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

Proceedings of the International Conference

Date: July 2

Beijing, China 2025

上合组织国家的科学研究：协同和一体化
国际会议

参与者的英文报告

International Conference
“Scientific research of the SCO countries: synergy and integration”

Part 3

2025年7月2日，中国北京
July 2, 2025. Beijing, PRC

Proceedings of the International Conference
“Scientific research of the SCO countries: synergy and integration” - Reports in English

(July 2, 2025. Beijing, PRC)

DOI 10.34660/conf.2025.21.36.078

这些会议文集结合了会议的材料 – 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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DOI 10.34660/conf.2025.21.36.078

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DOI 10.34660/INF.2025.29.84.033

提高预算预测中机器学习结果的准确性和可解释性的方法：柯尔莫哥洛夫-阿诺德网络

WAYS TO IMPROVE THE ACCURACY AND INTERPRETABILITY OF MACHINE LEARNING RESULTS IN BUDGET FORECASTING: KOLMOGOROV-ARNOLD NETWORKS

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摘要：与传统预测方法相比，在预算预测中使用机器学习 (ML) 技术的优势在于：更高的预测准确度；更高的效率，因为预测过程的自动化和加速，可以处理无法手动分析的海量数据；更大的灵活性，因为 ML 技术允许处理不同类型的数据和格式，包括非结构化数据，最终可以更有效地优化预算规划和决策。当然，ML 技术并不能解决预算预测的所有问题和任务，并且使用 ML 也存在一些固有的缺点和风险，例如：- 数据质量和可用性，因为质量差、不完整或不准确的数据可能导致错误或误导性的预测，并危及预测的有效性和可靠性；- 模型的复杂性和可解释性，因为基于 ML 模型的预测背后的逻辑和原理可能不透明或无法解释，这可能会影响对 ML 模型和结果的信任和信心。因此，迫切需要开发不仅能提供高预测精度，而且还能证明所获结果具有可靠可解释性的模型。作为最先进的人工智能 (AI) 技术之一，柯尔莫哥洛夫-阿诺德网络 (KAN) 是传统机器学习技术的一个有前途的替代方案，为提高 AI 模型的可解释性开辟了新的机会。本研究的目的是对由俄罗斯联邦预算统一国家登记册上的每日预算余额组成的时间序列的预测模型的精度进行比较分析：1) 基于时间序列的初步分解，使用离散小波变换；2) 基于柯尔莫哥洛夫-阿诺德神经网络 (KAN)，同时考虑到模型的各种充分性指标（精度指标）。结果表明，在所有考虑的模型充分性指标中，KAN 预测模型均优于基

于离散小波变换对时间序列进行初步分解的预测模型，而后者又优于 LSTM 机器学习模型和传统的 ARIMA/SARIMA 统计模型，这表明 KAN 模型具有很高的预测潜力。从实践角度来看，所获得的结果无疑对建立有效的公共财政管理系统具有重要意义，该管理系统基于对联邦预算收入的准确预测，而联邦预算收入对中短期预算稳定性具有重要影响。此外，本研究结果将有助于州现金管理者制定有效的州现金管理政策，该政策基于对单一国库账户每日现金余额的更准确预测。

关键词：预测、每日现金余额、单一国库账户 (STA)、机器学习、神经网络、柯尔莫哥洛夫-阿诺德网络。

JEL 分类：C45、C60、C63、C56、H68

Abstract. *The advantage of using machine learning (ML) technologies in budget forecasting, compared to traditional forecasting methods, is that they allow to achieve: higher forecast accuracy; higher efficiency, due to automation and acceleration of the forecasting process, processing huge volumes of data that cannot be analyzed manually; greater flexibility, since ML technologies allow to work with different types of data and formats, including unstructured data, which ultimately allows to more effectively optimize budget planning and decision-making. Of course, ML technologies cannot solve all the problems and tasks of budget forecasting and there are some inherent disadvantages and risks associated with the use of ML, such as: - data quality and availability, since poor, incomplete or inaccurate data can lead to erroneous or misleading forecasts and jeopardize the validity and reliability of forecasts; - complexity and interpretability of the models, since the logic and rationale behind the forecasts based on ML models may be opaque or unexplainable, which may affect the trust and confidence in the ML models and results. Therefore, there is an urgent need to develop models that not only provide high forecasting accuracy, but also demonstrate reliable interpretability of the results obtained. As one of the most advanced artificial intelligence (AI) technologies, the Kolmogorov-Arnold network (KAN) acts as a promising alternative to traditional ML technologies, opening up new opportunities to improve the interpretability of AI models. The objective of the study is to conduct a comparative analysis of the accuracy of forecasting models for a time series composed of daily budget balances on the Unified State Register of Federal Budgets of the Russian Federation: 1) based on preliminary decomposition of the time series, using discrete wavelet transforms; and 2) based on the Kolmogorov-Arnold neural network (KAN), taking into account various adequacy indicators (accuracy metrics) of the models. The results show that the KAN forecasting model outperforms the forecasting model based on preliminary decomposition of time series using discrete wavelet transforms in all the considered indicators of model adequacy, which in turn outperforms the LSTM machine learning models and traditional ARIMA/SARIMA statistical models, which indicates a high forecasting potential of the KAN model. From a practical*

point of view, the obtained results are of undoubted interest in the development of an effective public finance management system based on accurate forecasts of federal budget revenues, which significantly affect the short- and medium-term budget stability. In addition, the results of the study will be useful for state cash managers in developing an effective state cash management policy based on more accurate forecasts of daily cash balances on the Single Treasury Account.

Keywords: *forecasting, daily cash balances, single treasury account (STA), machine learning, neural networks, Kolmogorov-Arnold network.*

JEL Classification: *C45, C60, C63, C56, H68*

1. Introduction

Forecasting is a fundamental component/element of an effective public financial management (PFM) system, providing a basis for assessing future economic conditions and government revenue flows, which in turn allows for reliable budget planning [1]. Traditional PFM forecasting tools are statistical and econometric models based on time series data, incorporating variables that affect financial performance, such as GDP growth rates, tax revenues, and the structure of government expenditures.

Creating conditions for the preparation and improvement of the accuracy of fiscal and macroeconomic forecasts has been and remains the focus of many countries, including Russia, through improving statistical and econometric models and more widely disclosing the assumptions underlying forecasting models using artificial intelligence and machine learning methods [2]. However, in the last decade, PFM forecasting has been seriously challenged by a number of economic and non-economic shocks, from the 2007/08 global financial crisis to the COVID-19 pandemic and global geopolitical events (such as political tensions, military conflicts, trade disputes and changes in government policies), which have dramatically affected the forecasting potential of statistical and econometric models, exposing their inability to predict non-linear, and sometimes critical, behavior of financial and fiscal indicators.

Modern artificial intelligence technologies, especially machine learning (ML) and deep learning (DL), which can process large volumes of data, including unstructured data, and identify complex patterns that are not easily or sometimes impossible to detect using existing traditional forecasting methods, can help solve the problems with traditional forecasting methods by improving the accuracy and timeliness of forecasts [3]. It has been shown that machine learning-based models significantly outperform traditional economic forecasting models in accuracy). Recent studies have shown that machine learning models can provide more accurate and predictable forecasts than traditional time series models, even when using unstructured underlying data [4]. Time series forecasting is an important

task in AI [5], based on the assumption that time series data exhibits predictability, including mining hidden temporal patterns and forecasting future trends based on past historical data. In practical scenarios, time series data in a forecasting task often contains complex temporal patterns, including seasonality, trends, random fluctuations, and sudden abrupt changes (structural breaks). These patterns are often intertwined with each other, resulting in complex and dynamic behavior, especially in various real-world applications such as fiscal forecasting (where various factors are intertwined: financial, macroeconomic, social, demographic, political, etc.). Recently, the development of deep learning methods and technologies has been a catalyst for the development of numerous deep time series forecasting models, including those based on recurrent neural networks (RNNs) [6], convolutional neural networks (CNNs)[7], multilayer perceptrons (MLPs)[8], and Transformers [9]. Forecasts, especially those based on MLPs, have achieved superior results compared to forecasts based on traditional statistical approaches. However, AI-based forecasting models, which have the highest accuracy in fiscal forecasting results, have been criticized for their "black box nature" [3], as the assumptions and calculations they use may not always be fully understandable, and in this regard, they represent both a step forward in accuracy and a step back in the transparency of fiscal policy.

The forecast results based on AI/ML methods are often uninterpretable due to their highly complex network structures. In addition, there is no explicit symbolic representation (e.g. rules, formulas, or tree structures) of the decision-making process, making it difficult to follow the decision justification process of the model. The lack of interpretability makes it difficult for potential stakeholders to understand the underlying features and rationale of the model forecasts, posing enormous risks to their use in mission-critical applications such as budget planning and budget analysis, where the consequences of incorrect decisions can cause serious economic consequences. Therefore, there is an urgent need to develop models that not only provide high forecasting performance but also demonstrate robust interpretability.

As one of the most advanced artificial intelligence technologies, the Kolmogorov-Arnold network (KAN) [10] stands out as a promising alternative to MLP, opening up new possibilities for enhancing the interpretability of AI models [11]. Technically, KAN replaces traditional fixed activation functions with learnable activation functions, i.e., 1D spline-parameterized functions, and performs summation operations on the nodes. Thus, KAN allows the behavior of each node to be intuitively explained in the form of its activation functions and summation operations. This interpretability is not limited to the node level but can be extended to the entire network structure since its theoretical foundations ensure that the network can be approximated by a finite number of 1D functions and summation

operations. Thus, humans can analyze these 1D activation functions to understand the working mechanics of the entire model, which greatly improves the transparency and robustness of the model. Its interpretability has been widely applied, providing a clear path of understanding for complex problems such as dynamic systems [12]. Thus, given their enormous advantages, KANs provide great potential for improving the interpretability of time series forecasting. Previously, in the works ([13]; [14]), a comparative analysis of the accuracy of two methods for forecasting the time series of daily balances of funds on the Unified Account of the Federal Budget of the Russian Federation for 2023 was carried out: the method of deep machine learning of recurrent neural networks LSTM; and a method based on preliminary decomposition of the time series using a discrete wavelet transform, based on parent wavelet functions from 10 wavelet families, taking into account information criteria (AIC and BIC), the coefficient of determination (R2 and Adj-R2) and the RMSE error metric. The results of the works ([13]; [14]) indicate that forecasting models based on wavelet transforms significantly outperform both traditional econometric models (ARMA/SARMA) and modern forecasting models with machine learning, in particular, models based on the LSTM network, which are subject to either excessive smoothing of time series data or excessive influence of noise. Forecasting models based on wavelet transforms achieve this balance due to their inherent ability to cover both local and global features in the behavior of time series.

The purpose of the study is to conduct a comparative analysis of the accuracy of forecasting models for a time series compiled from daily balances of budget funds on the Unified State Account of the Federal Budget of the Russian Federation in 2023: 1) based on preliminary decomposition of the time series, using discrete wavelet transforms; and 2) based on the Kolmogorov-Arnold neural network, taking into account the information criteria (AIC and BIC), the determination coefficient (R2 and Adj-R2) and the RMSE indicator, as a measure of the proximity between the actual and predicted values of the time series.

The source data are daily balances of funds on the Unified Accounting System of the federal budget of the Russian Federation in 2023 (trillion rubles), downloaded from the website of the Treasury of Russia [15], based on the procedure for accounting for working days in Russia in 2023 and their subsequent alignment. In Russia in 2023 there were 254 calendar working days, these data are distributed unevenly throughout the year, therefore the standard procedure for uniform alignment is used using the TimeSeriesResample function [16] from the Wolfram Mathematica library, after application, 355 points / days are obtained, distributed evenly throughout the year. The ordinal numbers of calendar days are counted from January 10, 2023. Research Methodology

To build a forecasting model based on the Kolmogorov-Arnold network, the main consequences of the Kolmogorov-Arnold superposition theorem are used,

which states that any continuous function of many variables can be represented as a finite sum of continuous functions of one variable ([17]; [18]). This theorem provides a theoretical basis for the ability of neural networks to approximate complex functions ([19]; [20]).

In this paper, for the practical implementation and construction of a forecasting model based on the Kolmogorov-Arnold network (in the Wolfram Mathematica computer system), the approach [21] was used.

The forecast of the time series compiled from daily balances of funds on the Unified Accounting System of the federal budget from January 1 to December 31, 2023, using the KAN model was carried out by dividing the entire range of 355 observations into 2 sections:

from 1 to 299 - training points,

from 300 to 355 - test points.

4. Results.

Discussion

The results of the correspondence between the forecast and actual values of the time series compiled from the daily balances of budget funds on the Unified Accounting Station of the federal budget of the Russian Federation in 2023, as well as the adequacy tests ("Goodness-of-Fit") of the forecasting model based on the Kolmogorov-Arnold network, and the actual values of the time series are presented in Table 1.

Table 1 presents the numerical values of the adequacy indicators (accuracy metrics) (AIC, BIC, Adj-R ^ 2, R ^ 2, RMSE) of the forecasting models for the actual values of the time series from the daily balances of funds on the Unified Accounting Station of the federal budget of the Russian Federation in 2023: 1) based on the Daubechies Wavelet maternal wavelet functions [8] - the best model from the entire ensemble of 10 wavelet families [13]; 2) based on the Kolmogorov-Arnold network; and 3) based on a 10-layer LSTM network[14].

As can be seen from Table 1, the forecasting model based on the Kolmogorov-Arnold network outperforms the forecasting model based on preliminary decomposition of the time series using discrete wavelet transforms and the forecasting model based on the 10-layer LSTM network in all indicators (AIC; BIC; Adj R^2; R^2; RMSE), which indicates the high forecasting potential of the model based on the Kolmogorov-Arnold network in forecasting the nonlinear behavior of daily cash balances on the Unified Accounting Account of the federal budget of the Russian Federation in 2023. The forecasting model based on the Kolmogorov-Arnold network demonstrates the highest comparative efficiency, achieving the lowest root mean square error (RMSE ≈ 0.019) and the highest value of R^2≈0.977.

Table 1.

The final result of the adequacy of forecasting models to the actual values of the time series from daily budget balances on the Unified State Account in 2023: 1) based on preliminary decomposition of time by discrete wavelet transforms; 2) based on the Kolmogorov-Arnold network; 3) based on a 10-layer LSTM network

Forecasting model	AIC	BIC	Adj-R^2	R^2	RMSE
DaubechiesWavelet[8]	**-218.5**	**-212.4**	**0.950**	**0.951**	**0.035136**
Kolmogorov-Arnold Network (KAN)	**-249.7**	**-243.1**	**0.974**	**0.977**	**0.019256**
10 Layer LSTM Network	-180.3	-174.9	0.866	0.876	0.05930

Source: authors' calculations.

The results of a comparative analysis of the accuracy of forecasting a time series compiled from daily cash balances on the Unified State Account of the Federal Budget of the Russian Federation in 2023, models: 1) based on the Kolmogorov-Arnold neural network; and 2) models based on preliminary decomposition of the time series, using discrete wavelet transforms, based on mother wavelet functions from all 10 wavelet families, indicate that forecasting models based on the Kolmogorov-Arnold neural network outperform forecasting models based on preliminary decomposition of the time series, using discrete wavelet transforms, in all selected indicators of the accuracy metric (AIC; BIC; Adj R ^ 2; R ^ 2; RMSE). It has been shown previously [13, 14] that wavelet transform-based forecasting models significantly outperform both traditional statistical models (ARMA/SARMA) and modern forecasting models, in particular, LSTM-based models, which are subject to either excessive smoothing of time series data or excessive influence of noise. Wavelet transform-based forecasting models achieve this balance due to their inherent ability to capture both local and global features in the behavior of time series. By decomposing the time series into different frequency components, wavelet transforms allow us to identify and preserve meaningful patterns in the behavior of time series, discarding irrelevant noise. Such multi-scale analysis provides a more accurate and detailed representation of the original time series without the pitfalls of overfitting with noise. 5. Conclusion

Machine learning (ML) technologies and algorithms are a powerful and promising tool that can enhance and complement the budget forecasting process without replacing human judgment and expertise. ML requires careful and critical evaluation and application, as well as continuous monitoring and improvement to ensure its validity, reliability, and usefulness for budget forecasting. ML can also open up both new opportunities and challenges for budget forecasting that require careful exploration and study.

