy in the Strait of Malacca, with initiatives like the ASEAN Maritime Forum promoting dialogue, cooperation, and a unified approach to maritime security [15.P.70].

Maritime crime poses a substantial challenge not only in the Strait of Malacca but also on a global scale. This region, known for its strategic importance as a major shipping route, has been particularly affected by piracy, smuggling, and other illicit activities. The implications of maritime crime extend beyond immediate security threats, impacting international trade and regional stability [7.P.180]. There needs to be close collaboration among governments, regional bodies, and the private sector to secure major trade routes and enhance maritime safety. The root cause of this issue needs to be understood in order to put in place proactive preventive measures [7.P.130]. The Strait of Malacca is one of the globe's most important corridors for oil and commodity trade, making it a persistent target for piracy and maritime terrorism [7.P.75]. Given its strategic importance, these threats are likely to continue, particularly in light of emerging challenges such as geopolitical tensions. Therefore, ongoing vigilance and coordination among regional governments are essential for addressing these issues. By integrating modern technologies, enhancing information-sharing networks, and increasing naval deployments, regional authorities can effectively mitigate piracy and terrorism. As the maritime landscape evolves in an increasingly interconnected world, innovative and proactive strategies will be necessary to manage the complex nature of high seas crime. Only through coordinated global efforts can we significantly reduce these threats, protect international waters, and ensure the security of future generations.

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区域安全威胁: 东南亚有组织犯罪

REGIONAL SECURITY THREATS: ORGANIZED CRIME IN SOUTHEAST ASIA

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摘要: 有组织犯罪是全球冲突的主要驱动因素, 跨国犯罪对东南亚构成了复杂的挑战。这一问题涵盖贩毒、非法移民、恐怖主义、洗钱、跨国卖淫、海盗、武器走私、信用卡欺诈和腐败。过去十年, 东南亚已成为跨国犯罪网络的中心, 尤其来自中国的犯罪网络, 其活动范围涵盖正规和非正规经济部门。这些网络通常利用与当地精英的关系, 而这些精英通过赌场、度假村、酒店和经济特区 (SEZ) 等机构为其提供支持, 换取丰厚的利润。这些犯罪组织的壮大与治理不力和官员腐败密切相关, 从而形成了一个由强大网络组成的有害生态系统。要解决这些根深蒂固的体系, 需要地区政府和国际组织的合作。本文探讨了跨国犯罪组织对地区安全、经济稳定和治理的影响, 同时探讨了包括虚假网络广告在内的各种欺诈活动, 并评估了东南亚国家和国际机构打击这些犯罪的应对措施。

关键词: 国际有组织犯罪、东南亚、国际安全。

Abstract. *Organized crime is a major driver of conflict globally, with transnational crime posing a complex challenge in Southeast Asia. This issue encompasses drug trafficking, illegal migration, terrorism, money laundering, transnational prostitution, piracy, arms smuggling, credit card fraud, and corruption. In the last decade, Southeast Asia has emerged as a hub for transnational criminal networks, particularly from China, operating across both formal and informal economic sectors. These networks often exploit connections with local elites, who support them in exchange for lucrative opportunities, manifesting in structures like casinos, resorts, hotels, and Special Economic Zones (SEZs). The growth of these criminal organizations is linked to weak governance*

and corruption among officials, creating a toxic ecosystem of powerful networks. Addressing these entrenched systems requires collaboration between regional governments and international organizations. This paper examines the impact of transnational criminal organizations on regional security, economic stability, and governance, while exploring various fraudulent activities, including fake online advertisements, and evaluating the responses of Southeast Asian countries and international bodies to combat these crimes.

Keywords: *international organized crime, Southeast Asia, international security.*

Transnational organized crime (TOC) has been recognized by multiple international bodies as a serious threat to international as well as national security, destabilizing set frameworks and casting a shadow of skepticism over the efficiency of criminal justice systems. The United Nations Convention against Transnational Organized Crime (UNTOC), established in 2003, focuses on the ill effects of organized crime, having identified it as a serious danger to global security [1.P.1]. The convention seeks to promote international collaboration and enhance the legal mechanisms required to effectively fight TOC [1.P.5]. In Southeast Asia, TOC involves a variety of illicit activities, particularly drug trafficking, with Myanmar being a significant opium producer [2]. Prominent criminal groups, such as Chinese triads and Japanese yakuza, exploit corruption and weak governance to further their operations, destabilizing emerging democracies in the region [3]. The drug trade, particularly in the Golden Triangle, has surged, complicating law enforcement efforts as evidenced by the seizure of 190 tons of methamphetamine in 2023 [4]. Human trafficking and cybercrime have also emerged as pressing issues, necessitating comprehensive regional strategies (IOM). The Southeast Asian states are working together in addressing transnational crime using regional mechanisms such as the ASEAN Plan of Action to Combat Transnational Crime (APA-CTC). Challenges, however, persist, particularly in enforcement capability and interagency coordination [5.P.45]. Greater collaboration between Southeast Asian countries and engagement with South, West, and Central Asian organizations is critical to comprehend the complexities of TOC and to provide regional security.

Transnationalism theory, as defined by Joseph Nye and Robert Keohane in the early 1970s, reasserts how it is used within the field of international relations. Transnational activities entail “networks, associations, or interactions that cut across national borders, establishing thus linkages between individuals, groups, organizations, and communities that cross a number of nation-states.” [6.P.331]. Transnational crime exists at the intersection of crime and security, as outlined by the United Nations (UN), which defines it as “offenses whose inception, prevention, and/or direct or indirect effects involve more than one country.” This

definition distinguishes transnational crimes from international crimes, tried in international courts, and domestic crimes, contained within the territorial boundaries of a single nation-state. To be regarded as transnational, the crime should have entailed crossing boundaries or jurisdictions, highlighting its complex nature and the challenge it poses to law enforcers [7.P.15]. The UN has identified 18 categories of transnational crime, including significant offenses like drug trafficking, human trafficking, arms trafficking, money laundering, cybercrime, and organized crime [8.P.15]. Lesser offenses include smuggling, counterfeiting, environmental crimes, and piracy.

Transnational crimes pose a significant danger to national and international security systems. McFarlane and McLellan (2023) indicated that “transnational crime is now emerging as a serious threat in its own right to national and international security and stability [9. P .12]. This perspective underscores the growing recognition of transnational crime as a distinct challenge that not only undermines legal frameworks but also destabilizes economies and societies across borders. Addressing this issue requires coordinated efforts from nations to enhance security measures and foster international collaboration [9.P.45]. These crimes challenge governments, economies, and civil society. Money laundering and drug trafficking can threaten governmental authority, discredit financial institutions, and destabilize social stability by corrupting the rule of law and promoting violence. Societies with weak legal frameworks struggle to provide security and suffer economic and social harm. Vulnerability to transnational crime is particularly pronounced in weak states and open societies [10.P.78]. Addressing these pervasive threats requires comprehensive strategies that enhance institutional integrity, foster international cooperation, and promote the rule of law.

Transnational organized crime groups (OCGs) pose formidable challenges to law enforcement agencies worldwide due to their highly sophisticated operational capabilities and access to substantial financial, technological, and logistical resources [7.P.21]. The incorporation of information and digital technologies has further enhanced their ability to engage in transnational crime, enabling them to achieve their objectives with greater efficiency and reach across borders. This technological integration not only streamlines their operations but also complicates efforts to monitor and disrupt their activities [11.P.88]. Understanding the various organizational structures of OCGs can offer valuable insights into predicting their behavior, which may ultimately enhance law enforcement efforts to investigate and dismantle organized crime activities [12.P.210].

In analyzing the structure of transnational organized crime groups, a structural or network approach is beneficial. A report by the United Nations Office on Drugs and Crime (UNODC) in 2002 identified five distinct types of organized crime structures: standard hierarchy, regional hierarchy, mass hierarchy, major group,

and criminal network. These classifications highlight the diverse organizational forms that criminal enterprises can take, each with its own operational dynamics and implications for law enforcement efforts [13. P. 5]. This study examined organized crime groups (OCGs) from various regions, including Europe, the Americas, the Pacific (notably Australia), and Southeast Asia. Within Southeast Asia, the activities of Chinese and Japanese organized crime groups were particularly significant, often characterized by hierarchical structures that facilitate their operations and influence [14.P.150]. In this region, significant crime groups include the Chinese ‘black societies’ or triads, the Japanese Yakuza, and military-style ethnic groups involved in producing amphetamine-type stimulants (ATS) and opium in the Golden Triangle. The region’s enhanced infrastructure and free trade agreements have facilitated the movement of people and goods, creating new criminal opportunities for OCGs [15.P.22].

The resurgence of criminal gangs and the evolution of triads in the People’s Republic of China (PRC) have occurred against a backdrop of rapid modernization and globalization [16.P.62]. Triad operations have transitioned from traditional street crimes, such as extortion and drug dealing, to more corporatized activities, including trafficking, cybercrime, and financial fraud [17.P.145]. These operations have increasingly spread from regions like Hong Kong and Taiwan to the mainland, often facilitated by corruption among officials [18].

A significant challenge in combating these black societies in the PRC is the legal requirement to establish a formal organizational structure for criminal groups, compounded by the limited capacity of Public Security Bureau units and the absence of conspiracy laws akin to those in Hong Kong. Addressing organized crime and corruption in China necessitates clearer legal provisions, stricter enforcement of Chinese Communist Party disciplinary measures, and enhanced transparency in the oversight roles of CCP Political and Legal Committees [19.P. 88].

Their roots going back to the secret societies of Japan’s Tokugawa dynasty, the yakuza consists of over 20 crime syndicates with fingers deep in a wide variety of criminal ventures like drug trafficking, human trafficking, and corruption [20.P.78]. Recent analyses indicate that approximately 40% of small business loans in Japan are linked to yakuza connections, signaling a shift towards greater involvement in the legitimate economy [21. P. 112]. The annual revenue of these syndicates is estimated at around US\$45 billion, with their influence extending internationally, particularly through groups like the Yamaguchi-Gumi [22.P.940].

The ‘Golden Triangle’ region, where Myanmar, Thailand, Laos, and China intersect, remains a significant hub for narcotics trade, exacerbated by ethnic conflicts and lawlessness [23.P.204]. Various ethnic militias and splinter groups have exploited this environment for drug production and trafficking. While Myanmar, Cambodia, and Laos may not be the primary centers of regional fraud, they play

crucial roles in facilitating smuggling, forced labor, and sophisticated gambling operations tied to criminal networks [24. P .88]. Recent law enforcement actions by China against scam compounds along the Myanmar border have led to a displacement of trafficked individuals to neighboring regions, highlighting the ongoing challenges in addressing these complex criminal enterprises [25].

Southeast Asia has been notably affected by evolving crime patterns, influenced by socio-economic challenges, political instability, and geographical factors. Among the various criminal activities prevalent in the region, four sectors demand urgent attention. The most pressing issue is the illicit drug trade, primarily driven by opium production in the Golden Triangle, which encompasses Myanmar, Laos, and Thailand. Organized criminal groups, both local and transnational, are deeply involved in the cultivation, production, and distribution of drugs such as heroin and methamphetamine, significantly impacting public health. Challenges such as government corruption, inadequate political control in border areas, and insufficient regional cooperation hinder effective responses to these issues [24.P. 78].

The second critical area is human trafficking, which predominantly involves forced labor and sexual exploitation. Contributing factors include poverty, lack of education, and political instability, which render individuals particularly vulnerable to traffickers [26.P.102]. Arms trafficking constitutes the third sector of concern, fueled by ongoing regional conflicts and rising demand for weapons. This illicit trade exacerbates violence and instability, posing serious threats to national and regional security [27.P.45]. Finally, online gambling scams have emerged as a significant issue, with Southeast Asia becoming a hub for transnational criminal networks, particularly from China. These organizations exploit millions of victims worldwide through illegal online gambling platforms and sophisticated scams. By the end of 2023, estimates indicate that the annual value of funds stolen by these syndicates approached \$64 billion [28. P. 233].

Globalization has significantly transformed the landscape of organized crime, elevating it from a domestic issue to a transnational threat. This evolution is closely tied to concerns about the connections between organized crime and terrorism, as well as the instability associated with “failed” states. Consequently, there is an increasing necessity for multilateral law enforcement responses to bolster mutual legal assistance in addressing both long-standing issues like narcotics trafficking and emerging challenges such as cybercrime [23.P.204].

Just like the European Union and the Council of Europe, the Association of Southeast Asian Nations (ASEAN) has tried to coordinate action in addressing non-traditional security challenges, including transnational crime and counter-terrorism. This cooperation is meant to promote regional stability and security through the promotion of collaboration among member states in tackling these

emerging challenges [29]. However, unlike its European counterparts, ASEAN has yet to implement significant institutional reforms or integrate cross-border policing efforts effectively [23.P. 206]. The perceived lack of decisive action on critical issues such as maritime piracy, drug trafficking, and terrorism has drawn criticism regarding ASEAN's progress in addressing these non-traditional security challenges [30.P.23].

Within ASEAN, initiatives such as appointing police liaison officers to consular posts, establishing 24/7 contact points for senior officers, and enhancing protection for judicial and law enforcement personnel have become standard practices. The effectiveness of these measures varies significantly across Southeast Asia due to differences in legal frameworks, resources, and political will. To tackle these disparities, regional policymakers are focusing on improving information-sharing mechanisms, conducting joint law enforcement operations, and strengthening mutual legal assistance agreements [31]. However, since the mid-1990s, the 'securitization' of transnational crime within ASEAN has made it more challenging to develop effective cooperative policing arrangements and has hindered meaningful dialogue among member states [23.P. 208].

Since then, ASEAN has made strides in establishing multilateral frameworks to enhance law enforcement cooperation among its member states and to engage more closely with the ASEAN + 3 (China, South Korea, and Japan) and ASEAN + 6 (which includes South Korea, Australia, and New Zealand) groups. Interpol, founded in 1923, now comprises 176 member states, facilitating international police cooperation. In response to the growing challenges of transnational crime, the European Union took a significant step in 1999 by establishing Europol. This organization was created to foster collaboration among member states, helping them work together to combat crime that knows no borders. Earlier, in 1989, the G7 nations recognized the alarming rise of money laundering and came together to form the Financial Action Task Force (FATF), demonstrating their commitment to tackling this serious issue. Building on these efforts, the Lyon Group was established in 1995 to further enhance international cooperation against transnational crime [32.P.5]. Additionally, the United Nations has established several bodies focused on crime prevention, including the UN Commission on Crime Prevention and Criminal Justice, which plays a crucial role in promoting effective crime prevention strategies and improving criminal justice systems worldwide [32. P.5]. The United Nations has played a pivotal role in addressing global drug trafficking and related offenses through the introduction of key international conventions. [32.P.10].

International collaboration is vital for addressing serious crimes effectively, and organizations like Interpol and the United Nations Office on Drugs and Crime (UNODC) play a crucial role in this effort. By working together, countries can

share information, resources, and best practices, creating a united front against criminal activities that cross borders [33.P.10]. A major milestone in the global fight against organized crime was the adoption and ratification of the United Nations Convention against Transnational Organized Crime (UNTOC) in 2000 and in September 2003, the convention had gained the assent of 135 states, including all of the major nations of Asia except for the noteworthy exception of North Korea [33.P.5]. Notable progress has been made in combating human trafficking, one of the eight recognized areas of transnational crime [34.P.12]. Although an additional protocol on human trafficking and smuggling was adopted, fewer countries have ratified the protocol on firearms smuggling. ASEAN has advanced its efforts by developing a regional convention on trafficking in persons, and the Bali Process aims to address people smuggling as a significant cross-border crime [23.P.210]. The ASEAN Chiefs of Police (ASEANPOL), an organization facilitating law enforcement cooperation among Southeast Asian nations, held its 32nd conference in Myanmar in May 2012 [35].

Transnational organized crime undermines the stability, security, and economic development of Southeast Asia through its wide-ranging illegal operations. Criminal networks engage in diverse activities such as drug and arms smuggling, human trafficking, and financial fraud, creating complex challenges for the region [7.P.45]. These activities not only jeopardize public safety but also undermine governance and contribute to the erosion of trust in institutions, fostering corruption among officials [36]. The lack of effective bilateral and regional law enforcement cooperation further facilitates the proliferation of these crimes. To combat this issue, it is essential to strengthen police reforms, build functional judicial systems, and implement anti-corruption measures similar to those in Hong Kong and Singapore [37.P. 32].

Southeast Asia's complex socio-political landscape, characterized by persistent poverty, governance challenges, and uneven law enforcement capacity, provides fertile ground for transnational criminal networks to operate [38]. Addressing the transnational nature of these criminal networks requires a coordinated strategy that spans national jurisdictions. Regional collaboration, particularly through ASEAN frameworks and support from international organizations, is crucial for crafting effective responses to organized crime [39.P.70]. Engaging local communities and increasing public awareness are essential for building resilience against organized crime. Local populations play a critical role in preventing and reporting illicit activities, as their involvement can significantly enhance the effectiveness of law enforcement efforts and community safety initiatives [40. P. 67].

A holistic strategy integrating social development, rule of law reforms, and regional cooperation is essential for effectively combating transnational crime in Southeast Asia [41]. Ultimately, addressing organized crime in Southeast Asia re-

quires persistent cooperation among governments, civil society, and international partners. Regional countries should also leverage advanced technologies to identify and mitigate threats proactively. By addressing the root causes of organized crime and implementing effective countermeasures, Southeast Asian nations can work toward a more secure and prosperous future, free from the pervasive influence of organized criminal enterprises.

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中学美术教育的现代化与变革：审美能力、创新思维与信息技术的多维重构
**MODERNIZATION AND TRANSFORMATION OF SECONDARY
SCHOOL ART EDUCATION: A MULTIDIMENSIONAL
RECONSTRUCTION OF AESTHETIC COMPETENCE, CREATIVE
THINKING AND INFORMATION TECHNOLOGY**

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摘要. 自1978年我国改革开放以来,中学美术教育逐渐发展起来,但由于受传统教育观念的影响,仍存在一些不适合素质教育的地方,表现在实践中过于注重美术专业的知识技能,以及学科取向,在一定程度上脱离了学生的生活经验,忽视了学生的审美能力,导致学生对美术学习缺乏兴趣。这是美术学习兴趣缺失的原因。本文通过历史梳理和实证数据分析,揭示了传统教学模式的局限性,提出了基于核心素养框架的改革路径。研究强调,美术教育的本质是培养“完整的人”,美术教育的现代化不仅是个人成长的需要,也是国家文化战略的重要组成部分。

关键词: 艺术教育; 核心素养; 创新与创造; 教育现代化数字化教学

Abstract. Since China's reform and opening up in 1978, art education in secondary schools has gradually developed, but due to the influence of traditional education concepts, there are still some unsuitable places for quality education, which are manifested in the practice of paying too much attention to the knowledge and skills of art majors, as well as academic orientations, which to a certain extent are detached from the students' life experience and neglect the students' aesthetic ability, which leads to a lack of students' interest in art learning. This is the reason for the lack of interest in art learning. Through historical sorting and empirical data analysis, this paper reveals the limitations of the traditional teaching mode and proposes a reform path based on the core literacy framework. The study stresses that the essence of art education is to cultivate "complete human beings", and that its modernization is not only a personal growth requirement but also an important part of the national cultural strategy.

Keywords: art education, core literacy, innovation and creativity, modernization of education digital teaching and learning.

I. From Skill Development to Aesthetic Ability: Changes in the Objectives of Secondary School Art Education

The biggest difference between art education and other subjects is that evaluation is more subjective and there is no fixed standard for creation. Nowadays, China's secondary art education is facing some major problems, among which is the over-emphasis on professional skills training, which is more prominent. In the traditional classroom, the mode of "teacher demonstration-student imitation-skill scoring" is commonly used, and the accuracy of shape drawing is taken as the main scoring criterion. Under the influence of this factory-like teaching method, students' works show highly similar characteristics. According to a survey conducted by the China Academy of Art in 2021, the stylistic similarity of students' works in classes using traditional imitation teaching was as high as 63%, and they generally lacked their own aesthetic expression. Artist Jiang Xun has criticized, "When art education becomes a mechanical reproduction of skills, it loses its most important nurturing function - the cultivation of aesthetic ability, which is not only a way of understanding the world but also the key to personal spiritual growth."^[2]

The system of aesthetic education in China's schools began with the drawing and painting classes set up in 1904 under the Constitution of the Zuoding Academy, and developed significantly during the Republic of China period. 1912, the School System Order set "cultivating a sense of aesthetics" as the goal of art education for the first time, and the National School of Fine Arts began to offer ink and wash sketching classes and to train the students' drawing skills and aesthetic ability through the contents of "sketching of bird and flower figures," "sketching of mountains and landscapes", etc. In 1940, the revised Secondary School Art Curriculum Standards added the content of "appreciation of Chinese and foreign art masterpieces" on the basis of skills training. In 1940, the revised "Secondary School Art Curriculum Standards" added the content of "Appreciation of Chinese and Foreign Art Masterpieces" on the basis of skills training, and secondary schools began to require systematic study of outstanding works of different eras; in 1948, the "University Art Curriculum Standards" put forward the teaching principle of "Inspiring Wisdom through Aesthetic Education," which formed the educational framework of combining skills training and aesthetic cultivation. These historical experiences provide a reference for the new curriculum reform in the 21st century, and it can be concluded from the study of the improvement of the two versions of the high school art curriculum standards in 2003 and 2017, especially the five core qualities of "image recognition, artistic expression, aesthetic judgement, creative practice, and cultural understanding" put forward in the 2017 version, which breaks through the traditional problem of "focusing on skills but not on qualities".^[3] The five core qualities point out that the purpose is to change the traditional trend of "emphasizing skills over nurturing". Because art education is not only a simple skill but more importantly, it is to cultivate a person's cogni-

tive and aesthetic ability, students should feel the enhancement of artistic cultivation when learning to paint.

II. Stimulating Creativity: How Art Education Shapes Innovative Thinking

Innovation is the soul of a nation's progress, and nurturing innovative talents is the core of art education. The famous futurist John Naisbitt emphasized that "in the era of booming information economy, innovation is the most valuable resource". His philosophy of education echoes the Chinese educator Tao Xingzhi's assertion that "education does not directly create material things, but it can enlighten children's innovative thinking", and that art education is recognized by the international community in the 21st century as an important means of fostering creativity, with unique advantages in the training of visual and imaginative thinking in particular.^[5]

At the Asia Art Education Development Forum, the Chinese Ministry of Education released key data: Beijing has formed a sizeable cluster of innovative companies, and Shanghai is on track to grow from 36 to 60 innovative companies, although these companies in innovative industries are still in their infancy, nurturing innovative talent is extremely important as a key component in developing innovative industries and building an innovative nation. The arts are also a key area of innovation. Art is also an integral part of innovative fields such as cartoons and films, and art education has a unique role to play in fostering innovative talent, as Professor Qian Chuxi of East China Normal University highlights in his book, *Building 21st Century Innovation with Art Education*: "Art education is a key vehicle for fostering innovative thinking,"^[1] and "Art education is a key vehicle for fostering innovative thinking. This point of view has been widely recognized in the education sector. Since the 1980s, under the guidance of the policy of the Ministry of Education of China, China's art education system has gradually built up a system of cultivating innovative practices, and since entering the new century, innovative education has become the core issue of global education reform.

The following are three major ways to implement innovative education in secondary school art programs:

1) Multi-dimensional teaching activates learning interests. Taking the Chinese Folk Art course as an example, a three-dimensional teaching model is constructed: "Technique Teaching - Cultural Perception - Emotional Resonance", and teachers enhance students' innovative literacy through progressive teaching design.^[4]

2) Reform and update the teaching material system. The development of exploratory curriculum resources, the construction of a knowledge transfer system, guiding students to use their previous experience to actively construct new knowledge.

3) Teaching model innovation. Build an open classroom ecology, adopt project-based and inquiry-based teaching methods, establish teacher-student co-creation mechanisms, and stimulate students' independent inquiry ability.

III. Technology Enabling: Information Technology Changing Art Education

Artificial intelligence and big data are now transforming art education. The report of the Central Academy of Fine Arts 2023 points out that the teaching efficiency of classes using online and offline teaching together is 40% higher than that of traditional classrooms, and the degree of satisfaction of students' personalized learning needs is 58% higher, which shows that the rational use of information technology can rapidly improve the teaching classroom and so on. Specifically, the impact of information technology has three points:

Multimedia technology allows for a richer way of perceiving art. For example, by using information technology to dynamically display “Qingming Riverside Drawing”, students can clearly see the details of the clothing patterns of the characters in the Song Dynasty, and the teacher can also simulate the sounds of the marketplace hawking at that time so that the students can visualize the painting in an immersive way. Digital tools can change the creative process. Procreate can be used in art teaching, allowing students to draw and colour in separate layers, withdraw any mistakes, and add special effects to make ink drawings glow, which allows for greater creative freedom. 2023 surveys showed that 92% of students who used digital tools felt ‘not afraid to make mistakes’ and were more confident in trying new styles.^[6] Intelligent systems can improve the assessment of teaching and learning. For example, using an AI assessment system can automatically check the line weight and shading ratio of sketches, and directly mark the places that need to be modified, students can instantly see the feedback, without having to wait for a week for the teacher to correct it, which greatly improves the efficiency of assessment, so that students can get timely feedback.

Information technology in education has also changed the role of teachers. Experts have developed the concept of the “dual teacher”, which means that a teacher must be able to teach drawing and painting as well as use computer technology. This is why the Ministry of Education launched the “Information Technology Training for Art Teachers” in 2020.^[7] Schools are now using information technology to teach drawing and painting. Schools are now using technology to solve many old problems. In rural schools, where there is a shortage of art teachers, city teachers can teach five classes at once via live webcasts, and students in remote areas can learn sketching and coloring. Students don't need to bring drawing paper to hand in their homework, they can upload their electronic work directly, and teachers can correct it with their mobile phones. These changes have made art classes more convenient and better suited to the habits of modern students.

However, it is important to note that technology is only a tool and cannot replace the role of the teacher. Ai can teach students to draw straight lines and mix colors, but they need face-to-face guidance from the teacher on how to match the

colors beautifully, how to express their ideas, etc. Therefore, a good art education should be “technology plus teacher”, the two together to help students grow.

Conclusion

The modernization of secondary school art education is essentially an improvement of the traditional education model, with the help of cultivating the aesthetic ability to reshape students' values, relying on innovative practices to stimulate students' creativity and expanding teaching methods by means of information technology, all of which are geared towards the fundamental goal of art education - cultivating modern human beings with an aesthetic vision, creative ability and cultural identity, all these three aspects are moving towards the fundamental goal of art education - to cultivate modern human beings with aesthetic vision, creative ability, and cultural identity. When educators really understand the truth that “art education is not to cultivate painters but to create complete human beings”, the curriculum reform will change from the updating of the method to the sublimation of the educational concept. Against the backdrop of the synergistic development of traditional culture and the digital age, such reform is a matter of personal growth and a strategic need to enhance the country's cultural strength and build an innovative society.

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运用创新技术教授母语：保护口头传统

THE USE OF INNOVATIVE TECHNOLOGIES IN TEACHING THE NATIVE LANGUAGE: PRESERVING THE ORAL TRADITION

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摘要：在创新技术快速发展以及文化全球化进程的背景下，保护口头传统已成为当今的重要任务。科研人员致力于研究现代技术，这些技术不仅有助于母语的保存，也有助于母语的传播。作者详细研究了各种数字工具，这些工具为使用和传播传统歌曲（包括故事和录音）提供了机会。本文探讨了一些旨在复兴口头传统的有效项目案例，并探讨了社会群体在年轻一代中推广母语过程中的重要性。不仅关注与母语人士的互动，还关注数字化框架下创新技术的运用。研究结果指出，将创新技术与课程和文化活动相结合至关重要，这在现阶段有助于母语的整体保护和

关键词：语言、母语、传统、语境、创新、文化、数字化形式。

Abstract. In the context of the rapid development of innovative technologies, as well as the processes of globalization of cultural processes, in order to preserve oral traditions, important tasks are presented today. Scientific research is devoted

to the study of modern technologies that contribute not only to the preservation, but also to the transmission of the native language. The author examines in detail various digital tools that provide an opportunity to use and distribute traditional songs, including tales, audio recordings. The article examines examples of effective projects aimed at reviving the oral tradition, including the importance of social communities in the process of popularizing the native language among the younger generation. Much attention is paid not only to interaction with native speakers, but also with innovative technologies within the framework of digitalization. The results of the study note the importance of adapting innovative technologies to curricula, as well as cultural initiatives, which at this stage contributes to both the preservation and development of the native language as a whole.

Keywords: *language, native language, traditions, context, innovation, culture, digital format.*

Introduction. Today, cultural traditions are an important part of the cultural heritage of many peoples, which include not only folklore, but also myths, legends with songs and various formats of oral folklore, passed down from the older generation to the younger [2-3].

“From the day of birth, a person hears the sounds of his future native language. Language introduces him to the world around him, imposing on him a vision, a picture that was “drawn” in front of him and without him. At the same time, through language, a person gets an idea of the world and society, of which he has become a part, its culture, system of values, morality, behavior, etc. Each national language not only reflects, but also forms the national character of a representative of the people - a native speaker, and forms him as a person, playing a constructive role in the formation of the national character”[8, p. 246]. In the context of globalization and the progress of innovative technologies, it is important to develop innovative approaches to the process of preservation, including the transmission of the native language. Innovative technologies open up a relevant opportunity to preserve oral traditions, providing an opportunity not only to preserve linguistic heritage, but also cultural affiliation [3].

The purpose of the scientific work is to study the influence of innovative technologies on the process of transmitting oral traditions, as well as preserving the native language, to identify successful digital tools, including online platforms that facilitate dissemination, and also help to study the interaction between traditional native speakers, including with modern technologies for the process of forming practices for preserving cultural heritage.

The materials of the study are scientific publications on the topic, modern technologies in the transmission of the native language, as well as Internet resources

with didactic materials, digital content (considered using the example of materials for preserving oral traditions).

Research methods include the analysis of current online resources, as well as those that store audio recordings of oral traditions, including national folklore, it is possible to determine the methods of the language preservation process, including transmission methods. Monitoring of native speakers provides a relevant opportunity for a deeper understanding of the native language. Contextual analysis provides an opportunity to determine how innovative technologies contribute to the popularization of oral traditions, as well as the dissemination of the native language in general. Research into the stages of the use of information technologies for the preservation of the native language in different communities can provide relevant methodological recommendations [5].

In addition, new technologies play an important role in the process of documentation, as well as the dissemination of oral tradition in general, provide an opportunity not only to record, but also to preserve oral folklore, making it open to the target audience in the process.

Also, recording oral folklore using audiovisual technology provides an opportunity not only to preserve the sound of the native language, but also intonation, including emotional coloring, which seems necessary for languages that are endangered today.

Audio recordings are a valuable resource for the study of rare languages in general. The development of digital archives that contain audio recordings of the native language provides scientists with an opportunity to gain open access to special materials. For example, archives that include the well-known Endangered Languages Archive (ELAR) project, which collects and stores audio recordings of endangered languages today [6].

Educational technologies, including contribute to the process of preserving the native language through interactive platforms, as well as mobile applications at the present stage.

Online platforms, such as courses provide open access to a course of study of different languages, these courses can consist of components of oral tradition [10], such as storytelling in the native language or singing songs also in the native language. Various applications, such as Duolingo for learning foreign languages, can be implemented for the process of learning native languages, which can include components of oral tradition, offering a relevant opportunity for users and the general public to explore folklore, as well as national songs [4].

It is worth emphasizing that social communities play a key role in the process of supporting the native language [1], as well as in the process of its dissemination among the younger generation.

Internet sites, such as YouTube, provide a relevant opportunity for users not only to share videos with oral traditions, but also to form a new type of interaction with cultural heritage in the process, attracting young people at the present stage.

Forming an online community with native speakers helps not only to exchange knowledge, but also to exchange practices. These groups can talk about various events in the virtual space, where participants can exchange not only their knowledge of traditions, but also tell stories with subsequent discussion.

Despite the advantages of innovative technologies, there are also disadvantages. For example, it is important to note that not everyone has open access to modern technologies, which at this stage leads to inequality in the process of preserving the native language [7].

It seems important to take this fact into account in the process of developing initiatives to preserve oral tradition in general. In addition, today there is a risk of commercialization, including when culture is a commodity, leading to a loss of identity, as well as a distortion of the textual content of the work (originality).

Let's consider effective examples

Example 1. An application for mobile devices for learning the native language, which provides an opportunity for a wide audience to take courses in an interactive mode through game modeling, performing various exercises and tasks and listening to audio materials [9].

Example two. The use of smartphones, as well as digital tools, makes it possible to record stories in the native language, etc. These recordings can not only be saved, but also distributed via the Internet.

Example 3. The development of podcasts to support the oral tradition provides relevant opportunities for disseminating information to users, including the opportunity to develop listening skills in the process of learning the native language. Example 4. Also, the development of games that use the native language provides the younger generation with an opportunity to study the language in an interesting interactive format. The examples discussed above in the future can not only contribute to the preservation of the native language, but also provide an opportunity to use the native language at the present stage.

“Today, when television and some printed media openly promote immorality, cruelty, violence, the most effective, powerful weapon against lack of spirituality and cruelty is the native language and national culture. Only those who have enriched themselves with the spiritual and moral values of their people are able to resist the evil and violence of the modern world. Now it is undeniable that the use of the native language is the main condition for the preservation and transmission of national culture, its features, since many components of this culture (oral folklore, folk songs, national literature, theater) exist due to its functioning” [8, p. 246].

Findings

Today, innovative technologies play an important role in the process of preserving oral traditions, as well as in the process of transmitting these traditions. The digital platform provides an opportunity for a wide audience not only to study their native language, but also to maintain knowledge of their native language in general.

Online courses, as well as mobile applications, contribute to more effective learning, including maintaining the level of interest and motivation for the native language among the younger generation.

The development of digital archives provides an opportunity to preserve the native language for the younger generation in the future. It seems important to take into account the impact of the globalization process, which today threatens these languages. In general, innovative technologies open up new opportunities for active interaction not only with the language, but also for the preservation process at the present stage.

Conclusion

Thus, innovative technologies today provide a powerful mechanism for the process of preserving the native language, as well as for the further transmission of oral tradition. Digital technologies and learning platforms, as well as social communities can help preserve this heritage for the younger generation in the future. It is also important to consider the current threats that are interconnected with open access to innovative technologies, as well as the general commercialization of content (cultural). It is necessary to jointly ensure support for the native language at the present stage, as well as the oral tradition in general.

Further research

Prospects for further research emphasize the importance of studying mobile applications that can help in the process of preserving the native language, as well as help the younger generation study oral traditions.

In addition, it seems possible to conduct research on the use of media space for dissemination, as well as for the preservation of oral tradition, which at this stage includes the development of content taking into account the specifics of the native language. It is important to analyze modern digital archives to identify effective practices, as well as their development and further application.

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跨民族、跨文化、跨种族关系话语中的宽容（古代雅利安国家的历史经验）

**TOLERANCE IN THE DISCOURSE OF INTERETHNIC,
INTERCULTURAL AND INTERETHNIC RELATIONS
(HISTORICAL EXPERIENCE OF ANCIENT ARYAN STATES)**

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注释。本文提供了关于宽容在跨文化关系、民族与宗教代表之间以及在解决国际问题中的重要性各种信息。雅利安国家的历史经验直接证明了宽容理念在国家结构以及信奉不同宗教和习俗的不同民族代表之间的跨文化关系中发挥着有效作用。

本文作者认为，宽容在历史上一直是不同民族和国家团结的一个因素，而在当今世界，宽容具有普遍性，被评价为国际关系经验中的积极现象，并被认为是不同文化、民族和宗教人士之间关系的必要条件。

结论是，宽容是对代表不同民族、宗教和文化的人类代表的尊重，是现代文明生存和发展的必要条件。

关键词：宽容、人类、文化、共存、历史、东方、西方、社会、古代雅利安国家、宗教。阿契美尼德王朝、居鲁士宣言、宽容思想的理论基础、文化层面、历史。

Annotation. *The article provides a variety of information about the importance of tolerance in intercultural relations, between nations and representatives of different religions, as well as about tolerant relations in solving international problems. The historical experience of Aryan statehood is a direct proof that the idea of tolerance plays an effective role in the state structure and intercultural relations between representatives of different peoples who professed different religions and customs.*

According to the authors of the article, tolerance throughout history has been a factor in the unification of different peoples and nations, and today, in the modern world, it is universal in nature, is assessed as a positive phenomenon in

the experience of international relations and is considered a necessary condition for relationships between people of different cultures, ethnic groups and religions.