The field of ML has undergone profound changes in recent decades, with neural networks serving as the main catalyst for numerous breakthroughs in areas such as computer vision and natural language processing. Although traditional feedforward neural architectures such as multilayer perceptrons (MLPs) and convolutional neural networks (CNNs) have achieved significant empirical success, they are often viewed as black-box models with limited interpretability and sometimes suboptimal generalization performance. Against this backdrop, Kolmogorov-Arnold networks (KANs) have emerged as a theoretically sound and structurally innovative class of models that leverage fundamental results from mathematical analysis to improve the representational and computational capabilities of neural architectures. Kolmogorov-Arnold networks represent a significant theoretical contribution to the field of neural networks, in the direction of improving their ability to predict nonlinear behavior of multivariate time series describing complex behavior of dynamic systems. In contrast to traditional machine learning approaches and techniques, Kolmogorov-Arnold networks offer a different perspective on how complex multivariate functions can be approximated, with potential advantages in terms of interpretability and efficiency.

Forecasting the reserves (balances) of cash on the federal budget's Unified Accounting System is an integral part of effective government cash management, as it helps solve important government tasks: facilitate and support orderly budget execution; ensure uninterrupted financing of budget expenditures and the absence of delays; provide advance warning of liquidity shortages that may force the government to postpone expenditures or otherwise ration liquidity if it is unable to increase borrowing; develop active liquidity management strategies, i.e. plan in advance and, where possible, adjust financing plans to ensure the availability of liquidity as needed, while avoiding the formation of an excess of temporarily idle cash that does not generate sufficient income.

The accuracy of forecasts of state cash balances on the Unified Accounting System is an important condition for developing a policy for effective government cash management. However, achieving high forecast accuracy is quite difficult, including due to the fact that in most cases, the source of errors in forecasts is the chosen forecasting method. This study is aimed at finding new approaches to improving the accuracy and reliability of forecasts of daily budget balances on the Unified Accounting System (EAS) based on the Kolmogorov-Arnold network (KAN). The study provides a comparative analysis of the results of two methods for forecasting the time series of daily balances of funds on the EAS of the federal budget of the Russian Federation for 2023: 1) a method based on the Kolmogorov-Arnold neural network; and 2) a method based on preliminary decomposition of the time series using a discrete wavelet transform, based on the best forecasting model, based on mother wavelet functions from 10 wavelet families. The analysis

of the proximity of the forecast and actual values of the time series was carried out, taking into account the information criteria (AIC and BIC), the determination coefficient (R2 and Adj-R2) and the RMSE indicator. The results of the work show that the Kolmogorov-Arnold network-based forecasting model outperforms the discrete wavelet transform-based forecasting model on all the considered indicators, which in turn significantly outperforms both traditional econometric models (ARMA/SARMA) and modern forecasting models, in particular, LSTM-based models, which are subject to either excessive smoothing of time series data or excessive influence of noise.

The obtained results highlight the potential of the Kolmogorov-Arnold network as a powerful tool for developing interpretable and high-performance neural networks with applications spanning various areas, including budget forecasting and marks an important step forward in the field of artificial intelligence.

The obtained result highlights an important aspect of the KAN model: its performance tends to exceed all expectations when working with large and complex datasets and high-dimensional inputs, where its advanced approximation capabilities and ability to model complex patterns are most evident. However, on simpler datasets, LSTM-based models may be more suitable due to their inherent ability to optimize simpler feature interactions and to adapt effectively to limited datasets.

Thus, the results of the study demonstrate the high predictive potential of short-term forecasting methods for daily cash balances on the (EKS) based on the Komogorov-Arnold network and are of undoubted interest to treasurers, cash managers and cash managers in their professional activities, allowing them to use state funds more efficiently based on more accurate forecasts of daily cash balances on the (EKS).

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DOI 10.34660/INF.2025.96.37.034

研究数字化对人口生活质量影响的方法
METHODS OF STUDYING THE IMPACT OF DIGITALIZATION ON THE QUALITY OF LIFE OF THE POPULATION

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摘要：本研究的意义在于评估快速发展的数字化进程对人口生活质量的影响。本研究旨在确定一种合适的方法，以有效评估数字化进程对人口生活质量的影响。本研究对现有的人口生活质量评估方法进行了回顾、比较和结构分析，确定了最新的方法，并得出了可能引起科学界和政府部门关注的主要结论。本文的科学创新之处在于，它定义了一些方法，使我们能够最准确地评估数字化对人口生活质量的影响，并确定其积极和限制性方面。本研究结果扩展了关于数字化进程对人口生活质量影响的信息和方法论知识库。

关键词：人口生活质量、数字福祉、电子商务、数字化、数字经济、人口生活质量指标。

Abstract. *The relevance of the study is explained by the need to assess the impact of rapidly developing digitalization processes on the quality of life of the population. The purpose of the study is to determine a suitable methodology for a relevant assessment of the impact of digitalization processes on the quality of life of the population. The study included a review, comparative and structural analysis of existing methods for assessing the quality of life of the population, identified the latest methods and formulated the main conclusions that may be of interest to the scientific community and government authorities. The scientific novelty of the article lies in the definition of approaches that allow us to give the most accurate assessment of the impact of digitalization on the quality of life of the population and to determine the positive and limiting aspects of this impact. The results of the study expand the information and methodological knowledge base on the impact of digitalization processes on the quality of life of the population.*

Keywords: *quality of life of the population, digital well-being, e-commerce, digitalization, digital economy, quality of life indicators of the population.*

In recent decades, digital technologies have been rapidly penetrating all sectors of the economy, bringing significant changes to the previous way of life of

the population. Such development has undoubtedly had and continues to have a significant impact on the quality of life of the population to a greater or lesser extent, depending on regional characteristics. At the same time, the quality of life of the population is the most important criterion for assessing the development of countries and regions in the 21st century, since this concept includes a large number of indicators: working conditions, availability of services, development of trade, income and expenses of the population, education, quality of medical services, housing, social infrastructure, culture, ecology, demography, etc. The quality of life of the population is under constant control of the Government of the Russian Federation, as well as regional and municipal authorities, since it is the main priority of the socio-economic development of the country and is enshrined in the national security strategy of the Russian Federation at the federal level. The relevance of the issues of quality of life of the population is confirmed by the inclusion of this topic by the Government of the Russian Federation in the program of priority fundamental scientific research in the Russian Federation for the long-term period (2021-2030), paragraph 5.6.1.2 [1]. At the regional level, programs aimed at improving the quality of life of the population are also enshrined [2].

The assessment of the quality of life of the population is approached with varying degrees of detail and considers its individual components, since it is difficult to assess the category as a whole. Some researchers consider the concept of quality of life as a narrow sector, considering a specific area, others, on the contrary, multidimensional with a large number of criteria and parameters [3; 4; 5; 6]. However, it can be concluded that the general meaning is practically no different, everywhere a set of characteristics of human life is distinguished that express the quality of life, the difference lies only in the area of specialization, the degree of detail and the quantitative measurement of indicators [7; 8; 9; 10].

An important aspect in assessing the quality of life of the population is the regional component. The structure of the quality of life is formed by ethnocultural factors, therefore the peculiarities of the perception of the quality of life of the population are local in nature and affect the main elements of the quality of life of the population. In this regard, it is difficult to assess the QOL using a universal methodological approach, without taking into account the ethnocultural aspect, since the assessment of such binary categories as wealth or poverty and any others differs greatly depending on religious beliefs, historical characteristics, upbringing and traditions, which form the public understanding of the quality of life of the population (what is the norm of life in one society may be perceived as poverty in another). There may be a large difference in the perception of the QOL even within one country. For example, the central regions of the Russian Federation and regions where Islam is practiced have different attitudes to alcohol, tobacco, meat and, as a result, to a healthy lifestyle. Therefore, official statistics and assessments

of the quality of life of the population based only on it most often distort the real picture. A number of factors have a contradictory effect on different indicators of the QOL. For example, industrial development in a region, on the one hand, has a positive effect on the well-being and employment of the population, the labor market, on the other hand, it has a negative effect on the ecology of the region and, as a consequence, on the health of the population, demography and heredity. Thus, the assessment of the quality of life of the population must be approached taking into account ethnocultural, socio-economic, historical and religious, natural and scientific-technical factors, as well as the contradictory nature of their influence on the QL [11].

Considering that the QL is determined by objective and subjective indicators, there are three main approaches to its assessment: objective (statistical or quantitative), subjective (qualitative) and combined [12]. Objective indicators are quantitatively measurable, therefore the approach based on taking into account objective indicators has the maximum reliability, formality, validity and the ability to appeal to these indicators. However, with this approach, the definition of the QL is based only on material indicators and does not take into account the content of the quality of life and the subjective assessment of people, which often differs from the objective values. For example, the assessment of the average salary in a region may be higher than the standard values, but most of the population of this region have much more modest incomes, and a high “objective” assessment is associated with a large gap between different strata of the population in terms of material status. There is another drawback of the objective approach to assessing the QL and it is associated with the fact that most objective indicators change very slowly over time and long periods of time are required to assess the dynamics. In this context, the data accumulated over time are of great importance, allowing us to show the dynamics of changes and most accurately assign certain indicators with the corresponding coefficients and “weights”. With an objective approach to determining the quality of life indicator of the population, the most commonly used methods are instrumental, calculation, statistical and expert methods [12]. Some researchers use a combined method that combines the above methods to one degree or another. Assessing the quality of life with an objective approach involves constructing an integral indicator. Experts believe that when constructing an integral indicator of the quality of life, three main factors will influence the resulting absolute value of the indicator: 1) the choice of the basis for comparison; 2) a sample of reporting statistical indicators on the basis of which the integral indicator of the quality of life should be formed; 3) the choice of the method for integrating individual private characteristics into a summary characteristic of the quality of life (type of model, its constant parameters) [11]. One of the authoritative methods of the objective approach, based on integral indicators of the

quality of life, was proposed by the domestic researcher S. A. Ayvazyan. In his methodology, the author divides the system of quality of life components into four levels: 1st level - a summary integral indicator; 2nd level - integral properties of key synthetic categories of quality of life; 3rd level - block integral indices compared with integral properties; 4th level - initial statistical indicators of the basic level [7]. Another fundamental methodology of the objective approach is the methodology of P.S. Mstislavsky, based on the fact that objective indicators of the quality of life must be compared with indicators of people's needs, that is, objective data are correlated with the standards of people's needs, and not with the indicators of the compared regions, while each indicator is given a certain weight. P.S. Mstislavsky identifies 5 main components of the quality of life of the population: health, labor activity, provision of consumer goods, family, spiritual sphere. Thus, this methodology is based on the understanding of the quality of life as "the level of development and the degree of satisfaction of a complex of positive, objectively reasonable needs and interests of people" [7]. In addition to domestic researchers and rating agencies, most international ratings, such as the UN Human Development Index, the World Bank Human Capital Index, and the quality of life rating in different countries from the Serbian crowdsourcing online database Numbeo, also predominantly use an approach based on the assessment of objective and measurable indicators [8;13].

The approach based on the assessment of QL based on subjective indicators has become popular in various studies of the happiness index, life satisfaction index (for example, the World Happiness Report), that is, with this approach, the decisive role in the assessment of QL is played by socio-psychological indicators and people's expectations. The approach to assessing QL based on subjective indicators can be justified when a small group of people is assessed (for example, a university, school, hospital or organization), in the case of large-scale studies of QL at the regional or national level, such an approach will not provide reliable data and distorts the real state of affairs, and the complexity of conducting sociological research at the regional and national levels makes this approach unpopular in modern studies, despite the importance of the subjective component of the quality of life of the population. One example of a subjective approach to assessing the quality of life of the population is the concept of the World Health Organization (WHO), which considers the quality of life as a complex structure that includes an individual's perception of his psychophysical state, level of independence, his attitude to the environment, level of relationships with other people, personal beliefs. This approach is used by WHO to assess health-related quality of life. In 1991, WHO developed an international methodology for assessing the quality of life of the population, applicable in different cultures and allowing to assess the feelings of individuals in the context of their personal interests, goals, cultural

values, etc. The methodology is based on a measuring instrument consisting of two types of questionnaires with 100 and 26 questions. The 100-question questionnaire is focused on the basic parameters of the quality of life of the population from 6 spheres of life, common to all individuals. The 26-question questionnaire contains two general questions about the quality of life and health of the survey participants and another 24 questions on individual components of quality of life [7]. Another supporter of the subjective approach is Balitsky E.V., who proposed a methodology for assessing QL based on the integral satisfaction index. The author evaluates the QL using a generalized life satisfaction index, which is made up of the sum of factor indices of satisfaction in the areas of life: personal security, material well-being, family well-being, goal attainment, self-realization, leisure, comfortable climate, social status, social relationships, confidence in the future, comfortable environment, and health. The obtained values are then reduced to a generalized integral index, taking into account the weight coefficients of each factor and the coefficients of their significance for the individual. This method was tested in 2005 by VTsIOM, and the results of the survey revealed the primacy of psychophysical factors over material ones [14]. The most accurate assessment of the QL can be achieved by using a combined approach, which takes into account both measurable objective indicators (income, consumption, expenses, housing, health care, etc.) and subjective ones (degree of satisfaction, happiness, expectations). This approach is used by both foreign and domestic researchers, for example, the study of the quality of life index using the methodology of the British research center The Economist Intelligence Unit. The index is calculated based on the sum of indicators with a given scale of weights determined by experts during the survey [7; 13]. Another foreign methodology based on a combined approach is the better life index, which was developed by specialists from the Organization for Economic Cooperation and Development (OECD). They identify 11 key areas of life, each of which is assessed by a number of indicators based on statistical data and sociological information [13].

The number of indicators used to make the assessment is of great importance for the accuracy of QL studies; the more of them there are, the more accurate the assessment is considered. The level of satisfaction with the totality of needs of a person or a group of people is measured using the indicators of the quality of life of the population. QL is determined by both material indicators measuring the level of security and well-being of the population, and socio-economic indicators measuring the level of provision with social infrastructure, comfort, and the availability of conditions for meeting needs. However, in addition to the number of indicators, the accuracy of the QL assessment is affected by a number of subjective factors, the most important of which are the lack of a generally accepted calculation method and the “custom-made” nature of the assessment. Thus, even when

assessing objective indicators, subjective coefficients can distort the real state of affairs, and somewhere "pull up" the indicators to the required or convenient values for the customer of the research, which is often government agencies. Even by adding individual "artificial" indicators, it is possible to improve the integral indicator. Therefore, a large number of indicators also cannot be unambiguously perceived as a guarantee of the accuracy of the QL assessment [12]. Using a combined approach, systematic research and assessment of the quality of life of the population in Russia, in the regions and cities of the Russian Federation are carried out by: the rating agency "National Credit Ratings" (commissioned by the holding company RBC and Sber); the corporation VEB.RF (using the methodology developed by RANEPA jointly with the consulting company PwC and ASI based on the OECD Better Life Index); the Financial University under the Government of the Russian Federation (the methodology is based on only 11 indicators); the Ministry of Construction and Housing of the Russian Federation (with the participation of the companies "DOM.RF" and KB "Strelka") [12].

The need to assess the quality of life of the population in the regions was also noted by the President of the Russian Federation V.V. Putin in his public address: "The quality of life rating not only makes it possible to assess the situation in the regions and borrow best practices, but also allows management teams to receive feedback from people and more effectively solve the problems that concern them." The Agency for Strategic Initiatives (ASI) responded to this request and, as part of the implementation of the National Social Initiative, launched an annual rating based on a set of regional and federal measures to improve the quality of life of Russians in 10 different areas presented in (Table 1). Three areas of assessment are used to compile the rating: subjective indicators of satisfaction, objective indicators of the environment and the dynamics of their changes. To calculate the integral value, 141 assessment indicators were used, including 67 survey indicators, statistical data and geoanalytics [15].

Table 1

Elements of the environment and indicators of the quality of life of the ASI rating [15].

Element of the environment	**Objective indicators of QL**	**Subjective indicators of QL**
Housing and infrastructure	17 indicators	18 indicators
Consumption and leisure	13 indicators	9 indicators
Cleanliness and ecology	4 indicators	5 indicators
Inclusion and equality	3 indicators	2 indicators
Security	5 indicators	3 indicators

Opportunities for work and business	8 indicators	5 indicators
Social protection	2 indicators	7 indicators
Government services and services	3 indicators	1 indicator
Education and development	13 indicators	10 indicators
Medical care	6 indicators	7 indicators

RIA Rating and ASI agencies study the quality of life at the macro level, that is, across the country and across a large number of parameters, which is a very labor-intensive process and there is a high probability of distorting the results from real indicators, so there are few such studies.

In the era of comprehensive digitalization, when assessing the quality of life of the population, one cannot ignore digital technologies and factors affecting the QL indicators. A comprehensive assessment of the impact of digitalization on a person is carried out by the OECD (Organization for Economic Cooperation and Development) in its study, which assessed the impact of digitalization on 11 dimensions of well-being of the Better Life Index [13]. Foreign authors have introduced a special term “digital well-being”, which assesses the impact of digitalization on all spheres of human life [16]. This term is defined as “the maintenance and growth of human well-being in a social environment, characterized by the digitalization of almost all spheres of life” [17]. In 2020, the Center for Interdisciplinary Research of Human Potential was established in Russia on the basis of an alliance of four research organizations (RANEPA, HSE, MGIMO, IEA RAS), which, based on the methodology of the OECD Better Life Index study, formed a model of the Digital Well-Being Conditions Index to compare the conditions created in Russia and OECD countries, which identified five factors affecting the well-being of the population in the context of digitalization: access to ICT; education and development of digital skills; expanding employment opportunities and increasing income; availability of services; socialization using ICT. Each of these factors is considered using indicators that assess the opportunities and risks of digitalization in the areas of life under consideration. In total, the model has 16 indicators, 11 of which are opportunity indicators and 5 are risk indicators. It is worth noting that, in the opinion of the authors of the study, due to the ambiguity of the concept of digital well-being and the subjective approach to determining the factors and indicators of QL, today qualitative assessments of the impact of digitalization prevail over quantitative ones, for which there is insufficient necessary data and metrics. One of the main conclusions of this study is that the quality of assessing the impact of digitalization on QL can increase as new metrics are developed and data analysis methods are improved (this is possible with the help of artificial intelligence tools), while special attention should be paid to mechanisms and studies that allow

assessing the impact of specific digital technologies on QL [17]. Based on the analysis of the framework model of the Digital Well-Being Index, developed by experts from the Institute for Statistical Studies and Economic Knowledge of the National Research University Higher School of Economics, based on the methodology of the OECD Better Life Index, the author identified the following digital technologies that have a noticeable impact on QL: e-commerce; social networks; e-government (public services portal); online learning; job search services; socially oriented services (entertainment, information, navigation, logistics, household). It is worth mentioning separately the artificial intelligence (AI) technology, which has been actively developing in recent years. However, the author classifies it as "end-to-end" software that develops and influences other digital technologies. When assessing the impact of digitalization on QL, it is necessary to assess each of the listed digital technologies using additional methods and study techniques.

Considering that e-commerce and e-trade, in particular, are one of the main and socially oriented elements of digitalization, studies of its impact on the quality of life of the population are of particular importance. In this regard, additional scientific research is needed on the direct and indirect impact of e-commerce on all elements of the living environment of the population and further consideration of this impact when assessing the indicators of QL. Of particular importance are the methods and tools for studying the strength and nature of the impact of digital technologies on the quality of life of the population. One of the newest methods for assessing the impact of digitalization processes on the quality of life of the population, characterized by high accuracy, is the "digital traces" method. According to the exterior approach, digital technologies are considered as an external factor in the quality of life of the population, and the interior approach assumes that in the context of digitalization of life, offline life of a person cannot be separated from his online life. Among foreign researchers of this method, one can highlight the works of such scientists as N. Wang, Ya. Algan, H. Schwartz, L. Chen, K. Bellet. Among domestic scientists, E.V. is engaged in comprehensive studies of the digital traces method. Shchekotin. In his study, the author proposed a methodology for assessing the quality of life in a regional context using digital methods and data from the VKontakte social network. This method allows extracting a large array of data from a social network with regional differentiation and targeting in a short time, and the analysis of the obtained data array is performed using machine learning and linguistic methods. Thus, in addition to sociological surveys, a new tool based on digital traces has appeared for collecting subjective assessments of the quality of life, which objectively reflects the presence of an individual in the virtual space. The key disadvantage of this method is that the resulting data array does not reflect the assessment of all segments of the population, which makes it insufficiently accurate in terms of representativeness of the sample [18; 19]. Thus, for assessing

the impact of digitalization processes on the quality of life of the population, a combined approach based on objective and subjective assessments is the most relevant and accurate. In turn, the latest method of "digital traces" allows for a large array of data to be collected and analyzed in a short time, which makes it possible to track the dynamics of changes, which is the most important component of the accuracy of assessment for such rapidly developing processes as digitalization.

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DOI 10.34660/INF.2025.23.98.035

商用制冷设备市场结构转型：主要趋势及其经济后果
TRANSFORMATION OF THE STRUCTURE OF THE COMMERCIAL REFRIGERATION EQUIPMENT MARKET: KEY TRENDS AND THEIR ECONOMIC CONSEQUENCES

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摘要：本文探讨了技术创新、消费者需求变化和全球经济进程推动的商用制冷设备市场结构转型的当前趋势。本研究的意义在于，在制裁背景下，商用制冷设备市场正在快速转型，并同时考虑到全球技术和环境趋势的影响。研究特别关注俄罗斯市场，该市场正受到全球趋势和特定因素的影响，包括制裁压力、进口替代以及对新物流条件的适应。

本研究介绍了作者对商用制冷设备市场结构性变化本质的理解，并对其后果进行了定性和定量评估。最后，作者总结了转型的长期性，并概述了商用制冷设备市场在适应新现实过程中面临的主要挑战和机遇。

关键词：商用制冷设备、市场转型、俄罗斯零售、绿色化、数字化、进口替代、经济后果。

Abstract. *The article examines current trends in the transformation of the commercial refrigeration equipment market structure caused by technological innovations, changes in consumer demand and global economic processes. The relevance of the study is due to the rapid transformation of the commercial refrigeration equipment market under sanctions, taking into account the simultaneous impact of global technological and environmental trends. Particular attention is paid to the Russian market, which is developing under the influence of both global trends and specific factors, including sanctions pressure, import substitution and adaptation to new logistics conditions.*

The study presents the author's approach to determining the essence of structural changes in the commercial refrigeration equipment market and provides a qualitative and quantitative assessment of their consequences. A conclusion is made about the long-term nature of the transformation and the main challenges and opportunities arising in the process of adaptation of the commercial refrigeration equipment market to new realities are outlined.

Keywords: *commercial refrigeration equipment, market transformation, Russian retail, greening, digitalization, import substitution, economic consequences.*

Introduction

The modern commercial refrigeration equipment market is experiencing a period of deep and large-scale transformations caused by changes in the technological, economic, institutional and consumer environment. In the context of sanctions, greening, global challenges and new geoeconomic realities, traditional forms of organization of the commercial refrigeration equipment market are losing their former dominance, giving way to new formats, production cycles, distribution channels and approaches to interaction with the consumer. These processes are not exclusively opportunistic in nature - on the contrary, we are talking about fundamental structural changes affecting not only the market architecture, but also the mechanisms of functioning of key economic entities. The topic of transformation of the commercial refrigeration equipment market has become especially relevant in the context of a series of crises of the last decade: the COVID-19 pandemic, disruptions in supply chains, international sanctions restrictions and redistribution of capital and goods flows. These shocks have become a catalyst for an accelerated transition to new technological chains, acceleration of import substitution, primarily the creation of local manufacturers to replace gaps in logistics hubs, thereby forming a new technological hub. At the same time, environmental and institutional risks associated with the expansion of new local production hubs are increasing.

The purpose of this article is to theoretically and analytically understand the processes of transformation of the commercial refrigeration equipment market in the context of modern economic reality, identify key areas of structural changes and substantiate their economic consequences for various categories of market participants.

Literature review

It should be noted that in recent years, issues of structural changes in the commercial refrigeration equipment market have been reflected in the scientific literature. Researchers draw attention to the multi-level nature of the transformations: from technological and infrastructural shifts to institutional and organizational changes affecting both consumer behavior and the strategy of market participants.

The sanctions policy of the EU countries is considered one of the key drivers of transformation. Thus, in the work of Ivanov A.A. and Petrova E.S. it is emphasized that the sanctions have become a catalyst for the accelerated transition to localized production. [1] Restrictions on the import of key components for the production of commercial refrigeration equipment forced manufacturers to find other supply chains and, in particular, the complete localization of individual com-

ponents, such as electronics and automation of electrical panels of the equipment. Russian economists also assess the impact of the sanctions ambiguously, but the prevailing opinion is that the sanctions cannot significantly affect the state of the Russian economy [8]

The restructuring of the industry is emphasized in the study of Semenov I.K. The problem of supplying components that cannot be localized has opened up the industry to new manufacturers that were not previously major players [5]. Turkish manufacturers have made it possible to adapt to the new competitive environment by providing competitive alternatives to the main European suppliers.

The problems of digital transformation of retail trade are described in detail in the work of V.L. Smirnov. The researcher emphasizes that the business models of companies are becoming flexible and susceptible to the influence of the external digital environment, which requires the adaptation of strategies and the structure of activities. [6] The structure of demand in the era of digitalization has changed significantly, shifting several positions from classic commercial refrigeration equipment to alternative ones, such as parcel terminals.

Along with sanctions factors, considerable attention is paid to the influence of environmental bills that directly dictate the technological parameters and refrigerants permitted for commercial use.

In general, the existing scientific literature reflects a high interest in the topic of transformation of the commercial refrigeration equipment market. At the same time, a certain fragmentation of research is observed: some works focus primarily on digitalization and innovation, others - on the impact of sanctions and institutional changes. At the same time, the need for an integrated approach remains relevant, allowing to systematize the accumulated knowledge and develop a holistic view of the structural changes covering both the format and subject configuration of the commercial refrigeration equipment market.

Research results

Let us conduct a more detailed study of the main trends characterizing the structural changes in the commercial refrigeration equipment market in Russia.

The first trend is a *significant increase in the share of localization in the production of commercial refrigeration equipment.* Data from analytical reports of the Federal State Statistics Service indicate a significant increase in the share of localization of local production, especially starting from 2022 (Table 1)

Table 1

Key production indicators of the commercial refrigeration equipment market

Year	Production volume, thousand units	Growth rate, %	Share of localization, %
2020	245.7	-3.2	38.5

2021	268.4	+9.2	41.2
2022	214.6	-20.1	52.8
2023	287.3	+33.9	63.4
2024	315.2	+9.7	68.1

Sources [4]

If in 2020, the share of commercial refrigeration equipment of local equipment was 38.5% of 245.7 thousand units, then in all subsequent years it increased, following the trends and influence of the sanctions policy of the EU countries. Short-term crises, such as the pandemic and sanctions, accelerated the transformation processes, acting as a catalyst for the transition to local production, and many foreign manufacturers ceased their activities in the Russian Federation, thereby freeing up a niche for local manufacturers, which allowed local manufacturers to take the place of the departed manufacturers.

The second trend characterizing structural changes in the Russian commercial refrigeration equipment market is associated with the transformation of the composition of participants due to the departure of a number of foreign brands and the emergence of new, both domestic and foreign players. From 2022 to 2023, 31 foreign brands left the Russian market, which was associated with both sanctions pressure and general changes in international trade. However, the departure of these players was compensated by the emergence of 37 new brands, mainly from friendly countries such as Turkey, South Korea, Belarus and Lebanon. During 2024, the market was replenished with 28 new foreign brands, which indicates that international companies continue to show interest in Russian consumers despite the existing restrictions (See Fig. 1).

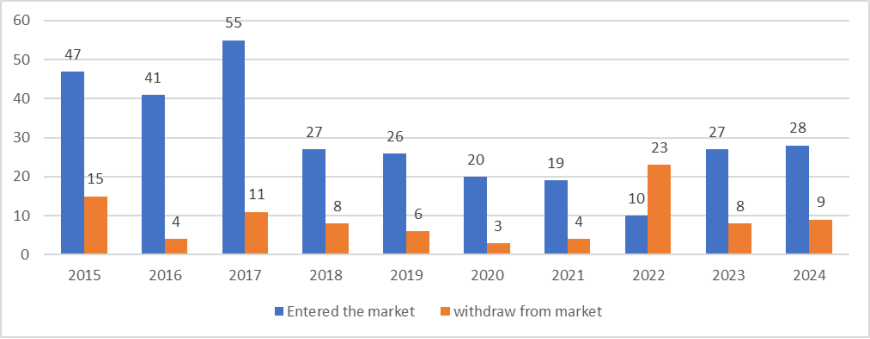

Figure 1. *Dynamics of international brands entering and leaving the Russian market, units, 2015-2024 [7]*

The third trend is the emergence of a new retail format – pick-up points. In recent years, the pick-up point (POP) format has become a key element of the online retail infrastructure. For the commercial refrigeration equipment market, this has become an opportunity to develop a product that differs from the classic one, in the form of a refrigerated parcel terminal. According to Data Insight, "pick-up points are the most popular franchise on the market, although one of the riskiest" [2]. This format shows high potential and is in demand among buyers, which explains the active development of POP networks by the largest marketplaces. From August 2023 to August 2024, the total number of pick-up points of Russia's three largest marketplaces - Wildberries, Ozon and Yandex Market - increased by 54%, from 71,000 to 109,000 points (See Fig. 2). This exceeds the number of stores of one of Russia's largest retail chains, X5 Group.

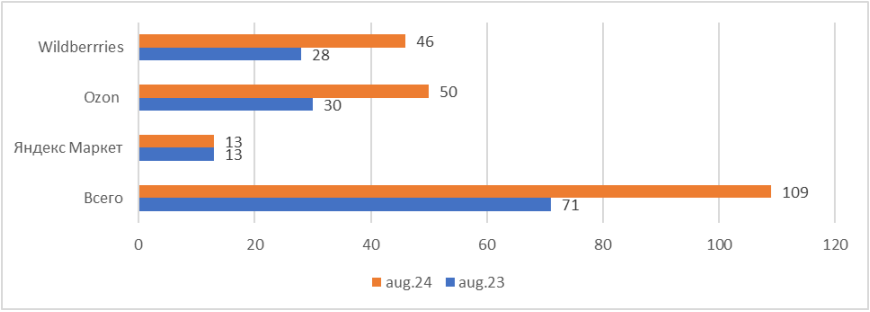

Figure 2. *Number of pick-up points of the largest marketplaces in Russia, thousand units.[3]*

Conclusion

The conducted study of the transformation of the commercial refrigeration equipment market in Russia for 2020–2024 allowed us to systematically and multifacetedly characterize the structural changes taking place in the Russian commercial refrigeration equipment market. The analysis substantiated that structural changes are not just short-term adaptive responses of the market to external shocks, but form a sustainable long-term trend in the transformation of the institutional, technological and format architecture of the commercial refrigeration equipment market. Unlike temporary fluctuations caused, for example, by a pandemic or sanctions, structural shifts are manifested in a change in the very logic of the market: Localization has become the driving force of this market, trade formats are changing, roles are being redistributed between participants, and traditional production lines have been supplemented by new ones and made it possible to master a new format in the form of pick-up points, which is developing along with the process

of digitalization of the consumer market. The long-term nature of these changes is confirmed by the stable dynamics of key indicators: an increase in the rate of production growth, a decrease in dependence on foreign suppliers and foreign components; structural shifts are not neutral in their economic content: they create both new opportunities for development and challenges for market participants.

Thus, structural changes in the commercial refrigeration equipment market are a multifaceted and irreversible process that covers technological, institutional and organizational-economic levels.

The formation of adequate adaptation strategies and the development of government regulation mechanisms aimed at supporting the balanced and sustainable development of the trade sector are becoming necessary conditions for the effective functioning and modernization of retail in the long term.