It is concluded that tolerance, as respect for representatives of the human race, representing different ethnic groups, religions and cultures, is an essential condition for the survival and development of modern civilization.

Keywords: *tolerance, man, culture, tolerance, coexistence, history, East, West, society, ancient Aryan states, religion. Achaemenids, Declarations of Cyrus, theoretical foundations of the ideas of tolerance, cultural aspects, history.*

The phenomenon of “tolerance” in modern philosophy has been intensively developed since the mid-90s of the 20th century. In philosophical literature, the category of “tolerance” is considered as multidisciplinary, i.e. in several aspects. If in the Western historical-philosophical school its representatives rely on traditional views on tolerance, which originate from ancient times, then in Eastern philosophical thought the concept of “tolerance” in the meaning of “forbearance” was touched upon back in the era of Zoroastrianism. And this approach persisted until the Age of Enlightenment.

Recently, scientists-philosophers, political scientists, sociologists have begun to pay much more attention to the problem of tolerance than before. At the same time, of course, it cannot be said that it was not considered by famous thinkers of the past, both in the East and in the West. What is common to both the West and the East is that, firstly, the concept of “tolerance” conveys the essence of tolerance and implies sacrifice, empathy, compassion; secondly, tolerance acts as a moral category and forms the basis of morality; thirdly, the principle of a tolerant attitude towards others is expressed through the doctrine of love for one’s neighbor, common to all religions.

In social relations, the principles of harmony and mutual understanding of subjects, tolerance have always played a very important role. In turn, the problem tolerance, its specificity depended on those conditions, on that level of cultural development that were inherent in society at one or another stage of its evolution. It should be noted that in the past, the religious form of manifestation of tolerance was especially important. Thus, in Khorasan and Maverannahr, thanks to the tolerant culture, many religions and beliefs peacefully coexisted - Islam, Christianity, Buddhism, Zoroastrianism, etc.

Khorasan and Maverannahr were located at the crossroads of major trade routes. Accordingly, the cultural and civilizational exchange in this region was very active. The Great Silk Road united peoples, and the ideas of tolerance, of course, could not fail to receive a response in those societies that had formed by this time in Central Asia.

Meanwhile, the development of the Great Silk Road was highly dependent on the geopolitical rivalry of different countries for control over it and other caravan routes. For their successful functioning, political stability was necessary, which was even more important because the Silk Road passed through many countries – from China to the Mediterranean. Stability could be achieved either by creating a huge empire that controlled all the most important Eurasian caravan routes, or by “dividing the world” between large regional powers that could ensure the safety of trade. The collection of duties from merchant caravans brought high income to the rulers of the Asian states along which the caravan routes ran. Therefore, they sought, on the one hand, to ensure the safety of merchants, and on the other, to establish control over as large a section of the route as possible. Civil wars and the decline of central power led to the devastation of cities, nodal points on trade routes, and the plunder of caravans. As a result, the functioning of the Great Silk Road could not only be disrupted, but cease altogether. Therefore, tolerance as an important factor of peace acquired the status of an important cultural value in this vast space.

An analysis of the philosophical and religious-philosophical heritage of the Tajiks shows that their humanistic ideas have always been closely linked to the idea of tolerance. This is confirmed by written monuments, treatises of philosophers, theologians, works of poets and writers. As a spiritual value, tolerance was used in the practice of political, religious, scientific, and cultural life to resolve various conflicts that arise in society. Moreover, tolerance as such was based on respect for the culture, traditions, and customs of other peoples, on the desire to understand them and accept them as a given.

The territories inhabited by Tajiks have been repeatedly attacked by foreign invaders throughout history. In the first half of the 1st millennium BC, the Tajiks were part of Bactria and Sogdiana, and in the 6th – 4th centuries BC – part of the Achaemenid state, and at the beginning of the 4th century BC, Central Asia was conquered by Alexander the Great (336-323 BC). Thus, in the middle of the 3rd century BC, part of the lands of historical Tajikistan were part of the Greco-Bactrian Kingdom, in the 1st century AD – part of the Kushan Kingdom, in the 5th century – part of the Hephthalite Kingdom, and then these were the territories of the Sassanids and the Turkic Khaganate [3, p.193-235].

This historical situation, of course, had a great influence on all spheres of life of the Tajik people and the peoples historically living next to them. Therefore, we can clearly trace in the culture of the Tajiks many elements borrowed from the peoples of China, India, Greece, Rome, Byzantium and other peoples. In turn, the culture had its impact on its close neighbors.

First of all, it is necessary to point out that the ideas of tolerance were the basis of the political ideology of the ancient Iranians. Their “first shoots” appeared al-

ready during the formation of the first Iranian-speaking states of Mesopotamia in the 3rd millennium BC, and in the 6th century BC, with the creation of the Achaemenid Empire, ruling the world, the Iranian-speaking peoples were able to unite more than 20 countries and 70 peoples in one state, who not only relied on their historical traditions, but also widely used and creatively developed the experience and achievements of neighboring countries. They managed to form a highly developed and effective system of governing the empire, and the Achaemenids were able to create quite favorable living conditions for their multinational subjects.

The experience and achievements of the Achaemenids in governing a multinational state are relevant for the modern world, where there are many multinational, federal countries. The Tajik people and their culture have been open to the entire world since ancient times. In all historical periods, Tajiks actively interacted with other peoples, and there could be no talk of any isolation.

The Achaemenid Empire included the states of Sogd, Bactria, Khorezm in Central Asia, Elam, and Media. The high culture of the peoples living there contributed to the flourishing of the region during the Hellenistic period. "The Achaemenids came to power at a time when the ancient states of the East were in the process of disintegration. The Central Asian dynasties of Aryan origin of that time were just beginning to actively assert themselves, declaring their power and flourishing in all spheres of life. The Achaemenids, who based their state structure on human intellect and the justice of the Zoroastrian religion, not only asserted themselves, but also worked miracles in the field of law enforcement and state building. In fact, they became the legal successors of the ancient states of the East. It is interesting that they, like many newly emerged empires of the East, did not take the path of destruction and collapse of former values, but on the contrary, sought ways to preserve and spread them in other underdeveloped regions." [5, p.54]

The Achaemenids practically became a bridge for the exchange of cultures and civilizations of the ancient peoples of the East and created a confederation of states of Aryan origin. Strict state governance, a developed system of road communications, free movement along internationally protected roads, a powerful and disciplined army, an improved communication system comprehensively contributed to the development of this state. There are several reasons for such a lightning-fast development of the young Aryan state.

Here we must take into account both the objective factors of the collapse of ancient states, and the subjective ones - the personalities and determination of the rulers who played a special role in the creation of their empire. At the same time, we note that each of the Achaemenid rulers showed himself to be a unique political leader and bearer of supreme power.

Among them, Cyrus the Great (559-530 BC) and Darius (550-486 BC) occupy a special place. These kings were not only unrivaled among the great rulers of their

era. The surviving inscriptions and orders of the Achaemenid kings not only reveal the essence of their rule, they confirm in the best possible way the justice of the ideas and aspirations of this dynasty.

“Zoroastrianism in its simplified early form influenced Judaism and became the forerunner of the mysterious beliefs of the Romans and of Christianity itself.” [7] In the history of the ancient states of the world, it is difficult to find a state that did so much for peace, cooperation, the well-being of peoples and the flourishing of small principalities, cities and entire civilizations as the Achaemenid.

We also observe the manifestation of tolerance in the field of architecture, in the architecture of fire temples, sanctuaries, and other public and private buildings. In Sogd, Ustrushana, and Bactria in ancient times and up until the Arab conquest, along with fire temples, the main Zoroastrian sanctuaries, there were temples of Zoroastrian gods with their statues, i.e., temples of idols [4, p.138]. Abureihan Beruni in “Monuments of Past Generations” writes about how the Sogdians spend significant days in the fire temple in the village of Ramush. [2, p.258]

The tolerance of the Tajik people is especially clearly demonstrated in their mass events, permeated with humanism and universal joy, in connection with which the holidays of the Tajiks quickly become close to other nations - neighbors, representatives of other cultures and civilizations. Such unique phenomena are Navruz, Sada, Mehrgon, Tirgon and others, among which the holiday of Navruz has a special meaning. During its celebration, the most important ethical and moral values - universality and common culture, polyethnicity - are clearly manifested. This holiday reflects the principles of relations between the peoples of Ancient Iran recorded in the Declaration of Cyrus. The Declaration proclaimed liberation from violence and oppression - both political and religious. Cyrus managed to unite different peoples and religions within the borders of his state, not by force, but on the principles of equality, tolerance, respect for the ethnic and religious feelings of people. As we can see, the main leitmotif of the Cyrus Declaration is the idea of tolerance, forbearance and freedom of religion, or, in modern language, freedom of conscience.

Cyrus recorded in his Declaration that he conquered Babylon without “a single shot” and bloodshed. He was shocked by the internal state of the city, the state of its holy places, and his first order was to proclaim freedom of religion. He called for non-oppression and tolerance of non-believers, which won the hearts of the city’s inhabitants by showing nobility, tolerance, and respect for their traditions and customs. “When I entered Babylon without a battle and in peace,” he wrote in his message, “all the people greeted me with joy. In the palace of the rulers of Babylon, I ascended the royal throne. Marduk, the supreme God, disposed the noble hearts of the inhabitants of Babylon in my direction, since I treated them with respect and reverence. My countless army entered Babylon without wars and

concussions. I did not allow any disaster or oppression to happen to the city and this land.”[1, p.286-287]

Inspired by the rights and freedoms set out in the Declaration, the priests of the 53 churches of Babylon opened the doors of their temples, freeing themselves from the authority of the chief priest of the temple of Esagila, Hasbu-Bel-Usur: “I have ordered that, beginning with Babylon, Ashur, Shusha and Akkad and all the lands located beyond the Tigris, erected since ancient times and in which the temples were closed and destroyed, should be opened and restored. All the gods of these temples I have returned to their places and installed on solid foundations so that they could permanently reside there”; “I gathered all the inhabitants of this region and rebuilt their houses that were destroyed, and returned them to them anew. The gods of Sumer and Akkad, whom Nabanid brought to Babylon, I returned without damage to their palaces, which were called “Joy of the Heart”. I gave peace and quiet to all the people.” [1, p.287].

Cyrus’ message encouraged the Jews to return to their homeland after 50 years of exile. There they built the Temple and began to profess the religion of their ancestors - Judaism. Cyrus’ plans for the social transformation of his empire on the principles of tolerance, mercy and justice were of historical significance. He can be called the “savior of the peoples” who lived in the vastness of his empire at that time, for he contributed to the return of their lands and faith, their own identity, language, traditions, customs and culture.

The Persian kings highly respected the traditions of their ancestors, this was part of the aristocracy’s prescriptions, so the traditions of Cyrus were continued by other Persian kings - Darius and Artaxerxes. Firdausi writes about this in his *Shahnameh*: respect for people, adherence to justice and truth is a sign of the purity of the family and the Shah’s blood.

«Агар шоъро шоъ будї падар,
Ба сар барниъоди маро тоъи зар.
Агар модари шоъ бону будї,
Маро симу зар то ба зону будї...»,
«Агар шоъ бодонишу фаррухпай аст,
Хирад бегумон посбони вай аст.» [8,p.144]

If the padishah had a padishah father,
He would have put a crown on my head.
If a maiden became the mother of a padishah,
He would cover me with jewelry up to my knees.
If the padishah is knowledgeable and blessed,
Only wisdom protects him.

Based on the historical experience of ancient Aryan states in development cultures and civilizations of the ancient peoples of the East, we can conclude that features of the formation of the idea of tolerance in the historical, philosophical and cultural aspects gives grounds to assert that the characteristic features of the development of this idea in the philosophical heritage of the past are calls for the integration of cultures and ethnic groups, cooperation between cultures, ethnic groups and religions, social communities and groups.

Thus, an examination of the theoretical foundations of the ideas of tolerance in Tajik-Persian philosophical thought allows us to conclude that most often tolerance, considered in the historical and philosophical aspect, is defined as a specific moral activity of a person aimed at the practical implementation of moral requirements emanating from God, society and the person himself.

In modern philosophical and cultural literature, tolerance is considered as a way to achieve harmony in both nature and society. When affirming tolerance, it is necessary to observe sense of proportion. Tolerance is interpreted as the most important and general in all ethical doctrines, is considered as an integral part of humanism, as justice, love and devotion, as an important quality of a virtuous person. The nature of man as a social being forces him to be tolerant. In the modern cultural studies space, tolerance, while preserving the aforementioned foundations as a necessary component of humanism, is nevertheless criticized for its excessive passivity, when indifference and neutrality are often interpreted as tolerance.

Tolerance in the ethical concepts of the cultural past was not formalized in a theoretical philosophical form, but was presented within the framework of philosophy in relation to man to man. It was expressed as tolerance for another's way of life, customs, views, beliefs and social origin. Tolerance is derived from other values such as humanism, freedom, respect, justice, integrity and interpersonal recognition and acceptance, but is not reducible to them, since it has a number of autonomous purposes and uniqueness.

The basis of tolerance is the ability of a person to perceive another person (or people in general) without hostility, despite the fact that the latter's opinion differs from his own, as does his behavior, appearance, language, faith, etc.

The events that are taking place in the modern world indicate that the establishment of tolerant principles in the sphere of interfaith and interethnic relations is a rather complex problem, with its own history and its own specifics. Today, many nations and ethnic groups have to take steps for their stable development, preservation and protection of their language, their cultural values and traditions.

Based on this the concept of tolerance is increasingly acquiring a universal, all-human significance, and today international practice defines it as a necessary condition for the relationship of people of different cultures, ethnic and interfaith groups. We believe that tolerance as a philosophical category means the mani-

festation of a sense of patience towards those subjects who have opposing views, ideological attitudes, differences in theoretical calculations, religious and political views. Moreover, tolerance is the ability to suppress an aggressive, hateful, irreconcilable attitude towards one's opponent, to search for peaceful ways to remove contradictions that lead to conflict.

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儒家哲学中的人与社会（概念类型学层面）
**MAN AND SOCIETY IN THE PHILOSOPHY OF CONFUCIANISM
(CONCEPTUAL-TYOLOGICAL ASPECT)**

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注释：本研究旨在厘清儒家哲学基本概念之间的概念和类型学关联，以此作为个体与社会互动的客观基础。作者从逻辑认知话语的角度，对儒家思想的主要美德进行了描述。研究已确定，个体与社会环境关系的认知类型学范式取决于决定该范式的概念体系。本研究的结论将为中国哲学概念学的发展提供一些有前景的进一步研究方向。

关键词：个体、社会、儒家哲学、辩证法、类型学、概念。

Annotation. *The aim of the study is to identify the conceptual and typological connection of the basic concepts of Confucian philosophy as objective basis of interaction between individual and society. In the aspect of logical-cognitive discourse, the author characterizes the main virtues in Confucianism. It has been established that the cognitive-typological paradigm of the relationship between the individual and the social environment depends on the system of concepts that determine it. The conclusions of the study are specified in promising areas of further research related to the development of philosophical conceptology in China.*

Keywords: *individual, society, Confucian philosophy, dialectics, typology, conceptual.*

In the long history of ancient Chinese culture and ideology, Confucianism occupies a primary place, the founder of which was the great thinker, the first Chinese philosopher Confucius (551-479 BC). His teachings made a serious contribution to the development of the methodology of the philosophy of science, the substantiation of socio-ethical, psychological-pedagogical, cultural-historical approaches that motivate the relationship between individual and society

The origins of Confucianism lie in the traditional religious views of ancient China, according to which everything is “subject to heavenly predestination,” and heaven, as the supreme deity, insistently prescribes its absolute will to individual [7]. Confucius was sincerely convinced that individual is completely in the power of the inevitability of fate, which does not hinder, but, on the contrary, contributes to his virtuous, moral and ethical socially recognized behavior. The scientific and epistemological foundation of Confucianism is a deep understanding of human nature, a contradictory understanding of relationships in society in the aspect of a virtuous desire for universal harmony, positive communication and a specific order in the world.

It is worth noting that in the integrative context of the conceptual-typological approach, the scientific-theoretical problem of conceptual the role of typological properties of the social environment in the formation of a virtuous person, the true meaning of cognitive communication in the paradigm of “individual - society” has not yet served as an object of analysis in the philosophical problems of Confucianism. As the review of literature has shown, this problem is organically connected with the logic manifestations philosophical and ethical views in Chinese civilization, that gives it a purposefulness of relevance and self-sufficient significance in social cognition (A.I. Alexandrov, A.A. Kovalev [2], Guerrero L.K.S. [4], Zheng Y. [8]).

The typological feature of human nature in the philosophy of Confucianism is the individual's belonging to a certain group of people, whose social needs and cultural and everyday interests conceptually influence his moral formation, ideological development, intellectual positioning and moral self-improvement. The main Confucian imperative in the development of moral and ethical qualities of a person is their constant self-improvement based on virtues.

The cardinal virtues in Confucianism are usually referred to as the “five constants” (English: Wǔcháng). As M.A Yushin noted: “They are ‘humanity’, ren (Chinese. 仁), “decency”, li (Chinese. 礼), “wisdom”, zhi (Chinese) 智), “loyalty” xin (Chinese. 信) [9, p.129]. Their typological content is dialectically interconnected, constantly oriented towards the human desire for perfection and, accordingly, includes: respect for others; adherence to moral principles in one's proper behavior; insightful development of the intellect; reliability in words and deeds (actions).

The practical application of virtues reveals their ontological interconnection and socially expressed mutual conditioning in social existence. For example, “ren” (philanthropy) orients the inner world of a person toward the comprehensive use of “zhi” (wisdom) in terms of the individual's ability to distinguish between good and evil in such a way that this “intellectual prudence” serves as a good intention for others. In turn, “yi” (Chinese: 义, Yi), as a sense of moral obligation, ensures

the regularity that the observance of “li” (decency) will promote harmony and justice, will increase the degree of duty in respectful attitude to the Other, social norms of behavior. In this regard, “xin” (loyalty) is a fundamental semantic concept for all other virtues, since without deserved trust and respect of others it is unrealistic to build strong interpersonal relationships and create a democratic and fair society. The quintessence of the virtues of the Chinese people is the philosophical and ethical axioms of Confucius, the meaning of which is simple: to respect every individual as oneself, and to treat him as one would wish to be treated, there is nothing higher than this; virtuous people look at themselves, petty people at others; heard - forgot, saw - remember, did - understand.

Conceptual unity group relations constitute a society, for the hierarchy of which the manifestation of the role and social status of a person in the social order of social organization is typical. That is why in Confucianism the “red thread” runs through the establishment that each person must have clear responsibilities and rights in accordance with his socio-typological position (parents - children, husband - wife, elders - younger, ruler - subjects, friend and friend).

Chinese Confucius Society— is a dynamic nonlinear system of a special type, strictly taking into account the conceptual and typological certainty of a person’s place in its hierarchy. Being in a system of interdependent meanings, the virtuous interaction of a person and society represents a complex unity of connections and relationships between social objects and social subjects, determinedly connected in various civilizational forms and social formats of their essential manifestation.

Based on Confucian theory of virtuous attitude in society can be stated that it is built on the typology of “conceptual axes”, namely: a) *family* is the basis of society. Respect for elders, family harmony and filial piety “xiao” (孝), constant care for parents, respect for ancestors are the key values of high moral culture of a person; b) the ruler is an indisputable moral authority. He must be a model of virtue, exercise fair governance with the help of the power of moral conviction, and not the force of administrative coercion; c) etiquette and rituals (Li) maintain social harmony, strengthen social ties and help people better understand their duties in order to be devoted to the ideals of the state.

The dialectic of connections and relations between individual and society in the philosophy of Confucianism reflects the cognitive process of their typological interaction. The contradictory nature of this complex process recreates a discursive system of dialectical interdependencies, in which the individual and the social environment, constantly influencing each other, are formed in this interaction, and, crystallizing their typological properties in it, they improve themselves.

This dialectical formula interaction depends on the linguacultural structure of concepts that determine the content of this process. It is important to emphasize that social component of this dynamic process concretized by the typological

structure of essential concepts that reveal the content of the concepts of “man”, “society” in the logical and semantic patterns of their mutual influence and interdependence in Chinese Confucian philosophy, these concepts have historical content, logical-cognitive coherence, ethical orientation and social significance.

In its universality, a concept is a complex mental form human consciousness(thinking)self-reproducing characteristic. In its methodological objectivity the concept serves as a determinant of subjective-semantic nature, which is aimed at comprehending typological reality [6]. The main property of the concept is the all-encompassing knowledge of reality (cognitive-semantic “grasping” of reality – author),noted by Abelard [1]. The cognitive-typological paradigm of the relationship between the individual and the social environment depends on the system of concepts that determine it.

Concept is reflexive form of expression of intellectual processes of cognition by an individual. He is dialectically contradictory, typologically multidimensional, and therefore in an accessible form predetermines the reflexive-semantic activity of a creative person. According to the author, the conceptual-typological is a complex form of thought of the subject of sociality, which is intellectually capable of dialectically recreating the integrity of the typological content of reality in its figurative-semantic intentions of all-encompassing essentiality.

The application of the principle of system city in the cognition of the socio-typological properties of individual and society leads to an understanding of the primary role in this interaction of the structural integration of the basic concepts of Confucian philosophy. These are: “philanthropy” “justice”, “virtue”, “righteousness”, “wisdom”, “prudence”, “etiquette”, “honesty”, “duty”, “ritual”, “respect for elders”, “noble man”, “perfect man”, “responsibility of a leader” and others. Logic of the mutual influence of the identified concepts acquires the present significance of social action of both individual and society in understanding the methodological mediation of their true content in the practice of being.

The content of the noted concepts has a correlative socio-ontological character. In the philosophy of Confucianism, this peculiarity has a systemic organization, the sign-conceptual orientation of which has a species typology of categorical construction. The integrity of the sign-conceptual system of concepts of Confucian philosophy (the system of “sign-concepts” Confucian philosophy - author) socially significant, methodologically constructive, dialectically potential, typologically comprehensive, which naturally defines it as a philosophical and ethical imperative in various forms of manifestation of human virtue. In other words, the set of concepts of Confucian philosophical thought is socio-culturally associated with various forms of their manifestation on the potential basis of the “comprehensive” category of “virtue”. This obviousness allows us to assert: the sign-conceptual meaning of the category “virtue” is extremely important as an ontologically basic component of social relations in the paradigm of “man - activity - society”.

In passing, we note that the philosophy of the active development of reflection of the individual's inner world is determined by the interaction of social existence and social consciousness, as a result of which it is aimed, first of all, at axiological search for ideological regulators of ideological and moral, socio-psychological, cultural and everyday nature. In conceptual discourse disagreements of modern existence rationality of value relationships between the individual and society directly related to social-typological potential of society, which according to Y. M. Lustin, "filled with social meanings, socio-cultural values, interactive values, intellectual interests and needs of people. Their contradictory discovery reveals the cognitive foundations of the axiology of the social environment, which has an ontological depth (width) and epistemological width (depth) of its manifestation" [5, p. 117].

It is precisely in practical manifestation modern existence, cultural, cognitive-informational, civil-political, integrative-functional, professional-business relationships of progressive countries and their leaders are built, based on the fundamental axioms of the philosophical thought of the best representatives of their people. Thus, speaking about the modern prospects for the further development of the cultures of Russia and China, A.V. Bredikhin and A.D. Zotova emphasize: "For the full integration of cultures, our countries have a huge number of new opportunities, and we must use these chances, strengthening our friendly cooperation and establishing connections between the citizens of the countries" [3, p. 18].

Thus, the philosophy of Confucianism is an extremely complex scientific and cultural form of intellectual development of not only Chinese, but also global reality, the civilizational essence of which is conceptually manifested in the dialectic of the individual and society.

The dialectic of connections and relations between individual and society in the philosophy of Confucianism reflects the cognitive process of their typological interaction. The social component of this interaction is specified by the typological structure of essential concepts that reveal the content of the concepts of "man", "activity", "society", "sociality", reproduced by Chinese philosophy and having cultural and historical content, psychological and pedagogical multifunctionality, ethnonational focus and social significance.

The structure of the mutually related concepts of "man" and "society" in Confucian philosophy has a systemic organization. Various combinations of concepts systematically reflect the cognitive forms of unity of individual and society, the structure of various social processes in the Chinese social environment, the dynamics of civilizational transformations, and the results of effective cultural and educational activities of the state.. The integrity of this conceptual-typological system is socially essential, methodologically constructive, dialectically potential, which defines it as a philosophical-ethical imperative in various forms of manifes-

tation of human virtue. The scientific meaning of the category “virtue” defines its fundamental role in Confucianism. It is not just a set of moral and typical rules, but a fundamental root cause of the harmonious development of society and the moral and spiritual self-improvement of the individual.

Built on the highest level of intellectual speculation, the system-defined philosophy of Confucius is constructive, as it still contributes to the implementation of innovative technologies. Education, expansion of the boundaries of socio-cultural knowledge, policy design, progress of democratic rights and freedoms in the state.

The subject matter of the stated topic provides prospects for further scientific research may be related to:

- with the methodology of developing the socio-typological foundations of the philosophical conceptuality of China;
- development and implementation of highly effective Chinese methods and techniques aimed at self-improvement and self-discipline of a person, increasing the intellectual qualities of his critical thinking;
- conceptual search for new forms of interaction between the basic concepts of classical Chinese philosophy and modern information, digital, logical-mental, virtual technologies that optimize interaction between individual and society.

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克里门季·科尔奇马列夫根据米哈伊尔·马图索夫斯基诗歌创作的清唱剧《自由中国》中艺术形象的演变

THE EVOLUTION OF ARTISTIC IMAGES IN KLIMENTY KORCHMAREV'S CANTATA "FREE CHINA" BASED ON POEMS BY MIKHAIL MATUSOVSKY

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注释。本文作者分析了克莱门蒂·科尔奇马列夫根据米哈伊尔·马图索夫斯基的诗歌创作的康塔塔《自由中国》的音乐和诗歌主题的演变：从抒情的祖国形象到英勇的中国争取自由斗争的斗争。特别关注诗歌文字和音乐的相互影响，分析了革命斗争的诗意形象如何体现在各种音乐形式中，从人物的抒情反映到戏剧场景。本文探讨了各个音乐主题、乐器和动态细微差别在塑造时代及其英雄人物的多面艺术形象中的作用，分析了中国发生的具体历史事件对康塔塔作者艺术视野的影响。总而言之，结论是，在苏联音乐文化领域中形成了一部原创的、意义深远的艺术作品，表达了康塔塔所反映的时代思想和形象的特征。

关键词：克利门蒂·科尔奇马廖夫、米哈伊尔·马图索夫斯基、清唱剧《自由中国》、艺术形象、文化价值、曲式、语调、诗意词语。

Annotation. *The authors of the article analyze the evolution of musical and poetic motives of Klimenty Korchmarev of the cantata "Free China" by Klimenty Korchmarev based on Mikhail Matusovsky's poems: from lyrical images of the Motherland to the heroic display of the struggle for freedom of China. Special attention is paid to the mutual influence of the poetic word and music, the analysis of how the poetic image of the revolutionary struggle is embodied in various musical forms, ranging from lyrical reflections of the characters to dramatic scenes. The article examines the role of individual musical themes, instrumentation and dynamic nuances in creating a multi-faceted artistic portrait of the era and its heroes, analyzes the influence of specific historical events, that took place in*

China on their artistic vision by the authors of the cantata. In conclusion, it is concluded that an original, significant work of art was formed in the space of Soviet musical culture, expressing the characteristics of ideas and images of the time reflected in the cantata.

Keywords: Klimentiy Korchmarev, Mikhail Matusovsky, cantata “Free China”, artistic image, cultural value, musical form, intonation, poetic word.

In the modern world, when Russia, in contrast to the trends of global globalization, preserves and rethinks its historical and cultural heritage, values that were undeservedly forgotten until recently are being updated. Turning to the national culture, Russia shows great interest in the historical and cultural events of the countries of the world community. Today, interstate relations between Russia and the People’s Republic of China are actively resuming, aimed at expanding and strengthening interstate relations: contacts are being restored at all levels, and there is an active exchange between the cultures of our countries. In this regard, researchers are interested in works of Russian art dedicated to significant events in the history of China. Thus, the once-forgotten cantata “Free China” by Klimentiy Korchmarev based on poems by Mikhail Matusovsky, is now of great scientific interest not only from domestic researchers, but also from foreign scientists. This is evidenced by such works as “Music as a space for dialogue between Russia and China: on the question of the “Chinese trace” in the works of composer Klimentiy Korchmarev” by Chen Zizhan [10] (2022), “Chinese Culture in the Music of Russia”, Zuo Zhengguan (2023) [9], as well as the dissertation research “Cantata and oratorio genre in Soviet music of the 1930s-1950s: on the problem of the Socialist-realist “big style”” by I. S. Vorobyov [2].

The cantata “Free China” by Klimentiy Korchmarev based on the poems of our fellow countryman Mikhail Matusovsky is a promising research topic for the scientific community of Luhansk region. The Academy of Culture and Arts of the Luhansk People’s Republic is named after Mykhailo Matusovsky, whose 110th birthday we are celebrating this year. All of the above factors determine **the relevance** of our chosen research topic.

In our opinion, the main factor in the artistic world of the cantata is the poetic word of Mikhail Matusovsky. The depth of the philosophical and aesthetic meanings of culture inherent in his poetry opens up a new perspective of the vision of the surrounding reality, which allows us to extrapolate personal experiences and assessments of what is happening in the space of universal cultural contexts. The enduring cultural value of the poet’s poems lies in the fact that they convey not only the main vital meanings of human existence in the world, but this value is manifested in the deeply aesthetic (in the sense of saturation with sensory impulses), artistic form of his works, their perfect harmony and beauty. The phonetics of

the poetic word of Mikhail Matusovsky is initially characterized by a special musicality of sound, so it is quite natural that many of his works are embodied in musical song forms. Since childhood, we have known songs based on the poems of M. Matusovsky “Where does the Motherland begin?”, “Fly, pigeons, fly”, “On an unnamed Height”, “Ballad of a Soldier”, “Moscow Region Evenings”, “Moscow Windows”, “School Waltz”, “Soldier is always a Soldier”, “Shakhtersky character” and many others that have become symbols of epoch that convey its special cultural and spiritual state. The poems became not only songs, but they formed the basis of such a complex musical form as a cantata, which determined the subject of our research – the evolution of artistic images in the cantata “Free China” by Klimenty Korchmarev based on poems by Mikhail Matusovsky. The interaction of the poetic word of Mikhail Matusovsky with the music of Klimentiy Korchmarev significantly expands the horizons of sensory, intellectual, and purposeful universals of reality, which emphasizes the relevance of this research. The cultural approach to the study of the synthesis of words and music in the cantata “Free China” consists in identifying and hermeneutically combining Mikhail Matusovsky’s poetic images with the characteristics of Klimenty Korchmarev’s music, and defining the poetic and aesthetic features of such a synthesis in the form of a cantata.

The purpose of this article is to analyze the evolution of artistic images in the cantata “Free China”, identify their aesthetic potential, reveal the semantic depth of the cantata, its musical and poetic specifics.

In the study of the evolution of artistic images in the cantata “Free China”, it seems appropriate to clarify the definitions of the concept of “artistic image”. “Philosophical Encyclopedia” gives the following definition of this concept: “An artistic image, a universal category of artistic creativity, a means and form of mastering life by art ... An artistic image is the very way of being of an artistic work, taken from the side of its expressiveness, impressive energy and meaningfulness” [8, p. 728]. The aesthetic Dictionary defines an artistic image as “a form of reflection of reality specific to art and expression of the artist’s thoughts and feelings” [11, p.239]. The “Literary Encyclopedia” provides the following definition: “An artistic image, a category of aesthetics that characterizes a special way of mastering and transforming reality inherent only in art... In the artistic image, the objective-cognitive and subjective-creative principles are inextricably merged” [5, p. 252]. In the “Dictionary of the Russian Language” S. I. Ozhegov noted: “Image ... in art: a generalized artistic reflection of reality, clothed in the form of a specific individual phenomenon. *The poet thinks in images*” [6, p. 433]. Summarizing the definitions of an artistic image given in dictionaries, we note its most typical characteristics, which include a specific-figurative form of mastering life in art, which manifests itself in the artistic form of reflecting reality; a unique way to master and transform reality in the artistic image, the unity of objective and subjective-creative principles.

The musicality of poetry, its consonance with music, is an important part of the scientific and research discourse, which reveals the potential of the synthesis of arts, their intraspecific and intragenre interaction and mutual influence. These questions represent the expanded reflexive space of the classical aesthetic tradition, and they are characteristic of the entire history of human culture as a whole. Cultural dialogue and semantic exchange, carried out in the process of interaction of artistic texts, actualize hermeneutical problems, philosophical and cultural analysis of the existence of art. The phenomena of the artistic image in poetry and music in their historical and cultural aspects remain invariably relevant for the modern scientific community.

Let us analyze the interaction between the poetry of Mikhail Matusovsky and the music of Klimentiy Korchmarev in the cantata “Free China”. We have already noted that many of M. Matusovsky’s poems were set to music and became song texts, but the cantata is a special musical genre based on alternating arias, recitatives and choruses written in different verse meters. How did they combine poetry and music in a single, integral artistic form of the cantata, if “the purest case of genesis is music, whose language has no equivalent in any field of human activity; whose material-sound intonation and organized time-is taken from the real world; whose objectivity is fundamentally non-conceptual and no reduction is possible” [7, p.9]? In our opinion, the poetic word and music in the cantata “Free China” are united in a harmonious integrity by the intonation series, which provided the embodiment of the artistic image of “*free as spring China*” [4]. The emotional saturation of thought images in the spatial and temporal movement of the sounding human voice and the voice of musical instruments is a reflection of the “intonation nature of music”, where the musical form appears as a multi-layered, intonation process [1]. Poetic and musical intonation is the most important individual feature of a poet and composer, which determines their creative handwriting, author’s style, manner and, if intonation in music (timbre, volume, pitch) ensures the integrity of musical sound, then poetic intonation significantly complements the semantic structure of music. The melodic pattern of a piece of music embodies the movement of various intonations that reveal a person’s sense of the world, his involvement in the events taking place in it. In Klimentiy Korchmarev’s cantata “Free China”, we observe the development of musical content, enriched by the semantic and emotional expressiveness of the poetic word of Mikhail Matusovsky: “*There are new shoots everywhere you look, here the clear sun shines over the fields. But the recent days have been terrible, and the roads of victory have been difficult*” [4]. This text of the narrator is preceded by the cantata, sounding at the beginning of the first part – “The People’s Army (Partisans)”. It is here that the central images of the entire work are laid – the image of struggle, the image of the people’s dream of happiness, the image of victory and the advent of a new, just

world, that is, the image of a free China. The first movement opens with an orchestral introduction, where the low strings col legno, gong, tam-tam, pedal sounds of the French horn in the low register, the melody of the flutes in the high register that appears against their background, create an image of the earth scorched by the fire of battles, symbolizing the long and difficult path, and on the way to happiness, which is mentioned in the poetic text. I. S. Vorobyov, analyzing the features of the orchestration of the introduction to the cantata, points out the imitation of the sound of the Chinese orchestra of folk instruments [2]. But at the same time, the blows of the gong and tam-tam are associated with funeral bells, and the long sounds of the French horn in a low register vaguely resemble the sound of a large trumpet used in Chinese funeral rites: the composer seems to emphasize that victory and happiness are impossible without sacrifice and deprivation. This is confirmed by the choice of the key-*e-moll*. This choice is not accidental: in the musical tradition, both Western European and Russian, the key of *e-moll* (J. S. Bach. “St Matthew’s Passion”; N. K. Metner. Sonata in E minor), associated with mournful images, with “passion”, “procession to Calvary”, “Sacrifice”. All this is perfectly consistent with the poetic text that precedes the music of the first part, which the reader says: “*But the recent days were terrible, and the roads of victory were difficult*”. The first section of the movement “*You can hear the rumble of a deep thunderstorm over the blue Yangtze River*” is a harsh, courageous march: support in the melody on the pentatonic, syncopated rhythm as a reflection of the national symbols of China, low bass register, narrow ambitus the tunes (within a large third) are intended to embody the image of a revolutionary fighter – one of the key images of the work, as we indicated above.

Let us analyze in more detail the musical embodiment of the poetic text in the first part of the cantata, since it contains the key artistic images of the entire work. The subsequent choral fugato on the poetic lines “*The rumble of a deep thunderstorm is heard over the blue Yangtze River*” is perceived as a moment of unity, rallying the people in the struggle against trials, in this case, in the struggle for freedom and a happy future. In our opinion, such a musical solution is the most accurate embodiment of the image that is embedded in the poetic text of this section.