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DOI 10.34660/INF.2025.99.26.036

法人刑事责任的国际法律标准及其在吉尔吉斯共和国立法中的应用
INTERNATIONAL **LEGAL STANDARDS OF CRIMINAL LIABILITY OF LEGAL ENTITIES AND THEIR APPLICATION IN THE LEGISLATION OF THE KYRGYZ REPUBLIC**

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注释：吉尔吉斯共和国自2021年12月1日起实施新的刑事立法，取代了2019年生效、2017年作为刑法改革框架通过的旧法典。这是因为执法机构和法官因理论与实践之间的冲突和矛盾而开始遇到一些困难。这种变化的另一个结果是，2021年版的新《刑法》和《刑事诉讼法》删除了2017年版中关于以刑法强制措施形式追究法人刑事责任的规定。发起新项目的吉尔吉斯共和国总检察院将此解释为，追究法人对其雇员所犯罪行的责任非常困难。在这方面，研究国际规范性法律文件的主要规定具有重要意义，这也是2017年吉尔吉斯共和国将规范法人刑事责任的法律规范引入刑事立法的原因之一。结论：本文认为，吉尔吉斯共和国刑事立法中引入法人准刑事责任制度是法学界理论研究的成果，是对刑法理论中关于“法人作为刑事责任主体”这一概念的争议性问题的解答，同时也展望了吉尔吉斯斯坦刑法中法人刑事责任制度未来发展的方向。

关键词：实施、准刑事责任、没收、清算、制裁、刑事责任、刑事立法、罚款、法人。

Annotation. *In the Kyrgyz Republic, new criminal legislation has been in force since December 1, 2021, replacing the codes that came into force in 2019 and were adopted in 2017 as part of the criminal law reform, due to the fact that law enforcement agencies and judges began to experience certain difficulties due to conflicts and contradictions between theory and practice. A consequence of such changes was also the fact that the new Criminal and Criminal Procedure Codes of the 2021 edition excluded the provisions regulating the criminal liability of legal entities in the form of compulsory measures of criminal law, which were included in the 2017 edition. The Prosecutor General's Office of the Kyrgyz Republic, which initiated the new projects, explains this by the difficulty of holding legal entities accountable for crimes committed by their employees. In this regard, it*

is relevant to study the main provisions of international regulatory legal acts, which became one of the reasons for the introduction of legal norms regulating the criminal liability of legal entities into the criminal legislation of the Kyrgyz Republic in 2017. Conclusions: the article seems to justify the emergence of quasi-criminal liability of legal entities in the criminal legislation of the Kyrgyz Republic, as a result of theoretical research of the legal community, as a solution to the controversial issue of the theory of criminal law in relation to the category of "legal entity as a subject of criminal liability", and also outlines the direction of further development of the institution of criminal liability of legal entities in Kyrgyz criminal law.

Keywords: *implementation, quasi-criminal liability, confiscation, liquidation, sanctions, criminal liability, criminal legislation, fine, legal entities.*

In the Kyrgyz Republic, a new criminal legislation has been in force since December 1, 2021, replacing the codes that came into force in 2019 and were adopted in 2017 as part of the criminal law reform, due to the fact that law enforcement agencies and judges began to experience certain difficulties due to conflicts and contradictions between theory and practice. In order to eliminate the gaps, over two years (2019-2020), the Zhogorku Kenesh made 285 amendments and additions to the codes and adopted 20 laws on amendments. Despite this, the number of complaints from the population, including about red tape during investigations and unfair court decisions, continued to increase [1].

Another consequence of such changes was that the new Criminal and Criminal Procedure Codes of 2021 excluded the provisions regulating the criminal liability of legal entities in the form of compulsory measures of criminal law, which were included in the 2017 version. The Prosecutor General's Office of the Kyrgyz Republic, which initiated the new projects, explains this by the difficulty of holding legal entities accountable for crimes committed by their employees. "For example, when a violation of the rules for the protection and use of subsoil at a production enterprise is detected, which occurred due to improper performance of their duties by responsible officials, along with specific individuals, it is necessary to apply measures against legal entities that can be liquidated and their property confiscated. At the same time, the rights of the owners or co-founders of the enterprise, including the right to the inviolability of private property, are not taken into account," the justification note states [2].

Thus, due to the above circumstances, the scientific legal community of Kyrgyzstan once again faced questions requiring scientific analysis and understanding regarding the institution of criminal liability of legal entities, the introduction of which into the criminal legislation of the country in 2017 was perceived as a novelty, a progressive innovation "know-how" [3].

As Professor Sulaimanova N.N. notes, “if previously international acts were limited mainly to general calls and recommendations, then in recent years they have increasingly enshrined the obligations of states to establish and apply criminal liability for the most dangerous crimes of an environmental, economic and corruption nature, as well as for those acts (for example, terrorism, extremism, organized crime) that threaten the security of not only individual states, but also the world community as a whole” [4]. Also, “it should be noted that in standards and norms, the liability of legal entities has long been recommended to states” [5].

Experience in applying the institution of criminal liability of legal entities in foreign countries has shown that it is necessary in those crimes in which the consequences of socially dangerous acts of individuals are not so significant in comparison with the harm and damage caused by the criminal activity of a legal entity.

For many years, the Kyrgyz Republic has been discussing the implementation of the provisions of international Conventions on the establishment of criminal liability of legal entities for crimes. Thus, by the day of the adoption of the Criminal and Criminal Procedure Codes of 2017, the question was no longer whether legal entities needed liability for crimes specified in the Conventions ratified by the Kyrgyz Republic, but how this would be enshrined in our national legislation.

The result of a thorough analysis of international legal acts regulating the criminal liability of legal entities and the solution of theoretical issues on the establishment of such liability in criminal law was the establishment in the Criminal Code of the Kyrgyz Republic adopted in 2017, Chapter 20, where such liability is presented as compulsory measures of criminal law influence.

Among the large array of international legal acts on this topic, the following can be highlighted: the UN Convention against Transnational Organized Crime of November 15, 2000, the UN Convention against Corruption of October 31, 2003, the Convention for the Suppression of the Financing of Terrorism of December 9, 1999, the Convention of the Shanghai Cooperation Organization against Terrorism of June 16, 2009, the Convention on Cybercrime ETS No. 185, adopted in Budapest on November 23, 2001, and others.

As we can see, the institution of criminal liability of legal entities is currently the subject of regulation by many international legal acts. Let us consider their content in sequence. Thus, the UN Convention against Transnational Organized Crime of November 15, 2000, ratified by the Kyrgyz Republic by Law of the Kyrgyz Republic No. 74 of April 15, 2003 [6] is one of the first acts that considers the liability of legal entities. It establishes a list of socially dangerous acts subject to mandatory criminalization by participating countries.

The next international act regulating the criminal liability of legal entities is the UN Convention against Corruption of October 31, 2003, ratified by the Kyrgyz Republic by Law of the Kyrgyz Republic No. 128 of August 6, 2005 [7]. It deter-

mines that the criminal liability of legal entities occurs for all corruption-related crimes provided for by the Convention that can be committed by legal entities, except for those criminal acts where the subjects can only be individuals: illicit enrichment, abuse of office, theft in the private sector.

Another document ratified by the Kyrgyz Republic by Law of the Kyrgyz Republic No. 79 of April 15, 2003 [8] is the Convention for the Suppression of the Financing of Terrorism of December 9, 1999 [9]. Article 5 of this Convention provides for the obligation of a State Party to take measures to ensure that a legal entity located in its territory or established under its laws can be held liable (criminal, civil or administrative) in the event that an individual responsible for the management of this legal entity or control over it, who acts in his official capacity, commits a crime of financing terrorism.

The international legal act regulating the liability of legal entities is also the Convention of the Shanghai Cooperation Organization against Terrorism of June 16, 2009. It notes that the crimes covered by this Convention may not be justified under any circumstances, and individuals and legal entities guilty of committing such acts and (or) involved in their commission must be held liable, which may be criminal, civil or administrative. Each Party shall take such measures as may be necessary to establish the liability of legal entities for cases of their involvement in at least one of the crimes covered by this Convention. This Convention was ratified by the Kyrgyz Republic by the Law of the Kyrgyz Republic dated July 11, 2011 No. 90 [10].

It should be noted that the Shanghai Convention also determines that in relation to legal entities held liable for involvement in the crimes specified in this document, the following measures shall be applied, in particular: a warning; a fine; confiscation of the property of a legal entity; suspension of the activities of a legal entity; a ban on certain types of activities of a legal entity; liquidation of a legal entity [11]. This recommendation was embodied in the regulatory provisions of Articles 124–128 of Chapter 20 of the Criminal Code of the Kyrgyz Republic of 2017, entitled "Compulsory measures of criminal law influence in relation to legal entities" [12].

Thus, the above study of the content of the above-mentioned international legal documents allows us to conclude that the criminal liability of legal entities has received broad support and consolidation at the global level.

In Kyrgyzstan, for many years, during the judicial and legal reform of 2012-2019, work was carried out on the implementation of conventional provisions on the establishment of criminal liability of legal entities. As we have already noted, as a result of a thorough analysis of the provisions of international regulations and a study of the world practice of applying criminal liability of legal entities, as well as solving theoretical issues of criminal law, the institution of criminal liability of

legal entities was enshrined in the Kyrgyz criminal legislation of 2017 as a compulsory measure of criminal law.

As noted by T.S. Salibekova, "the institution of criminal liability of legal entities is necessary in those crimes in which an individual as a criminal recedes into the background, and a legal entity comes to the fore" [13]. And a legal entity, according to the doctrinal provisions of modern criminal law, can only be involved in the commission of a criminal act and bear criminal liability as for involvement in the crime committed.

The result of scientific research was that the Criminal Code of the Kyrgyz Republic of 2017 established the so-called "quasi-criminal" liability of a legal entity that is not the subject of a crime, but is subject to compulsory criminal law measures, i.e., it becomes the subject of liability. This approach is consistent with the principle of personal guilty liability existing in the Criminal Code and does not break its structure as a whole.

What is noteworthy about the Criminal Code of 2017 is that it defines a legal entity. Thus, Article 123 states that a legal entity is an organization created in accordance with the civil legislation of the Kyrgyz Republic, as well as a foreign legal entity. There is also a special clause stating that the following are not legal entities within the meaning of this chapter: the state, state authorities, local government bodies of the Kyrgyz Republic, legal entities exercising certain state powers imposed on them by law; foreign states, state authorities of a foreign state, foreign state bodies, legal entities exercising certain state powers, international organizations and their representative offices.

It should also be noted that the Criminal Code of 2017 in the same Article 123 provides grounds for the application of compulsory measures of criminal law influence to legal entities, which consist in the fact that the illegal act must be committed by an individual on behalf of or through a legal entity; in the interests of this legal entity, regardless of whether such an individual has been brought to criminal liability. It is noted that the application of compulsory measures of criminal law influence in relation to a legal entity does not exclude the criminal liability of an individual for the same illegal act, and also that the application of compulsory measures of criminal law influence in relation to a legal entity does not release it from obligations to compensate for the damage caused.

The court may impose on a legal entity the obligation to compensate for damage caused as a result of an unlawful act committed. This may be expressed in compensation for property damage, in preventing further pollution of the environment, in ensuring safe working conditions, etc.

The Criminal Code of the Kyrgyz Republic of 2017 clearly defined the list of criminal acts, the commission of which may result in the application of compulsory criminal-legal measures to legal entities: Act of terrorism; Air pollution; Water pollution; Abuse of authority in a commercial or other organization; Abuse of

authority by private notaries, auditors, experts or appraisers; Commercial bribery; Legalization (laundering) of proceeds from crime; False entrepreneurship; Violation of the procedure for holding public auctions, auctions or tenders; Violation of the rules for the protection and use of subsoil; Violation of the rules for the protection of fish stocks; Illegal cutting of trees and shrubs; Illegal participation of an official in entrepreneurial activity; Organization of financial pyramids; Damage to land; Mediation in bribery; Giving a bribe; Public calls for terrorist activity; Raiding; Assistance to terrorist activity; Creation of a danger to consumers; Human trafficking; Financing of terrorist activities.

Also, the Criminal Code of the Kyrgyz Republic of 2017 resolved the issue of the types of compulsory measures of criminal law influence listed in Article 124: "The court may apply the following types of compulsory measures of criminal law influence to a legal entity: 1) a fine; 2) restriction of rights; 3) liquidation of a legal entity.

Thus, the above study allows us to conclude that the Kyrgyz criminal legislation of 2017 successfully resolved the issue of implementing the requirements of international law on the introduction of the institution of criminal liability of legal entities, which corresponds, as noted by the Russian researcher V. N. Sizova, "to a fairly broad understanding of it in international acts, including the application of criminal penalties and other measures of a criminal law nature: it is obvious that legal entities do not always act as subjects of committed criminal offenses, sometimes it is sufficient to recognize them as subjects of criminal liability. The definition of criminal liability in relation to legal entities in specific states is determined by what exactly the national legislator understands by this definition" [14].

It should also be noted that the content of international legal acts concerning the issues of combating criminal acts in the context of globalization and the need to form a "promising model of the economic system" provides for the possibility for legislators in various countries to consider the issue of bringing to criminal liability a person who acted in the interests of a company, organization and such an institution, corporation or enterprise itself, by developing the necessary directions for preventing possible criminal acts on their part and imposing fair punishment for committing such acts, which was taken into account by Kyrgyz legislators when drafting the criminal codes of 2017.

Also, the study of international legal norms on the criminal liability of legal entities allows us to make a completely justified, in our opinion, conclusion about the colossal work in its scale that is being carried out by the global legal community in the direction of solving problems related to bringing legal entities to criminal liability.

In conclusion, we note that the substantive analysis of international legal treaties recommended for the establishment of criminal liability of legal entities in the national legislation of the participating countries, carried out in this study, shows that many provisions of these acts were duly reflected in the national crim-

inal legislation of the Kyrgyz Republic adopted during the criminal law reform of 2012-2019, but due to socio-political circumstances, they have lost their legal force at present. As noted earlier, the Prosecutor General's Office of the Kyrgyz Republic, which initiated the drafts of the current Criminal Code and the Criminal Procedure Code of the Kyrgyz Republic, as amended in October 2021, explains this by the difficulty of bringing legal entities to justice for crimes committed by their employees. However, government agencies should pay attention to the fact that the exclusion of the institution of criminal liability of legal entities from the legislation of the Kyrgyz Republic is a failure by the republic to fulfill its international obligations, in particular the recommendations within the framework of the Istanbul Action Plan to Combat Corruption, and may entail the inclusion of the Kyrgyz Republic in the "gray list" of the FATF, an international organization - the Financial Action Task Force on Money Laundering, the purpose of which is to combat money laundering and the financing of terrorism. Inclusion of a country in the "gray list" means that it is under increased control of the organization. And this can lead to: reputational risks for business, the fact that the private sector may face such problems as difficulties in business relations with partners, restrictions on correspondent relations with foreign financial institutions, a decrease in positions in international ratings.

In this regard, it seems fair to assert that T. Salibekov is right that the institution of criminal liability of legal entities is a powerful institution that takes control of such phenomena as money laundering, corruption, financing of terrorism, etc. Thus, the legal community of the Kyrgyz Republic is again faced with the issue of further improvement of criminal law and correction of legislation. And the correction of codes, as noted, is a natural process that should be carried out on an ongoing basis, taking into account law enforcement practice, in order to find the best sounding of the law [15].

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DOI 10.34660/INF.2025.28.39.037

体育是俄罗斯与西方政治对抗的工具
SPORT AS AN INSTRUMENT OF POLITICAL CONFRONTATION BETWEEN RUSSIA AND THE WEST

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注释：近十年来，世界见证了俄罗斯与西方在包括体育在内的所有领域对抗的急剧升级。本文作者将体育政治化视为一种现象和问题，探讨了体育与政治之间的关系。他们认为，如今体育常常被用作外交政策的工具，这对国际体育的发展产生了负面影响。此外，本文还探讨了现代体育政治化的现状，针对俄罗斯联邦的限制（制裁）规模和强度空前，阻止了俄罗斯运动员参加国际体育赛事。

关键词：奥运会、国际奥委会、国际奥林匹克运动、体育政治化、体育制裁。

Annotation. *Over the past decade, the world has seen a sharp escalation of confrontation between Russia and the West in all areas of activity, including sports. The authors of the article consider the politicization of sport as a phenomenon*

and a problem, exploring the relationship between sport and politics. In their opinion, Nowadays, sport is often used as an instrument of foreign policy, which has a negative impact on the development of the international sports movement. In addition, the article examines current aspects of the politicization of modern sports, in the direction of which unprecedented in their scale and intensity restrictions (sanctions) have been introduced against the Russian Federation, preventing Russian athletes from participating in international sports competitions.

Keywords: *Olympic Games, IOC, international Olympic movement, politicization of sports, sports sanctions.*

Introduction

The Olympic Games, which originated in Ancient Greece in 776 BC, were initially religious and cultural in nature. However, over time they became an important political tool. During the period of the Games, a sacred truce was declared [7].

However, one of the most popular opinions today, concerning both the Olympic Games and sports in general, is that sports should be separated from politics. They say that the politicization of sports is an artificial phenomenon, and it would be nice to return to some kind of "golden age of sports apoliticism." The opinion is popular, but absolutely naive and unviable. People who express such an opinion either do not understand the nature of the thing they are discussing, or, even worse, are simply hypocritical [20].

The modern world is becoming increasingly politicized and multipolar. Today, global world centers and players are included in the orbit of political games at the highest level. Political and ideological mobilization and politicization of such social institutions as sports, art, media, religion and others are becoming an integral feature of big politics not only at the level of individual states, but also on the world stage [8].

The long-standing accusations and exclusion of Russian athletes from the international sports paradigm only emphasize that, first and foremost, it is geopolitical factors that influence decisions in international sports in the 21st century. And as historical experience shows, such rhetoric is not new and has repeatedly undermined the Olympic Charter's guidelines on the inadmissibility of politicizing sports, which only proves the naivety of such statements [17].

Main content of the article

The politicization of sport was most clearly evident during the Cold War, when the Olympic movement was on the verge of collapse due to the boycott of the 1980 Olympic Games (Moscow) by the United States, and the 1984 Olympic Games (Los Angeles) by the Soviet Union. The 1980 Games were boycotted by representatives of 64 countries, led by the United States, in protest against the decision of the Soviet party leadership to introduce troops into Afghanistan. In 1984, under

the pretext of countering “anti-Soviet sentiments,” the Soviet Union decided to boycott the Olympic Games in Los Angeles. A similar decision was made by the other countries of the “socialist camp,” except for China, Romania, and Yugoslavia. Thus, sport opened up additional opportunities for politicians to implement their goals and programs [12].

After the end of the Cold War and the change of the world order, there was a certain illusion that the political component would leave the Olympics, but such hopes were quickly destroyed. Currently, with the aggravation of political disagreements between Russia and Western countries, the politicization of relations in the field of sports is increasing. Back in 2008, the United States tried to deprive Russia of the right to host the 2014 Winter Olympics in Sochi due to the Georgian conflict, and during the Winter Olympics in Sochi, political anti-Russian sentiments in Kyiv intensified. After the Sochi Olympics, due to the events in eastern Ukraine, a number of American and British officials demanded that the 2018 World Cup be taken away.

A new word in the sports policy of the 21st century has become the imaginary “fight against doping”, according to which it has become extremely convenient not only to neutralize dangerous opponents in sports, but also to deliver political “blows”, which is clearly seen in the anti-Russian sanctions policy of the IOC. On a global scale, the doping problem began to shake all domestic sports, after a frank letter from Russian track and field athlete Yulia Stepanova addressed to the World Anti-Doping Agency (WADA) in December 2014. In this message, her personal experience of doping was described in detail. Subsequently, “fuel on the fire” was added by the former director of the anti-doping center Grigory Rodchenkov, who soon fled to the United States of America. Following these events, a series of disqualifications of Russian athletes began, deprivation of medals won in international competitions, including the Olympic Games [15].

These allegations were later heavily supported by the findings of an investigation launched by the World Anti-Doping Agency (WADA) in 2016, just before the Rio Olympics. As a result of this investigation, first the International Association of Athletics Federations and then the IOC and the International Paralympic Committee imposed sanctions on Russian athletes. In July 2016, the IOC announced an investigation into the Russian officials named in the report WADA, and called for the temporary suspension of Russian athletes from participation in international sports competitions [14].

There was still hope that this would not become a system, but the situation was getting worse and worse with each passing day. Track and field athletes, weightlifters and a number of other athletes were suspended from participating in the Rio 2016 Games, and the entire Paralympic team was suspended. Russian athletes were accused of more and more sins, and Russian officials were accused of creat-

ing a state system to support doping. And the closer we got to the Winter Olympics in South Korea (Pyeongchang 2018), the more obvious it became that the fight was not against doping, but against Russia.

So, to my solution On December 5, 2017, the IOC, based on the materials on anti-doping investigations in Russian sports, imposed unilateral sanctions against the Russian Olympic Committee (ROC) and suspended its activities with immediate effect. Despite the sanctions against the ROC, individual Russian athletes were allowed to participate in the Winter Olympics in Pyeongchang 2018. They participated in individual or team competitions as "Olympic athletes from Russia". The IOC also adopted a number of sanctions against individual Russian sports officials.

Next, solution from December 9, 2019 WADA imposed sanctions on Russia, according to which the country will not be able to participate in the Olympic and Paralympic Games in Tokyo (2020), as well as the Winter Olympic Games in Beijing (2022). Russia will also not be able to host international sports competitions for a four-year period. Thus, it can be said that the protracted doping scandal is nothing more than political pressure and manipulation towards Russia by international organizations under the influence of Western political masses, since, in fact, the blockade of Russia in the field of international sports is considered precisely in the context of the general political situation [13].

In parallel with the investigations conducted by WADA into domestic sports, the entire world press (mainly Western media) was daily publishing articles about doping scandals involving Russian athletes. Today, in the space of the Internet, sports media, like classical media, acquire new properties and new qualities. It can be said that sports media should not have been in the space of political communication. They should not be politicized, but the current practice of holding international sports events shows that all major sports events in fact end up in the space of political communication [19]. It is obvious that this has become a kind of instrument of influence on mass consciousness, and, of course, has begun to be used as a tool for creating a negative image of Russia as a country as a whole.[17].

One of the striking examples of such a case is the situation that happened to Russian figure skater Kamila Valieva at the 2022 Winter Olympics in Beijing. After her performance in the team event, where the Russian team won the team event, our athlete was hit with a lot of "dirt" from foreign media due to a positive doping test a year ago.[20]. Obviously, the Western, primarily English-language media agenda in this case has gone far beyond the specific information pretext and has spread to a wide range of claims against all Russian sports.[16].

Along with the doping scandal, our athletes often faced biased judging. The loudest scandal of 2021 in sports can safely be called the incident with gymnasts Dina and Arina Averyna at the Tokyo Olympics, where the judges recognized the winner as the athlete from Israel Lina Ashram, who did not perform so "cleanly"

at the Olympics, since she dropped the ribbon during her performance. In modern gymnastics, this is a gross mistake and points are deducted for it. Of course, this is an outrageous case in the history of world sports. And there have been many, many such cases in the modern history of Russian sports. As we understand, these are links in the same "political chain", and the doping scandal is just one of the pretexts and levers of pressure on our country [18].

After the start of the special military operation in Ukraine, another wave of sanctions against Russian sports followed. Immediately after these events began, the IOC recommended that international federations suspend Russian and Belarusian athletes from competing in competitions held under their auspices. This reached its peak in the final politicization and interference in the work of international sports institutions. In March 2023, the IOC issued recommendations, where it is open, it is stated, that he does not intend to officially confirm the participation of Russian athletes in the 2024 Olympic Games. This decision by the IOC once again looks exclusively like a decision by the political conductor of the West with collective punishment for geopolitical grievances, which clearly cannot correspond to the principles of fair and non-politicized sports competition.

However, the legitimacy of such victories, obtained in conditions of artificially reduced competition and the overall competitive level, is highly questionable from a legal point of view, not to mention the moral side of the issue, when the winner himself understands the price of such a victory. For example, five-time Olympic biathlon champion and member of the IOC Athletes' Committee, Frenchman Martin Fourcade, unlike some irresponsible Western politicians, perfectly understands the meaning and content of real professional sports. He openly and unequivocally spoke out in favor of the participation of Russian athletes in the Olympic Games in Paris in 2024, formulating his point of view as follows: "I will be very ashamed for my country if it decides to ban Russian and Belarusian athletes from participating in the competition." In other words, Martin Fourcade is based, first of all, on the need to strictly ensure the rights of athletes, which should be considered as an element of the fundamental principle of equality, and not discrimination in general [6].

Let's take another example. An athlete from the USA, the 2016 Olympic champion in freestyle wrestling Kyle Snyder, supported his opponent on the wrestling mat, our athlete, two-time Olympic champion Abdulrashid Sadulaev, who was suspended from participation in the Olympic Games (Paris 2024) licensing tournament. Kyle Snyder told Sadulaev that he was very sorry that he would not be able to participate in the competition and expressed hope that the IOC would reconsider its decision [3].

It is impossible to compile a complete list of specific foreign athletes, coaches, sports functionaries and officials who support Russian athletes. Many of them

simply do not express public opinions on this issue due to circumstances that are clear to us, and those who speak out do so individually, not representing the entire sports community.

However, there are those who hate everything connected with Russia. For example, the legend of the National Hockey League (NHL), two-time Stanley Cup winner, Olympic champion – Czech Dominik Hasek. The legendary Detroit goalie has been taking a position of total hatred towards Russia for the past year. He called for Alexander Ovechkin and other Russians to be kicked out of the NHL and even suggested jailing Czech players who decide to continue their careers in Russia [4]. And this despite the fact thatAt the end of his career, Hasek played one season in Russia, in the Continental Hockey League, as part of Moscow Spartak.

On the other hand, there are international competitions in the world where Russian athletes compete without any problems, for example –Ultimate Fighting Championship (UFC), Grand Slam tennis tournaments (Australian, French, US Open and Wimbledon) and National Hockey League (NHL). For example, two-time Olympic hockey champion and State Duma deputy Vyacheslav Fetisov explained the absence of sanctions against Russian hockey players by the fact that Russian players' performance in the NHL is financially profitable. In his opinion, this is a deterrent to the introduction of sanctions.

Despite the circumstances that have developed around Russian sport, 15 Russian athletes still took part in the 2024 Paris Olympics, who competed in a neutral status. Our athletes were prohibited from using any Russian symbols, flag, and anthem during the competition.

There is another global problem. According to 2023 data, more than 200 Russian athletes have undergone the citizenship change procedure to obtain the right to compete in international competitions. According to the publication "Kholod", which cites this figure, in fact, there may be many more such athletes today. It is important to understand that Russian athletes left for other teams even before the introduction of sanctions - as a rule, they could not withstand competition within the country [11]. But now this movement has acquired a mass character and this despite the fact that Russia, in support of its athletes (primarily with the financial component), held a number of international competitions from 2022 to 2024, such as: the Spartakiad of the strongest in summer and winter sports, the BRICS Games and the Future Games, the Paralympic Games "We are together. Sport", etc. [2].

The Minister of Sports of Russia Mikhail Degtyarev spoke about those Russians who changed their sports citizenship. Hecriticized their decision and stated that he does not accept such a position. According to him, the actions of such athletes raise questions [5].

In our opinion, after Russia was disqualified from international competitions due to doping scandals and especially after the start of the SVO in Ukraine, many

athletes are looking for ways to continue their sports careers in other countries. It should be noted that quite a few Russian athletes who now represent other countries have achieved serious success. The same Chermen Valiev, in addition to the gold of the European Championship, won bronze at the 2024 Olympics. Freestyle wrestlers Magomed Ramazanov, Akhmed Tazhudinov and Razambek Zhamalov "brought" gold medals of the 2024 Olympics to Bulgaria, Bahrain and Uzbekistan, respectively. Freestyle wrestlers Dauren Kurugliev and Magomedkhan Magomedov won the bronze medal of Paris 2024 for Greece and Azerbaijan. Darya Varfolomeyeva brought Germany Olympic gold in Paris 2024 in rhythmic gymnastics, and judoka Zelim Kotsoyev "brought" a gold medal to Azerbaijan. And this is not a complete list of those athletes who are currently winning medals of various shades for other countries.

Conclusion

International sports organizations such as the IOC, WADA and CAS in the present time are instruments of unilateral political influence and pressure. The restrictions they have introduced have acquired a truly global scope and have exceeded all conceivable and inconceivable limits. At the same time, the so-called sanctions in force against Russia in the sports industry do not correspond to the provisions of the documents adopted within the framework of these organizations. According to the official position of the Ministry of Sports of the Russian Federation and the Russian Olympic Committee, they constitute a violation, including the Olympic Charter, which prohibits discrimination on the basis of nationality.

However, the newly elected president of the International Olympic Committee, Kirsty Coventry, said that she is against the exclusion of countries from the Olympic Games due to military conflicts. She intends to discuss the issue of the return of Russian athletes to the world arena with the working group [1].

Nevertheless, we will note positive shifts towards Russian sports. Thus, hockey matches are planned between the Russian and US national teams, and possibly in the format of the KHL team against the NHL team, which will be held in St. Petersburg and Washington. This was reported by the Minister of Sports of Russia Mikhail Degtyarev. According to the official, non-public negotiations are currently underway between the parties on holding friendly hockey matches between the two countries [10]. Next, the head of the Russian Wrestling Federation, Mikhail Mamiashvili, announced that a grand freestyle wrestling match will take place in July-August 2025"The Struggle for Peace "between the national teams of Russia and the USA, which will most likely take place in Uzbekistan [9]. In parallel, work is underway to hold tournaments between Russia and the USA in other sports.

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DOI 10.34660/INF.2025.24.50.038

在语言学专业学生进行外语小组交际教学过程中培养跨文化意识
DEVELOPMENT OF INTERCULTURAL AWARENESS IN THE PROCESS OF TEACHING STUDENTS OF PHILOLOGICAL SPECIALTIES TO GROUP COMMUNICATION IN A FOREIGN LANGUAGE

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摘要：本文探讨了在外语环境中参与小组交流活动的语言学学生的跨文化意识发展情况。本文探讨了跨文化意识在促进不同群体间有效且相互尊重的沟通方面所发挥的关键作用。此外，本研究还探讨了可用于增强学生对文化差异理解并促进成功跨文化合作的教学方法和策略。

关键词：跨文化意识、小组交流、沟通技巧、教学活动、人际互动。

Abstract. *This article explores the development of intercultural awareness among the philology students engaged in group communication activities in a foreign language setting. It examines the crucial role of intercultural awareness in fostering effective and respectful communication within diverse groups. Furthermore, the study investigates pedagogical approaches and strategies that can be implemented to enhance students' understanding of cultural differences and promote successful intercultural collaboration.*

Keywords*: intercultural awareness, group communication, communicative skills, pedagogical activity, personal interaction.*

In the modern society, we can observe significant shifts in the value priorities: the value of physical labor is inferior to intellectual work; material things lose their meaning. Changes in the values and orientations of the social development indicate the transition of humanity to a new era – the era of big data and artificial intelligence. Moreover, we are witnessing the impoverishment of the human soul, despite its intellectual growth. Every day a significant part of humanity does not show care and help to those who need it.

Representatives of the foreign scientific schools are actively engaged in research on the phenomenon of intercultural awareness. We should mention the investigations by S. Hamdamova [4], F. Kurbanova [5], W. Baker [2], N. Aripova

[1]. All of them study the issues of communication, learning foreign languages and intercultural awareness.

The study of these scientific research data shows that the development of intercultural awareness among the future philologists is not sufficiently studied from the point of view of pedagogical science. At the same time, the issue of the development of intercultural awareness in teaching foreign languages has not been fully worked out until now. It opens up a wide scope for further study of the problem.

Today, the ultimate practical goal of teaching foreign languages the students of the linguistic specialties is forming of the communicative competence, that is, the ability to perceive and to generate foreign language speech in accordance with the terms of verbal communication, the situation of communication considering the addressee and the nature of the partners' interaction. The requirement of the adequacy of the learning process to the real communication process is put forward by the majority of the scientists – psychologists and methodologists in the field of foreign language teaching methods. The approximation of the educational model of communication, in particular educational model of group communication, to the real communication should include the development of interpersonal communication skills, interpersonal interaction and interpersonal perception among the students, which are interrelated aspects/sides of the real communication.

The researchers of communication problems emphasize the significant role of intercultural awareness in the process of communication. Using intercultural awareness with its attempt to understand the problem of cultural differences, based on the experience of another person, considering the communicative behavior of representatives of another culture within this culture, increases the likelihood of understanding between the partners. In the early investigation we described the potentialities of the axiological approach in the process of foreign language teaching. The transformation of values in the language education at the present time was revealed. We note the necessity to use the resources of the axiological approach when mastering foreign philology, which will contribute to the preservation of national values, culture and identity [3].

The consideration of the problem of developing intercultural awareness in the process of teaching group English-speaking communication is due to several factors [2]. First, educational group English communication as a model of communicative processes in small groups in real conditions should reflect all the essential parameters of real communication, one of which, as it was mentioned above, is intercultural awareness. Secondly, the importance of developing intercultural awareness in the context of teaching group communication in English is due precisely to the foreign language nature of communication, because the ability to put oneself in the place of another, to understand his feelings is much more complicated if he is from another country and culture. Thirdly, the need to develop intercultural aware-

ness is also explained by the objectives of the overall development of the student's personality. Thus, it can be concluded that teaching group communication in a foreign language is impossible without the development of intercultural awareness among the students, without studying the differences in the signal systems of the emotional states of the representatives of the different countries.