The second section, which is more calm in accordance with the poetic text, opens with a mezzo-soprano solo on the words “*Softly noises in the field of Gao-liang*”. More sparse, compared to other sections, orchestral texture-bells, celesta, xylophone, harp, “rustle” tremolo for violas and first violins, pizzicato for second violins, cellos and double basses-lyrical melody, a wide range of vocal melodies with ascending, as if “soaring” up intonations, preservation of the fret relying on the pentatonic system creates an image of striving for happiness, victory, peaceful, creative work. The E-dur key chosen by the composer dur emphasizes the lightness and serenity of the image. In a similar musical embodiment, this image will

appear in the third part of “Young Patriots” and in the finale of “Chinese Spring” (solo mezzo-soprano on the text “*Where there was a war recently, spring is everywhere in the fields*”).

For the third section into the lines “*Our ranks are innumerable and solid, they grow stronger in battles*” again returns us to the central image of the first movement, but in a slightly changed form: the main key of e-moll, the tempo of the march returns, but the dynamics change-*f*, instead of the original *p*, respectively, and the orchestral texture becomes more dense, saturated. Percussion instruments that have not been played before (in particular, timpani, snare and large drums, cymbals) are included, emphasizing the marching movement. All of the above already creates an image of actual battles, struggles: we see that the image of the heroic partisan, familiar to us from the first section, is supplemented with new, even more convincing characteristics.

Fourth section in a more calm movement on the text “*Glory to him who in any battle piously honors his homeland*”, the composer reproduces in the chorus part the mezzo-soprano melody from the second section, but in a different key-A-dur. The idyllic image of happiness returns as a symbol of faith in victory, in a “bright future”. For the first time during the whole movement, the size changes – 12/8: the three-cornered figures of the strings that appear at this moment emphasize the overall smoothness, fluidity of movement, which again refers us to the serene, bright image of happiness.

On verses “*Our ranks are innumerable and firm in battle*”, there is a tonal shift As-dur, the orchestral and choral texture is compacted-tutti, which remains until the end of the movement. The means chosen by the composer create a solemn, hymnal image, which is preserved in the next section, i.e. the central image of the part is transformed: we are no longer looking at a heroic partisan, not the image of heavy battles, but the image of a victorious hero. Thus, the conflict between reality (the image of the struggle “for justice, freedom and work”) and the dream (the image of a new, happy world where justice, freedom and peaceful creative work reign) is eliminated.

The fifth section on the text “*The people themselves will come to power*” – completes the first part, which, according to I. S. Vorobyov, is a “micro-apotheosis” [2] symbolizing not just a person’s faith in victory, but actually victory, the onset of a new just world, the embodiment of the people’s dream.

Thus, the artistic images of the first part evolve from the image of a revolutionary fighter (heroic partisan), the image of the dream of happiness, through the image of struggle to the image of victory, embodying the people’s dream of happiness and freedom.

The interrogative intonation of the third part of the cantata’s text (“Young Patriots”) conveys the search for a new path, faith in a happy future for China:

"What song rises in the distance, soaring over a mighty country? It's the future that sings. This is China's tomorrow!" [4]; in this intonation sounds the eternal question of man about himself, the expediency of his stay in the world. Exclamation intonations encourage action, increasing the semantic and emotional impact on the listener, which is enhanced by the composer. The interrogative intonation of a poetic text in music is transformed into an affirmative, exclamation point. This is emphasized by the choice of musical and expressive means: light, transparent C-dur as one of the semantic signs of a new happy world, a melody, assigned to the "pure", "enlightened" timbre of the children's choir (a semantic sign of a new, just world, actually free China, a bright serene future), the fret basis of which is the pentatonic, transparent orchestral texture, represented by the sound of first and second violins, violas, celesta, bells, xylophone. The presented orchestration is similar to the orchestration of the second section of the first part, where the image of a person's dream of happiness, freedom and justice was exposed. But in the third part, this is no longer a dream – it is a new reality, it is the result of the struggle for *"freedom, justice and labor"*. The choice of musical form is also not accidental – a verse form of the "sing-chorus" type with a variation of the chorus in the first two verses and a re-harmonization of the chorus in the last verse and a modulation transition to a new key of F-dur (which is also a semantic sign of the image of happiness), which leads to a harmonic opening of the third movement. At the same time, stability, or, to use the terminology of B. V. Asafiev, a certain "crystal-like nature" of the form chosen by the composer [1] seems to us the most accurate embodiment of the image of the new world, where the *"grief and need"* mentioned in the text will no longer exist. In this way, the composer "embodies" the people's faith in a peaceful "bright future", which is perfectly consistent with the image of happiness, which is the central image of the poetic text of this part and one of the key artistic images of the entire cantata. Based on the above we come to the conclusion that the third movement of the cantata is its dramatic, semantic center. This is the true culmination of the entire work, which is confirmed, as pointed out above, by the choice of musical and expressive means that most accurately reflect the figurative content of the poetic text, but not by the dramatic and semantic miscalculation that the researcher I. S. Vorobyov wrote about [2, pp. 654-655]. On the contrary, the musical embodiment of the poetic text in this part of the cantata, its location at the point of the golden section, can not be more justified from the point of view of the dramatic logic of the whole.

The conducted cultural and musicological analysis of the cantata "Free China" allows us to conclude that this work conveys the historical experience of the Chinese people, the aesthetics of their worldview, which are part of the universal aesthetic culture. The vivid artistic and figurative character of the cantata, both on a musical and poetic level, reveals the figurative structure of its artistic fabric, and

allows us to trace the musical evolution созданных поэтом и композитором of the artistic images created by the poet and composer.

Currently, in the terminology of philosophy, cultural studies, and art criticism, the concept of “intermediality” has appeared, denoting intra-textual relationships in a work of art. Taking into account that the main purpose of a work of art is to create an artistic image, we will analyze the following question. By an image, we usually mean a certain element or part of a work that is characterized by its independent existence and meaning. Based on this attitude, the poetic and musical images of the cantata “Free China”, having artistic autonomy, could potentially act as isolated and self-sufficient, not requiring emotional, poetic reinforcement. The example of the cantata “Free China” by Klimenty Korchmarev based on poems by Mikhail Matusovsky shows the harmony of musical and poetic texts that embody specific historical events in their effective essence. The aesthetic pleasure that the listener receives from the cantata is based on the fact that in it the artistic image does not dissolve into a musical or poetic form, but appears as a single, complete and complete one, combining the original nature of the poetry of Mikhail Matusovsky and the music of Klimenty Korchmarev. As a fact of ideal existence embedded in the stage action, the artistic image uses concrete historical material as signs of its own content, develops it to the level of a symbol, which is always re-realized in the imagination of the public, who has a cultural “code” that allows them to find the right “key” to understanding what is happening. This was pointed out by I. S. Vorobyov, a researcher of the cantata genre in Soviet music of the 1930s and 1950s. Reflecting on K. A. Korchmarev’s cantata, the researcher notes: “As a result, the festive life-affirming emotion was born from the essence of the music itself, and not the meaning attached to it” [2, 657]

The specific hypothetical nature of the artistic image, based on its ideality and fantasy, requires a separate understanding. Conceived by the authors as a kind of ideal quintessence of emotional meanings, an artistic image may not take place in its original form if it does not develop in the direct perception of the public and is not strengthened by its emotional intentions, fantasy, imagination. Klimenty Korchmarev’s cantata based on Mikhail Matusovsky’s poems “Free China”, according to the contemporaries of this work, is a direct example of such co-creation of the theater audience with the authors, when the pure possibility of the original idea consisted in a real stage action. The cantata presents images of the Great Wall of China with maximum sensual persuasiveness: *“Steppe distances, mountain peaks, river rapids, transparent to the bottom. The Great Wall of China passed through the endless plains. How stern and gloomy these towers are, and how quiet they are everywhere. The Great Wall of China makes us think about the past days”* [4]. These words of the narrator precede the second part of the cantata “Chinese Wall”. The composer masterfully embodies the image laid down in the poetic text

in the orchestral introduction: a thick, rich, as if “mundane” sound is created by using the low and medium registers of flutes, clarinets, violins and violas. The parts of solo instruments, mezzo-soprano and chorus are filled with sad intonations. The musical and expressive means chosen by the composer are intended to embody the image of the oppressed people laid down in the poetic text: *“Our great people lived without knowing happiness. The rice stalks were drying in the field, and the song sounded like a terrible moan”*. The melody is based on a pentatonic centered on the tone “c”. The choice of such a fret support is not accidental: in the cantata, it is the personification of a new free and just world. The composer seems to anticipate the upcoming victory of the people over oppression and injustice, the embodiment of the dream of freedom and peaceful work in their native land (the central tone “c” in the context of the music of the second part is also connected with the image of the earth). That is why in the last section of the part, the words *“let this time [the time of suffering and deprivation, the intense struggle for happiness – our addition, V. M., I. N.] will never return to us”* finally fix the C-dur key as a symbol of the onset of a new just world, the embodiment of the people’s dream of freedom and happiness. Therefore, the next part of “Young Patriots”, written in a light, transparent C-dur, which is emphasized by the orchestration (high strings, celesta, bells, xylophone), is a logical continuation of the previous part. This is the image of a victory accomplished, a dream realized, and the result of the people’s struggle for justice, happiness, and a bright future. Created by M. Matusovsky and K. Korchmarev, the image of free China is beautiful, thanks to the harmonious unity of poetry and music, artistic self-concentration on the world. updating what is happening.

The subjective beginning, which is always and invariably inherent in both the artistic image itself and its perception, in the cantata “Free China” overcomes the framework of this subjectivity, building an objective, dialogical beginning between the authors and the audience experiencing collisions of dramatic action. Fixed moments of the inner form of the poetic syllable and music, projectively indicating to our imagination, in which direction it needs to move, nevertheless contain incomplete definiteness, creating space for fantasy, “completion” of the unfolding action, a game situation that includes multiple interpretations of what is happening. The internal form of artistic images of the cantata “Free China”, of course, contains the personal and evaluative characteristics of its authors, reflecting their ideological attitudes, which leaves an imprint of a certain relativity on the artistic truth of the created artistic images. At the same time, obeying the “laws of beauty”, which are an axiom of artistic creativity, создаваемые the artistic images created in the cantata are aesthetical harmonious, sometimes combining the incompatible in a holistic capacity of the sensual element, which gives these images the status of cultural value. The “hypnotism” of the cantata “Free China”

consists in the inseparability of the concrete historical from the imperishable, the personal from the transpersonal. Associative coupling of artistic images of the cantata, expressed in the allegory of the poetic word of Mikhail Matusovsky, counterpoints of the music of Klimentiy Korchmarev, raise this work to the level of artistic generalization, a cultural symbol of a historical era.

All of the above allows us to formulate the following **conclusions**.

The evolution of artistic images in the cantata “Free China” goes from an idealized, romanticized representation of the struggle for Chinese freedom in the initial parts of the cantata to a more realistic, dramatic presentation in the subsequent parts.

The role of the poetic word of Mikhail Matusovsky, as a fundamental factor in creating the artistic world of the cantata, is obvious. The images created in the verses serve as the basis for the development of the musical characteristics of the cantata’s action, expressing both ideological attitudes and the emotional palette of the events taking place. Musical interpretation of M. Matusovsk’s poems helps to reveal their multifaceted depth.

Means of musical expression—from dramatic and solemn opening parts to deeply lyrical and emotionally rich images in subsequent sections—contribute to the full disclosure of the ideological and emotional essence of the cantata. The diverse use of tempo, dynamics, fret and texture helps to create a dynamic, multi-faceted picture of the action taking place.

The use of images of the folk song tradition in the cantata creates a sense of the breadth and scale of the events depicted. Elements of folk melodies and rhythms give the work a special national flavor, enhancing the effect of emotional involvement of the listener in the topic.

The compositional structure of the cantata ensures the consistent development and evolution of artistic images. The logical transition from one stage to another contributes to the integrity of perception and a deep understanding of the ideological intent of the work.

The cantata “Free China” is an example of the synthesis of musical and poetic means of expression that can express the ideological attitudes and emotional context of the time of creation of the work.

The study of the evolution of artistic images in the cantata allows us to better understand the specifics of Klimentiy Korchmarev’s musical vocabulary, its ability to express complex, sometimes contradictory ideas of reality in artistic form.

The study of the cantata “Free China” by Klimentiy Korchmarev based on poems by Mikhail Matusovsky confirms the importance of a comprehensive analysis of musical and poetic means of expression for a deep understanding of the specifics of the artistic world and the ideological intent of the work.

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以书籍形式的宪法图像为基础创作的宪法共生图像
**SIMBIOTIC IMAGES OF THE CONSTITUTION IN WORKS OF
FINE ART, CREATED ON THE BASIS OF THE IMAGE OF THE
CONSTITUTION IN THE FORM OF A BOOK**

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摘要：书籍形式的国家宪法图像在许多国家的美术作品中被广泛运用。这种图像与作为知识的书籍相联系，尤其与神圣的知识相联系。艺术家们基于书籍形式的宪法图像创作新的国家宪法图像，并将其与其他图像共生地融合成一个整体。本文展示了这些共生图像的多样性，揭示了对国家宪法解读的不同方面。

关键词：书籍形式的宪法图像，知识的象征意义，宪法共生图像，宪法图像的多样性——共生体。

Abstract. *The image of the national constitution in the form of a book is widely used in works of fine art in many countries. This image is associated with the book as knowledge, associated, among other things, with sacred knowledge. Artists create new images of the national constitution based on the image of the constitution in the form of a book, combining it symbiotically into a single whole with other images. The article shows the diversity of these symbiotic images, revealing various aspects of the interpretation of the national constitution.*

Keywords: *image of the constitution in the form of a book, symbolism of knowledge, symbiotic images of the constitution, variety of images-symbionts of the constitution.*

Portraying the constitution as a book is a common way to create its image in a visual art work. Although the national constitution is not a book, but a set of rules of the highest level in the state, in the most accessible form to the population, it is published in the form of books or brochures (depending on the volume of the act itself). In this sense, to create artistic images of the constitution, it is the image of the constitution in the form of a book that is recognizable and understandable to the population. Recognition is usually enhanced by the fact that this image of the

constitution is often accompanied by an appropriate inscription, so that the viewer has no doubts which book the artist has in mind.

This image allows you to show a wide range of events and phenomena that occur with the national constitution in real life. To demonstrate respect for the national constitution, which is characteristic of various kinds of paintings praising this or that historical event, the book of the constitution is made an important part of this celebration, it takes an oath or signs its text. If cartoons emphasize the meaning of the constitution, then to exalt it, such a technique is used as increasing the size of the constitution book, sometimes very significant, compared to the original, but it remains a book. Insufficiently respectful attitude towards the constitution by politicians or representatives of state bodies can be depicted in the form of characters who spoil or even destroy the constitution: a book depicting the constitution can be torn, trampled (an artistic synonym for the literary expression “trample on constitutional values”), even gnaw, pull pages out of it, throw it down the toilet and get rid of it in another way [1, p. 18].

There are other ways to transform the image of the constitution of the book, which open up various opportunities for artists, especially cartoonists, to express their ideas and impressions of what is happening in the country. These possibilities indicate the plasticity of this image, its great potential. But they expand substantially when artists combine the image of the constitution in the form of a book with another established or new image of the national constitution, and as a result a symbiotic image of the constitution arises (for more information on symbiotic images of the constitution and their types, see: [2, pp. 156-163]). The combination of two images of the constitution in one symbiotic image often creates an unexpected effect, which arouses the viewer's interest in what is happening in the constitutional sphere of state life. The symbiotic image of the constitution is able to reveal different sides of the content and “being” of the constitution, i.e. its implementation in life, those that cannot be disclosed in one simple image. At the same time, the artist expects that the viewer, as a result of such a connection, will have new, rich and vivid associations, which will allow him to develop a meaningful and active position on what is happening.

Symbiotic images of the constitution can be formed on the basis of various images of the constitution, but it is the image of the constitution in the form of a book that is the most common basis for symbiotic images. The reasons for this are quite obvious, and they, as noted earlier, are connected with the fact that the constitution in most countries of the world is associated precisely with its publication for the population, i.e. “book”. When complementing this image with another in the symbiotic image, the characteristics of the constitution are fused together as a book and traits that are associated with another image connected to the “book” into a single whole. Symbiotic images of the constitution belong to different spheres

of life: construction, technology, human being, etc. In this sense, a lot of room opens up for the realization of the imagination of artists in the form of the most daring compounds. This allows the various sides of the national constitution to be revealed in a single piece of fine art.

1. Symbiotic anthropomorphic images of the constitution based on the image of the book

Anthropomorphic artistic symbiotic images of the constitution, created on the basis of the image of the constitution of the book, are found primarily in the form of the image of a female book. These images are anthropomorphic metaphors. The term “constitution” comes from the Latin word feminine. In ancient Rome, this was the name of one of the emperor’s acts. Therefore, in an obvious way, the image of the constitution is associated, first of all, with the female image, in the form of ancient statues or goddesses, but artists can play up the addictions and problems of modern women, depending on which constitution they are talking about [3]. The emotionality of women allows you to create vivid images of the constitution in various situations and form the necessary psycho-emotional state in the audience, riveting their attention to constitutional and legal problems. Anthropomorphic metaphor is distinguished by the fact that “a person models political reality in his own image and likeness, which allows metaphorically representing complex and distant from everyday realities” [4, p. 119]. The use of anthropomorphic metaphor creates “additional potential for the reader to feel the objectivity of the proposed evaluative meanings” [4, p. 113].

Thus, the cartoon of the Congolese cartoonist Kash (Fig.1) depicts a situation of acute discussion of various political forces regarding the amendment of the country’s Constitution (including creating the possibility of election for the president for a third term).



Figure 1. Author Kash. Caricature : “et si on ne changeait pas les articles verrouillés de la constitution?” Lundi 21 octobre 2024. URL: <https://actualite.cd/2024/10/21/caricature-et-si-ne-changeait-pas-les-articles-verrouilles-de-la-constitution> (accessed 25.03.2025).

The constitution is depicted as a spectacularly dressed woman with a fan in her hand. Her head is depicted as a book with the inscription “Constitution”. She is in difficulty and is trying to understand what the changes proposed by the crowding political actors are fraught with. This is evidenced by her posture and the question that torments her.

In general, the symbiotic combination of the anthropomorphic image of the constitution and the image of the constitution in the form of a book gives dynamism to what is happening and creates a feeling of «living knowledge» personified by the constitution. Anthropomorphic images of the constitution are close to those images that relate to the basic needs of a person, such as food and sleep.

2. Symbiotic image of the constitution in the form of food based on the image of the book

Gastronomic metaphors as applied to the constitution are usually associated with different stages of the constitutional process. The image of the constitution in the form of food is most often used to show the process of preparing the constitution. In this case, the first dish or dessert is usually prepared, and the focus is on both the ingredients that fall into the “cauldron of constitutional creativity” and the degree of coherence of the participants in the constitutional process (see, for example, [5, p. 18]. Depending on which dish the artist associates the constitution with, as well as which of the politicians or statesmen acts as a cook or cook, the viewer has a certain idea of the course of the constitutional process.

Having entered into force or, to use culinary terminology, the “prepared” constitution already acts as an object of eating. It is clear that in this case the damage to its provisions and integrity is symbolically depicted. Such an image, for example, was chosen to depict constitutional problems associated with the activities of the Constitutional Court of Colombia, a Colombian artist acting under the pseudonym Leo (Fig. 2).



Figure 2. Author Leo. Caricature “Corte Constitucional”. // *Semana*. 02.03.2015. URL: <https://www.semana.com/corte-constitucional-caricatura-leo/419797-3/> (accessed 25.03.2025).

It is quite obvious that, according to the author of the caricature, the activities of the constitutional control body, at least at the time of the creation of this work of fine art, led to a decrease in the possibilities of the influence of the Colombian Constitution on public relations.

3. *Symbiotic artistic image of the constitution in the form of a book acting as a bed*

Healthy sleep is an important part of human life. However, when the artist depicts the “sleeping state” of an important organ of the state, which is called upon to act in a certain way according to the constitution, then in this case the negative phenomena of non-compliance with constitutional norms are reflected in the work of fine art. This plot was used by cartoonist Paolo Calleri to express concern about the insufficiently effective, in his opinion, activities of the Office for the Protection of the Constitution in Germany (Fig. 3) to suppress extremist manifestations. The character personifying this organ sleeps in a bed depicting the constitution book. The alarm clock rings about the threat of fascism (swastika, instead of melody), but instead of active actions, the character, yawning, asks to sleep for another five minutes.



Figure 3. Author Calleri P. “In schlechter Verfassung”. Am 15. November 2011. URL: https://de.toonpool.com/cartoons/In%20schlechter%20Verfassung_150156 (accessed 25.03.2025).

In this cartoon, the author from Germany deliberately made an inaccuracy in the name of the national constitutional act: the constitution in Germany is officially called the “Basic Law of the Federal Republic of Germany” (Grundgesetz für die Bundesrepublik Deutschland), and not the “Constitution of the Federal Republic of Germany” (Verfassung, Bundesrepublik Deutschland) as it is written on the bedbook. This is done so that a pun appears: “poor condition” (“schlechter Verfassung”) and the name of the constitutional act in German are expressed in one word “Verfassung”.

4. Symbiotic artistic image of the constitution in the form of a mechanism book

Various mechanisms in themselves are a fairly common way of creating a vivid image of the constitution [6]. The symbiotic image of the constitution in the form of a book with a mechanism inside it allows us to show, on the one hand, the functioning of the constitution (in association with the expression “function like clockwork”), on the other, to demonstrate the possibility of adjusting its action. In addition, the mechanism can be damaged, repaired, improved, modernized, etc. The presence of an internal mechanism in the constitution book allows the artist to show the government’s ability to make the constitution “work” faster and more efficiently in his favor. The caricature is drawn “on the topic of the day”, but at the same time it has a generalizing character, in terms of the capabilities of the executive branch in other countries.

The image of the mechanism inside the constitution book allows the artist to strengthen the impression of the constitution as a valid legal act. In legal science, the term “legal mechanism” is used. And since the “constitutional mechanism” works, it can, under certain circumstances, break or require updating. Artists couldn’t get past this potential of a symbiotic image. For example, Salvadoran cartoonist Alecus in his cartoon entitled “Arreglando” (“Streamlining”) (Fig. 4), depicted the constitution in the form of a book with an internal mechanism, in which, judging by the tools scattered nearby, a certain character is already “digging”. He calls the owner on the phone with the words: “Look at Patron... And if better, we make it another?”. Even without knowing the situation in El Salvador at this point, the reader understands that we are talking about interference in the constitutional mechanism, most likely unfavorable in general, but it is clear that it is beneficial for the ruling elite.



Figure 4. Author Alecus. “Arreglando”. 12.08.2021.URL: <https://historico.elsalvador.com/historico/868346/caricatura-de-alecus-constitucion-la-republica.html> (accessed 25.03.2025).

5. *Symbiotic artistic image of the constitution in the form of a book-vehicle*

The national constitution is often depicted by artists in the form of a vehicle (car, sailboat, steamer and even rocket). When it comes to the image of the constitution in the form of a water vehicle, this image is used to show the implementation of the provisions of the constitution as successful (or not so) swimming [6, pp.186-192]. However, not all images of a water vehicle are suitable for “splicing” with the image of the constitution in the form of a book. As a basis for a symbiont with the image of the constitution in the form of a book on form, the raft is best suited. So, on a caricature authored by Indian cartoonist S. Sinha (Fig. 5), the Constitution of India in the form of a book is simultaneously a raft surrounded by sharks, on which a group of people is transported by sea, apparently of political life.

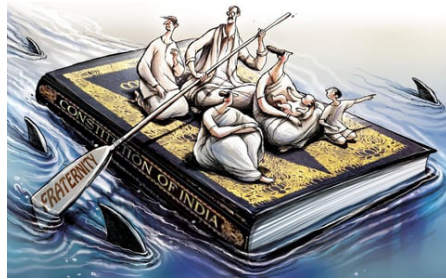


Figure 5. Author Soumyadip Sinha. Article illustration [6].

The article, the ideas of which are illustrated by this caricature, speaks of the significance of the word “brotherhood” used in the preamble of the Constitution of India (which is present in the caricature in the form of an inscription on an oar), and the need to develop appropriate constitutional practice [7].

Air vehicles are also represented by book-like imagery in symbiotic constitutional imagery. So, in the illustration to Article 108 of the Italian Constitution (Fig.6), dedicated to the judicial system, the cartoonist clearly used an analogy with the fabulous image of an airplane carpet from Arabic fairy tales, capable of floating in the clouds. At the same time, this caricature makes you wonder whether it is so good that these organs “float in the sky” or their place is still on earth?



Figure 6. The author is not specified. Illustration to Art. 108 of the Constitution of Italy. URL: <https://vignettistiperilno.wordpress.com/portfolio/vignette-per-la-costituzione/> (accessed 25.03.2025).

6. An artistic symbiotic image of the constitution in the form of a combination of a book and Pegasus

In the monument to the Constitution, located in front of the building of the Constitutional Court in Honduras, the image of the constitution in the form of a book is peculiarly connected with the image of Pegasus, whose wings are precisely the “book” of the constitution (Fig.7). The seven-ton marble monument was designed and carved by renowned sculptor Max Leiva and erected for the 25th anniversary of the Guatemalan Constitution in the Protection of the Constitution Square. Max Leyva is a sculptor with his own style, whose works have powerful energy. He boldly combines not only various materials, but also combines various images into a single whole (as, for example, in the sculpture “Bird Man” [8]. At the event dedicated to the opening of the monument dedicated to the Constitution, Guillermo Monsanto, art curator and director of the El Atico Documentation Center, commented on the purpose and meaning of this work of fine art as follows: “His crisp white whiteness represents purity, and the qualities that define his value and strength make him an ideal sentinel to guard the door behind which our most enlightened lawyers care about the observance of the guidelines contained in this document, that is, in the Constitution of the Republic of Guatemala” [9].



Figure 7. Monument at the building of the Constitutional Court of Guatemala. *Diario del mundo*. 26, febrero 2020. URL: <https://diario.elmundo.sv/El%20Mundo/corte-constitucional-de-guatemala-suspende-elecciones-de-jueces-y-magistrados-de-la-csj> (accessed 25.03.2025).

The monument to the Constitution depicts this act in the form of a zoomorphic winged object connected to a book. Winged horses are found in myths of folklore and different peoples of the world. In this case, we are talking about Pegasus, which in Greek mythology occupies a special place. He is an ambiguous figure in it [10], but in this case the most common myth about Pegasus as a source of creativity is clearly used. Pegasus in myths was credited with the ability to knock out the source that gave inspiration from the ground [10, p. 296]. Pegasus sculpture elevates the activities of the Supreme Court to poetic creativity. Its placement in front of the building of the Constitutional Court is complimentary, likening the interpretation of the articles of the constitution to poetic creativity.

Fourteen years have passed since the monument appeared in Guatemala (2011), and during this time it has become a symbol of the country's Constitutional Court. His image is actively used by artists in cartoons that reveal the peculiarities of the activities of the Constitutional Court of the country or events affecting the Constitution, which indicates the recognition of this image. So, in the caricature of the Salvadoran cartoonist Fo (Fig. 8), dedicated to the celebration of Constitution Day, the monument symbolizing it remained tied (like a real horse) outside Congress.



Figure 8. Author Fo. “Día de la Constitución”. Prensa Libre. 31 de mayo de 2023. URL: <https://www.prensalibre.com/opinion/caricatura/dia-de-la-constitucion/> (accessed 25.03.2025).

Thus, the appearance of a monument to the Constitution in Guatemala created a new facet of the cultural code of Guatemalan constitutionalism.

Conclusion

In works of fine art, the constitution can take on different images depending on what the artist wants to say to the audience about the processes taking place in the state. The imagination of artists turns the constitution into various, sometimes fantastic living beings, household items, technical devices, etc. The artist’s imagination in this case is unlimited. In the case of symbiotic forms based on the image of the constitution in the form of a book, the situation is different: the form of the basic image (book) introduces restrictions on images that enter into a symbiotic relationship with it. However, the undoubted advantage of symbiotic images based on the image of the constitution in the form of a book is their “multidimensionality”, which arises due to the combination of often seemingly unconnected images. This allows you to bring novelty to the perception of the «being» of the national constitution by the audience and draw their attention to serious constitutional problems.

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日常生活的诠释——中国现实主义油画的民族性
**INTERPRETATION OF DAILY LIFE - THE NATIONAL
CHARACTER OF CHINESE REALIST OIL PAINTING**

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摘要.现实主义油画,作为一种艺术形式,不仅是技法的展现,更是文化、历史和民族精神的载体。现实主义油画在中国有着百余年的发展历史,它以真实性、客观性的艺术描绘,深刻反映了中国社会发展的现实情景。其现实主义油画作品在反映社会生活、表达民族情感以及弘扬民族文化精神方面,展现出了独特的魅力。

中国现实主义油画的发展,既是对西方油画技法的借鉴与融合,也是对中华民族传统文化的深入挖掘与弘扬。在这一过程中,油画家们不仅注重技法的精进,更致力于在作品中融入民族元素,使其成为中国文化的重要组成部分。这种民族性的体现,不仅丰富了油画的艺术表现力,也为中国现实主义油画在世界艺术舞台上赢得了独特的地位。

关键词: 中国现实主义油画; 日常生活; 民族性;

Abstract. *Realist oil painting, as an art form, is not only a display of technique but also a carrier of culture, history, and national spirit. With a history of over a hundred years in China, realist oil painting, through its authentic and objective artistic depiction, deeply reflects the realities of China's social development. Its works have shown unique charm in reflecting social life, expressing national emotions, and promoting national cultural spirit.*

The development of Chinese realist oil painting is both an assimilation and integration of Western oil painting techniques and a deep exploration and promotion of traditional Chinese culture. In this process, oil painters not only focused on refining their techniques but also committed to incorporating national elements into their works, making oil painting an important part of Chinese culture. This embodiment of national character has not only enriched the artistic expressiveness of oil painting but also earned Chinese realist oil painting a unique position on the world art stage.

Keywords: *Chinese realist oil painting; daily life; national character.*

I. Overview of the Development of Chinese Realist Oil Painting

In the history of oil painting development in China, realist oil painting has always occupied a dominant position. Realist oil painting advocates observing real life and faithfully reproducing typical phenomena in accordance with the true appearance of life. In China, due to the uniqueness of its historical background and cultural context, the creation of realist oil paintings presents diverse external forms. By systematically sorting out the development trajectory of Chinese realist oil painting, we can further reflect on and explore the paths of its national character construction.

In the early 20th century, the concept of “realism” was introduced to China, representing a complex phenomenon of cross-contextual cultural dissemination. In the cultural context of China at the time, it primarily addressed the shortcomings of traditional Chinese painting, particularly its lack of realism. Figures like Kang Youwei and Cai Yuanpei explicitly proposed the idea of adopting the Western oil painting realist system. Therefore, in the interpretation of the concept, “Realism” was translated as “写实主义” (realistic art) rather than “现实主义” (realism). The explanation of “realism” not only related to Western realistic painting but also involved the concept of “portraiture” in ancient Chinese art theory, while also being influenced by Marx and Engels’ literary critiques and Soviet socialist realism.

During the early 20th century in China, society was in turmoil. A group of intellectuals, seeing China’s backwardness in the collision and fusion of Eastern and Western cultures, hoped to reform Chinese culture by introducing Western advanced science and democratic ideas. With the rise of the May Fourth New Culture Movement, many Chinese artists went to Europe to study. They combined Western painting techniques with Chinese aesthetic concepts, laying the foundation for the development of Chinese realist oil painting.

Xu Beihong was undoubtedly the most influential artist in the creation and development of “realistic art” in 20th-century China. In 1918, Xu Beihong proposed using European realism to overcome the deficiencies of Chinese painting and created a series of large-scale oil paintings based on real-life scenes. His works had a profound impact on the development of Chinese realist oil painting.

After the founding of the People’s Republic of China, the close friendship between China and the Soviet Union led to the adoption of the Soviet model in Chinese oil painting. The creation of oil paintings praising heroes, celebrating the era, and depicting revolutionary history and socialist reality became the mainstream. During this period, the combination of the Soviet social art model with the Chinese cultural context allowed realist oil painting to develop rapidly, producing a large number of works with distinct Chinese socialist characteristics. Notable examples include Dong Xiwen’s *The Founding Ceremony*, Xu Beihong’s *People’s Tribute to the Red Army*, and Zhan Jianjun’s *Five Warriors of Wolf

Teeth Mountain*. These works, based on socialist ideals, selected, processed, and created historical and real-life depictions, showcasing Chinese artists' understanding and innovative use of local cultural traditions while absorbing foreign artistic experiences, thus injecting vitality and depth into the development of Chinese realist oil painting.

During the "Cultural Revolution," the creation of realist oil paintings became highly politicized, with realism transforming into a form of pseudo-realism. Artistic development stagnated, although certain achievements were still made, such as the classic works *Chairman Mao Goes to Anyuan* and *Spring Breeze and Willow Trees*. After the reform and opening-up period, Chinese art entered a new era. Art creation returned to real life, with "scar art" and "rural realism art" becoming two main forms of realist oil painting during this time. Both scar art and rural realism art were rebellious and avant-garde in terms of subject matter and artistic expression, confronting reality and returning to real life, offering reflections on society and the nation. These two forms not only enriched the artistic language of realist oil painting but also brought new perspectives and thoughts to Chinese art creation. During this period, many outstanding realist oil paintings emerged, recording the social changes in China and carrying deep reflections and hopes of the artists for society and the nation.

In the 1990s, as society developed towards diversification, Chinese oil painting creation moved beyond merely learning from the West and began to pursue a more diversified creative path. The art created during this period established a direct connection with real life. The subjects of the art were no longer distant or abstract, but instead focused on the everyday reality that the artists directly engaged with. The artwork became strongly de-idealized, reflecting the most authentic aspects of real life through documentary-style depictions of the lives of ordinary people in society.

Entering the 21st century, the expression of realism has increasingly become a conscious and clear choice for many artists. This choice stems from artists' mature understanding of the realist creative method and their confidence in realism. People began to refocus on spiritual life and the real state of society in the present day, turning their attention to new social issues. Realism once again became a powerful artistic approach that could confront reality and address social problems. Artists like Wang Hongjian, Xin Dongwang, and Xu Weixin focus on current real life, directly facing reality, and paying attention to vulnerable groups, reflecting social issues and the current state of society. Over the past decade, realism has developed steadily and solidly. The realist creation of major historical themes and the depiction of contemporary Chinese life have become two prominent forms of realism in the new century. Realism is now required to shape national and contemporary spirits, highlighting the awareness of constructing both national identity and contemporary relevance in realist art.

2. The Selection of Daily Life Themes

The so-called “daily life,” from the perspective of time and space, primarily refers to the continuous and repetitive cycle of the subject within the basic elements of human social life in a material-based reality. Because this process unfolds as the extension of time and the recurring cycle of formal elements, its overall aesthetic characteristic is manifested in ordinariness and simplicity.

After the reform and opening-up, China entered a new period of social development, which also marked a rising period for domestic art. As some artists and art critics began to promote and advocate for the realist style, and during the same period, domestic artists were influenced by Soviet oil painting, Chinese realist oil painting began to show a vibrant side. The development of realist oil painting shifted from the previous focus on thematic and ideological creation to outdoor sketching, direct depictions of contemporary life scenes, and attention to the living conditions of the lower-class people.

In the 21st century, Chinese realist oil painting has increasingly focused on the theme of daily life. This focus is not only a true reflection of reality but also a deep exploration of national culture. Through the meticulous depiction of ordinary people’s daily lives, such as the lively atmosphere of street corners, the hardworking figures in the fields, and the warm moments of family chores, the artists vividly showcase the diligence, kindness, and optimistic spirit of the Chinese people. The choice of such themes highlights the artists’ attention to social reality and carries a profound love for and a firm commitment to the inheritance of national culture.

3. Artistic Expression of National Identity

3.1 Use of Color and Composition

Western realist oil painting emphasizes the authentic representation of the real world, and as such, color usage is focused on realism. Artists carefully observe and depict the color changes of natural objects, creating a lifelike effect in the painting. In terms of composition, there is also a pursuit of symmetry and balance to create a sense of stability. This effectively guides the viewer’s gaze and conveys an inherent sense of order and beauty when viewing the artwork.