Materials and methods

To study intercultural awareness, we used the Balanced Scale. This questionnaire was developed by us. The questionnaire consists of 25 closed-ended judgments, both direct and inverse. The subject should assess the degree of his agreement/disagreement with each of them. The scale of answers (from "I fully agree" to "I completely disagree") gives an opportunity to express the nuances of attitude to each communication situation. Compared with the initial version of the questionnaire, the scale of answers was somewhat changed, tables for recalculating "raw" points into standard grades were compiled.

Results and its discussion

Three necessary conditions for the development of intercultural awareness can be distinguished: obtaining one's own positive experience; awareness of one's own emotions and feelings; the awareness of what the other person supposedly feels. These conditions are also the stages of intercultural awareness. Based on this, we worked out exercises, which were done by students in foreign language practical classes in three stages.

The purpose of the first stage is to stimulate students' general interest in the perceptual aspect of communication, acquaintance with the meaning of intercultural awareness for achieving communication effectiveness. There are techniques and exercises that allow you to check the students' general interest in the emotional sphere, as well as their emotional vocabulary.

The second stage of work involves students' learning the necessary lexical material by performing receptive, reproductive and productive exercises. These exercises can be linguistic in nature, but we believe that even at the level of individual lexical units, it is necessary and possible to offer conditional-communicative and communicative exercises, which allow the students to express their thoughts and to solve communication problems. Language (non-communicative) exercises should be performed in the competition mode. We give examples of exercises, most of which we tested while working as an associate professor at the Department of Romance and Germanic Philology (Lugansk State Pedagogical University) and the Department of Theory and Practice of Translation and General Linguistics (Donbass State Technical University).

The goal of the third stage is to develop the skills to determine the cultural states of others, to analyze the links between people's culture, emotions and their behavior. Most of the exercises, which students do, are communicative productive exercises. We'll present one of the exercises (Work in small groups. Look at

the pictures/photos, think about the person's feelings and events that might have caused him/her to feel that way).

The exercise is usually performed in the brainstorming mode. At first the small groups work separately, then there is a general group discussion. As a result, students agree or disagree with each other's options. However, the correct answers can be established if the drawing or photo was taken from a play or movie. This exercise can be done using photographs brought by the students of the group. Students' own interesting photos with their friends, relatives increase students' interest and activity. In addition, the owner of the photos can always assess the correctness of the assumptions of his groupmates according to the emotions of those whom they see in the photos.

Active teaching methods increase the level of intercultural awareness, communicative competence is developed among the future philologists, students learn to exercise control over the emotions and to manage them. The significant factor in the development of intercultural awareness is the reliance on the knowledge and students' existing experience, the mutual respect of all the subjects of the educational process to each other's emotional sphere, and the students' motivation to improve it [1].

We believe that the success of the development of intercultural awareness in teaching group communication in a foreign language largely depends on the teacher. Indeed, the student is a central figure in the educational process, but the teacher acts as the initial side of pedagogical communication. For an academic teaching communication, professional communication skills are of particular importance. The teacher's communicative competence includes forecasting students' reactions, knowledge of psychological barriers, the ability to switch, the ability to attract attention, generate interest, maintain contact, create an atmosphere of trust, the ability to solve various communication tasks, coordinate interaction, update communication methods. Anyone who teaches communication should be able to use speech as a means of influencing a student. It implies the ability to choose the appropriate modality (how to say), tonality (neutral, formal, informal), contact technique (verbal/non-verbal, intonation, facial expressions, and gestures), form of communication (functional, role, emotional). A large role is played by personal qualities and attitudes. Pedagogical optimism, reliance on the student's positive qualities contribute to forming his positive self-image, add self-confidence, openness, create a general friendly atmosphere in class. It is important to note that intercultural awareness is considered an important factor in the personal development in the professional activities. It is viewed as an effective means of disclosing and developing interpersonal relations, moral relations, aesthetic norms that are cultivated [5]. Intercultural awareness contributes to the establishment of human relationships, altruistic style of behavior. It is also considered by S. Hamdamova as "a means for a person to limit his aggressiveness" [4].

Conclusion. Three stages of the intercultural awareness development during teaching of group communication in a foreign language have been identified, in accordance with which a set of communicative exercises has been developed and tested. It has been ascertained that intercultural awareness acquires individual-qualitative specificity, which influences the motivation of the individual and the features of communication (empathic behavior, striving for social utility, acceptance, friendly attitude, communicative attitudes). The students' resource of intercultural awareness is considered, it affects professional forming of the individual, because in the real life practice, the specialists of the professional sphere "person-person" are met not only with the friendly attitude, but also with rigidity as a socio-psychological problem of society.

The author does not claim to complete and comprehensive study of the concerned problem. Intercultural awareness as an interpersonal perception has a positive effect on the effectiveness of forming of the communicative foreign language competence and on the person's future professional activity. Further research in this direction is to create a set of exercises that consider the peculiarities of the process of intercultural understanding of people from different cultures.

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DOI 10.34660/INF.2025.76.16.039

学童数字文化作为教育问题
DIGITAL CULTURE OF SCHOOLCHILDREN AS A PEDAGOGICAL PROBLEM

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摘要：数字社会社会空间的技术化对学生提出了信息处理方面的必要要求：收集、评估、概括、系统化和运用。现代人必须具备一定的素养和能力，这体现了“数字文化”的概念。数字文化的形成是教育体系最重要的任务之一。将数字教育资源引入教育过程有助于提升学生的数字文化。数字文化形成的根本因素是现代社会固有的、并应用于教育体系的信息和通信技术。

关键词：技术化、数字文化、信息和通信技术、数字化、数字化手段。

Abstract. *Technologization of the social space of the digital society imposes on students the requirements necessary for working with information: collection, evaluation, generalization, systematization, use. A modern person must have a certain level of literacy and competence, which reflects the concept of “digital culture”. The formation of digital culture is one of the most important tasks of the education system. The introduction of digital educational resources into the educational process contributes to the improvement of the digital culture of schoolchildren. The fundamental factor in the formation of digital culture is the information and communication technologies inherent in modern society and used in the education system.*

Keywords: *technologization, digital culture, information and communication technologies, digitalization, digital means.*

Introduction. Distinctive features of modern society are its network organization and information and communication focus, which determines the rapidly increasing technologization of social space. In a digital society, the concept of “digital culture” reflects a special level of literacy and competence [1].

Recently, we have been observing a process of changing requirements for students' skills, the ability to organize data resources, fruitfully collaborate, collect, evaluate and use information comes to the fore.

Thus, we can talk about the need for a modern person to have an information culture as an element of universal culture, and its formation is one of the most important tasks of the education system [2]. The introduction of digital educational resources into the educational process helps to increase the level of digital culture of students.

Main part. According to German scientists Bischof L., Bremer C., Ebert-Steinhübel A., Kerres M., Knutzen S., Krzywinski N., Müller W., Peetz A., Röwert R., Schlass B., Seufert S., "digitization" is a general social and global trend that covers almost all spheres of life and work and, thus, affects education in all educational institutions [3].

Scientists Zakharov M.Yu., Starovoitova I.E., Shishkova A.V., speaking about critical, digital understanding of the surrounding world, the use of numbers in any type of activity, turn to digital literacy. Historically, digital literacy is based on information literacy, which is traditionally understood as the ability and skill of a person to rationally assess their information needs for the subsequent extraction, evaluation and effective use of information for given purposes" [4]. The authors share the opinion of European scientists that the pedagogical competence of teachers in the use of educational technologies is of crucial importance [5], since "change does not happen if you simply put teachers in contact with technology" [6]. Indeed, it was found that novice teachers are better able to change and develop quickly than more experienced teachers, who also cite the lack of digital skills as an obstacle to using more educational technologies in the classroom, as well as systemic problems such as access to technology and workload [7]. Currently, the relevance of the term "informatization" is decreasing. Today's generation lives and grows up in a digital format from birth. In the digital era, the formation of a special, unique type of culture is of decisive influence. According to the authors V.Sh. Rasumov and Z.M. Akhmadova, traditional culture is currently immersed in the digital environment, which leads to the formation of new characteristics of the familiar culture [8].

In her research, D.N. Karpova points out that digitalization is "a global process of converting information into digital form, which radically changes the nature of intergroup and interpersonal relationships between people." This allows us to conclude that the fundamental factor in the formation of digital culture is precisely information and communication technologies, organically inherent in modern society [9].

Based on the data of modern pedagogy, we can conclude that sufficient experience in the use of digital technologies in education has already been accumulated.

Digital technologies are used effectively only within the framework of a digital environment that not only ensures the exchange of data between various information systems, but also consolidates various digital technologies. Taking into account the above, the digital educational environment should be considered as a set of resources that create conditions for the educational process and the process of managing an educational institution.

Digitalization of the educational process can be considered as a transformation of the educational process and its elements, on the one hand, and digital tools and technologies used in the educational process, on the other. The purpose of such transformation is to fully utilize the potential of the didactic capabilities of digital technologies and is aimed at their maximum possible adaptation to the effective solution of pedagogical problems.

In some cases, this type of students independently forms their educational route, while the integration of study, work and personal development is possible.

Obviously, in the conditions of a changing external environment, a modern person cannot comfortably exist in society until information culture becomes an element of its universal culture. Modern realities require the education system to implement one of the most important tasks as a necessary condition - the formation of a digital culture of schoolchildren.

“Digital culture” is a very multifaceted concept and, in addition to the above, reveals the level of digital competence and literacy.

According to E.E. Elkina, to analyze the levels of digital culture, it is necessary to study the influence of the Internet and convergent technologies on the change in human identity, social reality and culture as the life world of modern humanity [10].

Information and communication technologies, as a determining factor in the formation of digital culture, are reflected in the work of the authors I.I. Gorlova and A.L. Zorina. It is obvious that the construction of a digital educational process is based on a new pedagogical science - digital didactics.

Conclusions. Despite the numerous publications on the problem of forming a digital culture, there are practically no studies on the systemic formation of a digital culture within the framework of school education.

Digitalization of the educational process opens up new opportunities in learning and teaching. Information and communication technologies make it possible to use methods that promote learning that cannot be implemented in practice otherwise. Digital learning has actualized the need to create new pedagogically significant methods of work; joint forms of work, both in contact and remote situations, are coming to the forefront of learning.

Learning objectives, as well as the knowledge and competencies of students, are the starting point for developing a digital learning process. Understanding the

competence, knowledge and skills acquired as a result of the learning process based on the previous competence of students provides a clear basis for building the learning process. The key issue in design is the recognition that different students learn and achieve competence in accordance with goals in different ways [11]. Thus, we can talk about the need to form digital culture in schoolchildren as an element of universal culture. Its formation and improvement of the level of formation comes to the forefront of the school education system, becoming a pedagogical problem. Which is impossible without the adoption of information values, by which we mean specific formations in the structure of individual consciousness, which are ideal examples and guidelines for information activity in society, as well as the introduction of digital educational resources into the educational process.

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DOI 10.34660/INF.2025.64.86.040

在社会重要活动背景下塑造新闻专业学生专业素质的途径
APPROACHES TO MODELING THE FORMATION OF PROFESSIONAL QUALITIES IN JOURNALISM STUDENTS IN THE CONTEXT OF SOCIALLY SIGNIFICANT ACTIVITIES

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注释：作者介绍了喀山联邦大学未来记者培养领域教育活动的监测结果。考虑到未来记者在社会重要活动中的培养，作者定义了教育活动模式的特征和原则，并强调了将社交媒体活动理念作为项目式学习进行组织和实施的问题。系统性方法使我们能够突出该教育模式的运作特点，并强调其创造性。

关键词：媒体活动、未来记者的社会活动、媒体、记者的职业素质、媒体设计。

Annotation. *The author presents the results of monitoring educational activities in the field of training future journalists at Kazan Federal University. Considering the training of future journalists in the context of socially significant activities, the author defines the features and principles of modeling educational activities, emphasizing the problem of organizing and implementing the idea of social media activity as project-based learning. A systematic approach allows us to highlight the features of the functioning of this educational model, emphasizing its creative nature.*

Keywords: *media activity, social activity of a future journalist, media, professional qualities of a journalist, media design.*

A modern professional pays special attention to the adaptation of young novice specialists to the conditions of professional activity. This process is also of concern to researchers of journalistic activity and educational processes of training future journalists. In the context of the specifics of journalistic activity as public and socially oriented, social competencies of future journalists become important, as they contribute to both the development of fundamental ideas about the profession and professional activities, and the solution of practical problems of increasing the efficiency of journalistic work. One of the trends in professional journalism education is working ahead of time, which, according to O.N. Savinova, requires focusing on training future journalists in areas that are highly sought after in mod-

ern practical journalism, such as communications and multimedia, which form an integrated approach [9, p. 180].

In this regard, one of the most effective forms of educational activity is an integrated network training system that includes models and projects of social practices based on increasing the importance of professional activities in social development. Based on the monitoring of the main professional educational programs in the field of journalism implemented at Kazan (Volga Region) Federal University at the bachelor's, master's, and postgraduate levels over a period of 10 years (2015-2025), the main patterns of the educational process were identified, and the extent of the application of socially significant activities in the concept of education for future journalists was determined, along with the identification of specific features and challenges that require special attention. The monitoring allowed for the solution of the research task of determining the pedagogical conditions for implementing the methodology of socially significant activities and its integration into the educational process for future journalists.

The main postulate of the study is that any activity can be presented as a social phenomenon. Based on this postulate, journalistic activity can be characterized as a public activity that exists/functions in a social space and is designed to ensure the "publicity of large and small social spaces, without which the publicity of a unified social space is impossible." [10, p. 73]. As the researchers emphasize, journalistic activity is now largely associated with the representation of publicity in the social space, which leads to the need for journalists to engage in socially significant activities that require the subject to take socially oriented and effective actions to create intellectual products that are in demand as "knowledge, axiological, and behavioral information resources." [10, p. 73]. This is accompanied by ensuring openness and publicity in the development of reality at all levels, as emphasized by M.V. Shkondin, and, importantly, creating "opportunities for all subjects of intellectual activity to participate in enriching the information potential of society and for the public to use this enriched potential." [14, p. 186].

Given that the social environment generates media channels, organizes their activities as a special type of communication, and presents their potential for solving a range of social problems, it can be argued that media/journalistic practice allows for communicative social interaction as a multidirectional process, which is reflected in the educational activities of journalism students. Based on this, an important aspect of the educational activities of future journalists is the formation of professional literacy based on: students' awareness of the role of professional culture in ensuring personal and social professional success and effectiveness; the ability to formulate professional problems and develop solutions; understanding the importance of social integration in digital technological and social environments; and readiness to participate in socially significant practices (daily and professional) with a focus on media.

The characteristics of the educational activity of journalism students are based on the definition of activity as a social phenomenon. Within the framework of a systematic approach, it is described as a system of elements that include a subject, an object, a process, a goal, a result, and various working conditions. In the context of the cultural and activity-based concept of A.N. Leontiev, activity is subject-specific and corresponds to the nature of the reality in relation to which it unfolds. [3]. V.D. Shadrikov's functional system of activity presents activity as a manifestation of a direct connection between the subject and the object, in which the entire system of mental processes, states, and properties is formed, developed, and manifested [12], this continues S.L. Rubinstein's assertion that the psyche is formed and developed in activity, and the process of developing human feelings, psychology, and consciousness is determined by the objective world [8].

It is the subject activity that is the environment in which professional development takes place and professional personality traits are formed. R.S. Nemov, in his works on psychology, defines subject activity as being subordinate to the peculiarities of the objects of material and spiritual culture created by people. As the researcher emphasizes, such activity is designed to help people learn how to use these objects correctly, and it is aimed at developing the individual's abilities [6]. Considering subject activity as a phenomenon, psychologists and educators note that it is characterized by a purposeful and formalized nature, in which the subject's activity manifests itself primarily as cognitive, aimed at mastering the object as a cultural artifact.