In contrast, Chinese artists, when creating oil paintings, often showcase a unique artistic style and cultural depth. Whether consciously or unconsciously, they incorporate Chinese national spirit into their works. The use of color tends to be more subtle and restrained, reflecting the artist’s inner emotions and thoughts to some extent. In terms of composition, they draw inspiration from the concept of “leaving blank” (留白) in traditional Chinese painting, creating a visual effect of “virtual and real coexisting” (虚实相生) through skillful use of empty space. This not only gives the painting a sense of depth but also makes it more dynamic and poetic. The combination of color and composition reflects both the absorption of Western realist oil painting techniques and the artists’ deep cultural roots and unique creative abilities.

The Chinese contemporary artist Wu Guanzhong (吴冠中) devoted his life to the modernization of Chinese painting and the nationalization of oil painting. In his creations, he skillfully merged the compositional forms and brushwork language of Chinese painting with the formal language of Western modern painting. The unique artistic language and artistic ideas reflected in his works have provided new ideas for the creation of modern art.

In Wu Guanzhong's oil painting "Water Lane" (《水巷》), the artist simplifies the composition by eliminating unnecessary light and shadow, transforming specific scenes and human dynamics into visual symbols. Utilizing traditional Chinese aesthetics, the artist adopts the technique of "leaving blank space" and distills the black-tiled, white-walled buildings of the Jiangnan region into simple points, lines, and surfaces, arranged within the painting. In terms of color, Wu draws heavily from Chinese ink painting, using subtle and elegant tones to create a tranquil and distant atmosphere. The use of the three basic colors—black, white, and gray—not only makes the composition cleaner and more vibrant but also complements the characteristics of the Jiangnan water town, presenting a unique Eastern charm. It creates an artistic conception rooted in Chinese traditional aesthetics and expresses a deep sense of beautiful nostalgia. Wu Guanzhong made significant contributions to the development of both Chinese and Western cultures. The white walls and black tiles in his works have revolutionary significance, sparking reflections among the younger generation on the nationalization of Chinese oil painting and guiding them to realize their own artistic value in their oil painting creations.



Wu Guanzhong, "Water Lane", oil on canvas, 73 x 60 cm.

3.2 The Shaping of Human Figures

Realist oil painting places great emphasis on capturing the expressions, movements, and emotions of human figures. Through meticulous depiction, it vividly presents the joys, sorrows, thoughts, and feelings of individuals on the canvas. This highly detailed approach not only makes the figures appear lifelike but also deeply reveals the inner world and emotional changes of ordinary people, allowing viewers to perceive the stories and emotions behind the characters as they appreciate the artwork. By refining the depiction of human figures, realist oil painting not only achieves an accurate external resemblance but also attains a deeper spiritual likeness, vividly reflecting the true emotions and psychological states of people in various life scenarios.

Chinese artists, while drawing extensively from the Western tradition of realist figure painting, have skillfully integrated their own cultural elements. Xin Dongwang (忻东旺), for example, deeply studied the essence of realist oil painting while deliberately deviating from conventional realist techniques and stylistic norms. His realist paintings often exhibit slight exaggerations and distortions—his figures typically have short, stocky bodies with large hands and feet. This approach was inspired by Han Dynasty pottery figurines, Song Dynasty painted sculptures in the Jin Shrine, and the statues of celestial kings in Shuanglin Temple, among other forms of Chinese folk art. He incorporated the traditional Chinese aesthetic principles of expressive imagery, capturing the essence of a subject, and the belief that one's external appearance reflects their inner spirit, thereby infusing oil painting with a distinctly Chinese artistic sensibility.



Xin Dongwang, "Breakfast", oil on canvas, 190×200 cm.

His works often focus on the lives of people at the lower rungs of society, using an almost oppressive visual language and heavy brushstrokes to depict the daily existence of these marginalized individuals, highlighting their resilience and vitality. For example, in his painting “Breakfast” (《早点》), he portrays a group of ordinary laborers eating at a street-side breakfast stall. The painting features people from various backgrounds—laid-off workers, retirees, and migrant laborers—spanning different age groups. Their expressions of focus, satisfaction, and enjoyment while having breakfast not only capture their physical characteristics but also reflect their inner world and the hardships of their lives. With his unique artistic approach, the painter infuses his sympathy and respect for these ordinary workers into the artwork. His slightly exaggerated forms, inspired by Chinese folk art, make his depictions distinctive while preserving a strong sense of realism.

3.3 The Spiritual Outlook in Regional Characteristics

China, as a vast country with an expansive territory, nurtures a rich and diverse cultural landscape, with significant cultural differences among its various regions. Against this backdrop of cultural diversity, Chinese oil painting, when depicting scenes of daily life, goes beyond mere representation and focuses on deeply exploring and showcasing the unique regional characteristics and vibrant ethnic customs of different areas. For example, some works capture the gentle beauty of the water towns in Jiangnan, while others depict the vast and majestic landscapes of the northern grasslands. These oil paintings not only vividly reflect the natural scenery and profound cultural heritage of various regions in China but also, on an artistic level, deeply embody the distinct national and regional characteristics of Chinese oil painting. This infusion of cultural essence enhances the uniqueness and artistic charm of the works.

Zhang Dongfeng’s (张冬峰) landscapes are filled with poetic charm, warmth, and elegance, making him a prominent representative of the “Southern Landscape” school of painters. His works exude a sense of tranquility and ethereality, with free-flowing and expressive brushwork. He masterfully integrates the unique texture of oil painting with the emotional essence of Chinese freehand brushwork, creating a serene and peaceful aesthetic realm of landscape painting.



Zhang Dongfeng, "Homeland", Oil on Canvas, 160x150cm

The painting "Homeland" (《家园》) clearly embodies a new artistic style that integrates the expressive nature of traditional Chinese painting with Western techniques. It profoundly reflects Zhang Dongfeng's deep emotional connection to his hometown, where he grew up. In his later works, he further explored and refined his use of color tones. This piece conveys the hazy beauty and poetic atmosphere characteristic of traditional Chinese landscape painting. The influence of Chinese ink painting is evident, as despite the dominant green tones, subtle shades of dark green and yellow-gray are incorporated, enhancing the work's strong sense of Chinese cultural identity.

Bai Yuping (白羽平) was born in Shanxi, where the arid Loess Plateau nurtured his broad-minded and compassionate character. The hardships of life granted him a deep and profound understanding of existence. Bai Yuping's works often take the Loess Plateau as their subject matter, using the medium of oil painting to vividly depict its grandeur and richness. For instance, in his painting "Youyu" (《右玉》), he masterfully captures the vast expanse of the yellow earth, the boundless sky, and the towering mountains of the plateau. The composition is majestic and expansive, skillfully balancing solidity and emptiness. The strong contrast of light and shadow enhances the dramatic effect, while his adept use of yellow tones conveys the depth and substance of the landscape. Bai breaks away from traditional oil painting techniques by drawing inspiration from Chinese expressive landscape painting, integrating its essence into his work to develop a unique artistic style. His paintings not only showcase the natural beauty of the Loess Plateau but also reveal the lives and spiritual essence of the people inhabiting this land.



Bai Yuping, "You Yu" Oil on Canvas, 120x160cm

4. The Value of Chinese Realist Nationalism

The national character of realist oil painting not only refers to the differences in painting techniques and languages between China and the West, but more importantly, it reflects the artist's psychological grasp and reflection on national aesthetics and the characteristics of the times. The aesthetic consciousness of a nation often differs from that of other nations and is unique. This consciousness is formed through the accumulation of influences from various factors such as geography, environment, customs, politics, economy, morals, religion, and ways of thinking throughout the long course of history. It encompasses people's thoughts, emotions, and aesthetic ideals. The creative methods followed by a nation in artistic activities are specific embodiments of its aesthetic consciousness. Art, as both a form of national aesthetic expression and a cultural form, permeates into people's minds, accumulating as a "collective unconscious" that subtly influences the aesthetic psychological structure of the nation, thereby showing historical continuity in national aesthetics. Chinese art originates from the cultural background of Chinese aesthetics, philosophy, ethics, and history. The Confucian ideal of "the beauty of harmony" and the Taoist notion of "returning to simplicity and truth" form the theoretical foundation for the development of Chinese art.

In today's world, the national value of realist oil painting is reflected in its promotion and inheritance of national spirit. Through unique artistic techniques, realist oil painting materializes national spirit, allowing viewers to deeply feel its essence and power while appreciating the artwork. This power is an important source of inspiration for a nation to continuously move forward and strive relentlessly. At the same time, the national character of realist oil painting is also an important force driving Chinese art toward the world. As the saying goes, "What is

national is also universal,” under the context of globalization, cultural exchanges among nations are increasingly frequent. As an important part of Chinese art, the national characteristics of realist oil painting have not only gained international attention and recognition for Chinese art, but also provided unique cultural resources and spiritual support for Chinese art’s global presence.

Therefore, we should place great importance on the national value of realist oil painting, actively promote its development and inheritance, and allow this unique art form to shine even more brilliantly in the new era.

5. Conclusion

Realism in the art world, as an externalized thought and spirit, reflects the real life of the people. It is not only the artist’s profound insight into society but also a deep understanding and expression of national spirit. Realist oil painting, with its unique artistic language, records the joys, sorrows, and emotions of the people, showcasing the changes in society, and has become a bridge connecting the past and the future. In the context of the new era, we should continue to promote the fine traditions of realist oil painting, using the brush to record the daily lives of the people, convey the national voice, and make this art form an important force in driving social progress and promoting national spirit. Through realist oil painting, we can better understand the history and culture of the nation, feel the spirit and strength of the nation, and thus better inherit and develop our national culture.

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乌孜别克斯坦和俄罗斯家庭角色与关系的心理特征
**PSYCHOLOGICAL FEATURES OF FAMILY ROLES AND
RELATIONSHIPS IN UZBEK AND RUSSIAN FAMILIES**

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摘要：本文以乌兹别克斯坦和俄罗斯家庭的跨文化比较为例，探讨了家庭角色和关系的心理特征。基于两组相关图和婚姻满意度比较表的分析，作者揭示了传统家庭结构和文化价值观对人际关系动态的影响。研究结果表明，情绪氛围、家庭角色分配和满意度水平存在显著差异，强调了文化背景在塑造家庭行为方面的重要性。

关键词：家庭、关系、家庭角色、文化、传统、跨文化心理学、婚姻满意度。

Abstract. *The article examines the psychological characteristics of family roles and relationships using the example of a cross-cultural comparison of Uzbek and Russian families. Based on the analysis of two correlation constellations and a comparative table of marital satisfaction, the author identifies the influence of traditional family structures and cultural values on interpersonal dynamics. The results indicate significant differences in the emotional climate, distribution of family roles and level of satisfaction, emphasizing the importance of the cultural context in shaping family behavior.*

Keywords: *family, relationships, family roles, culture, traditions, cross-cultural psychology, marital satisfaction.*

The psychological climate in the family plays a key role in the personal development of its members. This is especially evident when analyzing families within different cultural traditions, such as Uzbek and Russian. Cultural-comparative analysis allows us to understand how the characteristics of family roles influence the behavior and values of different generations.

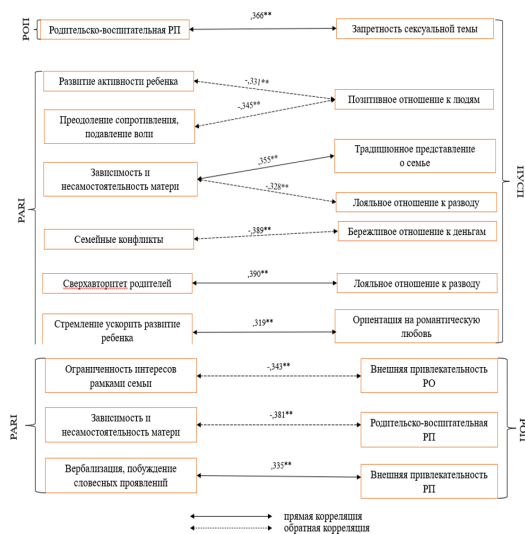
This study focuses on how the cultural background of Russian and Uzbek traditions influences the interaction of family members in modern times. While Russian families are gradually moving towards an egalitarian model, many Uzbek families continue to maintain a traditionally hierarchical structure. This discrepancy creates the basis for comparative analysis.

The aim of the study is to demonstrate the importance of a qualitative description of the cultural context within the framework of family psychology and to conduct a practical comparative analysis.

Research objectives:

1. To determine the significance of the psychological characteristics of family roles and relationships based on a theoretical comparative analysis.
2. To compare Russian and Uzbek families using correlation analysis and marital satisfaction assessment.

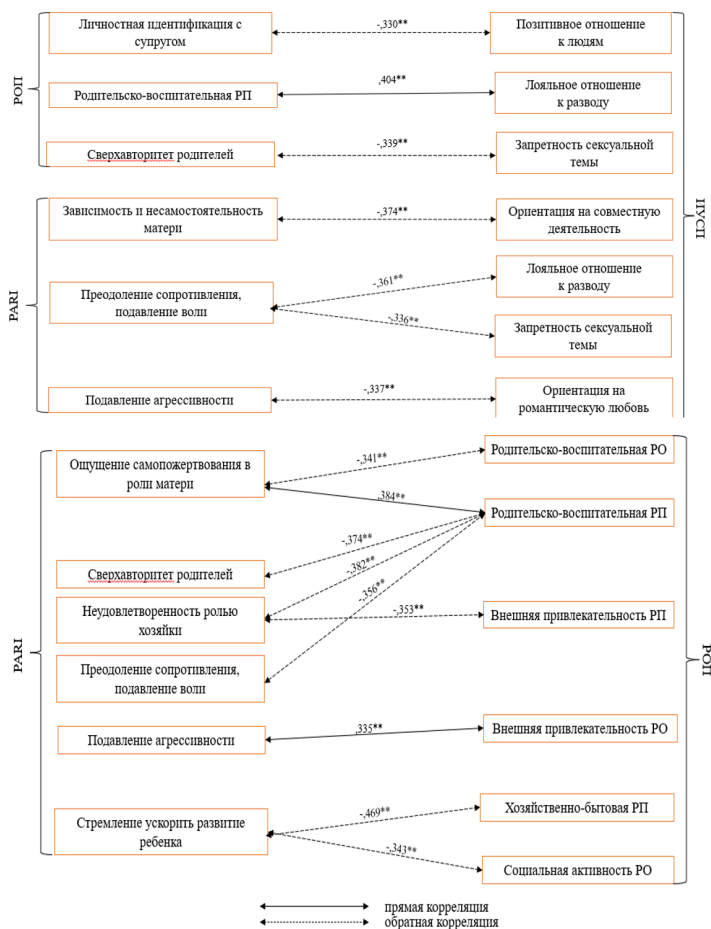
Previously, scientists have noted differences in the dynamics of family relationships between cultures. For example, E.G. Alimova indicated that in traditional Uzbek families, the practice of several generations living together leads to complex relationships, where the older generation puts pressure on young spouses, especially women [1]. A.D. Gusova emphasized the spread of the egalitarian model in Russian families, where responsibilities are shared equally and the emotional needs of spouses play an important role [2]. O.N. Kharlova emphasized the importance of the role of older family members in the formation of intergenerational interaction and upbringing [3]. The comparative part of the study is based on the analysis of two correlation constellations: one for Russian married couples and one for Uzbek ones. These constellations allow us to identify relationships between variables such as attitudes toward parenthood, conflicts, divorce, and romantic expectations.



Note: * $p < 0.05$; ** $p < 0.01$

Figure 1. Correlation constellation of research variables for Russian married couples (Source: compiled by the author)

In turn, the correlation constellation of research variables for Uzbek married couples will look like this:



Note: * $p < 0.05$; ** $p < 0.01$.

Figure 2. Correlation constellation of study variables for Uzbek married couples (Source: compiled by the author).

Based on the correlation analysis, it can be noted that, at present, there is a certain progress in the aspect of Russian and Uzbek family relations. However, it should be emphasized that the course of this progress is far from ideal. In most

cases, this occurs due to the irrelevance of influential family customs and traditions to everyday family life.

Additionally, a comparative analysis of marital satisfaction was conducted based on rank statistics. The results are presented in the table below:

Table 1.
Results of comparative analysis of the marital satisfaction index of Uzbek and Russian married couples

	<i>Middle rank</i>		<i>Asymptotic significance</i>
	<i>Uzbeks (n=60)</i>	<i>Russians (n=66)</i>	
<i>Marital Satisfaction Scale</i>	57,42	69,03	0,074

As can be seen from the analyzed factual data, Uzbek married couples are not as happy as Russian married couples. As mentioned above, this fact is explained by the presence of many outdated traditions in Uzbek families, which mean, in practice, the unquestioning submission of the wife to her husband in all matters. Russian married couples are much more liberal in this matter, the views of many spouses are aimed at finding some kind of compromise and mutual understanding between spouses in relation to various joint affairs.

In conclusion, I would like to note that this work analyzed the psychological characteristics of family relationships and roles using the example of comparing Russian and Uzbek families. By demonstrating the correlation constellation of research variables for Russian and Uzbek married couples and the final table of family happiness indicators for Russian and Uzbek married couples, it was shown that Russian married couples are, in general, happier than Uzbek married couples. This is mainly due to greater liberality and the rejection of outdated traditions. These data were most clearly visible in the context of the final scale of marital satisfaction among Russian and Uzbek families.

The results of the study will be considered intermediate, since the human psyche is constantly subject to change, which is especially relevant for marital relationships. Therefore, in the context of correlation psychology, further research can be expected in relation to this topic.

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单克隆抗体药物市场的主要特点

**KEY FEATURES OF THE MARKET FOR MONOCLONAL
ANTIBODY-BASED PHARMACEUTICALS**

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摘要: 为民众提供高质量、高效、安全且价格合理的单克隆抗体 (mAb) 药物是此类产品市场的主要使命。本研究旨在明确俄罗斯单克隆抗体药物市场的主要特征。研究采用了系统分析、结构分析、比较分析、市场营销和内容分析等方法。结果表明,单克隆抗体市场创新性强、技术含量高、价格昂贵、在疾病分类学中应用广泛、处方风险较高、科学发展迅速,研发数量、原研药和仿制药数量以及采购量均呈快速增长趋势。但俄罗斯制造商数量少,剂型种类少。确保公平获得创新的单克隆抗体治疗方法对于落实医疗保健发展优先方向、恢复和加强公众健康至关重要。

关键词: 单克隆抗体、单克隆抗体、单克隆抗体市场、药品市场、药品市场特征。

Abstract. *Providing the population with high-quality, highly effective, safe and affordable drugs based on monoclonal antibodies (mAb) is the main mission of the market for these products. The purpose of the work is to establish the key features of the Russian market for drugs based on mAb. The work uses the methods of system, structural, comparative, marketing and content analysis. It is shown that the mAb market is innovative and high-tech, expensive, with a wide range of applications in nosologies, prescription with increased danger, rapidly developing scientifically and rapidly growing in the number of developments, in*

the number of original and reproduced drugs, in terms of purchase volumes, with a small number of manufacturers in Russia and a small number of dosage forms. Ensuring fair access to innovative treatment methods using mAb is vital for the implementation of the priority direction of healthcare development to restore and strengthen public health.

Keywords: Monoclonal antibodies, mAb, monoclonal antibody market, drug market, features of the pharmaceutical market.

In recent decades, due to the rapid development of biotechnology, innovative drugs based on monoclonal antibodies (MAbs) have been actively developed and used in medical practice [1-4]. Antibodies (immunoglobulins) are a special class of glycoproteins produced by B-lymphocytes in response to the introduction of foreign antigens into the body [5]. MAbs for medical use are immunoglobulins or immunoglobulin fragments with established specificity, produced by a single clone of cells [6]. Due to the unique ability of MAbs to selectively interact with antigens, the scope of their application is expanding every year. The development, circulation and use of drugs based on MAbs is one of the most promising and actively developing areas in medical and pharmaceutical science and practice. The market for drugs based on MAbs is part of the general market for drugs (pharmaceutical market), and functionally belongs to the market of consumer goods and services [7-11]. Its main mission is to provide the end consumer with high-quality, highly effective, safe and affordable drugs based on mAbs. Therefore, consideration of the features of the market of drugs based on mAbs is relevant and promising.

The purpose of the work is to establish the key features of the Russian market of drugs based on monoclonal antibodies.

Materials and methods

The object of the study is the market of drugs based on mAbs in Russia. The subject of the study is the distinctive features of this market. The work used the methods of system, structural, comparative, marketing analysis, content analysis.

Results and discussion

The market of drugs based on mAbs is innovative and high-tech. The production of drugs based on mAbs is a complex process using the latest technologies. When choosing a strategy for isolating antibodies, the source of their production, the required level of affinity, the scope of application, time and budget constraints are taken into account [12]. Each method has its strengths and weaknesses. This is reflected in the time of their production, cost, quality, consumer properties, including their specificity. The use of advanced innovative technologies and artificial intelligence (AI) helps in the development of drugs based on mAbs [12-14].

This market is expensive. Obtaining MAbs and drugs based on them is associated with significant costs. This is reflected in their cost. According to the analyti-

cal company DSM GROUP, the highest average weighted cost of a package of the drug is noted in the group “Antineoplastic drugs and immunomodulators” - about 745 rubles [15]. The high cost of drugs based on mAbs significantly limits their availability for certain categories of citizens. It is in this market that the goals and objectives of the state social policy to ensure the rights of citizens to life and health are realized. The inclusion of drugs based on mAbs in the annually approved list of VED (vital and essential drugs) and their sale at the expense of the state budget make it possible to implement the appropriate preferential provision of the population with essential drugs. This is a market with a wide range of applications of mAbs and drugs based on them in nosologies: oncological, autoimmune, cardiovascular and infectious diseases, inflammatory reactions of various genesis, hepatitis B, AIDS, allergic reactions, muscular dystrophy, Alzheimer’s disease, asthma, diabetes and other diseases (Table 1). Growing demand for drugs for the treatment of oncological diseases and immunotherapy, as well as a decrease in the number of side effects will contribute to the growth of this market.

Table 1
Medical use of some mAbs

Trade name: <i>mAbs</i>	Pharmacological group	Code MKB-10 [16]	Application [17]
Adalimumabum	Immunosuppressants	H20.0, H20.9, K50, K51, L40.5, L73.2, M06.9, M07.2, M07.3, M07.4, M07.5, M08.0, M08.9, M45	Rheumatoid arthritis, Crohn’s disease, plaque psoriasis, psoriatic arthritis, ankylosing spondylitis, juvenile idiopathic arthritis, ulcerative colitis, hidradenitis suppurativa, uveitis
Bevacizumabum	Antineoplastic agents	C18, C19, C20	Metastatic colorectal cancer
Benralizumabum	Other respiratory agents	J45.9	Bronchial asthma
Infliximabum	Immunosuppressants	K50, K51, L40, M06.9, M07.3, M45	Rheumatoid arthritis, ankylosing spondylitis, psoriatic arthritis, psoriasis, Crohn’s disease, ulcerative colitis
Nivolumabum	Antineoplastic agents	C34, C43, C64	Melanoma, non-small cell lung cancer, renal cell carcinoma
Palivizumabum	Other respiratory agents	B97.4, J22, P27.1, Q24.9	Prevention of severe lower respiratory tract infection

Risankizumabum	Immunosuppressants	L40, L40.5	Crohn's disease, psoriasis, psoriatic arthritis, asthma
Rituximabum	Immunosuppressants, antineoplastic agents	C82, C83, C85.1	B-cell non-Hodgkin's lymphomas
Trastuzumabum	Antineoplastic agents	C50	HER2-overexpressing disseminated breast cancer
Cetuximabum	Antineoplastic agents	C18, C19, C20, C76.0, C79.8	Metastatic colorectal cancer, squamous cell carcinoma of the head and neck
Eculizumabum	Immunosuppressants	D59.3, D59.5, G36.0, G70.0	Atypical hemolytic uremic syndrome, paroxysmal nocturnal hemoglobinuria, generalized myasthenia gravis, neuromyelitis optica-associated disorders

The market for mAb-based drugs is rapidly growing in terms of the number of drug developments and rapidly developing scientifically, with a trend of further steady increase in the number of new drugs and loss of relevance of existing, but already outdated drugs on the market. Noteworthy is the significant share of newly registered Russian drugs in this market, for example, Arvestio® (11.02.2025), ACELBIA® (15.08.2024), Vectibix® (14.01.2025), Pemboria® (14.10.2024), Trastuzumab (09.09.2024), FORTEKA® (19.11.2024). An increase in research and development in the field of mAb creation, large investments in them will contribute to the development of this market.

This is a rapidly growing market both in terms of the number of original drugs and biosimilars (bioanalogs). In the Russian Medicines Register, 49 trade names are presented in group 0055 Antineoplastic agents – monoclonal antibodies alone, 16 of which are biosimilar [17]. The phenomenon of mass loss of intellectual property protection for drugs based on mAbs was observed on the world market in the 2010s. This led to the development of several biosimilars at once and a gradual increase in their market share, while the prices for these drugs were significantly lower. In addition, the presence of biosimilar drugs on the market significantly affects government procurement. The competition between manufacturers of original and generic drugs necessary for market development is created. This is a market with a small number of manufacturers in Russia and a small number of dosage forms. Of the completely Russian companies, only two were able to put mAb production on stream: the BIOCAD and R-Pharm groups of companies. Currently, the BIOCAD portfolio consists of 68 drugs, 13 of which are original and 23 are biological. More than 40 drugs are at various stages of development. The portfolio of the company “R-Pharm” includes 40 drugs, including 10 antitumor.

The Russian pharmaceutical company “Binnopharm Group” (part of AFK “Sistema”) is currently actively working on organizing the production of drugs based on mAbs. Among the company’s first products are denosumab for the treatment of osteoporosis and adalimumab, which is effective in autoimmune diseases such as rheumatoid arthritis and psoriasis. Currently, the task is to optimize the production process, use technologies that ensure the rapid extraction of mAbs, improve the quality and volume of production of the target product. The market for drugs based on mAbs is rapidly growing in terms of drug purchases. The total market size is currently about \$ 190 billion, and by 2032 it may reach more than \$ 600 billion [18]. Its average annual growth rate is expected to be 8.4-8.5%. Figure 1 presents our own data on the volume of purchases of drugs based on mAbs in 2014-2023.

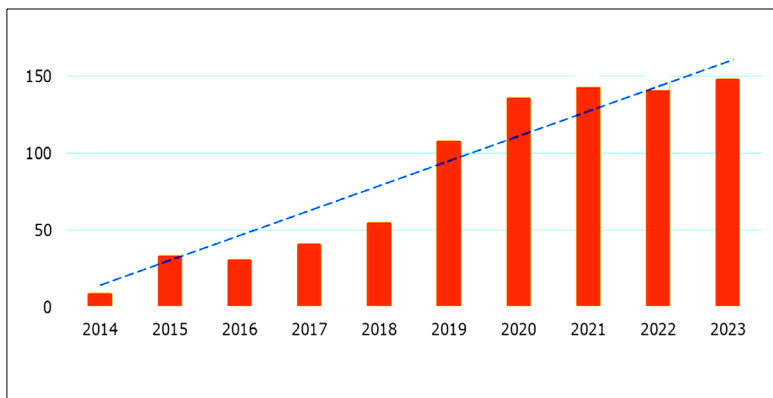


Figure 1. Dynamics of the total volume of purchases of mAb-based drugs in Russia in 2014-2023: on the abscissa axis - the year of purchases; on the ordinate axis - the sum of purchases, billion rubles

This market is represented by prescription drugs with increased danger, therefore they have a significant number of contraindications and use with caution, a strict dosing regimen and special dosing instructions for certain groups of patients, a significant list of possible side effects, as well as special instructions for pharmacokinetics in individual patients.

Conclusions

Despite the promising growth in the number of original and generic drugs based on mAbs in Russia, the increase in the volume of their purchases, this market faces certain difficulties and limitations. High production costs create significant problems for drugs to enter the market. The complexities of the mAb production process require significant investments in technology and infrastructure,

which prevents small companies from entering the market. In addition, lengthy regulatory approval processes delay the use of new drug treatments, limiting timely access for patients in need. Another constraint on the development of the mAb-based drug market is the emergence of alternative drug therapies. This increases competitive pressure on mAbs and requires continuous innovation to maintain the relevance of the market.

Market opportunities are associated with the development of various mAbs for the treatment of oncological diseases and their growth, technological advances, and increasing collaboration among stakeholders. In addition, the expansion of mAb-based drugs in autoimmune diseases and infectious diseases creates new opportunities for market growth. The integration of innovative technologies and artificial intelligence in drug development increases the efficiency and success of identifying promising mAbs.

One of the challenges for the development of the mAb-based drug market is the gradual increase in competitive players. On the one hand, this can lead to “price wars” among manufacturers and affect profits and sustainability, but on the other hand, it will have a positive effect on consumers. The problem of accessibility of this group of drugs for patients remains extremely critical, especially in low-income regions. Ensuring fair access to innovative treatment methods using mAbs is vital for the implementation of the priority direction of healthcare development to restore and strengthen the health of the Russian population.

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欧米伽-3 多不饱和脂肪酸对健康受试者认知能力的影响
**EFFECT OF OMEGA-3 POLYUNSATURATED FATTY ACIDS ON
COGNITIVE PERFORMANCE IN HEALTHY SUBJECTS**

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摘要：本实验旨在探究 Omega-3 多不饱和脂肪酸对健康患者认知功能的影响。受试者服用膳食补充剂“Doppelherz Active Omega-3”4 周。在服药前（对照组）、服药 2 周后和 4 周后评估认知功能状态。结果发现，服用含 Omega-3 多不饱和脂肪酸（PUFA）的药物可有效改善健康患者的工作记忆、短期记忆、言语学习过程以及语义记忆系统中语义信息的处理状态。

关键词：Omega-3 多不饱和脂肪酸（PUFA）、二十二碳六烯酸、二十碳五烯酸、认知功能、脑源性神经营养因子（BDNF）。

Abstract. *The experiment investigated the effect of omega-3 polyunsaturated fatty acids on the cognitive functions of healthy patients. The subjects took the dietary supplement “Doppelherz Active Omega-3” for 4 weeks. The state of cognitive functions was assessed before taking the drug (control), after 2 weeks and after 4 weeks of taking the drug. It was found that the use of a drug containing omega-3 PUFA effectively improves the state of working, short-term memory, verbal learning processes and processing of semantic information in the semantic memory system in healthy patients.*

Keywords: *omega-3 polyunsaturated fatty acids (PUFA), docosahexaenoic acid, eicosapentaenoic acid, cognitive functions, brain-derived neurotrophic factor (BDNF).*

Adequate nutrition implies sufficient intake of all macro- and micronutrients necessary for a person. Epidemiological studies of the state of actual nutrition in various regions of Russia reveal violations of the nutritional status, the most common of which is a deficiency of omega-3 polyunsaturated fatty acids (omega-3 PUFA). Insufficient dietary PUFA intake is not only a problem in Russia. This situation is typical for the Western diet. A similar situation is also observed in countries with a traditionally high consumption of seafood, for example, in Norway, where the level of saturated fat intake is at the upper limit of the recommend-

ed norm, and polyunsaturated fatty acids are at the lower limit [9]. Meanwhile, a deficiency of essential PUFA, despite their small quantitative volume in relation to the nutrients of the diet, can be decisive for human health. It has now been proven that long-chain omega-3 PUFAs help to normalize the lipid profile and slow down atherogenesis; prevent thrombus formation, protecting against the early development of coronary heart disease, heart attack, stroke; restore elasticity and tone of blood vessels, reduce blood pressure; have a therapeutic effect in diabetes mellitus, metabolic syndrome [4]. While the role of omega-3 PUFA in the treatment of cardiac and therapeutic diseases is well known, the use of omega-3 PUFA in neurology and psychiatry has a relatively recent history. However, the results of a systematic analysis have shown that, from both fundamental and practical points of view, the use of omega-3 PUFA, primarily in the form of docosahexaenoic acid (DHA), has broad prospects in the treatment and prevention of dementia, age-related decline in cognitive abilities, depression, stroke, visual impairment, and various neurological pathologies in children. Similar studies are covered in the literature. And there are currently practically no studies of the effect of omega-3 PUFA on memory and learning processes in healthy adult patients under mental and physical stress.

Objective. To study the effect of omega-3 PUFA on memory processes in healthy subjects.

Materials and methods. The experiment involved 11 students aged 19-20 years. The subjects took the dietary supplement “Doppelherz Active Omega-3” for 4 weeks, 1 capsule once a day during meals. The drug contains fish oil from arctic salmon (the component contains docosahexaenoic and eicosapentaenoic acids in the amount of 24% of the daily intake).

The state of cognitive functions was assessed before using the drug (control), after 2 weeks and after 4 weeks of taking the drug, using a battery of tests: “test for the reproduction of 30 monosyllabic words” to determine the volume of working and short-term memory; test “reproduction of a list of 30 monosyllabic words after arithmetic counting”, assessing the volume of long-term memory; test “reproduction of a list of words and numbers after their threefold subvocal repetition”; “test of memorization of 30 monosyllabic words in four sessions”, characterizing the learning process with the participation of semantic memory; test “countdown by threes” to identify the speed of elementary thinking; test for classification of words by structural, phonemic, semantic and autobiographical code. Statistical data processing was performed using the Microsoft Office -2000 software package. The reliability of differences (control-experiment) was assessed using the Student’s (t) criterion and the Mann-Whitney (U) criterion.

Results and discussion. At the first stage, the volunteers’ working and short-term memory was examined. As established in the experiment, “Doppelherz Aktiv

Omega-3” reliably increased the working memory index, i.e. the percentage of reproduced monosyllabic words after a single reading of a list of 30 words. After 2 weeks of regular use of the drug, this indicator reliably increased by 8%, after 4 weeks by 15% compared to the control indicators ($P < 0.05$).

After using the drug omega-3 PUFA, short-term memory (i.e. the percentage of reproduced words at the end of the list from 26 to 30 places) significantly improved only after 4 weeks of using omega-3 PUFA by 20% compared to the control.

The use of omega-3 PUFA did not affect the long-term memory indicators. The percentage of reproduced words after counting back by threes did not change even by the fourth week of the experiment. The course of treatment with Doppelherz Aktiv Omega-3 also did not affect the processing of information in the process of verbal-digital coding.

Four-week treatment with the drug containing omega-3 PUFA improved the process of preserving semantic information in memory, as evidenced by a reliable increase in the number of reproduced words in the 1st, 2nd, 3rd, 4th sessions of verbal memorization of 30 monosyllabic words by 12%, 16%, 14% and 17%, respectively.

In the word classification test, it was revealed that the four-week course of treatment with omega-3 PUFA significantly improved the reproduction of words with a semantic characteristic. The number of reproduced words increased in the 1st, 2nd and 3rd sessions by 16%, 25% and 29%, respectively ($P < 0.05$). Distinguishing words by size, sound, autobiographical characteristics did not improve compared to the control.

Our study revealed that the use of a drug containing omega-3 PUFA improved semantic memory processes. This may be due to various mechanisms of action of omega-3 PUFA on the central nervous system (CNS). The extremely important biological role of PUFA is determined by their structural function. PUFA are key components of phospholipids embedded in cell membranes. This determines a number of their properties, especially fluidity, which in turn affects the activity of neurons. The fluid state of membranes, imparted to them by PUFA, allows for the creation of optimal conditions for the functioning of membrane-embedded enzymes, cellular pumps, ion channels, makes it possible to maintain the activity of cellular receptors and, accordingly, ensures their correct recognition of mediators and signaling molecules [7]. Omega-3 PUFAs, increasing the plasticity of erythrocyte membranes, increase their deformability, which contributes to an increase in blood fluidity and optimization of the process of oxygen transport to neurons of the central nervous system [11]. Recently, an important mechanism of the effect of omega-3 PUFAs, especially docosahexaenoic acid, on the central nervous system and cognitive functions has been identified, consisting in the regulation of

the level of brain-derived neurotrophic factor (BDNF). It has been established that BDNF is involved in the processes of formation of synaptic plasticity, influencing some forms of long-term potentiation of synaptic transmission (long-term potentiation, LTP) and long-term depression (long-term depression, LTD), underlying the processes of learning and memory [1, 8]. For the development of the neurophysiological correlate of memory – long-term potentiation of synaptic transmission (LTP) – the activity of NMDA receptors of cell membranes (N-methyl-D-aspartate) in the hippocampus and cortical neurons is of great importance. It has now been established that BDNF increases the activity of phosphorylation of NR1 and NR2B subunits of NMDA receptors and increases the number of channels opened by NMDA receptors [2]. Coding of synaptic events, as well as the formation of long-term memory, requires stabilization and maintenance of the active state of AMPA receptors (α -amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid receptor). There is evidence of an increase in the level of surface expression of AMPA receptors mediated by BDNF, including the movement of AMPA receptor subunits in the synapse [3]. BDNF regulates the balance of excitatory (glutamate) and inhibitory (GABA) mediator reactions in the brain. BDNF modulates postsynaptic inhibition of GABAergic neurotransmission by increasing the activity of GABAA receptors [6], which is an important mechanism, since maintaining a balance between inhibition and excitation is necessary for the normal functioning of the central nervous system (CNS).

The content of acetylcholine is also regulated by BDNF. Among neurotransmitters, acetylcholine is considered to be almost the main cognitive metabolite, and the cholinergic mechanisms of the brain, which provide mainly the information component of the learning process, play a major role in memory processes. It is believed that BDNF increases the activity of choline acetyltransferase in the structures of the forebrain, increasing the content of acetylcholine. BDNF is closely associated with the serotonergic (5-HT) system of the brain. A huge number of studies have established the participation of 5-HT in the regulation of various forms of behavior, motivation, in the development of adaptive skills and the organization of the process of consolidation of a memory trace [5, 10]. The close connection between BDNF and 5-HT has been demonstrated by numerous studies and is beyond doubt. The identification of the significant role of BDNF in the regulation of cognitive functions and stimulation of neuroplasticity opens up new opportunities for researchers in the treatment and prevention of vascular, traumatic, neurodegenerative diseases, memory and attention disorders in children, mild cognitive impairment in healthy people due to emotional and physical overload. However, the delivery of large protein molecules to various structures of the nervous system remains a difficult obstacle to overcome. In this regard,

the discovery of BDNF-stimulating effects of omega-3 PUFAs and, in particular, docosahexaenoic acid is very promising.

Thus, omega-3 PUFAs are the most important essential nutrients. The literature has accumulated a sufficient amount of data on the possible mechanisms of action of omega-3 PUFAs on cognitive processes and various types of memory, which explains the feasibility of their use in all ages of humans.

Conclusions. Thus, four-week use of a drug containing omega-3 PUFA effectively improves the state of working, short-term memory, verbal learning processes and processing of semantic information in the semantic memory system in healthy patients.

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在牙科实践中应用医疗康复技术“创伤记忆”的经验

**EXPERIENCE IN THE APPLICATION OF THE MEDICAL
REHABILITATION TECHNOLOGY «MEMORY OF TRAUMA» IN
DENTAL PRACTICE**

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摘要。牙医诊所的并发症通常发生在创伤发生之前或期间，表现为血压升高或降低、心率剧烈波动（高血压危象导致）、昏厥、心律失常等。记忆会储存、积累、复制，并将新旧事物进行比较。童年时期的最初创伤事件会形成一种瞬时、整体、个体的反应，这被称为“创伤记忆”。在创伤事件发生之前、发生时和发生之后发生的一切都会被固化，形成稳定的分子信号结构，被定义为恐惧情绪，是神经肌肉系统紧张和为求生做好准备的条件。任何创伤性创伤，无论是身体上的还是精神上的，都会形成类似的反应。最初的体验与后续事件紧密相连。新事件与记忆中存储的事件的比较会持续进行。“创伤记忆”是构成后续创伤抵抗机制的主要因素。

关键词：植入、创伤记忆、颞下颌关节疾病、记忆、牙科恐惧症、并发症、疼痛、侵袭、恐惧情绪。

Summary. Complications at the dentist's office occur before or during the invasion and manifest themselves in the form of an increase or decrease in blood pressure, strong fluctuations in heart rate, as a result of hypertensive crises, fainting, arrhythmias, etc. Memory stores, accumulates, reproduces, compares the new with the old. The first traumatic events of childhood create an instantaneous, global, individual response, which is recorded as a "trauma memory". Everything that happened before, on time and after the traumatic event is fixed, becomes a stable molecular signaling structure, defined as the emotion of fear, and is a condition for the tension of the neuromuscular system and readiness for action in order to survive. A similar reaction is formed in any traumatic invasion, whether it is physical or mental. The first experience is in continuous connection with

subsequent events. The comparison of a new event with one stored in memory occurs constantly. "Trauma memory" is the main factor that includes the mechanism of resistance in subsequent invasions.

Keywords: *implantation, trauma memory, diseases of the temporomandibular joint, memory, dentophobia, complications, pain, invasion, emotion of fear.*

Introduction. In any physical and chemical processes, electronic, electrical, magnetic, resonant-oscillatory relationships occur, which determines this or that voltage both in bodies located in space and in the space itself. Such voltages are in a dynamic state and are capable of accumulating and being expended (1). It has been established that when energy is accumulated in a chain of successive chemical isomeric reactions, and this is typical for a living organism, at the end of the process a material form with higher energy ("energetically excited") is organized, subsequently, even with a relatively small impact (as a kind of "trigger"), a physical and chemical process can be launched with the release of large energy at the final stage. The process of discharging the voltage of matter in space occurs due to the energy previously stored in the molecular system. The accumulation of energy occurs gradually, and the release of energy is fast, short-term. According to the model of directed transmission of signals in complex molecules (2), a group of molecules is capable of receiving a single, clear signal from the external environment and transmitting it in the form of electron-vibrational disturbance to the body and converting it into a chemical signal with the release of a molecule that was previously absent in the system. This is not just a recoding of information, but a fundamental change in it. A complex molecule is capable of not only responding to a specific external signal, but also of reconstructing the spatial position of molecules, as a result of which a complex molecule, transforming its isomeric form, can change the spectrum of the perceived signal. Thus, molecular systems have the property of not only transmitting energy to another region of space, but also transforming information (2).

There is evidence in the literature that electromagnetic radiation (EMR) of the millimeter range interacts with the structures of the body at the molecular, cellular and organ levels (3). At the same time, the cells of the body generate their own EMR of the millimeter, infrared and visible range of ultra-low intensity ($\mu\text{W}/\text{cm}^2$) in the form of a modulation signal. This allowed us to assume the existence of electromagnetic connections, through which a constant information exchange occurs within a single closed system of the organism. Considering that hundreds of thousands of interconnected physical and chemical processes occur simultaneously in a cell, an idea of the amount of perception of specific signals and the speed of processing the entire volume of information arises (4). Living cells are built on the basis of information, exist in a dense information environment, and live and

survive on the basis of the ability to generate, perceive, analyze and use information, directing it to maintaining their own homeostasis (6). Human perception of information from the external and internal environment begins with molecular structures through electronic, electrical, magnetic, resonant-oscillatory processes. These processes occur with weak energy costs, due to the initial state of tension of complex molecular systems, in which there is sufficient wave action for a response to occur (2). Input systems of perception are a filter tuned to input effects, are under the control of their own experience, and are capable of constructing an image (5). It is generally accepted that living organisms are highly organized open systems that exist on the basis of exchange of matter and energy with the external environment. Living bodies perceive only a certain tiny part of the surrounding information. Only that part that they can perceive, for which there are usually special analyzers or receptors, as well as an internal system for analyzing and using this information. Such a specific system for perceiving and analyzing semantic information in living systems can be called a biothesaurus (6) (the term thesaurus is used in information theory to denote the totality of all information that a subject possesses). Different types and kinds of organisms have features of thesaurus organization, and therefore, they also have features of perception and processing, both the quality and quantity of information. Organisms are able to analyze the perceived information and adequately respond to it. Subsequent adaptation is ensured by physiological and behavioral reactions, changes in activity or the formation of new enzymes and other macromolecules needed in these conditions. As a result, an adequate response to signals from the outside world allows one to adapt and survive in changing environmental conditions. Streams of external information are inextricably linked with streams of internal information, which regulate all intracellular processes.

Organisms with a neuromuscular system, unlike a unicellular organism, meet their metabolic needs by combining with other elements of the organism into a functional system. A nerve cell collects, processes, and transmits information from other cells of the organism and is the place where information signals coming from a group of cells are analyzed, which significantly accelerates the reaction of the entire organism to the perception of information from the outside and from the inside (2,4,7). The formation of functional systems acts as a metabolic cooperation of nerve cells (7,5), which is the result of interactions of a more complex ordered process than in the simplest unicellular organism. The emergence of long-term memory as a complex, dynamically stable molecular structure is associated with an “engram”, a physiological trace of memory in the nervous system (8). Long-term memory requires the synthesis of RNA and protein, that is, it is based on the mechanisms of gene expression activation in the nervous system (7), which is directly related to the function of complex molecular systems and resonant-wave

interactions in them, their ability to process information. According to the hypothesis of the origin of muscle and nervous tissue, their development was simultaneous (6,7,8) and led to the emergence of the tension-relaxation, spasm-dilation mechanism, which contributed to faster and safer movement of the organism in space for the purpose of survival (5). Genetic information is stored in DNA molecules in the form of a genetic code - a strict sequence of nucleotide triplets. This information is used for the development and stable maintenance of the structural and functional organization of organisms and cells as systems. The input systems of nerve cells, synapses, can be considered as a filter for input signals, through which signs are formed (4). As information passes through the nervous system, it is quantitatively simplified and qualitatively complicated, which leads to the formation of an image, an "engram". The image that arose as a result of exposure, with the inclusion of the stress-realizing system, leads to the formation of a stable structure, a "trauma memory", and subsequently manifests itself as an emotion of fear, an expectation of a future dangerous event (9,10). In our opinion, "trauma memory" is the readiness of the muscular system to escape through action and is associated with the emotion of fear. Thus, "trauma memory" is one of the "engrams", a map of space for safe orientation in the surrounding world and keeps the neuromuscular system tense, spasm in constant readiness to escape from danger, while the diagnosis of the surrounding space for signs similar to the image of "trauma memory" becomes dominant and occurs continuously.

Due to the fact that information in the body is carried out in both directions, from the receptor to the central nervous system and back, then with the help of the voice, associated with the meaning of speech, that is, by transmitting ordered signals, it is possible to qualitatively change the system of relationships of signs in the subject and influence the objective system of perception.

Purpose of the study: assessment and analysis of the possibilities of medical rehabilitation technology, defined as "Trauma Memory" - a physiological complex response to surgical intervention.

Materials and methods: In the period from 2014 to 2024, over 12 thousand patients with various dental diseases were observed in the clinic. All patients were examined for the presence of "trauma memory" at the consultation stage. We tracked the feedback between the patient's primary reaction to the environment during the consultation, between the topic of conversation with the patient and the reaction to them by examining the pulse, using the pulsometry method, thus identifying the presence of traumatic experiences. In addition to the pulse, non-verbal signs were analyzed - paleness or redness of the skin, sweating, stiffness in conversation, tension, fussiness, the patient's train of thought was tracked, the possibility of an internal picture of the world was determined, and other examination methods were used. The study revealed groups with mental and physical injuries.

In the identified groups, after psychological preparation, there was a decrease in the quantity and quality of all types of common complications, and in the presence of a tendency for objective indicators to shift towards the development of pathological processes, regulation by the body's own reserves towards stability was noted. Identification of "trauma memory" made it possible to detect the risks of future complications at the stages of consultations; when identifying "trauma memory" and conducting appropriate preoperative preparation, the number of all types of complications decreased by more than 70%; the lack of psychological preparation significantly increases the risks of complications and patient dissatisfaction with the service. We used the obtained result to prevent complications (9). We conducted studies of the influence of mental processes (conscious and unconscious) on the treatment process; we conducted a study of a group of patients with TMJ dysfunctions (10). For the purpose of further research, we paid attention to patients who, when collecting anamnesis, revealed more than 1 phobia and analyzed the structure of the group. This group consisted of 56 people. As a result of the group study, the following incidence of the emotion of fear was revealed for such factors as: dentophobia (fear of dental treatment) in 45 people; acrophobia (fear of heights) in 39 people; social phobia (fear of interacting with people) in 32 people; hydrophobia (fear of water) in 29 people; achluophobia (fear of the dark) in 24 people; aerophobia (fear of flying on aircraft) in 16 people; claustrophobia (fear of confined spaces) in 22 people; arachnophobia (fear of spiders) in 6 people; thanatophobia (fear of death) in 6 people; zoophobia (fear of animals) in 5 people; autophobia (fear of loneliness) in 4 people; iatrophobia (fear of doctors) in 3 people; agoraphobia (fear of open spaces) in 3 people; amaxophobia (fear of car accidents) in 2 people; cancerophobia (fear of cancer) in 1 person; cacophobia (fear of deformity) in 1 person; paruresis (fear of uncontrolled urination) in 1 person.

The incidence of phobias in one person was: 2 phobias in 2 people; 3 phobias in 12 people; 4 phobias in 19 people; 5 phobias in 14 people; 6 phobias in 6 people; 7 phobias in 3 people.

It should be noted that we associate the high incidence of dentophobia with the specifics of patients seeking dental care.

All patients had the following diseases and symptoms most often in their medical history: diseases of the musculoskeletal system - myofascial pain of various localizations, protrusions and herniated discs, spinal pain of unknown genesis; cardiovascular diseases - tachycardia, hypertension, heart attacks, strokes; gastrointestinal diseases - gastritis, chronic gastric ulcers and duodenal ulcers, cholelithiasis, pancreatitis; other diseases were detected less frequently - fibroids, oncological processes, etc.

In understanding that the "Trauma Memory" is the result of the primary perception of a traumatic event, its image, and the emotion of fear is the "switch" of the stress-realizing system and is inextricably linked with the "Trauma Memory",

we conducted a systemic analysis of the study group and came to the following cause-and-effect relationships. An obligatory factor in the emergence of the emotion of fear is aggression from the external environment, for example, actions are taken that result in pain. It is especially important if this is accompanied by a forced, fixed position in space associated with the inability to move, for example, by physical restraint (violent actions, medical interventions, etc.) or psychological restriction (prohibition to show one's weakness, especially characteristic of men). The most frequent occurrence of the emotion of fear occurs in the period of 3-7 years, in conditions when the child, in his opinion, gets into a situation of death, for example, was punished and locked in a dark (fear of the dark) and limited space (claustrophobia), there was a risk of drowning in a pond (hydrophobia), was punished for an unfulfilled task (social phobia). Also, a mandatory factor is the emergence of a feeling of helplessness, hopelessness. It is at this moment that all the signs of the event are fixed, all signals about the outside world are tuned at the molecular level, the "Trauma Memory" is formed in the form of a physiological trace, "engram" and manifests itself in a reaction of the neuromuscular system in the form of a spasm. Spasm is one of the important physiological reactions in the development of diseases, given that muscle tissue is contained in the musculoskeletal system, cardiovascular and digestive systems. Spasm will occur whenever an event similar to the signs of the "Trauma Memory" is expected. The more phobias, the greater the risk of spastic conditions of muscle tissue, the more often pathological processes occur in organs and systems. Psychological correction was carried out with the understanding that the mental image of "trauma memory" is built on the basis of the perception by the senses of an objectively occurred event, the signs of its components, which corresponded to the experience of the time in which the traumatic event occurred. In order to relieve tension in relation to a specific event, classes were held with imaginary symbols of time and space, in which all life events were subjectively ordered into a single cause-and-effect relationship, but at the same time new signs were subjectively introduced and fixed signs were corrected so that the image of "trauma memory" changed at the level of feelings, that is, a new perception of objectively occurred events appeared. Changes in the structure of the signs that make up the "trauma memory" led to the perception of new clear signals, with a subsequent cascading change in the processing of all information by the nervous system, to the creation of a new map for safe orientation in space, which led to relaxation of muscle structures.

Conclusion. Based on the totality of observations of the study group, we came to the following conclusions: "trauma memory" is reproduced instantly and is not controlled by consciousness; "trauma memory" is consistent only with personal life experience and is the basis for the emergence of the emotion of fear. The emotion of fear is a marker of fixation in memory of those events that are not

resolved, a hopeless situation is created, as a result of which the muscle structures are tense, ready to leave. When changing the traumatic image in memory through subjective ideas and creating a new, safe way out of the event, the perception of the future event changes, the reaction of muscle structures changes from tension to relaxation. Further research into the phenomenon of "Trauma Memory" and its more detailed theoretical substantiation are needed.

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晚期早产儿出生后1年营养状况分析
**ANALYSIS OF NUTRITIONAL STATUS OF LATE PRETERM
INFANTS IN THE FIRST YEAR OF LIFE**

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摘要: 众所周知,新生儿的营养状况会影响肠道菌群的形成、免疫系统以及终生健康机体的形成[1]。研究并了解不同营养来源如何影响这些过程,以便制定最佳喂养方案至关重要。本研究分析了134例晚期早产儿出生后第一年喂养的性质及其对健康状况的影响。结果发现,出生后第六天以后的首次母乳喂养与6个月和9个月龄时过敏性疾病的发生相关。出生后第一个月进行人工喂养会增加6个月龄时呼吸道感染病毒感染的风险。出生后第一个月功能性肠道疾病的发生仅与该时期的母乳喂养有关。

引言: 孕34周(0/7-36周)出生的婴儿,即晚期早产儿,占早产儿的大多数。然而,关于其最佳喂养方案的文献研究数量有限[2;3]。

母乳是新生儿营养的黄金标准。然而,这一说法并不完全适用于晚期早产儿,因为在妊娠晚期,婴儿摄入的钙、磷、蛋白质和脂肪酸的浓度高于母乳[4]。不同厂家生产的配方奶粉成分大同小异,无法适应婴儿不断成长的身体需求,从而增加肥胖、糖尿病和炎症性肠病的风险[5;6]。

因此,目前婴儿营养领域的一个重要方向是研究人工喂养和母乳对晚期早产儿机体的近期和远期影响,并探索在优先支持自然喂养的情况下,补充母乳以满足其营养需求的方法[6; 7]。

关键词: 晚期早产儿, 营养状况, 晚期早产儿营养。

Abstract. *It is known that the nutritional status of the newborn influences the formation of intestinal microflora, immune system and the formation of a healthy organism throughout life [1]. It is important to study and understand how these processes are influenced by different sources of nutrition in order to achieve the*

most optimal feeding regimen. The study analyzed the nature of feeding and its impact on the health status of 134 late preterm infants during the first year of life. As a result, it was found that the first breastfeeding later than the sixth day of life correlates with the development of allergic diseases at six and nine months of age. Artificial feeding during the first month of life increases the risk of respiratory viral infections at six months of age. The development of functional bowel disorder in the first month of life was associated exclusively with breastfeeding during this period.

Introduction: *Infants born at 34 0/7-36 6/7 weeks gestation, or late preterm infants, constitute the majority of preterm infants. However, the literature contains a limited number of studies on their optimal feeding regimen [2;3].*

Mother's milk is the gold standard in the nutrition of a newborn baby. However, this statement is not quite true for late preterm infants, because in the last terms of pregnancy the child receives calcium, phosphorus, protein and fatty acids in higher concentrations than contained in breast milk [4]. The composition of milk formula, which is very similar in different manufacturers, is not able to adapt to the changing needs of the growing body, which increases the likelihood of obesity, diabetes and inflammatory bowel disease [5;6].

Thus, at present, an important direction in the field of infant nutrition is to study the immediate and distant effects of artificial feeding and breast milk on the organism of late preterm infants and to find ways of its enrichment to cover nutritional needs with priority support for natural feeding [6; 7].

Keywords: *late preterm infants, nutritional status, nutrition of late preterm infants.*

Objective: *to analyze the nature of feeding of late preterm infants in the first year of life and to identify its influence on the subsequent state of health.*

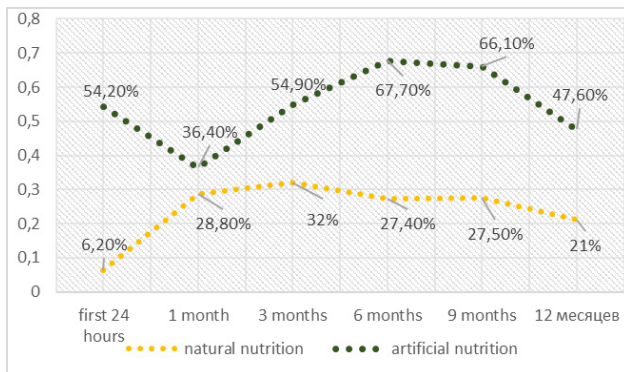
Materials and methods: *the nutritional status of 134 late preterm infants from birth to 12 months was evaluated. The nutritional status analysis included the following components: the time of the first breastfeeding, the organization of feeding in the first, third, ninth and twelfth months of life. The development of infectious, allergic diseases, digestive system disorders and their relationship to the organization of feeding in the first year of life were also studied. Statistical analysis was performed using the program StatTech v. 4.8.0. Differences were considered statistically significant at $p < 0.05$.*

Results and discussion: *the study examined how the distribution of natural and artificial feeding changed among late preterm infants from birth to one year of age (see Diagram 1). On the first day of life, more than half of the newborns received adapted milk formula, which was associated with difficulties in organizing breastfeeding due to the severe condition of the child, the mother or the woman*

taking medications incompatible with breastfeeding. The prevalence of exclusive breastfeeding increased to 32% by the third month of life, but then declined.

Diagram 1

Ratio of natural and artificial feeding from birth to one year of age



Such dynamics can be associated with different manifestations of functional intestinal disorders during the first month of life of the child, which entailed mothers' refusal of breastfeeding and transition to adapted milk formulae. Thus, based on the findings, functional bowel disorders during the first month of life were 3.667 times more common in breastfed late preterm infants (see Figure 1; $p = 0.011$, Pearson Chi-square OR = 0.273; 95% CI: 0.098 - 0.762). One of these manifestations was lactase deficiency (see Figure 2; $p = 0.034$, Fisher's exact test).

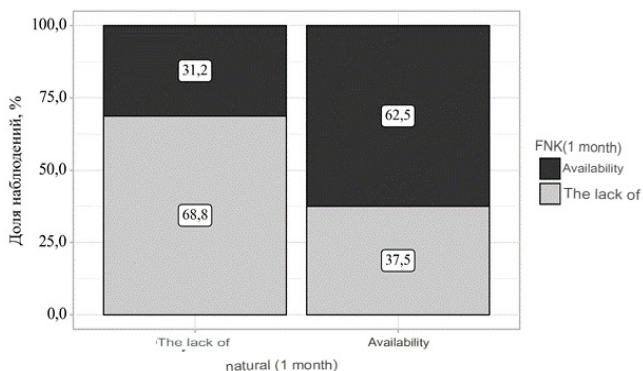


Figure 1. Analysis of functional bowel disturbance in the first month depending on natural feeding in the first month

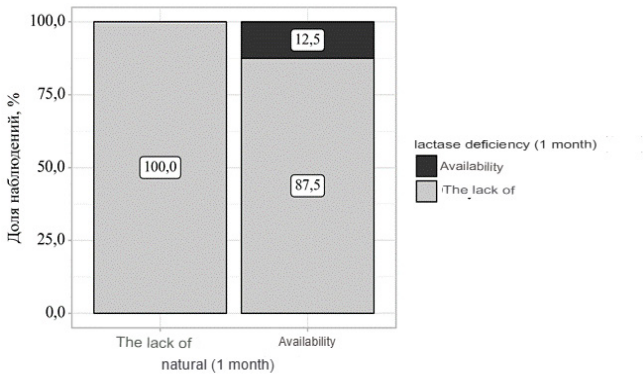


Figure 2. Analysis of lactase deficiency in the first month according to natural feeding in the first month

Further, there was an association between evidence of functional bowel disorder in the first month and a decrease in the proportion of natural feeding at three months of age (see Figure 3, $p = 0.049$; method used: Pearson's Chi-square). Breastfeeding retention by six months of age was 3.238 times lower in the presence of functional bowel disorder in the first month (95% CI: 1.085 - 9.663).

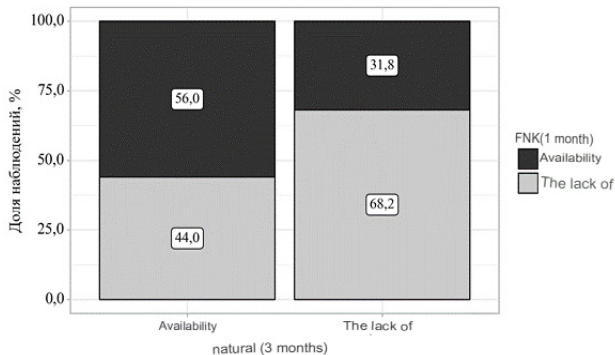


Figure 3. Analysis of the relationship between retention of natural feeding at 3 months and functional bowel disturbance at month 1

It is worth noting the importance of the influence of social factors on the formation of lactation during this period. These include psychological support of a woman and counseling on breastfeeding by medical workers [8].

The study investigated the time of the first breastfeeding of a newborn baby and its influence on further health status. In the first 30 minutes after birth, 7.3% of late preterm infants were breastfed, another 2.1% were breastfed within 24 hours, 4.2% within 48 hours, and 13.7% within 72 hours. More than 70% of late preterm infants were first breastfed after the third day of life.

A positive correlation was found between the time of first breastfeeding and the development of food allergy (L27.2, K52.2) at six months of age and manifestations of allergic contact dermatitis (L23.9) at 9 months of age ($p = 0.012$, $p = 0.048$, respectively; methods used: Mann-Whitney U-test, Mann-Whitney U-criterion). The most probable development of such allergic processes was predicted at the first breastfeeding later than the sixth day of life (see Figures 4,5,6,7)

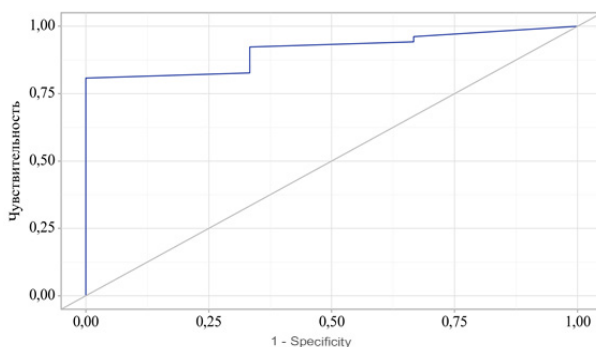


Figure 4. ROC curve characterizing the discriminatory power of first breastfeeding in predicting food allergy at six months of age

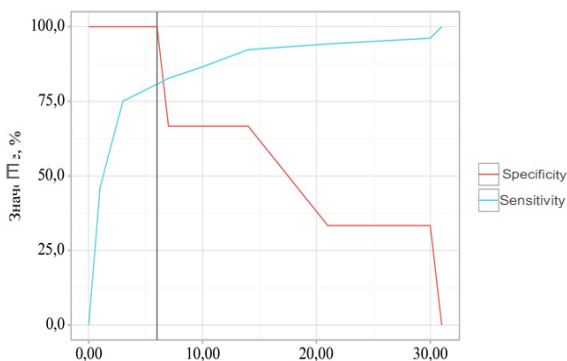


Figure 5. Sensitivity and specificity analysis of the model as a function of threshold values of food allergy probability estimates at six months of age

Note: The sensitivity and specificity of the resulting predictive model were 80.8% and 100.0%, respectively. AUC = 0.910; 95% CI: 0.684 to 1.000, $p = 0.012$

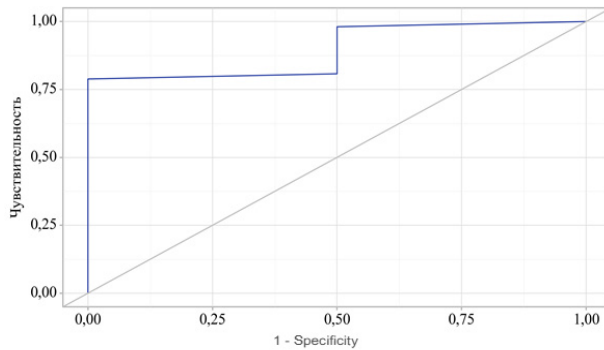


Figure 6. ROC curve characterizing the discriminatory power of the first breast-feeding in predicting atopic dermatitis at nine months of age

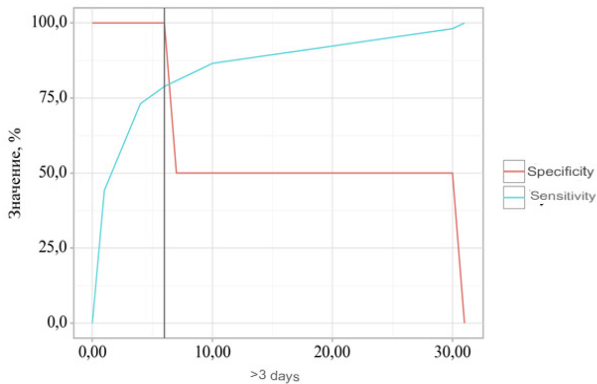


Figure 7. Analysis of sensitivity and specificity of the model depending on the threshold values of probability estimates of atopic dermatitis at nine months of age.

Note: The sensitivity and specificity of the resulting predictive model were 78.8% and 100.0%, respectively. AUC = 0.894; 95% CI: 0.598 to 1.000, $p = 0.048$

Manifestations of food allergy in the first month of life (L27.2, K52.2) were associated with artificial feeding in the same age period (see Figure 8, $p = 0.030$; method used: Fisher's Exact Test)

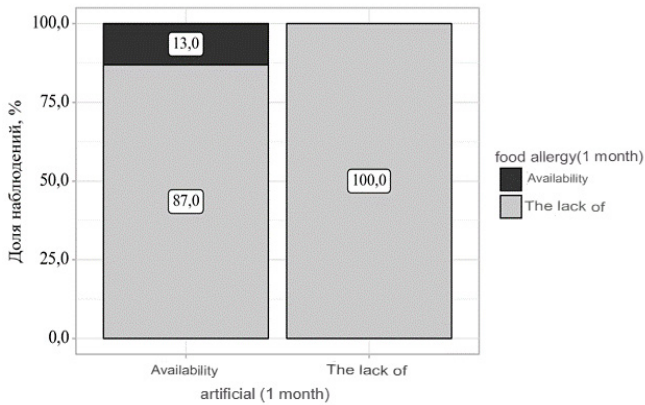


Figure 8. Analysis of food allergy manifestations in the first month depending on artificial feeding at this age

Late preterm infants exclusively artificially fed during the first month of life were 22.846 times more likely to have respiratory viral illness (J06.9) at six months of age (see Figure 9, $p = 0.009$; 95% CI: 1.174 - 444.587; method used: Fisher's Exact Test)

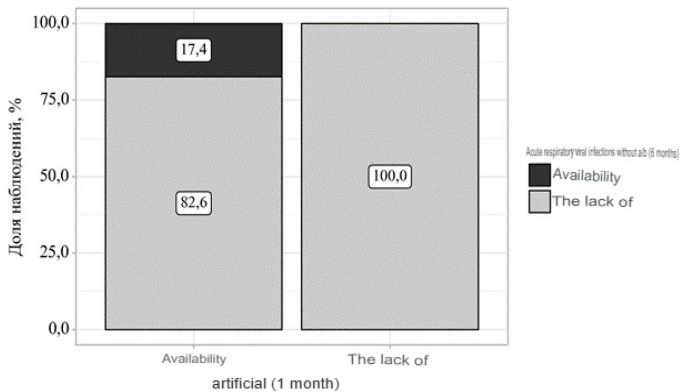


Figure 9. Analysis of respiratory viral disease development at six months of age depending on artificial feeding at the first month of age

According to the data obtained, the introduction of complementary foods by six months of age has a statistically significant effect on the formation of pro-

tein-energy deficiency grade II (E 44.0) in a late preterm infant (see Figure 10, $p = 0.022$; method used: Fisher's Exact Test). Introducing complementary foods later than six months of age was 31.667 times more likely to develop nutritional deficiencies (OR = 0.032; 95% CI: 0.001 - 0.705).

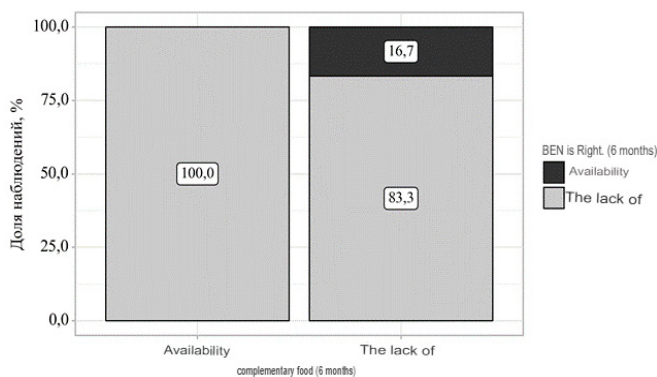


Figure 10. Analysis of the formation of protein-energetic insufficiency of the II degree at six months of age depending on the introduction of complementary foods by this age

The findings may suggest that by six months of age, complementary foods are needed to meet the nutrient requirements of the child for further growth and development [9].

Conclusion: the results of the study showed the importance of further study of the nutritional status of late preterm infants, the need to develop practical recommendations to ensure their need for macro- and micronutrients, as well as to advise parents on the formation of healthy eating behavior from birth.

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血友病患者现代牙科治疗及预防的特点

**FEATURES OF A MODERN DENTAL TREATMENT AND
PREVENTION OF PATIENTS WITH HAEMOPHILLIA**

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摘要. 本文探讨了血友病患者牙科治疗管理的特殊性。血友病患者在咨询血液科医生和其他医生后，必须接受牙科护理。采用个性化的牙科疾病预防和治疗方案至关重要。当务之急是通过医生间的合作，并考虑到血友病患者的个体特征、口腔健康以及牙科干预前的合理止血支持，最大限度地降低出血风险。

本文还阐述了在牙科诊所为儿童提供服务时可能出现的主要生物伦理问题。

我们得出结论，有必要及时开展现代牙科疾病预防和血友病患者卫生教育工作。

关键词： 血友病、口腔健康、治疗、血友病患者、牙科问题、儿童。

Abstract. *This article considers the peculiarities of management of patients with haemophilia dental treatment. It's imperative to provide dental care to patients suffering from haemophilia after consultation with haematologist and other doctors. It's important to use individually developed algorithms of prevention and treatment of dental diseases. The priority is to minimize the risk of hemorrhaging by joint work of doctors and taking into account individual characteristics of patients with haemophilia, dental health and rational hemostatic support before dental interventions.*

The main bioethical problems, that arise, when working with children at the dental clinic, are described.

We concluded, that it is necessary to develop timely modern prevention of dental diseases and sanitary education work for patients with haemophilia.

Keywords: *haemophilia, dental health, treatment, patients with haemophilia, dental problems, children.*

Introduction. When providing dental care to such a group of the population as children, difficulties arise related to the peculiarities of the psyche of the small patient and their parents or legal representatives. The severity of various mental reactions often prevails in patients suffering from hemophilia. In order to ensure the safety, quality and comfort of dental care for such patients, a pediatric dentist must be able to apply methods of minor psychotherapy in combination with professionalism and clinical thinking [5, 6].

It is important to use not only practical competencies, but also a patient-oriented approach during dental appointments with patients with hemophilia. The patient-oriented model includes: elements of minor psychotherapy (eye contact, sitting communication, nodding, open posture of the doctor), elements of a problem interview (collection of the disease history is carried out using a combination of open and closed questions). Open questions allow you to collect information about the patient's "pain" and begin to talk about the problem. Closed questions are of a clarifying nature to form a hypothesis of the patient's disease.

Taking into account the psychoemotional characteristics of patients with hemophilia, especially children, this tactic allows you to create a comfortable environment for the patient. A dentist must be patient-oriented, namely, know about different types of teeth cleaning and their features, items and means of personal oral hygiene. The ability to find an individual approach to a patient suffering from hemophilia during an initial consultation at a dental appointment, identifying the patient's needs, as well as forming motivation to receive appropriate treatment and maintain contact with the dentist is the basis for forming a patient-oriented approach in modern medicine. In a patient-oriented model, the dentist acts as an expert, the patient makes a request for knowledge, and whether to use it is up to the patient, not the dentist.

Therefore, an important component of a consultation with a dentist is the correct establishment of communication with a patient suffering from hemophilia and increasing patient compliance; in our studies, low compliance of patients with hemophilia was revealed for the first time. Increasing compliance of patients with hemophilia is an important task of a dentist and helps to maintain the dental health of this population group.

Hemophilia is a hereditary hemorrhagic disease, predominantly affecting males, which is based on a disorder of blood clotting, namely its first phase with a deficiency of factor VIII or IX and manifested by frequent, long-term bleeding and hemarthrosis. Hemophilia A is most common in patients, and B is less common. The incidence of hemophilia in the world ranges from 10 to 14 males per 100 thousand men examined. [1].

The disease is transmitted linked to the X-recessive chromosome, so only-males get sick. Women are carriers of the gene - hemophilia conductors. It is gen-

erally accepted to divide hemophilia into 3 degrees of disease severity, based on the activity of a certain coagulation factor in the blood plasma. The division is as follows: mild severity - factor activity is more than 5% and less than 40%; moderate - factor activity is 1-5% and severe severity - factor activity is less than 1% [2].