The subject activity of a future journalist is carried out within the framework of educational activity as an activity aimed primarily at developing professional and creative competencies. It is based on the principles of individualization of educational outcomes through the construction/design of individual learning trajectories in a student-centered educational environment. The level of mastery of subject-specific activities and the formation of subject-specific/professional-creative competencies is assessed based on a number of criteria, including: the degree/depth of mastery of the subject of creativity (levels: introductory, superficial, specific, and professional deep); the degree/level of mastery of knowledge (levels: reproductive, heuristic, and creative-subjective); and the degree/level of mastery of skills and abilities (levels: fragmented, productive, heuristic productive, and creative productive).

When planning/designing the subject activities of future journalists, it is important to take into account the individual capabilities and needs of students, as well as their initial/entry-level knowledge (level of preparation for professional and creative activities). As I.D. Stolbova emphasizes, it is the reliance on an individual competence-based approach in the implementation of subject-specific educational activities, which takes into account the personal characteristics of stu-

dents, that allows for improving the overall quality of professional and creative education [11].

Presenting the professional development of a future journalist as a process of approaching certain stages of mastery, during which the professional qualities of a future media worker are formed, it is important to emphasize the significance of the specific social environment, the media environment, in which this activity takes place. This, in turn, requires consideration of the behavioral characteristics of a journalist/future journalist and their adaptability, which, in the context of the complexity of the environment and the need to focus on specific conditions, such as technological and professional-technical aspects, further complicates the process of developing the subject's qualitative characteristics.

The professional activity of a future journalist in the context of the educational process is associated with the manifestation of social activities, which is a key factor in social development and allows for the formation of socially significant professional qualities. N.V. Rebrova rightfully defines this activity as one of the "essential indicators of a person's socialization, which involves the assimilation of cultural elements, social norms, and values that shape personal qualities." [7, p. 274].

There are several approaches to the definition of social activity. In the context of the pedagogical approach, social activity is a social result of education that manifests itself in activities aimed at social creativity, taking place in "various forms of movement" and being "a form of interaction as one of the basic laws of life's existence" [4, p. 7]. The sociological approach interprets social activity as a manifestation of self-activity and independence in various spheres of social life (the economy, culture, labor, etc.). As R.M. Shamionov notes, the sociological view of social activity focuses on its general social and group effects [13]. The psychological aspect represents social activity in terms of changing one's social identity, one's place in society, and, consequently, society as a whole.

T.K. Mukhina defines social activity as a person's purposeful and conscious activity, as well as a personality trait that reflects the level of influence a person has on an object, process, or environmental condition (V.Z. Kogan) [5]. Social activity is carried out through socially significant activities, which are processes aimed at satisfying certain socially significant needs.

Journalistic activity is characterized by a high level of social orientation, which is its essence and meaning. As a socially oriented activity, it encompasses various forms of socially significant activities aimed at understanding and transforming society and social relations, as well as addressing important issues related to the structure and improvement of society, including the dissemination and exchange of information about the course and outcomes of social processes. In the era of project-based thinking, media project activities have become a prominent man-

ifestation of the social engagement of future journalists. Project activity ensures the formation of a range of social competencies, such as teamwork, the ability to identify and solve social problems, presentation and representation/media representation of social issues, etc. The use of project activities in the educational process helps to combine diverse types of activities into a single team-based group of activities that are defined as socially significant activities.

Thus, when forming the professional qualities of future journalists, the use of types of socially significant activity (project activity) contributes to increasing the efficiency of the process of mastering journalistic activity. The pedagogical support of this format is based on a number of principles that ensure the educational process:

- *the principle of system-targeted individualization* in students' project activity, which manifests itself in the form of activity aimed at creating special products of journalistic thinking, which is included in the field of social design. According to S.B. Kalinina, it is the idea of project-based education that makes education open and heterogeneous [2], which contributes to the development of constructive thinking capable of unconventional solutions and modeling of real professional activities;

- *the principle of taking into account the pro-social activity of a future journalist,* which is defined in the context of carrying out socially significant activities as a special format of media activity, participatory journalism – the real content of an event is presented through the stories of ordinary people [1]. This format provides professional solutions to problems based on active participation in public life;

- *the principle of actualizing the project activity of future journalists* in solving socially significant problems through the development and implementation of social projects (adaptation ("trying out") – creativity – (creative vision of solving a socially significant problem) – social creativity (solving social problems));

- *the principle of diversity* is that all objects created during projective activity have a high degree of adaptation to the changing world of social relations. They can be applied in different thematic vectors, offer solutions that are acceptable for different vector directions, and so on, which ensures a broad representation of the presented task and its solution;

- *the principle of dynamic development* contributes to solving the problems of developing professional skills through participation in various formats of educational and social activities, including the development of social and media projects aimed at integration into the media system based on professional interaction.

Adaptive media and information design is the basis of the pedagogical model for the formation of professional qualities in future journalists in the context of socially significant activities, which integrates projective activity into the training of future journalists as an independent form of educational activity that organically

fits into various areas of training: professional and creative; practical and theoretical; and creative self-realization. It is based on the assumption that the project activities of a future journalist are goal-oriented, aimed at solving social problems through the means and forms of journalism; they are unique and unpredictable in specific conditions, resource-determined, and adaptive to changing environments.

The following are important factors in the effectiveness of the project activity model for future journalists in solving socially significant problems:

1) actualization of the interaction and interflow of the subject of design from educational to professional and creative, with integration into the media system (cooperation with real media outlets, publication of projects in the media sphere, etc.);

2) modeling a real professional environment in an educational environment with a focus on developing the student's cognitive motivation and professional qualities in socially significant activities (creating and maintaining media channels that cover socially significant activities such as volunteering, education, etc.);

3) flexibility of innovative and traditional technologies and methods of project activity for the future journalist (transmedia media products based on crowdsourcing and other activities);

4) understanding the meaning and social purpose of professional and creative activities based on the subject of creativity;

5) participation/co-creation (emotional support) in subject-specific activities when performing professional and creative actions with a demonstration of how to perform them – a master mentor, a team of like-minded people, and a professional and creative group;

6) the creation and functioning of a developing subject-spatial media environment in which professional and creative action can be carried out to realize the potential of independent professional and creative activity in the social context of the future journalist's development.

Thus, one of the forms of educational activity of future journalists is pro-social activity, within the framework of which the attitudes towards active participation in the life of society are implemented, the system of professional qualities of the future journalist is formed and developed. The most effective form in the context of professional education of journalists is project activity aimed at solving socially significant problems through informing and media promotion.

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DOI 10.34660/INF.2025.15.36.041

中国地名中词素“河”、“江”、“川”的使用特点
FEATURES OF THE USE OF THE LEXEME “RIVER” IN GEOGRAPHICAL NAMES OF CHINA

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摘要：本文描述了中国地名形成过程中“河流”一词的使用案例。选择这一主题是因为，精神和物质文化的根基诞生于大江大河的流域。本文探讨了“川”、“江”、“河”等词的起源历史及其在地名中的使用特点。

关键词：汉语，“河流”一词，同义词使用特点，川、江、河。

Abstract. *This article describes some cases of the use of words with the meaning of “river” in the formation of toponyms of China. The choice of topic is because it was in the basins of large rivers that the foundations of spiritual and material culture arose. The article examines the history of the origin of the words* 川，江，河*, the peculiarity of their use in geographical names.*

Keywords: *Chinese language, the word “river”, the peculiarities of the use of synonyms,* 川，江，河.

The Chinese language belongs to the type of isolated languages, where hieroglyphic writing is its peculiarity. Both in the radical (in Russian Sinology the name “key” is accepted), that is, the semantic component of the hieroglyph, and in the hieroglyph itself, information about the object, phenomenon or subject is embedded. With the development of Chinese civilization and the increase in lands and peoples, the Chinese language was enriched with new concepts, which led to the emergence of a large number of synonyms and words close in meaning. We find clear examples of the use of synonyms in the toponyms of China. The object of the study was words with the term “river” (“川- chuān”, “江- jiāng”, “河- hé”).

This choice is due to the fact that “川” is found in the name of the province of Sichuan, and “江” and “河”, according to the Chinese proverb “南江北河” (In the south jiang, in the north he), divided the sphere of use in toponyms into

north and south. The subject of the study was the history of the origin of Chinese toponyms. The purpose of the study is to identify the features of the use of words with the meaning of "river" in the geographical names of China. Famous Russian scientists R. A. Ageeva [Ageeva, 1990], O. E. Afanasyev [Afanasyev, 2007], A. V. Superanskaya [Superanskaya, 1984] and others conducted research in the field of the origin of ethnonyms, their connection with toponyms. In her work, R. A. Ageeva, based on the conducted research, came to the following conclusion. The bodies of water on the banks of which ancient people settled and then founded the first settlements gave their names to many toponyms around the world. Famous Chinese geographers claim that some cities, provinces and regions received their names from bodies of water (rivers, lakes) [Shmarova, 2013].

1. 川 (chuān) – river

This symbol first appeared in inscriptions on oracle bones during the Shang Dynasty. Its ancient form imitated water flowing between two banks. The original meaning of the word "chuan" is river. Nowadays, it is found in such common expressions as "constant flow" (川流不息), "mountains and rivers" (山川大河), "all rivers flow into the sea" (百川归海), etc. The second meaning of 川 was formed historically. Since the banks of rivers are mainly plains or fertile soils, the word "chuan" acquired the meaning of "plains and grasslands". For example, the idiom "一马平川" means flat land where horses can gallop. It is used as a toponym in the names of a number of counties located on the banks of the Zhou River in Sichuan Province. For example, during the Sui Dynasty (598 AD), the existing Shicheng County (石城县) was renamed Tongchuan County (通川县) due to its convenient transportation location. "通川" literally means "流通的河川" (flowing, circulating on the river). And at present, Tongchuan (now a municipal district of Dazhou City, Sichuan Province) lives up to its name, being one of the largest transportation hubs in the PRC, through which hundreds of thousands of goods pass every day. [达州市通川区人民政府]

Of great interest is the history of Wenchuan County, which has a history of more than 2,000 years. It was founded by Emperor Wu (141-87 BC) of the Han Dynasty. Due to its advantageous strategic location, Wenchuan became significant not only as a transportation hub but also as an outpost, receiving its name from the Minjiang River (岷江), formerly known as Wenshui (古称汶水).

The county received its modern name Wenchuan (汶川) during the Northern Zhou Dynasty (557–581 AD). [汶川县人民政府] The origin of the name of the province of Sichuan, in which the county 汶川 and the district 通川 are located, is controversial. For a long time, it was believed that the toponym "四川" ("Sichuan"), which means "four rivers", indicates the junction of the four main rivers flowing in this province. However, the leading scholar of the 20th century Tang Qixiang (谭其骧), a historical geographer, the author of the fundamental work

"Historical Atlas of China", the last volumes of which were published after his death, proved that in this case the word "川" means "path, road", but not "river". [达州市通川区人民政府].

Thus, Chinese scholars now generally believe that the name of the province 四川 is no longer associated with the "river". However, the connection between 汶川 and 通川 with the "river" is undeniable.

2. 河 (hé) - river and "江" (jiāng) - river

Since the Qin and Han dynasties, rivers were usually called "水", which means "water". As the influence of river basins grew and had a great impact on the formation of the way of life and culture of the peoples living there, gradually the rivers in the south began to be called 江 "Jiang", and in the north - 河 "He".

The symbol "河" appeared on the oracle bones of the Shang dynasty. On the left side of the character is the radical or "key" water ("水"), indicating its connection with water. Initially, "河" was a proper name and was used only in the name of one of the main rivers of China, "黄河" (Huang He - Yellow River). [Rowan K. Flad, 2013]. By the way, in Chinese the adjective "yellow" (黄) does not only mean the color of gold or the color of the emperor, but is also used to describe the turbidity of river water. As is known, the bottom of the Huang He has sediment, which gives a yellowish tint to its waters. Many researchers are inclined to this version of the origin of the toponym "Yellow River". One of the first independent mentions of "河" appeared in the Xizi Book of Changes. Part 1" (《易　系辞上》), a large work compiled by Confucius and other Confucianists of the pre-Qin era, which states: "河出图，洛出书，圣人则之", which can be translated as "the Yellow River gave (people) trigrams, the Luo River revealed (them) writing, and the learned men (studied them) and followed them" [系辞传　原文全文]. Here we are talking about two spatial-numerical schemes (河图 and 洛书 - he tu and lo shu), which are described in detail by A. I. Kobzeev in his book "The Doctrine of Symbols and Numbers in Classical Chinese Philosophy". It is believed that these are "super numbers" capable of not only reproducing the information entered into them, but are also a symbol of Chinese philosophy. [**Kobzeev, 1993, p.25**] It was then that "河" acquired its current independent meaning of "river".

Historically, "河" is commonly used to name hydronyms and toponyms in northern China, such as the provinces of 河南 (Henan) and 河北 (Hebei), the municipal district of 临河 (Linhe), the city of 沙河 (Shahe), and the plain located in the bend of the Yellow River, 河套 (Hetao).

It can be said that the names of the above examples were influenced by the proximity of two major rivers in China, 黄河 (Yuanghe) and 淮河 (Huaihe, flows between the Yellow River and the Yangtze). Nowadays, the term "河" is no longer associated only with the name of the major river in China 黄河 (Huang He), now "河" (river) has acquired a broader meaning and is used to designate water chan-

nels, routes, straits, and is also used to translate foreign geographical names where the lexeme “river” is found, for example, 多瑙河 (Danube River)

If we talk about the Yangtze River, in ancient times it was simply called “Jiang”. Some believe that this word came from the language of some ethnic groups in the south, just as the Tibetans call lakes “Cuo” and rivers “Qu”. When the ancestors of the Chinese from the Central Plains migrated to the south, they called the river Yangtze, but in the south the name “Jiang” took root, so most river names include “江”. The lexeme “江”, meaning “river”, just like “河”, originally served to designate the longest river in China 长江 (Yangtze), that is, it was a proper name. With the beginning of the formation of separate principalities and the migration of the population, the term “江” began to mean “river” in general and was included in the names of hydronyms and toponyms both to the south, east and north of the Yangtze River bed (清江 (Qingjiang, a river in Hubei Province), 珠江 (Zhujiang, Pearl River, Canton River), as well as the river and province (黑龙江 Heilongjiang), located in the northeast of China. Also, “江” can be found in the names of the districts 江南区 (Jiangnan, Nanning City District), 江北区 (Jiangbei) or the provinces 浙江 (Zhejiang), 江苏 (Jiangsu), 江西 (Jiangxi). Unlike the word “河”, which in Nowadays, it has a wide range of applications, for example, 山河 (literally meaning: mountains and rivers, and in a figurative sense - the territory of the native country) or 河豚 (fugu fish), “江” is still associated with the Yangtze or is found in the names of toponyms.

Thus, the authors came to the following conclusions:

1. The use of these words with the meaning of “river” in the toponyms of China is due to historical factors.

2. The term “川”, which originally meant the concept of “river” in fortune telling, is currently associated with the name of the province of Sichuan and everything connected with it, for example, it is part of the concept of “Sichuan cuisine” (川菜).

3. The lexeme “河”, although it retained the meaning of “river”, is widely used in the terminology of fish, waterways, in the translation of foreign hydronyms, etc., while “江” has retained its original meaning.

From the above, it follows that being synonyms or words close in meaning, having in the past one meaning “river”, in modern Chinese 川， 江 and 河 have different areas of application

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DOI 10.34660/INF.2025.15.10.056

德语和乌克兰语材料计量词汇的语义特征比较

SEMANTIC FEATURES OF METROLOGICAL VOCABULARY IN A COMPARATIVE ASPECT ON THE MATERIAL OF GERMAN AND UKRAINIAN LANGUAGES

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注释：本文致力于研究与理论和实践相关的问题。
研究主题是计量词汇体系中的语义学。
研究对象是基于德语和乌克兰语材料，探究计量词汇的语义特征。
旨在从比较的角度，找出它们在术语学上的共性和差异性特征。
为此，本文完成了以下任务：1）确定研究单位的清单；2）基于所比较语言的材料，确定计量词汇的特征类型。
关键词：原位、计量单位、米制、计量学、计量词汇、音韵词、语义特征。

Annotation. *The article is devoted to the study of issues that are relevant both in theoretical and practical terms.*

The subject of the research is semantics in the system of metrological vocabulary.

The object is the semantic features of metrological vocabulary based on the material of the German and Ukrainian languages.

The aim is to establish their common and differential features in terminology in a comparative aspect.

To achieve this, the following tasks were solved: 1) the inventory of the units under study was determined;2) the types of features of metrological vocabulary were established based on the material of the compared languages.