For patients with hemophilia, it remains important to ensure the effectiveness and safety of dental interventions [3]. For this purpose, before treatment by a dentist, a consultation with a hematologist is necessary to prescribe the correct hemostatic support. In this way, a multidisciplinary approach to complex dental treatment is implemented. Joint work of a dentist with doctors of other specialties (pediatrician, endocrinologist, etc.) will reduce or minimize the risks of bleeding and infection [4].

A pediatric dentist can inevitably face emotional anxiety of a small patient, therefore, to prevent negative perception, it is necessary to take into account the psychological and physiological characteristics of different periods of childhood, namely, that children of preschool and primary school age during daytime sleep may refuse to build a dialogue with the doctor and fulfill his requests, this happens, among other things, due to reduced concentration. Therefore, the time of the visit should be chosen, excluding the hours of the child's usual daytime sleep. It is also necessary to take into account the duration of treatment and choose a method based on the emotional status, lability of each child with hemophilia. During long procedures, there is a very high probability of moodiness and changes in mood, which can directly affect the quality of dental care provided. The appearance of a pediatric dentist affects the emotional background only indirectly, but as an additional effect of reducing the emotional background, you can use medical clothing not of the standard white color, but of light colors with bright patterns. And the leading place is given to the communication skills of the dentist. The right conversation, an individual approach will form a trusting relationship with the child, which is important for providing dental care to patients with hemophilia. Such relationships are formed through non-verbal interaction. It is important to understand that the success of treatment and the patient's peace of mind will depend on the well-coordinated interaction of not only the medical staff (pediatric dentist, assistant, nurse), but also the involvement of the child himself, his parent or guardian. Non-verbal communication consists of behavior and emotions. Maintaining visual contact, genuine interest, a pleasant smile, the absence of sharp and quick hand movements, a positive confident attitude of the doctor will ensure half the success. The style of communication with the patient is chosen taking into account the characteristics of each age. An important aspect is also a friendly and polite tone of voice, because not every patient understands what the dentist is saying due to his age.

It is important to remember that our patient is not a combination of his illnesses that the doctor must detect and cure, but, first of all, a personality. Therefore,

when working with patients with hemophilia, it is necessary to be guided by humanitarian principles, using a natural-scientific approach, this is the only way to avoid ineffective treatment and sometimes cruel treatment of patients. The pediatric dentist must remember that prevention of dental diseases plays a key role in ensuring the dental health of children with hemophilia. Patients with hemophilia are more often motivated to achieve quick results, rather than to maintain their own health in the long term. Maintaining one's health is important today, which implies a conscious choice of health care. Involving patients with hemophilia in a healthy lifestyle should begin with the formation of their motivation to comply with preventive measures. Therefore, the formation of motivation to care for children and adolescents with hemophilia requires significant efforts not only from the patients themselves, but also from dentists in achieving a common goal. Before any dental intervention, it is necessary to explain in a form accessible to the patient why and for what purpose it is necessary to use such a method of treatment and what the consequences of further refusal of treatment may be. Thus, the dentist is guided by the principle of respect for human dignity and ensures the patient's right to health protection and its preservation. A special role is given to filling out the patient's informed consent for dental intervention. Detailed, correct informed consent solves the problem of many bioethical issues. It is important to remember that the formation of a positive attitude and motivation of parents or guardians is as important a task for a pediatric dentist as high-quality dental care for patients with hemophilia. It is important to remember that a child can copy the behavior of parents, so first you need to calm down "anxious" parents, and then establish communication with the little patient.

An important aspect of the success of treatment is the initial preparatory appointment - to determine the child's psychotype, the level of anxiety that arises when seeing a pediatric dentist. The area and invasiveness of the intervention are also determined, based on this, an appointment and the number of visits are made. A pediatric dentist should remember that prevention of dental diseases plays a key role in ensuring dental health of the population. This is especially important to remember when working with patients with hemophilia.

Conclusion. Formation of a systematized approach to creation of algorithms of preparation for dental intervention, based not only on taking into account the severity of hemophilia, but also on individual features of dental status, results of salivary diagnostics will help patients and doctors in increasing safety and effectiveness of subsequent treatment. The combination of a health questionnaire and a problem interview forms a new vector of development of communication skills of a dentist in a patient-oriented model of interaction with patients with hemophilia. There is still a need for timely and modern prevention of major dental diseases in such patients, raising awareness of the need for prevention. This will help to avoid

complications, invasive treatment and improve the level of dental care for patients suffering from hemophilia. When treating such patients, a pediatric dentist must understand and be aware that he is, first and foremost, a doctor, and this concept includes strict adherence to the doctor's oath, moral principles, and guarantees the child's right to maintain dental health.

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采用模块化教学法研究聚合物性能

RESEARCHING THE PROPERTIES OF POLYMERS USING MODULAR TEACHING METHODS

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Introduction: The effectiveness of teaching methods is of particular importance in the modern education system. The use of modular teaching methods in the field of chemistry and materials science contributes to a deep understanding of the material by students and the development of practical skills. Polymers are materials widely used in modern technologies. The study of their properties and their effective use play an important role in the creation of new materials.

Relevance of the research: The study of the physical and chemical properties of polymers allows expanding their industrial and domestic applications. Using modular teaching methods, it is possible to systematize students' knowledge in this area and effectively organize research work [1]. Therefore, the use of modular teaching technology in the educational process is one of the current issues in the training of future specialists.

The purpose of the study: To determine the effectiveness of using modular learning methods in studying the properties of polymers and to suggest ways to incorporate it into the learning process.

Research tasks :

- Modular teaching of methods theoretical the basics to consider ;
- Polymers properties to study for laboratory the works systematization ;
- Polymers in research applicable physical , chemical and mechanical methods description ;
- Modular teaching methods improvement according to to make suggestions .

Modular teaching methods . Pedagogical of the process , its inside modular of teaching efficiency increase teachers teaching methods right to choose Dependent . Modular. in teaching used when here requirements in memory to get required :

- teaching with the laws and from them coming out principles ;
- teaching goals and duties ;
- given of the subject of topics content and methods ;
- students to read opportunities (preparation) level , students of the group with features);
- teachers with their capabilities , with experiences theoretical and practical with preparations , known one interactive methods use with the ability and etc. to be determined So , the module learning , modular technology, modular program about to concepts deeper concept Let's give it . For that First , the word «module» meaning what that Let's find out . If S.I. Ozhegov to the dictionary If we look closely , the module is known. one system , structure own independent , separable receiving said

Study module is that scientists according to him , reading content and its mastery based on of technology one for the purpose Module – student's content , reading method own independently mastery level and education individual according to action to read program . Its discipline student own independently or teacher with the help of with module known one to the result He is with the teacher . what remember save what write , what Where to find, how effective action to do , what to know need about written in writing in a way tasks takes . The module lessons compose sitting and reading about information provided by : textbook , supplement literature , tables , diagrams , pictures illustrations , technical equipment , oral tools to use will be . The module in classes tasks execution progress and knowledge to master checking every different observations They are : self-check , mutual check , teacher check , current and intermediate check , etc. These through education gaps , modular mastery level was identified . Additional works conducted , every student as much as possible education takes . The module of teaching to tradition turned class hour in the system explanatory-illustrative from the method difference that to the problem Let's stop . The most First , the student his/her personal your intelligence conscious in a way develop sitting and reading content classify learns , and the teacher is only an organizer , coordinator , and helper. provider , controller duty The module of teaching many ideas programmed from teaching received .

It is traditional. of teaching high to the extent organized alternative type . Lesson to the process modules gradually introduced correct . Modular teaching conditional in a way three to type classified as : *cognitive* (science) the basics while reading used) , *operational* or *action* (action) of actions methods formation and development for) , *mixed* . This last type often is used . Then after teacher to read of elements content , size , order , their to each to leave time , work type determines . Students for lesson at the end what know what to read what should showing integrated goals determines . Additional materials visual tools.[2]

Lesson during students instruction with a plan own independently work does . And the teacher to watch walking , for the weak help and strengthen praise , every with a student personal communication does . If possible every module in front of students of knowledge level determine , precisely on time correction to do tried Every to read element determined after current and intermediate observations to drive necessary . At this time students in education gaps identified and repeated in addition to studying materials to listen instructions The teacher 's role on educational material information from the carrier coordinator , help giver , advisor to the giver The module lesson with structure work when doing first one with a group work doing and too much material not to be considered it is better .[3]

Study of the properties of polymers. Special laboratory work is carried out to study the mechanical, thermal and chemical properties of polymers. Studying the properties of polymers allows you to identify their application possibilities, create new materials and increase production efficiency. Using modular teaching methods, the following research methods are considered:

Research methods through modular learning

The following modules are recommended for studying the properties of polymers:

• **Module 1: Structure and Classification of Polymers**

Module Objective: To study the structural features of polymers, chemical structure of polymers.

Structure of polymers

Polymers are high-molecular compounds composed of repeating structural units (monomers). Their structure can be considered at three main levels:

Macrostructure – the overall shape of the polymer (linear, branched, networked).
Microstructure – the chemical bonds in the molecules and their arrangement.
Structural units (monomers) – the basic repeating groups of atoms.

To the structure related polymers :

- Linear polymers – molecules straight chain in the form of located (for example , polyethylene).
- Branched polymers are the main from the chain additional has branches (e.g. , amylose).
- Mesh polymers – lattice -like in space structure correct polymers (e.g. phenol-formaldehyde resins).

Modular tasks:

Task type	Contents
Laboratory work	Macro- and microstructures of polymers microscopic structure study
Group project	Polymers classification table in the form of to offer
Analysis report	Known one polymer chemical to the structure towards his/her properties prediction

This module is made of polymers structural features to understand and their properties to guess helps .

• **Module 2: Physical properties experimental study**

Module Purpose: Polymers main physical properties to determine and them experimental study methods mastery .

The main physical properties of polymers determine their application and characterize their response to various external influences. **Density** - The mass of a polymer per unit volume. Polymers with high density are usually strong and stable. **Melting point** - The temperature at which a polymer changes from a solid to a liquid state. This property determines the temperature at which a polymer can be used. **Softening point** - The temperature at which a polymer changes from a solid to a soft, but not liquid, state.

Module tasks:

Task type	Contents
Laboratory work	Polymers density and thermal properties to determine
Group project	Miscellaneous polymers physical properties comparison
Analysis report	Polymer use to the field related his/her physical properties study

This module is made of polymers physical properties specific to study opportunity gives and their practical the meaning to understand helps .

• **Module 3: Chemical stability study methods**

Module Purpose : Polymers chemical stability and their different in the middle change properties research .

Module tasks:

Task type	Contents
Laboratory work	Polymers acids , alkalis and organic solvents stability to determine
Group project	Polymers chemical stability industry importance
Analysis report	Polymer chemical stability and its long periodic use study

This module is made of polymers chemical stability study through their practical use wider to understand helps .

• **Module 4: Polymers use scope and environmental aspects**

Module Purpose : Polymers use in various fields and their surrounding to the middle the effect research .

Module tasks:

Task type	Contents
Laboratory work	Polymers biodegradation study
Group project	Environmentally friendly polymers search and their alternatives to offer
Analysis report	Polymers surrounding to the middle touching the effect assessment

This module is made of polymers use industry widely consider them environmental the effect reduce ways to study directed .

Conclusion. The use of modular teaching methods in the study of the properties of polymers contributes to a deep understanding of the material by students and the development of practical skills. This method increases the creative thinking of students and allows them to engage in scientific research. Through the modular teaching method, students gain a deep understanding of the properties and scope of applications of polymers. Each module guides them to improve their knowledge through specific experiments and scientific research. By understanding the chemical, physical and environmental aspects of polymers, students acquire not only theoretical knowledge, but also practical skills. This, in turn, allows students to effectively use polymer materials in industrial and scientific research.

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某工业企业电力自动化控制系统项目
**THE PROJECT OF THE AUTOMATED CONTROL SYSTEM OF AN
INDUSTRIAL ENTERPRISE POWER SYSTEM**

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摘要：本文探讨了现代工业企业中，由于降低能源设施维护成本和提高电力安全性的需求，如何高效利用能源资源这一紧迫问题。本研究的主要目的是开发用于工业企业能源系统的自动化控制系统解决方案，重点是实现工艺过程状态监控和电力特性控制的自动化。

关键词：自动化控制系统、供电系统、调度、能耗、重工业、神经网络。

Abstract. *The article discusses the urgent problem of efficient use of energy resources in modern industrial enterprises, caused by the need to reduce the cost of maintaining energy facilities and improve electrical safety. The main purpose of the research is to develop solutions for mastering an automated control systems for energy systems of industrial enterprises with an emphasis on automation of monitoring the state of technological processes and control of electric power characteristics.*

Keywords: *automated control systems, power supply system, dispatching, consumption, heavy industry, neural network.*

Modern industrial companies are increasingly experiencing the need for efficient use of energy resources, reducing the cost of maintaining their energy facil-

ities and increasing electrical safety in production [1]. In the context of the rapid development of information technology, the introduction of automated control systems (ACS) can significantly facilitate the work of operational personnel and identify problems in the operation of the electric power complex.

The purpose of the research is to develop design solutions for an automated control system of an industrial enterprise power system with the study of automation of monitoring the state of the technological processes at the production sites and control of electric power characteristics.

The main tasks of the research are:

1. Study the regulatory documents necessary for the development of automated control systems, and review the relevant areas of their application.
2. Analyzing the typology of neural networks and choosing the most optimal model suitable for the project objectives.
3. Drawing up the list of signals to be collected from energy facilities and points of technical accounting of energy resources.
4. Development of the structural diagram of the automated control system.
5. Calculation of the amount of data transmitted to an automated control system server. Definition of requirements for information accuracy and data transfer rate. Checking the bandwidth of communication channels.
6. Development of the information model and the principle of operation of an energy management monitoring system.
7. Feasibility study of the application of the ACS in industrial enterprises.

The object of the study is the power supply system and heating and technological networks of industrial enterprises. The subject of research is automation of dispatching and energy monitoring systems.

The basis of the research methodology is:

- general scientific methods related to the study of the structure and principle of operation of automated systems;
- comparison of applied technologies and equipment for automation;
- analysis of the current conditions of the domestic and foreign market of energy and heavy industry in order to identify the required criteria that meet the current needs of industrial enterprises;
- research in the field of application of artificial intelligence technologies and comparison of types of neural networks;
- methods of technical and economic calculations in the feasibility study of the project.

The tasks of control automation have long been one of the key areas of industry and the electric power industry. During this time, many studies have been conducted, such as a nationwide automated system [2] or technologies for controlling the mode of electric networks with distributed low-power generation [3].

However, despite the extensive experience of domestic and foreign science in this field, one of the problems is the use of a end-to-end automated control system for the energy sector of large industrial enterprises. In particular, this problem is pronounced in large enterprises, where several disconnected automated systems may be present at once.

The scientific novelty of the research is the development of automation tools for work of industrial dispatching center to control energy consumption in a large industrial enterprise with a distributed system of remote production sites, and also modernization the information model of energy monitoring systems using artificial intelligence technology. The practical significance of the study is due to such positive effects when implementing an automated system as:

- integration of disparate dispatching and monitoring systems;
- optimization of labor costs of operational personnel, which is characterized by a reduction in response time to emergency events and prevention of failures and malfunctions;
- improving the electrical safety of the energy sector by reducing the number of accidents and the influence of the human factor in the control and management of power supply system;
- identification of violations of the production process during the analysis of monitoring systems, which will solve the hidden problems of the enterprise;
- reducing the costs of the enterprise by correcting identified problems and saving technical resources of the energy system.

Energy facilities and points of commercial and technical accounting of energy resources in the area of one of the coal pits of the mining enterprise, distributed remotely from each other, were selected as the object of the study. Based on the analysis of the structure and principles of automated systems, the criteria of the automated control system of the industrial enterprise power system were identified, according to which a list of volumes of teleparameters to be collected was compiled, equipment was selected and a block diagram shown in Figure 1 was developed.

To integrate the automated system into the existing dispatching systems of the enterprise, the information model was improved and a flowchart of the algorithm for monitoring the state of the energy sector using artificial intelligence was compiled (Fig. 2). As a validation data set to identify significant problems affecting the loss of energy resources, or to confirm the serviceability of energy facilities, a comparison of the projected energy consumption of the enterprise at the outgoing feeders of two electrical substations is used, as well as the point of commercial accounting for electricity consumption from AMR system (Automatic Meter Reading) and the point of technical accounting for heat consumption, cold and hot wa-

ter consumption inside a boiler room and two drilling wells. If there is a positive difference between the actual and predicted values, the program displays a list of the most significant problems in the operation of the energy supply system and further allows management to determine the priority for correcting these problems.

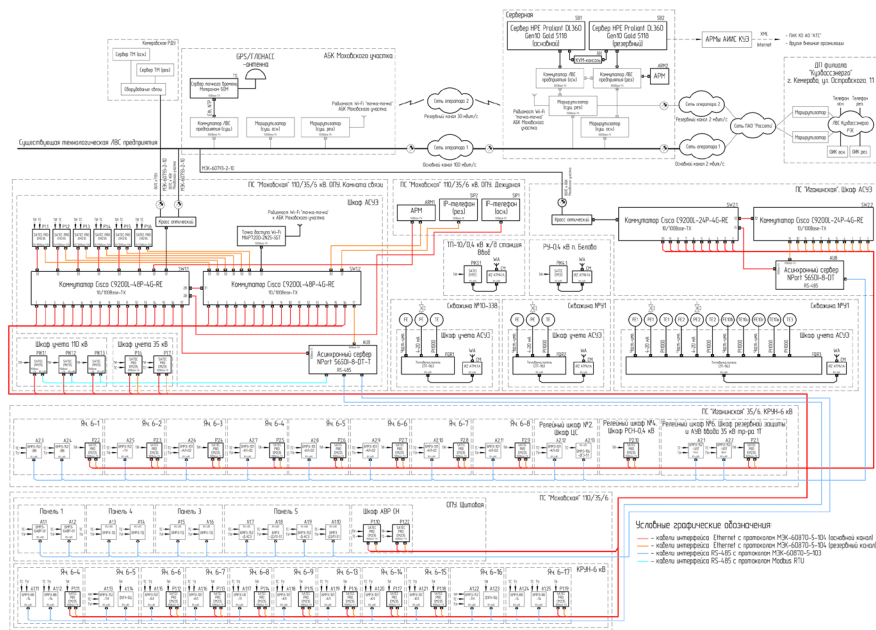


Figure 1. Structural diagram of the automated control system of the industrial enterprise power system

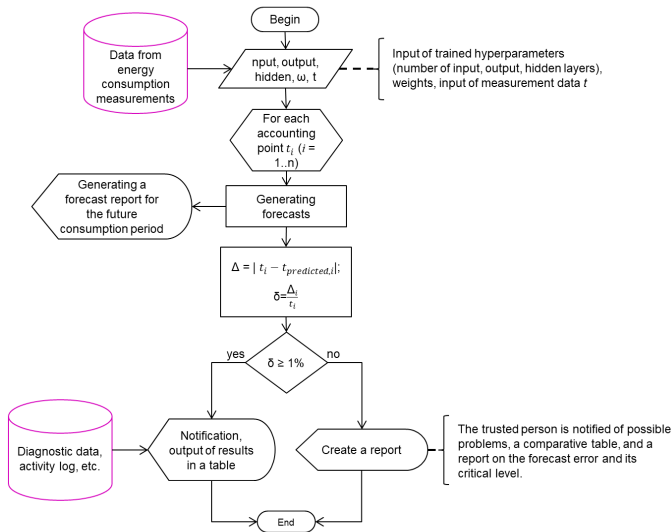


Figure 2. A flowchart of the algorithm for the operation of a trained neural network for monitoring the state of energy facilities in an industrial enterprise

Achieving efficient operation and increasing energy security is possible using unified automated control systems. The research methods listed earlier help to establish the structure and characteristics of an automated control system for industrial enterprises, and the created information model provides additional opportunities for optimizing production processes within the company.

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关于天然气抽油机运行过程中“驱动-压缩机”系统协同模式区域边界的确定问题。第一部分

**ON THE ISSUE OF DETERMINING THE BOUNDARIES OF
THE AREA OF COORDINATED MODES OF THE «DRIVE-
COMPRESSOR» SYSTEM DURING THE OPERATION OF GAS
PUMPING UNITS. PART 1**

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摘要: 在选择用于完成抽气装置的设备阶段, 评估确保运行设施(油气精炼或石化工厂的压缩机站或工艺管线)运行模式的概率至关重要。

本文讨论了由燃气轮机驱动装置和离心式压缩机组成的驱动压缩机系统, 其特点之一是“零”功率平衡与抽气装置的运行条件相关。在“零”功率平衡下, 驱动压缩机系统的功率和轴线速度匹配。“零”功率平衡运行模式区域的边界是一个闭环, 抽气装置在该闭环内运行, 闭环外不运行。

本文第一部分介绍了构建轮廓线的方法, 分析了可能影响轮廓线大小、位置和形状的一系列因素, 并阐述了在各种条件下驱动压缩机系统运行期间轮廓线的建模问题。

本文第二部分介绍了不同运行设施的面积轮廓计算结果。

关键词: 燃气轮机组、天然气泵送装置、压缩机站、驱动装置、天然气、自由涡轮、流道、燃气、涡轮机组、离心式压缩机。

Abstract. *At the stage of selecting equipment for completing a gas-pumping unit, it is important to assess the probability of ensuring the operating modes of the operating facility (a compressor station or a process line of an oil and gas refining or petrochemical plant).*

The article discusses a drive-compressor system consisting of a gas turbine drive and a centrifugal compressor, one of the characteristics of which is the dependence of the “zero” power balance on the operating conditions of the gas-pumping unit. With a “zero” power balance, the drive-compressor system is

matched in power and shaft line speed. The boundary of the region of operating modes with a “zero” power balance is a closed loop, inside which the gas-pumping unit is operational, and outside the loop it is inoperative.

Part 1 of the article presents the methodology for constructing a contour line, analyzes a list of factors that can affect the size, position and shape of the contour, and formulates the problem of modeling the contour line during operation of the drive-compressor system under various conditions.

Part 2 of the article presents the results of calculations of the area contour at different operational facilities.

Keywords: gas turbine unit, gas pumping unit, compressor station, drive, natural gas, free turbine, flow path, fuel gas, turbo unit, centrifugal compressor.

Introduction

The gas turbine unit (GTU) and centrifugal compressor (CFC) are manufactured and supplied by different equipment suppliers with their own sets of operating documentation containing their individual characteristics, as a rule, under the parameters of the nominal mode for the GTU and the nominal mode of the CFC.

When assembling the turbo unit of the GPA, the rotor shafts of the free turbine (FT) of the GTU and CFC are connected to the intermediate shaft (transmission), forming the shaft line of the “drive-compressor” system. Direct and feedback links are established between the GTU and the CFC, ensuring, on the one hand, the transfer of kinetic energy from the drive to the compressor for its conversion into potential energy during gas compression, and, on the other hand, regulation of power, rotation speed and stabilization of parameters in the established operating modes.

The resulting characteristics of the “drive-compressor” system do not coincide with the individual characteristics of the drive and compressor. Unlike the characteristics of the free turbine (FT) of the GTU and the gas-dynamic characteristics (GDC) of the CFC, the range of change of the parameters of the “drive-compressor” system is limited and separated from the rest of the field of characteristics by a closed loop. Inside the loop there is an area of operating modes of the “drive-compressor” system matched in power and rotor speed. Outside this area, the GPA is inoperative.

The following is meant by the “drive-compressor” system matched in characteristics:

1. Any planned mode of the GPA for the performance of the pumped gas ($Q_{\text{ГБК}}$) and its compression ratio ($\varepsilon = \frac{P_K^{\Gamma A3A}}{P_H^{\Gamma A3A}}$) with the actual parameters of the gas network (pressure and temperature of the gas at the inlet ЦБК $P_H^{\Gamma A3A}, T_H^{\Gamma A3A}$, gas composition) is installed at permissible values of the

rotation speed of the ST rotors (n_{CT}) and GG GTU ($n_{ГГ}$) in the range from minimum ($n_{CT}^{MIN}, n_{ГГ}^{MIN}$) up to maximum ($n_{CT}^{MAX}, n_{ГГ}^{MAX}$) of value (1):

$$n_{CT} \in (n_{CT}^{MIN}, n_{CT}^{MAX}), n_{ГГ} \in (n_{ГГ}^{MIN}, n_{ГГ}^{MAX}) \quad (1)$$

2. Deviation of the available drive power ($N_{РАСП}^{ГТУ}$) from the amount of power consumed by the compressor ($N_{ПОТР}^{ЦБК}$) in any planned operating mode according to (2) should not exceed the calculation error ($\Delta N_{РАСЧ}$) 1-2% (zero power balance).

$$N_{ПОТР}^{ЦБК}(n_{CT}, Q_{ЦБК}, P_H^{ГАЗА}, P_K^{ГАЗА}, T_H^{ГАЗА}, \text{состав газа}) = N_{РАСП}^{ГТУ}(n_{CT}, n_{ГГ}) \pm \Delta N_{РАСЧ}(1 \div 2\%) \quad (2)$$

3. Critical rotation speeds of the GPA shaft line are removed from its rotation speed in any of the planned operating modes (p. 1-2) by an amount corresponding to the requirements of API 617 [1].

With a rational engineering selection of the equipment of the “drive - compressor” system, as well as a correct algorithm for regulating the parameters in the GPA control system, the area of matched modes should cover all planned modes of the operating object.

To analyze the parameters of the “drive - compressor” system, it is advisable to consider constructing a contour line of the area with a zero power balance on the individual characteristics of the GTU and GDH CFC ST, the so-called combined characteristics.

Combined characteristic of the “drive - compressor” system

As characteristics of the “drive - compressor” system, we can consider the dependence of any controlled operational parameter of the system on the parameter of the set mode. For example, the dependence of the fuel gas flow rate on the flow rate of the pumped gas or the compression ratio.

Figure 1 shows the construction of the boundaries of the region of coordinated modes of the “drive-compressor” system on the field of characteristics of the GTU ST in the range of change in the rotation frequency of the GTU gas generator (GG) and the GTU ST.

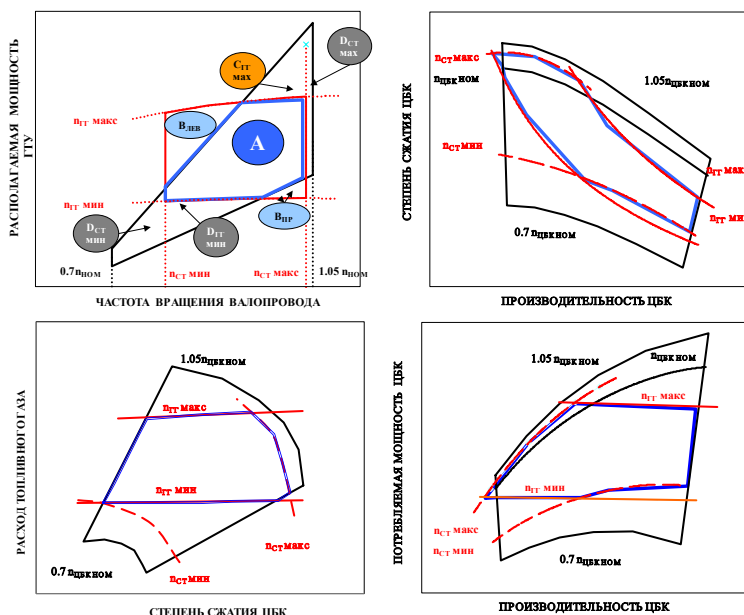


Figure 1. Combined characteristics of the “drive-compressor” system

The GPA operating area (area “A”) at the coordinated modes of the GTU and the pulp and paper mill, limited by the blue contour, is formed at the intersection of the contours of the GTU ST operating area (red contour) and the contour of the pulp and paper mill characteristics (black contour).

$B_{\text{ЛПВ}}$ - GPA operating areas in the high flow rate zone with reduced efficiency indicators and increased fuel gas costs. The limitation is the maximum permissible flow rates for the compressor in the “shut-off” modes. Operation of the GPA in this area is not recommended.

$B_{\text{ПР}}$ - the GDH area (from the surge limit) is almost completely cut off by the line of minimum rotation frequencies of the gas generator or the line of the minimum permissible power for continuous operation of the GTU. The GPA is not operational.

$C_{\text{ГТ max}}$ - the area of possible drive operation at increased available power in the cold season, in station conditions, the GPA is not operational in air. When increasing the power in winter, the region can partially or completely enter the region of GPA modes

$D_{\Gamma_{\text{мин}}}$ – the operating region where, at the set shaft line rotation speeds, the available GTU power cannot be reduced to the value of the pulp and paper mill power consumption, respectively, the drive-compressor system does not allow, at a given productivity, to reduce the compression ratio of the pulp and paper mill. When the characteristics of the GTU and pulp and paper mill are degraded, the value of the minimum shaft line and GTU GG rotation speed decreases.

ДСТмин, ДСТмакс. – regions outside the free turbine rotation speed range, the GPA is not operational

In the presented example, the rotation speed ranges of the ST rotor and the pulp and paper mill rotor do not coincide. This reduces the operating range of the drive-compressor system

The influence of operating conditions on the value of the pulp and paper mill power consumption and the available GTU power

The actual combined characteristic of the drive-compressor system differs from the “ideal” characteristic shown in Figure 1 due to changes in the individual characteristics of the equipment under real operating conditions. We are talking about the influence of environmental parameters and gas network parameters, as well as pollution and wear of the flow paths of the pulp and paper mill and gas turbine, on the values of the available capacity of the gas turbine and the consumed capacity of the pulp and paper mill.

The resulting values of the consumed capacity of the pulp and paper mill and the available capacity of the gas turbine can be obtained by direct calculation by the equipment manufacturer or by applying correction factors to the values given in industry standards [2, 3] or in the operating documentation [4-8].

The formula for the balance of power of the drive-compressor system (2) is transformed into formula (3) taking into account the introduction of correction factors or coefficients of degradation of equipment characteristics: $K_N^{\text{ЦБК}}$ for CFC, $K_N^{\Gamma\text{ТУ}}$ for GTU.

$$N_{\text{ПОТР}}^{\text{ЦБК}}(n_{\text{СТ}}, Q_{\text{ЦБК}}, P_{\text{Н}}^{\text{ГАЗА}}, P_{\text{К}}^{\text{ГАЗА}}, T_{\text{Н}}^{\text{ГАЗА}}, \text{состав газа}) \cdot K_N^{\text{ЦБК}} = N_{\text{РАСП}}^{\Gamma\text{ТУ}}(n_{\text{СТ}}, n_{\Gamma}) \cdot K_N^{\Gamma\text{ТУ}} \pm$$

$$\Delta N_{\text{РАСП}}(1 \div 2\%) \quad (3)$$

$$K_N^{\text{ЦБК}} = f(\tau_{\text{МРП}}^{\text{ЦБК}}) \quad (4)$$

$$K_N^{\Gamma\text{ТУ}} = K_{\text{Па}}^{\Gamma\text{ТУ}} \cdot K_{\text{Та}}^{\Gamma\text{ТУ}} \cdot K_{\text{ВЛАЖН ВОЗДУХА}}^{\Gamma\text{ТУ}} \cdot K_{\text{ОТБОРЫ ВОЗДУХА}}^{\Gamma\text{ТУ}} \cdot K_{\frac{\Delta P_{\text{РАХ}}}{\text{ВЫХ}}}^{\Gamma\text{ТУ}} \cdot K_{\text{СОСТАВ ТГ}}^{\Gamma\text{ТУ}} \cdot K_{\text{МРП}}^{\Gamma\text{ТУ}}(\tau_{\text{МРП}}^{\Gamma\text{ТУ}}) \cdot$$

$$K_{\text{загрязн}}^{\text{ОК ГТУ}}(\tau_{\text{МРП}}^{\Gamma\text{ТУ}}) \quad (5)$$

where

$K_{\text{Па}}^{\Gamma\text{ТУ}}$

$K_{\text{Та}}^{\Gamma\text{ТУ}}$

$(K_{\text{ВЛАЖН ВОЗДУХА}}^{\Gamma\text{ТУ}})^*$

– correction factors for deviation of temperature, pressure and humidity of atmospheric air from standard conditions according to GOST R 52200 (hereinafter referred to as SC)

- $(K_{\text{СОСТАВ ТГ}}^{\text{ГТУ}})^*$ – correction factors for deviation of fuel gas (FG) composition from the composition specified in the operating documentation
- $K_{\text{ОТБОРЫ ВОЗДУХА}}^{\text{ГТУ}}$ – correction factors for reduction of drive power when air is bled from the axial compressor (AC) of the GTU for the needs of the GPA and/or CS
- $\frac{K_{\text{ДРВХ}}^{\text{ГТУ}}}{\text{ВЫХ}}$ – correction factors for reduction of drive power when the inlet and outlet tracts of the GTU are contaminated depending on the total pressure loss ($\Delta P_{\text{ВХ/ВЫХ}}$) and when the OC of the GTU is contaminated depending on the operating time ($\tau_{\text{МПП}}^{\text{ГТУ}}$)
- $(K_{\text{загрязн}}^{\text{ОК ГТУ}}(\tau_{\text{МПП}}^{\text{ГТУ}}))^*$ – correction factor for reduction of GTU power due to wear of the material part during normal operation, not eliminated by washing and cleaning the flow part
- $(K_{\text{МПП}}^{\text{ГТУ}}(\tau_{\text{МПП}}^{\text{ГТУ}}))^*$ – correction factor for reduction of GTU power due to wear of the material part during normal operation, not eliminated by washing and cleaning the flow part

It should be noted that information on correction factors marked with an asterisk is not available in [2-8]. $K_{\text{МПП}}^{\text{ГТУ}}(\tau_{\text{МПП}}^{\text{ГТУ}})$ can be estimated based on the development [9].

Table 1 shows the factors that significantly affect the power balance of the drive-compressor system, the frequency of their impact and the nature of the change in impact over a certain period of time, seasonally or between major repairs.

Table 1

Gradients of change in the power of gas turbines and pulp and paper mills under the influence of various factors

Change power	External factors			Gas network			Technical condition			
	Altitude above sea level	Ta	Air extraction from OK GTU	Rn	TH	Gas composition	Wear of the equipment	Pollution of flow paths		
								in/out. GTU	OK GTU	CFC
GTU, %	1.08% per 100 m	(0.6..1.7)% per 1°C	(1.0...3.2)% per 1 kg/s			affects fuel gas composition	(0.09-0.16)% per 1 thousand hours.	(0.64...1.99)% / (0.4...1.87)% per 1 kPa	(2...6.6)% per 1 thousand hours	
CFC, %				0% (Pk const)	-0.4% per 1°C	-(4..8)% per 0.1 кг/м³	-0.04% per 1 thousand hours.			<4% 1 thousand hours
Period of impact	constantly			constantly			during the IRP	between washes		

Nature of impact	const for KS	seasonally	seasonally	gas network modes	growth by the end of the IRP	growth between washes and by the end of the IRP
MRP - inter-repair period or period between major repairs, time period of non-restorable degradation of the characteristics of gas turbines and pulp and paper mills due to the wear and tear of the resource of quickly wearing parts and units Ta, Th – atmospheric air temperature at the inlet to the GTU and gas temperature at the inlet to the CFC Pn, Pk – gas pressure at the inlet to the CFC and the inlet from the CFC. OK GTU – axial compressor GTU						

The data presented in Table 1 show that the most significant influence on the change in the power balance of the “drive-compressor” system is exerted by: an increase in the ambient air temperature, air bleeds from the OK GTU and contamination of the flow path of the OK GTU.

Accepted initial data and assumptions

When analyzing the influence of operating conditions on the characteristics of the “drive-compressor” system, a comparison was made of the position, shape and size of the contours of the area of matched modes for two options:

Option 1. Operation of a single-type “drive-compressor” system at different compressor stations;

Option 2. Operation of compressors with similar flow paths and gas-dynamic characteristics with different drives at different compressor stations;

To complete the “drive-compressor” system, drives based on the GTU-16 and CFC series “Ural” in the power class of 16 MW were selected, namely.

- GTU-16 based on engines NK-16-18ST (Aviastar, Kazan), HK-16ST (KMPO, Kazan), «ДГ-90 (Zorya-Mashproekt, Nikolaev), AJI-31CT (ODK-UMPO, Ufa), ПС-90П12 (ODK-Aviadvigatel, Perm);
- Ural series pulp and paper mill with a capacity of 16 MW:
 - Pulp and paper mill 1.35 - a group of compressors NC-16/76-1.44 (SNPO im. M.V. Frunze, Sumy) with SPCh 16/76-1.35-01 (NPO Iskra, Perm) as part of the GPA-C-16 (SNPO im. M.V. Frunze, Sumy) with the HK-16ST drive at the linear compressor stations of “Gazprom-transgaz Yugorsk” LLC (operation since 2022)
 - Pulp and paper mill 1.44 - a group of compressors of the Ural series manufactured by NPO Iskra, with similar design and GDH flow paths, as part of the GPA of the Ural series and other manufacturers at the linear compressor stations of PJSC “Gazprom” (operation since 2001).

Note: The compressors under consideration have a “dry”, “oil” or “combined” design according to the design of the support and sealing units. Systems of electromagnetic rotor suspensions, oil-lubricated bearings, gas-dynamic seal systems and mechanical oil seals from different manufacturers. For gas-dynamic calculations, the characteristics of the latest modifications of compressors manufactured in 2020-2022 were adopted.

Figure 2 shows the individual characteristics of the gas turbine and pulp and paper mill in the form of closed loops that limit the field of operating characteristics given in the operating documentation. The GDC of the pulp and paper mill are presented with the same parameters of the gas network ($P_k = 7.45 \text{ MPa}$, $T_H = 288.15 \text{ K}$, pumped gas with a molecular weight of $M = 16.3 \text{ kg / kmol}$, gas constant $R = 509.8 \text{ J / kg / K}$, density under normal conditions $\rho_{20^\circ\text{C}, 0.1013 \text{ Мра}} = 0.679 \text{ kg/m}^3$) in the rotor speed range of 3710-5565 rpm. The drive characteristics correspond to the dependencies of the available power on the rotation speeds of the GG and ST GTU at SC included in the TU. The corrections to the value of the available power, reduced to the same form and dimensions, are shown in Figure 3

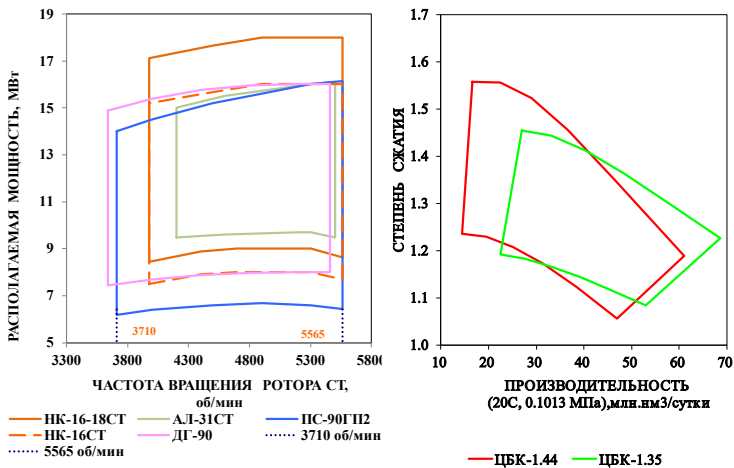


Figure 2. Characteristics of the ST GTU and GDH CFC

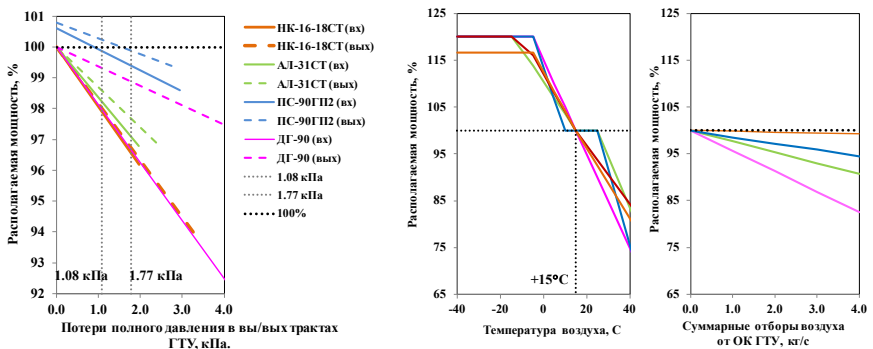


Figure 3. Corrections to the value of available drive capacity

The following is assumed in the calculations:

- the gas composition at the linear compressor station is taken in accordance with the questionnaires or acts with the compressor station, does not change during the year, the pressure at the compressor outlet is 7.45 MPa;
- when taking power for the GPA or compressor station's own needs at the minimum shaft line speed, the power balance can be zero
- degradation of drive and compressor indicators by the end of the MRP in accordance with the requirements of [1-7];
- data on the altitude marks of the compressor station location in accordance with Energybase www.gazprom.ru;
- maximum air temperatures are taken in accordance with the climatic regions of the location of the operating facility;
- the minimum air temperature in the calculations is -15°C.

The results of calculating the parameters of the drive-compressor systems are given in the second part of this article.

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关于天然气抽油机运行过程中“驱动-压缩机”系统协同模式区域边界的确定问题。第二部分

**ON THE ISSUE OF DETERMINING THE BOUNDARIES OF
THE AREA OF COORDINATED MODES OF THE «DRIVE-
COMPRESSOR» SYSTEM DURING THE OPERATION OF GAS
PUMPING UNITS. PART 2**

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摘要：本文介绍了在实际环境条件、天然气管网和实际技术条件下，在特定运行设施中运行的天然气泵机组，其驱动器或压缩机特性封闭区域的边界线的计算结果。在特定区域内，运行模式根据功率和轴线旋转频率进行协调，并以“零”功率平衡为特征。

本文第一部分探讨了当运行条件与驱动器和压缩机运行文件中构建单个特性的条件不同时，“驱动器-压缩机”系统协调模式区域边界的构建方法。

第二部分表明，“驱动器-压缩机”系统协调模式区域边界的形状、大小和位置会根据设备实体部件的运行条件和技术条件在组合特性范围内动态变化。已确定了满足运营机构需求的驱动装置动力输出储备。

本文探讨了俄罗斯联邦统一天然气系统现有设施在实际运行条件下“驱动装置-压缩机”系统的运行模式。这些设施的运行条件信息仅供参考，用于说明在约定的功率和转速模式下构建抽气机组运行区域的方法，并未包含有关运行设施的完整信息。

关键词：燃气轮机厂、抽气机组、压缩机站、驱动装置、天然气、自由涡轮、流道、燃气、涡轮机组、离心式压缩机。

Abstract. *The article presents the results of calculating the line that limits the closed area on the characteristics of the drive or compressor, in which the gas pumping unit is operational at a specific operating facility under actual environmental conditions, gas network and actual technical condition. The*

operating modes in the specified area are coordinated in terms of power and shaft line rotation frequency and are characterized by a “zero” power balance.

The methodology for constructing the boundary of the area of coordinated modes of the “drive-compressor” system when operating conditions deviate from the conditions for constructing individual characteristics in the operating documentation for the drive and compressor is considered in Part 1 of the article.

Part 2 shows that the boundary of the area of coordinated modes of the “drive-compressor” system dynamically changes its shape, size and position in the field of combined characteristics depending on the operating conditions and technical condition of the material part of the equipment. Reserves for power take-off from the drive for the needs of the operating organization have been identified

The article considers the operating modes of the “drive - compressor” system at existing facilities of the unified gas system of the Russian Federation under actual operating conditions. Information on the operating conditions of these facilities is provided in the volume necessary to illustrate the methodology for constructing the operating area of a gas pumping unit under modes agreed upon in power and rotation frequency, and does not contain complete information about the operating facilities.

Keywords: *gas turbine plant, gas pumping unit, compressor station, drive, natural gas, free turbine, flow path, fuel gas, turbo unit, centrifugal compressor.*

Parameters of the “HK-16CT – ЦБК-1.35” system (option 1)

The “HK-16ST-CFC-1.35” system has been in operation since 2022 at nine linear compressor stations (CS) of “Gazprom Transgaz Yugorsk” LLC. All stations operate in approximately the same climatic conditions, are located at zero above sea level, with the exception of one compressor station with an altitude of 259 m. The difference between compressor stations is insignificant deviations in the temperature of the pumped gas at the compressor inlet (T_H). Table 1 shows the parameters of the gas network, the ranges of change in consumed ($N_{\text{ПОПТ}}$) and available ($N_{\text{ПАЦИ}}$) power in seasonal modes. Figure 1 shows the contours of the area of agreed modes for the modes of “station conditions” (SC), nominal mode, winter and summer modes of operation of the GPA at a pressure at the compressor outlet (P_K) of 7.45 MPa and pumped gas with a molecular weight (M) of 16.3 kg / kmol, a gas constant (R) of 508.9 J / kg / K, a density under normal conditions $\rho_{20^\circ\text{C}, 0.1013 \text{ MPa}} = 0.67 \text{ kg / m}^3$)

Table 1.

Operating modes of the GPA with the “HK-16CT – ЦБК-1.35” system ($P_k = 7.45 \text{ MPa}$)

Operating modes of GPA	$T_h, ^\circ\text{C}$	Productivity ($Q_{20^\circ\text{C}, 0/1013 \text{ MPa}}$), million Nm^3/day	compression ratio (ϵ)	rotor speed (n), rpm	$N_{\text{ПОТ}}^{\text{P}}$ MW	$N_{\text{РАСП}}^{\text{P}}$ MW	
						$n_{\Gamma\Gamma}^{\text{MIN}}$	$n_{\Gamma\Gamma}^{\text{MAX}}$
S.C.	+15	38.6	1.35	5 160	14.7	8.0	16
Nominal mode	+10	38.6	1.35	5 080	14.4	7.4 - 8.1	14.8 - 16.2
Winter mode	+3 - +15	32.0	1.44	5 350... 5 525	14.8-15.5	8.6 - 9.4	17.1 - 18.7
Summer mode	+7 - +18	40.0	1.3	4 770... 4 950	12.7-13.5	6.5 - 7.5	11.9 - 15.1

Due to the discrepancy between the rotation frequency ranges of the free turbine (FT) of the gas turbine unit (GTU) and the centrifugal compressor (CC) in the lower part of the gas-dynamic characteristics (GDC) of the BDC (black dotted contour), about 10-12% of the GDC area is “cut off” by the power line at minimum rotation frequencies of the FT ($n_{\Gamma\Gamma}^{\text{MIN}} = 3975 \text{ об/мин}$) and the power line at the minimum rotation frequency of the gas generator rotor ($n_{\Gamma\Gamma}^{\text{MIN}}$, dashed curve). The upper right part of the GDH is limited by the line of maximum power at the maximum rotation frequency of the gas generator ($n_{\Gamma\Gamma}^{\text{MAX}}$).

To illustrate the shift of the area of the agreed modes relative to the S.C. mode, the position of the area of operation in the S.C. is fixed on all graphs (black contour).

For each mode, the upper and lower limits of the available power are defined. The upper limit is defined for the minimum air temperature, according to the technical condition at the beginning of the inter-repair period with the resistance of the inlet and outlet paths of the GPA no more than 1.08 and 1.77 kPa, respectively. In this case, the pulp and paper mill operates at the minimum gas temperature at the inlet.

The lower limit of the mode corresponds to the end of the inter-repair period, maximum contamination of the flow paths, maximum air temperature and maximum gas temperature, also taking into account the altitude above sea level.

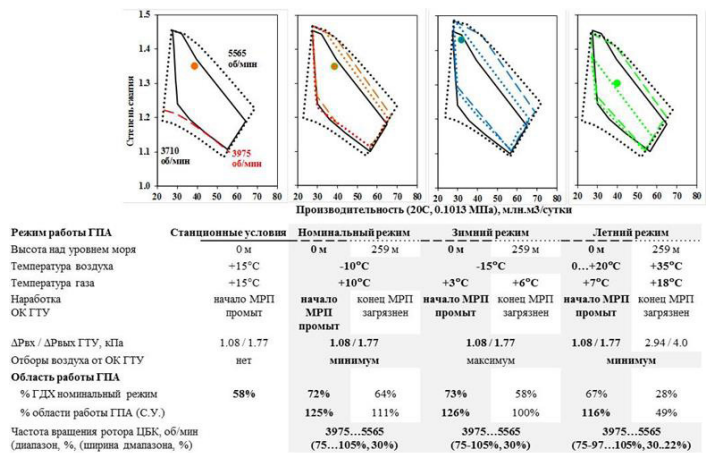


Figure 1. Contours of the area of coordinated modes of the system “HK-16CT – ЦБК-1.35” in design modes with certification points of operating modes.

Changes in the gas temperature at the compressor inlet in seasonal modes lead to a change in the consumed power of the CFC within 5%, the rotor speed - within 3.5%. The change in the value of the available power of the GTU during the season only taking into account the factors of Table 1 can vary in the range of 20 ... 30%

Parameters of the system “drive - ЦБК-1.44” (option 2)

When operating the “drive - ЦБК-1.44” system at various compressor stations in different climatic regions located at different altitudes above sea level, the CFC pumps natural gas of different compositions in different temperature ranges at the compressor inlet.

To analyze the impact of operating conditions on the GPU operating area, the following configuration was selected for the drive-compressor systems:

- HK-16ST – ЦБК-1.44 system, Gazprom transgaz Yugorsk LLC, in operation since 2008 (KS No. 1, KS No. 2);
- NK-16-18ST – ЦБК-1.44 system, Gazprom transgaz Tchaikovsky LLC, in operation since 2001 (KS No. 3);
- ПС-90ГП2- ЦБК-1.44 system, Gazprom transgaz Samara LLC, in operation since 2005 (KS No. 4);
- «ДГ-90 – ЦБК-1.44 system. Gazprom transgaz Ukhta LLC, in operation since 2012 (KS No. 5);
- АЛ-31СТ – ЦБК-1.44 system,
 - Gazprom transgaz Ukhta LLC, in operation since 2021 (KS No. 6)
 - Gazprom transgaz Ufa LLC, in operation since 2022 (KS No. 7, KS No. 8)

To simplify the analysis, one gas composition was adopted for calculations ($M = 16.2 \text{ kg / k Mol}$, $R = 512.9 \text{ kJ / kg / k}$, $p_{20^\circ\text{C}} = 0.1013 \text{ MPa} = 0.675 \text{ kg / m}^3$).

The nominal operating mode of the compressor corresponds to a compression ratio of 1.44 with a capacity of 32 million Nm^3 / day . The nominal operating mode of the GTU corresponds to the S.U. taking into account the altitude above sea level.

The calculation results are shown in Figure 2 and Table 2. For each configuration option of the “drive-ЦБК-1.44” system, the calculations were performed for three modes: nominal mode (solid line contour), maximum power mode (large dash contour), and minimum power mode (small dash contour). The graph shows the contour of the CFC GDH (black contour) under nominal mode conditions and the nominal mode point.

For all configuration options of the “drive-compressor” system, the contours of the region are shifted relative to the CFC GDH in nominal mode.

The range of variation of the degradation factors of the GTU characteristics (KN) for each system is individual and in the examples under consideration varies from 36 to 45% of the nominal value of the drive power according to the specifications.

Table 2.
Parameters of the system “drive-ЦБК 1.44”

Drive	Altitude above sea level, m	Input temperature change range, °C		Rotation speed of the rotors of the pulp and paper mill and the CT-ЦБК, rpm	K_N (%)
		air in GTU	gas in the CFC		
HK-16-18CT KC№3	0	minus 15 .. plus 35	minus 1 .. plus 21	ЦБК 3710 -5565 CT 3975 - 5565 CT-ЦБК 4100 - 5565	0.78 - 1.17 (37%)
HK-16CT KC№1 KC№2	297		minus 1 .. plus 21	ЦБК 3710-5565 ST 3975 -5565 CT-ЦБК 3975-5565	0.74 - 1.1 (36%)
ПС-90ПІ2 KC№4	284	minus 15 .. plus 45	minus 17 .. plus 28	ЦБК, CT 3710 – 5565 CT-ЦБК 3800 - 5565	0.60 - 1.05 (45%)
ДГ-90 KC№5	0	minus 15 .. plus 35	minus 1 .. plus 15	ЦБК 3710-5565 ST 3640...5460 CT-ЦБК 3900-5460	0.72 - 1.13 (41%)
АЛІ-31CT KC№6 KC№7 KC№8	139		minus 1 .. plus 15	ЦБК 3710...5565 ST 4200...5500 CT-ЦБК 4300-5500	0.70 - 1.09 (39%)
	219		minus 5 .. plus 19.5		0.69 - 1.08 (39%)
	267		minus 4.1 .. plus 26.6		

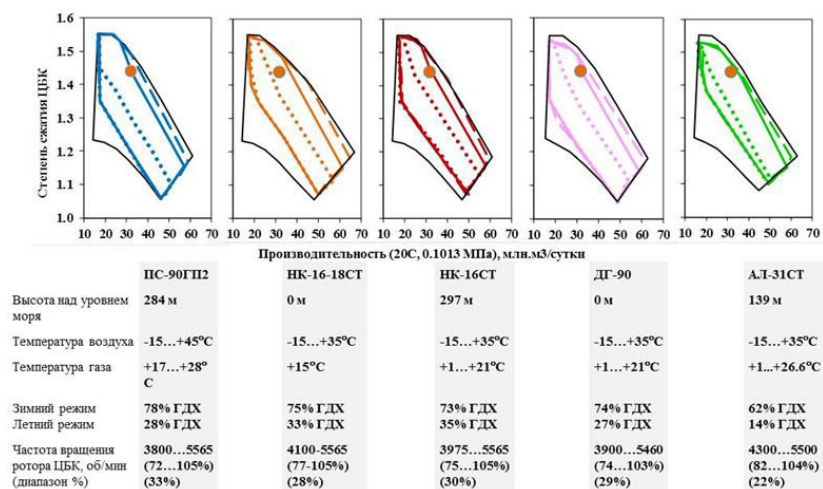


Figure 2. Operating area of the GPA with ЦБК-1.44

At minimum rotation speeds of the ST rotor of all drives, the minimum available power of the GTU exceeds the power consumption of the CFC. This does not allow reducing the shaft line rotation speed to a value corresponding to the planned mode. The shaft line rotation speed control range changes from 22% to 33% and becomes less than according to the individual characteristics of the drive or compressor in all the examples under consideration, with the exception of the НК-16СТ - ЦБК-1.44 system. In the НК-16СТ - ЦБК-1.44 system, a decrease in available power due to the influence of operating conditions made it possible to ensure a “zero” power balance at the minimum rotation speed of the ST rotor. For all other systems, it is possible to connect additional equipment for temporary power take-off for the compressor station or GPA’s own needs. The maximum area of the working region of the GPA and the range of speed control is achieved by the GPA equipped with the ПС-90П2 drive, despite the fact that in summer the ПС-90П2-ЦБК-1.44 system operates in more severe conditions than other systems, with an air temperature of up to 45°C, which is 10°C higher than at other compressor stations. This is equivalent to a decrease in available power by 1.5 MW.

Minimum area of the working region of the GPA with the АЛ-31СТ drive. In summer, the area of the agreed modes decreases in size by 4.5 times and becomes two times smaller than the area of the agreed modes of the system with the ПС-90П2 drive, despite the more moderate temperature conditions.

Analysis of the results of calculating the parameters of the HK-16CT – ЦБК-1.35 and Drive-ЦБК-1.44 systems showed the following

1. The region of operating modes of the Drive-Compressor system matched in power and rotation frequency is formed at the intersection of the fields of individual characteristics of the drive and compressor and is limited by a closed loop.
2. On the loop line and inside the loop, operating modes with a “zero” power balance can be ensured taking into account the calculation error.
3. The loop line is formed from the limiting power lines at maximum and minimum rotation frequencies of the ST and GG of the GTU, as well as the line of minimum gas generator power.
4. The position of the line of minimum gas generator power at minimum rotation frequency of the GG rotor of the GTU can be changed when changing the drive power at minimum rotation frequency of the GG due to degradation of the GTU characteristics, contamination of the flow paths or when taking off power for the GPA or CS own needs.
5. The contour line always lies entirely within the GTU ST field or the Pulp and Paper Mill GDH field, regardless of the parameters in which the system characteristics are constructed.
6. The contour line is not a stationary curve with a constant shape and location. It is “moving” and individual for each “drive-compressor” system at each operating facility, changing its shape, size and location on the graphic dependence field in accordance with the change in the individual characteristics of the drive and compressor.
7. The drive characteristics have a stronger influence on the size and shape of the area inside the contour than the compressor characteristics. The compressor characteristics determine the contour displacement to a greater extent depending on the gas network parameters
8. The area of the characteristic region limited by the contour line can change:
 - during the year: increase in winter by 15-20%, decrease in summer by 30%.
 - decrease by 40% by the end of the MRP
 - depending on the deviation of the drive speed range from the compressor speed
9. Determining the contour line in the control system without taking into account the actual operating conditions at a specific facility may lead to an incorrect assessment of the possibility of ensuring some operating modes, in particular the boundary ones

Tuning critical speeds from the operating range

Tables 2 and 3 show that the operating range of the drive-compressor systems is narrower than the range of 70-105% of the nominal value. It follows that the

tuning from critical frequencies should be carried out not from the boundaries of the GTC of the CFC or ST GTU, but from the boundaries of the region of agreed modes

Minimum shaft line rotation frequency

Analysis of individual characteristics of the ST GTU and CFC showed that at minimum shaft line rotation frequencies on new, uncontaminated equipment or restored after major repairs, the power balance can reach 3.-3.5 MW and can be reduced with degradation of the ST GTU characteristic or when taking off power for the own needs of the GPA and / or CS.

Considering that the change in the internal power of the compressor is proportional to the change in the rotor speed, and the change in the available drive power is proportional to the change in the rotor speed of the gas generator [2, 9], the condition of the “zero” power balance of the “drive - compressor” system in a simplified form can be described by formula (1) taking into account the degradation of the characteristics of the GTU and CFC during operation, where the degradation factors are determined by formulas (4) and (5) of Part 1 of this article.

$$\frac{\rho_H}{\rho_{H \text{ ном}}} \cdot \left(\frac{n_{CT}}{n_{CT \text{ ном}}} \right)^3 \cdot K_N^{\text{ЦБК}} \approx \left(\frac{n_{ГТ}}{n_{ГТ \text{ ном}}} \right)^{4.762} \cdot K_N^{\text{ГТУ}} \quad (1)$$

Where

ρ_H — gas density at compressor inlet
 ном — parameters at nominal mode

When calculating according to formula (1) at the minimum rotation frequency of the gas generator rotor on new equipment or after major repairs, the minimum rotation frequency of the shaft line of the ПС-90ГП2 - ЦБК-1.44 system will be about 90% of the nominal value.

In conclusion, it should be noted that the considered characteristic of the drive-compressor system is one of its most important properties, characterizing the provision of operating modes of the GPA operation facility.

The results of calculations of the parameters of systems with different gas turbines and pulp and paper mills showed:

1. The characteristic of the “drive-compressor” system **“boundary of the agreed-upon mode area”** with dynamically changing coordinates depending on the operating conditions allows for a simple visualization of the provision of operating modes of the object of operation
2. The proposed assessment methodology does not require recalculation of the entire field of gas turbine and pulp and paper mill characteristics for new conditions, while only the limiting contour is rebuilt..

3. It is shown that the range of parameters of the “drive-compressor” system is smaller than for the individual characteristics of the drive and compressor.
4. Reduction of the range of rotation frequencies of the shaft line of the “drive-compressor” system compared to gas turbines and pulp and paper mills changes the requirements for the adjustment of critical rotation frequencies not from the hypothetical range (70-105% of the nominal), but from the boundary of the agreed-upon mode area.
5. A reserve for power take-offs for the auxiliary needs of the gas pumping unit or compressor station is determined.
6. The considered characteristic does not allow to evaluate the energy efficiency of the “drive-compressor” system, but allows to draw a conclusion about the possibility of using a single-type system at a compressor station with similar operating conditions.

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葡萄加工为果胶来源的二次原料资源技术潜力评估

**ASSESSMENT OF THE TECHNOLOGICAL POTENTIAL OF
SECONDARY RAW MATERIAL RESOURCES FOR PROCESSING
GRAPES AS A SOURCE OF PECTIN**

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摘要: 对“Citron Magarach”品种葡萄渣中所含果胶物质的特性进行了分析研究。研究结果证实了从葡萄渣中提取果胶在食品工业中的应用前景和可行性。

此外,还分析了果胶生产所需的原料市场规模及其增长动态。

关键词: 果胶, 果胶生产, 食品工业, 葡萄渣。

Abstract. *Analytical studies of the characteristics of pectin substances contained in grape pomace of the “Citron Magarach” variety were conducted. The results obtained made it possible to substantiate the prospects and feasibility of using pectin obtained from grape pomace in the food industry.*

The volumes of the raw material market required for pectin production and its growth dynamics were also considered.

Keywords: *pectin, pectin production, food industry, grape pomace.*

The most important raw materials for the production of commercial pectin are apple pomace, citrus pomace and beet pulp - by-products of canning and sugar production.

The production of pectin from such food industry waste seems to be advantageous from both an economic and environmental point of view. This determines the relevance of the comprehensive processing of secondary raw materials in order to produce competitive products [1-5]. The winemaking process produces valuable industrial raw materials for the production of pectin — grape pomace. About 400 thousand tons of grapes are produced in our country annually, and this figure is constantly growing. For example, in the Krasnodar Territory, the gross grape harvest has increased by one and a half times over the past four years.

An analysis of the positioning strategies of winemaking enterprises in the Krasnodar Territory revealed the following trends in relation to the grape varieties and technologies used: 50% of enterprises are based on Russian and/or Soviet

winemaking traditions; 32% of enterprises use global technologies, of which 21% are guided by Western European countries, and 11% by the traditions of their winemaking regions; 20% of enterprises are inspired by local traditions.

In 50% of cases, producers use international grape varieties such as Riesling, Chardonnay, Aligote, Sauvignon Blanc, Muscat, Traminer, Gewurztraminer, Cabernet Sauvignon, Cabernet Franc, Pinot Noir, Merlot, Syrah (Shiraz), Malbec and others.

In 30% of cases, producers combine foreign and domestic grape varieties.

In 30% of wine descriptions, the winemaker or oenologist is mentioned. Among them,

45% are domestic specialists, and 35% are foreign. About 34% of winemakers from the Krasnodar Territory emphasize their commitment to international (foreign) approaches to wine positioning

However, up to 20% of waste is generated in the process of grape processing, which is currently almost not utilized. This leads to an increase in the cost of finished products [1, 3].

The properties of pectic substances obtained from plant tissues can vary significantly and depend largely on their source.

The characteristics of pectic substances are determined by their molecular weight, degree of esterification (or methoxylation) and content of acetyl groups. Such properties of pectin as solubility, ability to interact with metal ions and form gels largely depend on the ratio of free and esterified carboxyl groups in the pectin macromolecule, as well as on the chain length and degree of branching of the molecule [5, 6].

As a result of the fact that these parameters differ, pectins obtained from different sources have different properties, including the ability to form complexes and form a gel-like structure [3, 4].

In this regard, a study was conducted of the fractional composition and analytical characteristics of pectin obtained from grape pomace in order to determine its prospects and possibilities of application in the food industry.

The objects of the research were the pomace of white grape varieties: Chardonnay, Riesling, Rkatsiteli, Viorica, Stepnyak, Pervenets Magarach, Mura; from red grape varieties: Cabernet Sauvignon, Saperavi, Tsimlyansky Black. It was found that in the pomace of white grape varieties, the total pectin content varies from 2.64% to 4.9%, with an average value of 3.95%. The share of protopectin from the total amount of pectins ranges from 54.92% to 94.12%, and the average value is 76.90%.

In the studied red grape pomace, the total pectin content ranges from 1.74% to 4.40%, with an average value of 2.94%.

A lower average value compared to white pomace may be due to the use of various technological methods in primary winemaking. In particular, it is possible to use pectolytic preparations that destroy the pectin chain in the grape skin, which enhances maceration and increases the yield of must.

The content of protopectin from the total amount of pectins ranges from 55.0% to 97.05%, with an average value of 72.23%.

Since no significant differences in the pectin content in grape pomace were found, we isolated pectin from the variety mixture and determined its analytical characteristics.

From the data presented in Figure 1, it is evident that the content of free carboxyl groups in pectin is quite high and amounts to 4.0%. This quantitative value of free carboxyl groups determines the degree of esterification of the isolated pectin. Pectin is low-esterified, which allows us to talk about its high complexing ability and, as a consequence, its pronounced detoxifying properties. The relatively high content of methoxyl and low content of acetyl groups in the molecule of pectin substances, expressed as a percentage of the mass of pure pectin, will contribute to an increase in the viscosity of soft drinks. This, in turn, will improve their consumer properties, creating a denser consistency, which will be perceived as the “body” of the drink.

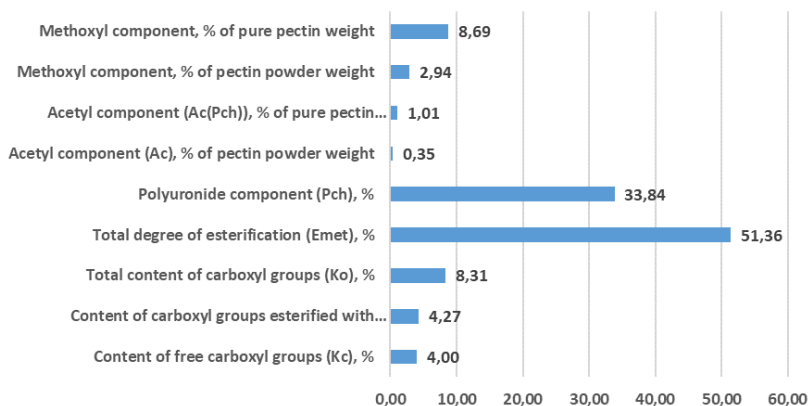


Figure 1. Analytical characteristics (average values) of pectin substances isolated from the pomace of Chardonnay, Rkatsiteli and Pervenets Magarach grape varieties.

To assess the technological potential of grape pomace, a comparative assessment was carried out with industrial pectins (Figure 2).

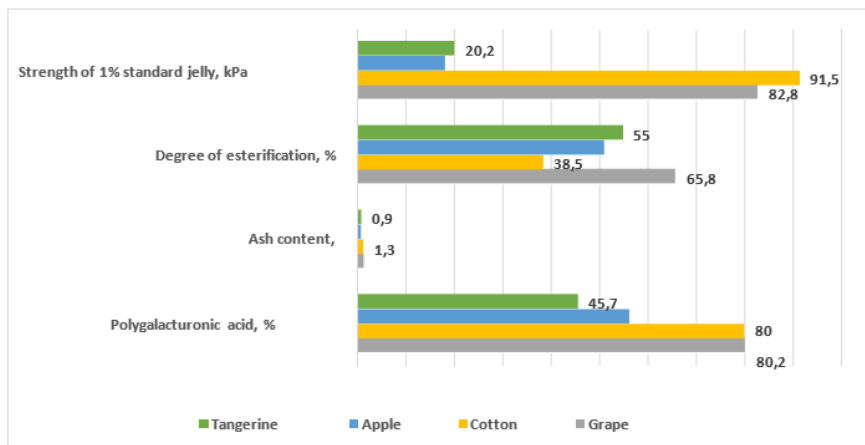


Figure 2. Comparative characteristics of different types of pectin.

Comparative characteristics of pectin from different raw material sources showed that grape pectin meets the established requirements in terms of its main quality indicators.

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Bi₂Te₃作为热电和自旋电子器件材料的晶格和能带结构分析
**ANALYSIS OF THE CRYSTAL LATTICE AND BAND STRUCTURE
OF Bi₂Te₃ AS A MATERIAL FOR THERMOELECTRIC AND
SPINTRONIC DEVICES**

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摘要: 本研究对著名的层状热电半导体碲化铋 (Bi₂Te₃) 的原子键合性质和电子结构进行了全面的理论和实验研究。研究重点关注其三角晶体对称性、自旋轨道相互作用在塑造其能带拓扑结构中的作用,以及层间弱范德华力的重要性。利用 Mooser-Pearson、Lagrenaudie 和 Drabble-Goodman 框架,对 Bi 和 Te 原子之间的键合类型进行了深入分析。结果表明,结构变化(尤其是在 60° 孪晶边界处)可以显著改变局部电子态,从而影响材料的输运和光学性能。这些发现可为基于 Bi₂Te₃ 的先进热电和自旋电子器件的设计提供参考。

关键词: 碲化铋 (Bi₂Te₃); 热电半导体; 电子能带结构; 自旋轨道耦合; 范德华相互作用; 原子间键合模型; 投影态密度 (PDOS); 孪生边界; 拓扑材料; 能带反转。

Abstract. *This study presents a comprehensive theoretical and experimental examination of the atomic bonding nature and electronic structure of bismuth telluride (Bi₂Te₃), a well-known layered thermoelectric semiconductor. Particular attention is given to its trigonal crystal symmetry, the role of spin-orbit interactions in shaping its band topology, and the significance of weak Van der Waals forces between layers. The bonding types between Bi and Te atoms are thoroughly analyzed using the frameworks of Mooser-Pearson, Lagrenaudie, and Drabble-Goodman. It is shown that structural changes, especially at 60° twin boundaries, can significantly modify the local electronic states and, consequently, the material's transport and optical performance. These insights may inform the design of advanced thermoelectric and spintronic devices based on Bi₂Te₃.*

Keywords: *Bismuth telluride (Bi₂Te₃); thermoelectric semiconductors; electronic band structure; spin-orbit coupling; Van der Waals interactions;*

interatomic bonding models; projected density of states (PDOS); twin boundaries; topological materials; band inversion.

Introduction

Bismuth telluride (Bi_2Te_3) has long attracted significant interest in thermoelectric research owing to its high efficiency in converting temperature gradients into electrical voltage, particularly near room temperature. Beyond its classical role in thermoelectrics, Bi_2Te_3 has more recently gained attention as a topological insulator, offering promising opportunities for next-generation spintronic and quantum electronic applications. The primary objective of this paper is to deepen the understanding of Bi_2Te_3 's physicochemical behavior by analyzing its crystal structure, interatomic bonding mechanisms, and band structure features based on both computational modeling and experimental findings.

Previous research has established Bi_2Te_3 as a key compound in thermoelectric engineering and quantum materials science. For instance, Kim et al. [3] demonstrated that the presence of 60° twin boundaries in Bi_2Te_3 can lead to new localized states in the band gap, affecting both conductivity and thermoelectric performance. Additionally, the bonding character in Bi_2Te_3 has been extensively studied through models such as those proposed by Drabble and Goodman [8], emphasizing the importance of interlayer interactions and orbital hybridization. Thermal and electronic transport properties across wide temperature ranges have also been confirmed experimentally by Akhanda et al. [9], validating theoretical models involving multiple ellipsoidal energy surfaces. These works provide a solid foundation for further investigation into the detailed atomic and electronic structure of Bi_2Te_3 , as undertaken in this article.

Materials and Methods

Bismuth telluride (Bi_2Te_3), which crystallizes in the trigonal crystal system, was selected as the research object. The crystal structure and electronic properties were studied using theoretical calculations and experimental methods, such as projected density of states, spin-orbit coupling, and twin boundary analysis. The types of interatomic bonds were analyzed using the Mooser-Pearson, Lagrenaudie, and Drabble-Goodman models.

Bi_2Te_3 is a compound of bismuth and tellurium, commonly known in the form of gray powder and also referred to as Bismuth(III) Telluride. It is a semiconductor that, when alloyed with antimony or selenium, becomes an efficient thermoelectric material for cooling or portable power generation. Due to its topological insulator properties, the physical characteristics of Bi_2Te_3 vary depending on the layer thickness and make it one of the most effective thermoelectric materials near room temperature. Its unusual electronic structure and narrow forbidden band define its thermoelectric properties.

Bismuth telluride crystallizes in the trigonal crystal system ($R\bar{3}m$, 166). This crystal structure consists of quintuple layers (Te–Bi–Te–Bi–Te), which are held together by Van der Waals forces. As a result, it easily cleaves along the trigonal axis (111 plane). The rotation mechanism of crystal structures and the changes in interlayer bonding during the formation of 60° twin boundaries play a significant role in the material's properties.

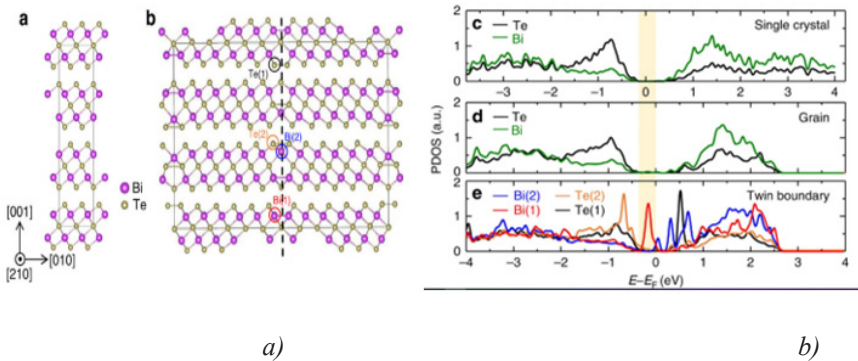


Figure 1. Atomic structures of Bi_2Te_3 : (a) Unit cell of Bi_2Te_3 and (b) Bi_2Te_3 structure with a 60° twin boundary.

The dotted black line indicates the 60° twin boundary. (c) Projected density of states (PDOS) for bulk Bi_2Te_3 , (d) particle region, and (e) boundary region (lower panel). To plot the projected density of states in the boundary region, four different atoms were selected (as marked in panel b). The dark blue, dark orange, red, and blue circles correspond to Te (1), Te (2), Bi (1), and Bi (2) atoms, respectively. All three panels (c–e) are aligned with the maximum of the valence band. The calculated forbidden zone width is shaded in yellow. [3]

Figure 1a shows the tetragonal unit cell of Bi_2Te_3 , with bismuth (Bi) atoms depicted in purple and tellurium (Te) atoms in light yellow. The main crystal directions are indicated ([001] and [010]). Figure 1b shows the 60° twin boundary structure of Bi_2Te_3 , with the twin boundary marked by the dotted black line. This boundary causes a structural misalignment of the atomic layers. Four atoms around the boundary are specially marked: Te(1) in black, Te(2) in dark orange, Bi(1) in red, and Bi(2) in blue. These atoms are selected to study the structural and electronic properties around the boundary. The graphs in (c–e) are aligned with the maximum of the valence band, and the energy scale $E - E_f$ is relative to the Fermi energy.

Figure 1c shows the projected density of states for pure Bi_2Te_3 crystals. The projected density of states for Bi and Te atoms is quite similar, but it can be ob-

served that the density of states for Bi atoms is higher in both the valence and conduction bands. The forbidden zone is shown as the yellow-shaded region. Graph (d) reflects the projected density of states for Bi and Te atoms in the particle region.

It can be observed that this graph is nearly identical in shape to the projected density of states for the bulk state. This indicates that the electronic properties in the particle region are very similar to those in bulk Bi_2Te_3 . Figure 1e shows the projected density of states diagram for the 60° twin boundary region. Significant changes are observed in this graph: New energetic states appear within the forbidden zone in atoms at the boundary region (especially Bi(1), Bi(2), Te(1), and Te(2)). In the case of the Bi(1) atom, a new filled state within the forbidden zone appears due to the shortening of the Bi–Bi bond (3.11 Å) (red line). A new filled state (dark orange line) appears within the forbidden zone as a result of the shortened Te(2)–Te(2) bond (3.54 Å). For the Bi(2) atom, new empty states appear near the minimum of the conduction band (blue line).

The research results show that Bi_2Te_3 crystals have a layered structure, with layers bonded by Van der Waals forces. According to the analysis of the electronic structure, the valence band is primarily formed by the p-orbitals of Te atoms, while the conduction band is formed by the p-orbitals of Bi atoms. When spin-orbit coupling is considered, a band inversion occurs, and the forbidden zone width decreases by approximately 0.11 eV. The presence of six equivalent ellipsoids plays a decisive role in the thermoelectric efficiency of Bi_2Te_3 . Additionally, Bi–Te bonds are a combination of covalent and ionic bonds, which define the electronic and optical properties of the material.

In Bi_2Te_3 crystals with a 60° twin boundary, changes in the structure lead to a shortening of interatomic distances. As a result, new states appear within the forbidden zone in the electronic structure, significantly affecting the material's electronic and optical properties. In particular, changes in the electronic structure of Bi and Te atoms in the boundary region can directly influence the material's physical properties, such as electrical conductivity, thermal, and optical characteristics. These results are consistent with findings in polycrystalline semiconductors, where similar boundary-related effects were observed to influence electronic and transport properties, supporting the applicability of the presented models to both single- and polycrystalline systems [4].

These approaches align with previous work on intergranular conductivity and boundary representation in polycrystalline semiconductors, demonstrating that similar structural and electronic analysis methods can be extended to polycrystalline Bi_2Te_3 as well [4].

The interatomic bonding in Bi_2Te_3 has a complex nature. When comparing interatomic distances, Bi–Te bonds are primarily covalent in nature, with an ionic component also present. The Bi–Te₁ bond (3.12 Å) is stronger than the Bi–Te₂

bond (3.54 Å), and this difference can be explained by the distribution of electron density. At the same time, Te–Te distances (3.57 Å) result in weak Van der Waals bonds, which facilitate the easy cleavage of the crystal into layers.

The electronic band diagram of Bi₂Te₃ is complex, and under the influence of strong spin-orbit coupling, the ordering of the energy bands changes. Figure 2 shows the calculated energy band structure of the Bi₂Te₃ semiconductor:

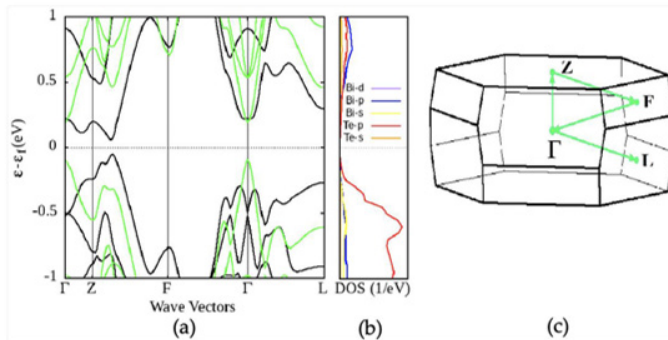


Figure 2. Energy band diagram of Bi₂Te₃ based on theoretical calculations.

In **Figure 2**, the green lines correspond to the case where spin-orbit coupling is neglected, while the black lines correspond to the case where spin-orbit coupling is taken into account.

Figure 2a shows the binding energy spectrum of Bi₂Te₃, with spin-orbit coupling included (black line) and excluded (green line). By incorporating spin-orbit coupling, the band gap decreases to approximately ~0.11 eV, and the valence and conduction bands swap positions around the Γ point.

Figure 2b presents the density of electronic states (DOS) for Bi₂Te₃, where the valence band is primarily composed of Te p-orbitals, and the conduction band is predominantly formed by Bi p-orbitals.

Figure 2c illustrates the Brillouin zone of the Bi₂Te₃ crystal.

According to the results for the electronic density of states in Bi₂Te₃, the valence band is formed by the p-orbitals of Te atoms, while the conduction band is formed by the p-orbitals of Bi atoms.

A distinctive feature of the band structure of Bi₂Te₃ is that the extrema of the valence and conduction bands do not occur at the high-symmetry Γ point. Due to spin-orbit coupling, band inversion occurs in Bi₂Te₃, and as a result, the valence band maxima appear at other points in the Brillouin zone. Both theoretical and experimental studies have shown that energy surfaces with equal values (Fermi surfaces) in Bi₂Te₃ form six equivalent ellipsoidal shapes. In other words, the up-

per state of the valence band and the lower state of the conduction band can be described by six equivalent ellipsoids.

This multi-ellipsoidal (six-ellipsoid) structure reduces the effective mass of charge carriers and ensures a high degree of ellipsoid degeneracy. This characteristic contributes to the high efficiency of Bi_2Te_3 as a thermoelectric material—multiple equivalent ellipsoids provide many states for charge carriers, enhancing electrical conductivity, while maintaining a relatively constant Seebeck coefficient without significant reduction. Hall effect and Seebeck coefficient measurements indicate the need to use the six-equivalent ellipsoid model for Bi_2Te_3 . The presence of these ellipsoids reduces the effective mass of charge carriers, improves electrical conductivity, and ensures high thermoelectric efficiency.

Discussion

According to the analysis results, the $\text{Bi}-\text{Te}_1$ bond lengths are closer to covalent bonding values than to ionic bond lengths. This suggests that Bi_2Te_3 is a semiconductor, and the $\text{Bi}-\text{Te}$ bond, which is of metallic nature, can be considered primarily covalent. In this case, the $\text{Bi}-\text{Te}_1$ bond is stronger than the $\text{Bi}-\text{Te}_2$ bond. Additionally, the Te_1-Te_1 bond lengths are larger than the sum of the covalent radii but smaller than the sum of the Van der Waals radii.

Mooser and Pearson, who analyzed the chemical bonding nature of bismuth telluride and its relation to its electrical and optical properties, considered the coordination of Te atoms in Bi_2Te_3 to have a purely metallic character, emphasizing the presence of vacant orbitals in the atoms [5, 6]. However, the main drawback of this approach is that it cannot explain why Bi_2Te_3 , which experimentally has a small energy gap, behaves as a semiconductor. This is because practical experiments have confirmed that Bi_2Te_3 materials exhibit typical semiconductor properties.

Lagrenaudie attempted to explain the bonding by treating Bi atoms as trivalent and Te atoms as having a pyramidal coordination. However, his approach also encountered several contradictions, as this model caused issues when calculating the total number of valence electrons and faced difficulties in explaining the semiconductor properties of Bi_2Te_3 [7]. Later, J. R. Drabble and C. H. L. Goodman suggested that the longer Te–Te distances (3.57 Å) between the layers of the Bi_2Te_3 crystal structure have weak Van der Waals-type bonds, which explain the material's easy cleaving into layers [8].

According to their proposed model, Te_1 atoms form strong covalent bonds with three nearby Bi atoms, using only p-orbitals. At the same time, the 5s electron pair does not participate in bonding and remains as a lone electron pair. Te_2 atoms and Bi atoms have nearly octahedral coordination, and the bonding orbitals are sp^3d^2 hybridized, meaning that both s and p electrons participate in bonding. This configuration results in each bond being fully saturated with two electrons. The total

number of valence electrons per unit cell is 24 (4 electrons from each Te_1 atom, 5 electrons from each Bi atom, and 6 electrons from one Te_2 atom). These electrons are distributed among the 12 bonds in the unit cell, with two electrons per bond. The difference in the bond lengths of Bi-Te_1 and Bi-Te_2 is also observed, indicating that the nature of these bonds is different. The Bi-Te_1 bond, being shorter (3.12 Å), is stronger and may have some ionic character, as the electron density in the Te_1 atoms is directed more towards the Bi atoms [8]. As a result, an ionic component exists between Bi and Te_1 atoms, strengthening this bond.

Spin-orbit coupling plays a significant role in the electronic band structure of Bi_2Te_3 . When spin-orbit coupling is included, the forbidden zone width decreases to approximately ~0.11 eV, and the valence and conduction bands undergo inversion [9].

Here is the table comparing the theoretical models (Mooser-Pearson, Lagrenaudie, and Drabble-Goodman):

Model	Advantages	Disadvantages
Mooser–Pearson	Provides a simple interpretation of metallic bonding features in tellurium atoms and clarifies basic coordination.	Does not sufficiently explain Bi_2Te_3 ’s narrow band gap and semiconductor nature.
Lagrenaudie	Attempts to define valence states and pyramidal coordination of Te atoms more clearly.	Faces inconsistencies in electron counting and cannot fully account for the observed semiconducting behavior.
Drabble–Goodman	Incorporates orbital hybridization theory, matching well with experimental data and explaining both covalent and Van der Waals interactions.	Lacks detailed accuracy in describing certain features of the electronic structure near the Fermi level.

The comparative analysis of the three primary bonding models used to interpret the structure of Bi_2Te_3 - namely Mooser–Pearson, Lagrenaudie, and Drabble–Goodman—reveals the complexity of accurately describing its electronic nature. The Mooser–Pearson model provides a foundational understanding of metallic bonding characteristics, especially within tellurium atoms; however, its simplicity limits its application in explaining the semiconducting behavior of Bi_2Te_3 , particularly the existence of a narrow band gap.

Lagrenaudie’s model introduces a more nuanced approach by considering pyramidal coordination and trivalence of bismuth atoms, yet it struggles with electronic balance and fails to align fully with observed semiconductor features. In contrast, the Drabble–Goodman model successfully applies hybridization theory (sp^3d^2) to describe bonding and aligns better with experimental structural param-

eters. It incorporates Van der Waals forces and lone electron pairs in Te atoms, making it the most comprehensive of the three. However, even this model lacks sufficient granularity to capture all aspects of Bi_2Te_3 's band topology, especially under strong spin-orbit coupling effects.

Therefore, a hybrid interpretive framework that draws on strengths from all three models is recommended for a complete understanding of Bi_2Te_3 's physical and chemical behavior, particularly in the context of advanced thermoelectric and spintronic applications.

Conclusion

In this work, an in-depth evaluation of the structural, chemical, and electronic characteristics of Bi_2Te_3 semiconductors has been conducted through a synthesis of theoretical insights and experimental evidence. The analysis emphasized how interatomic bonding, crystallographic features, and spin-orbit interactions contribute to the unique electronic structure of Bi_2Te_3 and its exceptional thermoelectric behavior. It was shown that variations in atomic arrangement—particularly at twin boundaries—play a critical role in altering the band structure and introducing new electronic states. These findings not only enhance our fundamental understanding of Bi_2Te_3 but also open pathways for engineering next-generation thermoelectric and spintronic devices by tailoring atomic configurations and exploiting band topology.

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用地球化学方法预测中西伯利亚沉积地层和火山沉积地层的油气潜力
**FORECASTING OIL AND GAS POTENTIAL OF SEDIMENTARY
AND VOLCANOGENIC-SEDIMENTARY STRATA OF CENTRAL
SIBERIA VIA GEOCHEMICAL METHODS**

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摘要：地球化学研究的分布范围涵盖年轻的西西伯利亚板块东部和东北部边缘的中生代地层以及西伯利亚地台西部古老的沉积-火山地层。提出了一种结合一般地质风险计算地球化学异常归类为蔡系成因的风险的方法。提出了一种评估油气勘探中地球化学信息可靠性的方法，其中考虑了地球化学屏障对油气从矿床中运移流动的影响。

关键词：地球化学勘探，中西伯利亚，风险因素，地球化学与地质风险，地球化学屏障。

Abstract. *Geochemical studies cover the territory of distribution in the section of Mesozoic strata of the eastern and north-eastern margins of the young West Siberian plate and ancient sedimentary-volcanogenic strata of the western part of the Siberian platform. A method for calculating the risk of classifying geochemical anomalies as naphthidogenic in conjunction with the general geological risk is proposed. A method for assessing the reliability of geochemical information in oil and gas exploration is given, taking into account the influence of geochemical barriers that distort the migration flow of hydrocarbons from deposits.*

Keywords: *geochemical exploration, Central Siberia, risk factors, geochemical and geological risk, geochemical barrier.*

Factual material. The data of long-term geochemical studies during geochemical exploration of oil and gas (GEOG) and environmental monitoring at oil and gas fields within the territory of Krasnoyarsk Krai were studied. More than thirty promising geochemical anomalies [7] identified during production of various-scale GEOG and the results of studies of oils, gases, condensates and formation waters at oil and gas fields and manifestations in Central Siberia were analyzed [1–4; 8–10]. These data served as the basis for assessing the chance of formation of hy-

drocarbon anomalies associated with oil or gas deposits in this geological section, which is very complex from the point of view of geochemical exploration of oil and gas in the presence of geochemical barriers in the section (Fig. 1).

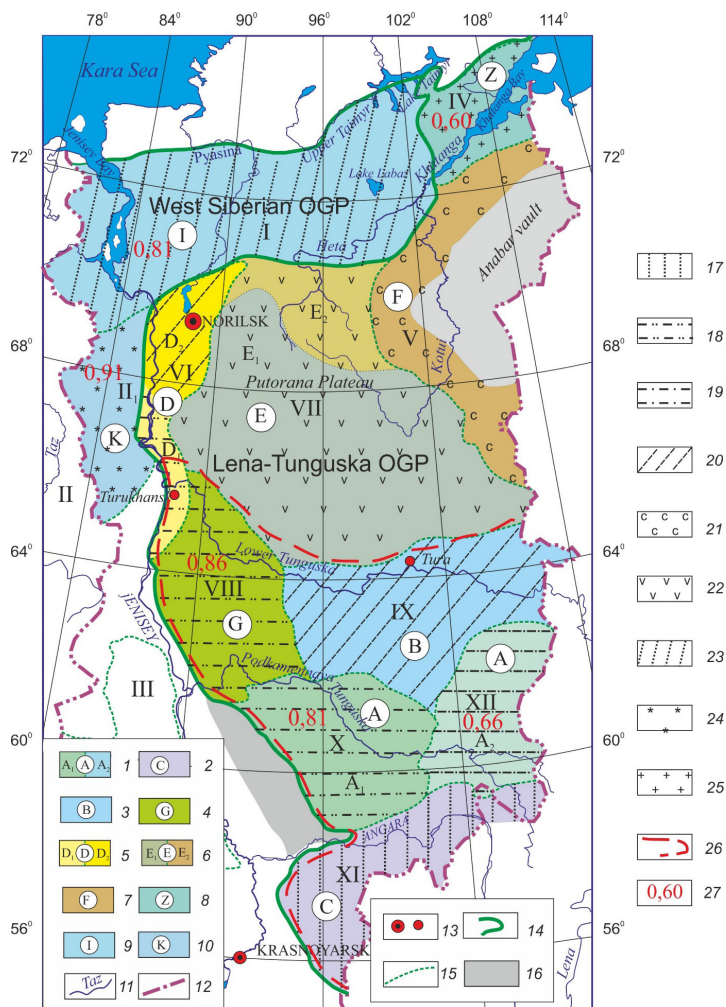


Figure 1. Scheme for assessing the chance of classifying a surface geochemical anomaly as an anomaly associated with a hydrocarbon deposit: I–XII oil and gas bearing regions (GBR) and areas (GBA) of geochemical exploration; **West Siberian oil and gas province (OGP)**: I – Yenisei-Khatanga GBR; II – Purtaiz GBR; III – Bolshekhetsky GBA; III – Priyenisei GBR; **Lena-Tunguska OGP**:

IV–XII – oil and gas bearing regions: IV – Anabar-Khatanga; V – Anabar; VI – Turukhano-Norilsk; VII – North Tunguska; VIII – Bakhtinskaya; IX – Central Tunguska; X – Baikitskaya; XI – Prisayan-Yenisei; XII – Nepa-Botuoba; A–K – geochemical zones and subzones of different information content of combinations of methods and objects of sampling by geochemical methods: 1 – Baikit-Katanga zone A with subzones A1 – Baikit; A2 – Katanga; 2 – Prisayano-Yenisei zone B; 3 – Central-Tunguska zone B; 4 – Bakhtinskaya zone G; 5 – Turukhan-Norilsk zone D with subzones: D1 – Kureysko-Baklanikhinskaya; D2 – Lamo-Khantaiskaya; 6 – Tunguska zone E with subzones E1 – Tunguska; E2 – Putorana; 7 – Priyanabarskaya zone G; 8 – Anabaro-Khatanga zone Z; 9 – Yenisei-Pyasinskaya zone I; 10 – Bolshekhetskaya zone K; 11 – hydrography; 12 – administrative boundaries of Krasnoyarsk Krai; 13 – settlements; 14–15 – borders; 14 – oil and gas province; 15 – oil and gas area; 16 – areas of exit to the erosion surface of the AR–PT basement of the Siberian platform; 17–25 – predicted thicknesses of the cryogenic barrier: 17 – zone B – area of complete absence of permafrost; 18 – subzones A1, G, D1, small-focal distribution of permafrost with a thickness from 0 to 70 m; 19 – subzone A2 with permafrost thicknesses of 70–150 m; 20 – zone B and subzone D2 with permafrost thicknesses of 150–200 m or more; 21 – zone G with permafrost of 400 m or more; 22 – zone E with permafrost of 400–500 m or more in high-mountain areas of the Putorana Plateau and with areas of 80–150 m in the valleys of large rivers and lakes; 23 – zone I with permafrost of 400–500 m or more with areas of permafrost distribution of 200–300 m under gas fields (Ozernoye); 24 – zone K with permafrost thicknesses of 500–600 m (Bolshekhetsky megaswell); 25 – zone Z, permafrost of 600 m or more; 26 – predicted area of distribution of the Vendian-Cambrian evaporite barrier [6]; 27 – chance of detecting anomalies associated with the deposit

Discussion of the results. According to the possibilities of applying geochemical methods, ten geochemical zones were previously identified [3], in which the choice of a geochemical complex and forecast indicators is quite individual, since it depends on the degree of study of the territory, the specific task set, taking into account the whole range of factors influencing the variability of the geochemical field (GF). At the same time, extensive experience in conducting geochemical studies to solve various problems in the geological conditions of Central Siberia made it possible to determine the main provisions for choosing geochemical forecast criteria. Such provisions include:

- inclusion in the complex of those indicators that provide information on various elements of the geochemical environment or processes occurring in it with the lowest degree of risk;

- compliance with a certain sequence of GPNG, characterized by increasing detail of the study of the object;
- the presence of geochemical barriers and consideration of the factors reflected in the zoning scheme of the territory (Fig. 1).

The fact that there are a large number of geochemical barriers in the section requires, first of all, to assess the geological risk and the possibility of forming anomalies associated with hydrocarbon deposits at the exploration sounding levels and to sort them out from “false” anomalies, i.e. those not associated with hydrocarbon deposits. Such a procedure is not performed during the production of gas oil and gas exploration, and its methodology is absent from the literature, therefore it is proposed to assess the geological risk of the influence of geochemical factors and, accordingly, the chance of detecting a reliable naphthidogenic anomaly, taking into account the risk.

Assessment of the probability of forming a naphthidogenic geochemical anomaly, taking into account the risk. The geological and geochemical risk factor for the formation of anomalies associated with oil and gas deposits is the result of the combined effect of individual geological and geochemical factors:

- influence of spatial factor (length of migration path) or depth of the first productive horizon or deposit from the surface in the studied zoning element, i.e. exploration geochemical zone P(Spr);
- presence in the section of a cryogenic barrier in the form of a layer of permafrost rocks (PMR) and their thickness P(Smmp);
- presence in the section of a regional screen represented by salt-bearing layers and limiting the upward migration of hydrocarbons, and its thickness P(Ssol);
- existence in the section of a regional clay screen, significantly limiting the upward migration, and its thickness P(Sgl);
- saturation of the section with layered effusive (traps) and intrusive magmatic bodies P(Sintr).

In the identified geochemical zones, these factors have various combinations. For example, in the Bakhtinsky geochemical zone “G” there may be two to three barriers simultaneously. The result of the combined action of these factors can be written as the following formula:

$$P = P(S_{\text{сп}}) \times P(S_{\text{ммп}}) \times P(S_{\text{сол}}) \times P(S_{\text{гл}}) \times P(S_{\text{интр}}) \quad (1)$$

The number of assessed geochemical risk factors depends on the degree of study of the object, the presence of geochemical barriers, the number and characteristics of which are specified in the process of geological study of the territory. The influence of each factor is assessed by an expert based on geological data. Each type of geochemical barrier is assigned its own weight depending on its significance (Table 1) and the probability of preserving the donor image by the

surface anomaly, i.e. the deposit that forms the anomalous field of element concentrations, is determined.

Table 1

Assessment of geological and geochemical risk and the possibility (chance) of forming anomalies associated with the donor deposit according to geological and geochemical indicators

Barrier type (weight)	Geochemical parameter (barrier) estimates				
Minimum depth to the first hydrocarbon deposit from the surface P(Spr), m (0.10)	<1 000	1000–2000	2000–3000	3000–4000	>4000
Presence of permafrost strata in the section, P(Skrz), m (0.25)	None	Island	< 150	150–500	>500–600
Presence of regional salt-bearing strata P(Ssol) and their thickness, m (0.25)	Absent	<250	250–300	300–500	>500
Regional clay caps P(Sgl) and their thickness, m (0.15)	Absent	<150	150–300	300–500	>500
Bed intrusions, % of the total well depth P(Smmp) (0.25)	Absent	До 10	10–25	25–40	> 40
General geological risk P	0.10	0,20	0,50	0,75	0,90
Possibility or chance of formation of an anomaly associated with the deposit (1–P)	Very high	High	Average	Low	Very low

It follows from Table 1 that in the absence of geochemical barriers in the section and at a shallow depth of deposit localization, the probability of classifying GP anomalies as naphthidogenic is very high. In the presence of sorption barriers in the section and at depths of deposit localization greater than 2000 m, the probability of forming such anomalies is significantly reduced, but still remains high. At a deeper location of deposits in the section (more than 3000 m), the probability of forming naphthidogenic anomalies is sharply reduced, which is primarily manifested in the contrast of the anomalous fields of HC concentrations [7]. The calculated probabilities of preserving the donor image, i.e. the scattering flux from deposits, by surface anomalies are shown in Fig. 1. It is currently not possible to calculate this indicator for all zones due to insufficient geochemical study. The proposed risk determination method has limitations in the presence of deeply destroyed oil deposits or gas-saturated water horizons in the section, as well as gas microdeposits localized in microtraps at shallow depths (<300–500 m).

The action of each of the barriers listed in Table 1 selectively affects both the intensity of the migration flow and the elemental composition of migrating hydrocarbons and their compounds and determines the technological complex of

geochemical forecasting of oil and gas content and geochemical indicators for mass application.

Assessment of the quality of geochemical information. An analogue of the proposed algorithm for assessing the quality of geochemical information based on the variation of the total indicator of change in chemical elements is published in [5] in relation to environmental studies.

The gas flow migrating from the deposit consists of six to seven chemical elements and their compounds; the work is carried out at different times, sometimes with a gap of more than ten years. The reproducibility of the data depends on many factors, therefore it is proposed to evaluate the degree of migration capacity of a mixture of elements based on the component migration index using formulas 2 and 3:

$$K_{C_i} = C_i / \bar{C}_i; \quad (2)$$

$$Z_{cm} = \sum_{i=1}^n K_{C_i} - (n-1), \quad (3)$$

where K_{C_i} – component migration index; C_i – the content of a specific component of the mixture at the sampling point; \bar{C}_i – average or background content of a component; Z_{cm} – degree of migration capacity of a mixture of elements; n is the number of samples in the sample.

Based on the data obtained, the criteria for the geological and geochemical value of the information obtained can be determined (Table 2).

Table 2
Categories of geological and geochemical value of information

Total index of migration capacity of elements, Z_{cm}	Categories of geological and geochemical information value
<3	Speculative
3–5	Satisfactory
5–20	Norm
>20	High

Each factor requires a reduction in the subjectivity of assessments, so they should be based on proven factual data. As a rule, these are primary data from geochemical studies obtained during geochemical exploration, reservoir geochemistry results, and well studies with a complex of geophysical observations published in geological reports and materials on reserve calculation, protocols for fluid and rock analysis, as well as production databases.

Conclusion. The analysis of geochemical exploration materials for oil and gas showed that it is possible to use geochemical exploration for oil and gas in combination with other geological exploration work practically throughout the entire territory of Central Siberia. The obtained geochemical information allows statistical methods to provide a probabilistic assessment of the validity of classifying geochemical anomalies as naphthidogenic, i.e. associated with hydrocarbon deposits in productive and prospective rock complexes. The chances of assigning an anomalous field of concentrations of geochemical elements and their compounds in the identified zones vary significantly and fluctuate in the range of 0.60–0.86.

Consequently, the technological exploration complex should be adjusted depending on the prevailing type of geochemical barriers developed in the section above the hydrocarbon deposits.

In conclusion, we note that in the Anabar-Khatanga, Priyanabarskaya and Tunguska geochemical zones, it is advisable to carry out experimental and methodological work, further scientific research and, first of all, using new sorption methods in the tandem of “geology - geophysics - geochemistry”.

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基本建设项目概念设计阶段的综合设计管理和风险缓解
**INTEGRATED DESIGN MANAGEMENT AND RISK MITIGATION
IN CAPITAL CONSTRUCTION PROJECTS AT THE CONCEPT
DESIGN STAGE**

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注释：本文分析了概念设计阶段在投资建设项目成功实施中的关键作用，并强调了一体化设计管理的重要性，即从一开始就协调建筑、结构和机电（MEP）系统。本文通过一个实际案例，探讨了仅基于建筑草图启动方案设计的风险，并阐明了协调不力如何导致可用空间减少、不符合法规以及成本增加。本文提倡尽早采用BIM方法、保持设计阶段的连续性以及利益相关方的参与，以此作为提高项目效率、最大限度降低风险和最大限度提高投资回报的关键策略。

关键词：概念设计阶段、一体化设计管理、投资建设项目、建筑信息模型（BIM）、项目协调、冲突检测。

Annotation. *This article analyzes the critical role of the conceptual design stage in the successful implementation of investment and construction projects. It emphasizes the importance of integrated design management, where architectural, structural, and MEP (Mechanical, Electrical, and Plumbing) systems are coordinated from the outset. The risks of initiating schematic design based solely on architectural sketches are examined through a real-world case study, illustrating how poor coordination can lead to reduced usable space, regulatory non-compliance, and increased costs. The text advocates for the early adoption of BIM methodologies, continuity across design stages, and stakeholder involvement as key strategies to enhance project efficiency, minimize risks, and maximize return on investment.*

Keywords: *Conceptual Design Stage, Integrated Design Management, Investment and Construction Projects, Building Information Modeling (BIM), Project Coordination, Clash Detection.*

Introduction

The efficiency and cost-effectiveness of investment and construction project implementation are largely predetermined by strategic decisions made during the

conceptual design phase. Within the framework of modern design management, this phase represents a critical juncture where fundamental project parameters are established, significantly influencing both capital expenditures (CAPEX) and operational expenditures (OPEX) throughout the project lifecycle.

Typically, the investor or the investor's representatives are responsible for approving the project concept. Their primary focus is often on macro-level planning parameters such as the architectural massing, external aesthetics, functional zoning, and the commercial viability of the built-up area. For instance, depending on the project typology—whether commercial, industrial, or mixed-use—attention may center on the sufficiency of leasable space, or the spatial allocation for technological and mechanical equipment essential to production or facility operations.

However, a critical gap frequently emerges when investors prioritize form over function without a comprehensive examination of the supporting engineering systems or constructability. In many cases, schematic design (SD) is advanced based solely on an architectural concept or visual sketch that lacks fundamental coordination with MEP (Mechanical, Electrical, and Plumbing) systems, structural design, and facade engineering. This omission presents significant systemic risks for the investor.

Risks Associated with Isolated Architectural Conceptual Design

Once a schematic design is approved, the investor may proceed to apply for a building permit, transitioning the project into the physical realization stage. However, post-permit revisions frequently reveal systemic inconsistencies, such as:

- Reduction of the gross floor area (GFA) by 15–20% due to misalignment between architectural assumptions and real-world constraints (e.g., load-bearing systems, utility corridors, or code-mandated egress).
- Incompatibility with site development regulations, including:
 - Land plot coverage and floor-area ratio (FAR) limits.
 - Required green space percentage and stormwater drainage requirements.
 - Parking norms based on project use and occupancy type.
 - Availability and feasibility of routing external utility connections.
 - Technical feasibility of landscaping and site grading works.

These factors often lead to significant design modifications that negatively affect commercial area availability or space allocated for critical technological equipment. The functional capacity of the facility, especially in production-oriented projects, can thereby be compromised—resulting in longer payback periods, decreased ROI, and diminished investor profitability [1].

One illustrative example involves a high-rise development wherein the architectural design was developed by a globally renowned firm. While the visual design met investor expectations, the MEP and structural concepts were underdeveloped. Key oversights included:

Absence of designated MEP corridors for horizontal and vertical system integration.

Inadequate vertical transportation planning, neglecting peak-time traffic simulations.

Lack of clearances between steel floor beams and service runs, resulting in reduced clear floor heights and noncompliant ceiling zones.

Space losses due to the ad hoc placement of risers, shafts, and mechanical floors.

These issues led to significant retrofit construction costs, design reworks, and delays in commissioning, emphasizing the need for integrated design workflows.

Design Management Best Practices: Systems Integration & Digital Design Continuity

To mitigate such risks, the design process must be structured as a continuum, wherein the quality and completeness of each design phase are consistent, differing only in level of detail (LOD). Adopting a Building Information Modeling (BIM)-based methodology from the concept stage is essential for integrated project delivery (IPD).

Key principles include:

1. **BIM at Concept Stage:** The conceptual model should include not only architectural massing but also schematic-level MEP and structural systems, ensuring volumetric and spatial coordination early on [2].
2. **Progressive Detailing:** Each successive design stage (SD → DD → CD) should build upon the previous stage, refining models rather than restarting them. This improves interdisciplinary coordination and reduces design conflicts.
3. **Clash Detection and Model Auditing:** Employ automated clash detection tools (e.g., Navisworks, Solibri) to identify and resolve geometric and logical interferences between MEP, architectural, and structural systems.
4. **Design Review Gates:** Implement design management checkpoints and multidisciplinary design review boards at each phase to ensure alignment with project performance, cost, and regulatory goals.
5. **Early Contractor Involvement (ECI):** Engage general contractors and trade specialists during early design to evaluate constructability, logistics, and procurement strategy.

Conclusion

In order to achieve efficiency, minimize risks, and ensure the long-term viability of capital construction projects, it is imperative that investors and design managers treat the conceptual design stage not as a preliminary formality, but as a critical milestone for defining the holistic performance parameters of the future facility.

Too often, projects advance to the schematic design (SD) or even detailed design (DD) stages based solely on architectural massing or conceptual sketches—while structural systems and MEP infrastructure remain undeveloped or only vaguely assumed. This fragmented approach introduces significant systemic risks and inefficiencies during subsequent design and construction phases.

1. Structural Concept: Load Paths, Grid Constraints & Buildability

- The structural design concept must be developed in parallel with the architectural vision for several key reasons:
- Alignment with Architectural Grid: Early coordination ensures that load-bearing elements (e.g., columns, shear walls, core locations) do not conflict with spatial layouts or façade openings.
- Vertical Shaft Planning: The structure must anticipate and accommodate core risers, elevators, and stairwells, ensuring efficient space utilization and compliance with safety codes.
- Constructability and Materials Strategy: Structural design defines critical parameters such as floor-to-floor heights, beam depths, and structural spans, directly impacting the cost and sequencing of construction.
- Foundation Load Transfer: Without an early structural concept, misalignment in column loads or lateral force-resisting systems can lead to expensive rework or oversized foundations.

Failure to resolve these aspects at concept stage leads to reductions in usable area, compromised ceiling heights, or even design revisions during construction, resulting in costly delays.

2. MEP Concept: Spatial Coordination and System Feasibility

Mechanical, Electrical, and Plumbing (MEP) systems are the infrastructure backbone of any building, directly influencing its functionality, energy performance, and maintainability. At the concept stage, it is essential to define a coherent MEP strategy, including:

- Horizontal and Vertical Routing: Main service corridors and vertical risers must be spatially reserved early to avoid later conflicts with structure and architecture.
- Technical Zoning and Equipment Space: Central plant rooms (e.g., HVAC equipment, transformer rooms, pump rooms) must be adequately sized and strategically located. Poor early planning can result in reduced net usable area or unfeasible system layouts.
- Ceiling Zone Planning: MEP systems often run above ceilings, where space is limited. If not accounted for during concept design, conflicts with beams, ducts, or fireproofing can lead to inadequate clear heights.
- Energy Strategy and Sustainability Goals: Early development of the MEP concept allows integration of energy-efficient systems, renewable energy,

and building automation strategies, which are increasingly required by regulations and green certification schemes (e.g., LEED, BREEAM).

Early MEP concept design reduces the likelihood of spatial conflicts, helps meet code and sustainability targets, and lays the groundwork for performance modeling and cost planning.

3. Multidisciplinary BIM Integration

The implementation of a BIM-based conceptual model that includes architecture, structure, and MEP enables:

- Interdisciplinary Clash Detection at the earliest stage.
- Scenario testing for different configurations of technical spaces, transportation systems, and structural spans.
- Accurate area takeoffs and volumetric zoning, supporting investment planning and compliance reviews.
- Continuity of design intent and data throughout all phases of the project lifecycle.

Treating the conceptual design stage as a fully coordinated multidisciplinary phase—rather than just an architectural exercise—lays the strategic foundation for project success. The cost of coordination errors increases exponentially as the project progresses, making early alignment not just technically advisable, but financially essential [3].

By embedding MEP and structural considerations into the initial concept, investors and design managers can ensure:

- Higher design maturity before permits and procurement begin.
- Reduced change orders during construction.
- Optimized floorplate efficiency and equipment layout.
- Better lifecycle performance of the asset.
- Faster project delivery and greater return on investment.

Ultimately, a well-developed multidisciplinary concept acts as a risk-control tool, a value-creation strategy, and a blueprint for predictable, high-quality execution.

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