Keywords: *archiseme, unit of measurement, metric system of measures, metrology, metrological vocabulary, metronym, semantic features.*

Modern linguistics reflects the problems of metrology – the science of measures and weights [1, p. 522]. Metrological vocabulary (hereinafter – MV) is represented by the terms –words or phrases of a special (scientific, technical, etc.) language, created (adopted, borrowed, etc.) to precisely express special concepts and designate special objects [2, p. 472].

Taking into account that the development of metrology as a science occurred gradually, taking into account such extralinguistic factors as scientific and technological progress and the development of international trade relations, two main stages can be distinguished, which in chronological order reflect the emergence of MT in the compared languages:

1) pre-scientific – from ancient times to 1795 (before the introduction of the Metric System of Measures), i.e. folk metrology. The vocabulary of this period is falling out of use and is obsolete. In the compared languages, 123 obsolete lexemes are recorded (of which 83 are lexical units (hereinafter referred to as LU) in the Ukrainian language and 40 LU in German), f.e.: German *Zoll* «veraltete Längeneinheit unterschiedlicher Größe (2,3 bis 3 cm)» *inch* 'an obsolete unit of length of various sizes (2.3 – 3 cm)', Ukrainian *гони* «Ukrainian old folk measure of length from 60 to 120 sazhni» *гоны* «Ukrainian old folk measure of length from 60 to 120 sazhni';

2) scientific – from 1795 (after the introduction of the Metric system of measures) to the present day.

- The second period covers different systems of units:
- The metric system of measures with the basic units of *meter, liter, kilogram*;
- the system of K. F. Gauss, which was proposed in 1832 and consisted of the basic units of *millimeter, milligram* and *second*;
- the GHS system approved in 1881 with the base units *centimeter, gram, second*. Derived units are *dyne, erg, erg per second, stokes, poise*, *dyne per square centimeter*;
- The practical system of electrical units, adopted in 1881, which included the units of measurement *ohm, volt, ampere, farad, joule, watt, henry, weber, tesla*;
- the ISS system proposed in 1901 the basic units of which include the *meter, kilogram, second*;
- the ICSD system, which includes the basic units of measurement: *meter, kilogram, second*, *degree Kelvin* and derivatives: j*oule, joule per kilogram, watt*;
- the MKSA system, based on the units of measurement of the *meter, kilogram, second* and *ampere*. Derived units are the *coulomb, volt, volt per meter, farad, ohm, weber, weber per square meter, henry, ampere per meter, var, siemens*;
- MTS system adopted in 1919 the basic units of measurement of which are the *meter, ton* and *second*, and the additional ones are the *kilojoule* and *kilowatt*. The derived units are the *sten* and *piezo*;

– the MCGSS system introduced in 1932 and includes the basic units of measurement - *meter, kilogram-force, second*. Derived units include: *kilogram-force per square meter, kilogram-force meter, kilogram-force meter per second*;
– the MKSS system with the basic units of measurement being the *meter, kilogram, second* and *candle*. The derived units of this system include: *lumen, lux, nit*;
– The International System of Measures (SI), adopted in 1954 and containing basic (*meter, kilogram, second, ampere, degree Kelvin, mole, candle*), additional (*radian, steradian*), derivative (*hertz, newton, joule, ampere per meter, pascal, farad, siemens*, etc.) and non-systemic units of measurement (*minute, hour, light year, parsec, diopter*, etc.).

The terms of this period are represented in more than three different unrelated languages, which gives grounds to consider them internationalisms [4, p. 197].

The methodological basis for the study of semantic features of MV was the work of L. M. Vasiliev, V. A. Zvegintsev, M. V. Nikitin, A. A. Ufimtseva, and J. Trier.

To establish the semantic features of the ML, component analysis was used, which made it possible to identify the archiseme – a generic integrating seme, inherent in all units of a certain class and reflecting their general categorical properties and attributes [3, pp. 151–152; 4, p. 437]. The general (integral) and obligatory feature of the MV is the unit of measurement, and the different (differential) and optional features are belonging to a certain system of units of measurement, an indication of the exact or approximate quantity, temporality (the time period during which a particular LU was used), locality (the place where the LU is distributed), and the surname of the scientist in whose honor the corresponding LU is named, as can be seen from the summary table. 1:

Table 1

Semantic features of MV in German and Ukrainian languages

Semantic features of MV						
Integral features	**Differential signs**					
Unit of measurement	**System of units of measurement**	**Exact quantity**	**Approximate quantity**	**Temporalness**	**Localness**	**Surname scientist**
German						
Elle elbow	-	-	+	-	-	-
Hufe ‘gufa’	-	-	+	+	-	-
Maxwell ‘maxwell’	+	+	-	-	-	+
Pascal pascal	+	+				+

Yard yard	-	+	-	-	+	-
Ukrainian						
voloka	-	-	+	+	+	-
лікоть elbow	-	-	+	-	-	-
Maxwell	+	+	-	-	-	+
pascal	+	+				+
yard	-	+	-	-	+	-

For example, component analysis allows us to establish that for the German metronym *Elle* < frühere Längeneinheit (etwa 55–85 cm) > 'elbow < ancient unit of length (approximately 55–85 cm) >' and the Ukrainian metronym *лікоть* < old unit of length approximately half a meter >' the common (integral) feature is "unit of measurement", and the differential feature is "approximate quantity".

An integral feature of the German metronym *Maxwell* < One of the magnetic fluxes in the electromagnetic CGS system, named after J.C. Maxwell. 1 M = 1 G cm^2 = 10^{-8} Wb > 'maxwell < unit of magnetic flux in the CGS electromagnetic system of units, named after J.C. Maxwell. 1 M = 1 G cm^2 = 10^{-8} Wb >' and the Ukrainian metronym *maxwell* < unit of magnetic flux in the CGS unit system. Named after J.C. Maxwell. 1 Mx = 10^{-8} Wb > 'maxwell < unit of magnetic flux in the CGS system of units. Named after J.C. Maxwell. 1 Mx = 10^{-8} Wb >' is the "unit of measurement", and the differential ones are the "system of units of measurement", "exact quantity" and "the name of the scientist after whom this LE is named".

For German metrononym *Pascal* < gesetzliche Einheit (SI–Einheit) des Drucks und der mechanischen Spannung, genannt nach B. Pascal. 1 Pa = 1 N/m^2 = 10^{-5} bar > 'pascal < standard unit (SI unit) of pressure and mechanical stress, named after B. Pascal. 1 Pa = 1 N/m^2 = 10^{-5} bar >' and Ukrainian metrononym *pascal* < unit SI vice, mechanical stress and modulus of elasticity. Named after B. Pascal [B. Pascal]. 1 Pa is equal to the pressure created by a force of 1 N, which is evenly distributed over a surface of 1 m^2. 1 Pa = 1 N/m^2 = 10^{-5} bar > 'pascal < SI unit of pressure, mechanical stress, and modulus of stress. Named after B. Pascal. 1 Pa is equal to the pressure created by a force of 1 N, which is evenly distributed over a surface of 1 m^2. 1 Pa = 1 N/m^2 = 10^{-5} bar >' the common integral feature is «unit of measurement», and the differential ones are «system of units of measurement», «exact quantity» and «name of the scientist after whom the given unit is named».

The common integral feature of the German metronym *Yard* < Length in Great Britain and the USA (= 3 Feet = 91.44 cm) > 'yard < unit of length in Great Britain and the USA (= 3 feet = 91.44 cm >' and the Ukrainian metronym *ярд* < unit of length in the English system of the world, which equals 91.44 cm > yard < unit of length in Great Britain and the USA (= 3 feet = 91.44 cm > ' is «unit of measurement», and the differential features are «exact quantity» and «locality».

For the German metronym *Hufe* < (in the Middle Ages) the amount of land measured according to the needs of an average peasant family (an old land measure of 7 to 15 hectares) > 'gufa < (in the Middle Ages) the amount of land measured according to the needs of an average peasant family (an old land measure of 7 to 15 hectares >' the integral feature is "land measure", and the differential features are "approximate quantity" and "temporality".

For Ukrainian metrononym *voloka* < in Ukraine, as well as in Poland, Lithuania, Belarus in the other half of the 15th–17th century - a plot of land with an area of approximately 16.8 hectares > 'voloka < in Ukraine, as well as in Poland, Lithuania, Belarus in the second half of the 15th-17th centuries – a plot of land with an area of about 16.8 hectares >' the integral feature is "plot of land", and the differential ones are "locality", "temporality" and "approximate quantity".

Conclusions. The conducted research allows us to draw the following conclusions: 1) the formation and development of metrology as a science with interdisciplinary connections was conditioned by extralinguistic factors and allowed us to distinguish two periods: pre-scientific, characterized by the presence of obsolete vocabulary, and scientific, covering different measurement systems and represented by internationalism terms; 2) in the compared languages, the component analysis of MV allowed us to distinguish the archiseme – a unit of measurement – and differential semes – belonging to a certain system of units of measurement, an indication of an exact or approximate quantity, temporality (the time period during which a particular LU was used), locality (the place of distribution of LU) and the surname of the scientist after whom the corresponding LU is named; 3) the differential seme "the surname of the scientist after whom the corresponding LU is named" is characteristic only of the MV of the second, scientific period.

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DOI 10.34660/INF.2025.63.15.042
UDC 501.55

艾达尔-阿尔纳赛湖系统的形成特征、现代形态测量特征和营养状态
FEATURES OF FORMATION, MODERN MORPHOMETRIC CHARACTERISTICS AND TROPHIC STATUS OF THE AIDAR-ARNASAY LAKE SYSTEM

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摘要。研究了乌兹别克斯坦艾达尔-阿尔纳赛湖泊系统（AALS）的形成阶段、现代形态、水化学特征和营养状态。结果表明，该系统发育的关键因素是集水区排水和1969年查尔达拉水库的紧急溃决。20世纪70年代至今，随着河流和集水区水量的变化，湖泊系统的形态特征发生了变化，包括相对孤立的阿尔纳赛湖、图兹坎湖和艾达尔库尔湖。揭示了水体矿化度和磷负荷的增长趋势。确定了湖泊的营养状态，反映出图兹坎湖位于中营养区和富营养区边界。阿尔纳赛湖和艾达尔库尔湖处于中营养状态。结果表明，自2006年以来，该系统已进入退化阶段（15年间水位下降了3.12米），这增加了环境风险。本文确定了现代形态特征、各成分水污染指标变化特征以及对湖泊系统区域环境条件形成和变化有直接影响的总体污染指标。

关键词：人为湖泊、水平衡、矿化作用、营养状态、磷负荷、环境退化、查达拉水库、集水区和排水区、CGC、沉积物、化学分析、渔业。

Abstract. *The stages of formation, modern morphometric, hydrochemical characteristics and trophic status of the Aydar-Arnasay lake system (AALS) located in Uzbekistan are studied. It is shown that the key factors in the development of this system were the discharges of collector-drainage waters and the emergency breakthrough of the Chardara reservoir, which occurred in 1969. After the 70s of the twentieth century to the present, depending on the variability of the inflow of river and collector waters, there have been changes in the morphometric characteristics of the lake system, including relatively isolated lakes Arnasay, Tuzkan, Aydarkul. Tendencies in the growth of water mineralization and phosphorus load are*

revealed. The trophic status of the lakes is determined, reflecting the fact that Lake Tuzkan is located on the border between the mesotrophic and eutrophic zones. Mesotrophic status is revealed for lakes Arnasay and Aydarkul. It is shown that since 2006 the system has entered a regressive phase (a decrease in the level by 3.12 m in 15 years), which increases environmental risks. Modern morphometric characteristics, features of changes in water pollution indicators by individual ingredients, as well as total pollution indicators that have a direct impact on the formation and variability of environmental conditions in the lake system area are determined.

Keywords: *anthropogenic lakes, water balance, mineralization, trophic status, phosphorus load, environmental degradation, Chardara Reservoir, collector and drainage waters, CGC, sediments, chemical analysis, fisheries.*

Introduction. The Aydar-Arnasay lake system (AALS) belongs to the category of reservoirs of anthropogenic origin. Peculiarities of the influence of external factors associated with the basin (catchment area), as well as intra-reservoir processes formed under the conditions of active impact of human economic activity, play a key role in the hydrological and ecological processes occurring in the studied water body. It should be noted that the process of formation of this lake system is due to a number of factors, mainly related to the irrational use of water resources of the Syr Darya River basin within its middle reaches. In general, the lake system initially included 3 relatively isolated reservoirs, which have the names: Tuzkan, Arnasai, Aydarkul. From the point of view of assessing the prospective changes in hydrological and ecological conditions in the existing lake system, as well as substantiating possible options for the rational use and protection of water resources, it is shown that the systematization of retrospective and modern information on water use in the basin of the said lake system, as well as the substantiation of the types and scales of prospective development of economic facilities, taking into account the need to ensure favorable hydrological and ecological conditions in it, are of great importance.

Statement of the problem. Based on the study, generalization and analysis of published and archive materials, it was revealed that from the time of its emergence in the 1970s to the present day, the formation of morphometric characteristics, hydrological regime, hydrochemical indicators and environmental conditions characteristic of lake systems in general has occurred. It should be noted that this occurred with noticeable variability in time of the inflow of river and collector waters, which caused the formation of corresponding variability in time of the components of the water balance in the lake system as a whole. The long-term dynamics of changes in the volume and levels of water in the AASO is reflected in Fig. 1.

Figure 1. *Dynamics of changes in the volume and water levels in the AASO*

From Fig. 1, it can be seen that from 1993 to 2023, the water volume in the AASO fluctuated within 16.7–34.1 km³, and the water level varied from 237.5 to 244.7 meters. The area of the water surface was 2,045–3,224 thousand km². The highest figures were recorded in 2006: the water volume reached 42.1 km³, the water surface area increased to 3,599 km², and the water level was 247 meters abs. From the point of view of solving issues related to assessing the possibility of using the lake system for solving economic problems, recreation, tourism, etc. in the future, it should be noted that such characteristics as complex indicators of lake water pollution, features of formation and variability of environmental conditions, methods of managing water management complexes and systems within the basin taking into account the need to maintain favorable hydrological and ecological characteristics, justification of optimal parameters for its use in the future in the context of climate change, etc. remain poorly studied. The main methods adopted by the authors during the study include comparative analysis methods, statistical processing of long-term information, as well as graphic and cartographic display of materials with the identification of the dynamics of ongoing changes. It should be noted that, starting in 2006, the Aydar-Arnasay lake system entered a regressive phase of development, which contributes to the deterioration of the environmental situation throughout the water system and in adjacent areas. Over 15 years, the water level in the lake system has dropped by 3.12 m. Against the background of long-term changes in the water level in the reservoir, intra-annual fluctuations occur associated with the redistribution of the inflow and outflow components of its water balance. In general, over the period 1970-2023, there was a change in

the morphometric characteristics of the lake system towards an increase, which is reflected in Table 1

Table 1.

Morphometric characteristics of the Aydar-Arnasay lake system

№	Morphometric indicators	1970 *	2023 **	Differences in indicators
1	Water level, H, m	237,1	243,0	5,9
2	Water surface area, F, km^2	2300	3502	1202
3	Water volume, W, km^3	19,94	34,19	14,25
4	Length, L, km	155	190	45
5	Maximum width, B_{max}, km	33	40	7
6	Average width, B_{avg}, km	15	19	4
7	Maximum depth, h_{max}, m	22	26	4
8	Average depth, h_{avg}, m	8,6	9,2	0,6

*Note: *N.E. Gorelkin and A.M. Based on Nikitin's data (1976) **Based on space images (Google Earth Pro.) and data from the Aidar-Arnasay Lakes Administration (2023).*

At the same time, the increase in the amount of saline collector waters entering and the decrease in water flow from the Chardarino Reservoir contributed to a significant change in hydrochemical parameters, which is reflected in an increase in the mineralization and salinity of the water, and the total pollution indicators of the lake waters. This has certain negative environmental consequences.

It is significant that collector and drainage waters form the main part of the incoming component of the AASO water balance. According to various estimates, their volume is 1.8-2.5 km^3 per year. In the period from 1993 to 2002. The average level of mineralization of collector waters was estimated at 4.3 g/l, with annual fluctuations from 2.6 to 6.5 g/l. The total amount of dissolved compounds entering the lake reaches 10.2 million tons per year. In addition, it is necessary to take into account the entry of a certain amount of salts in the composition of atmospheric precipitation, from the surface of adjacent salt marshes, groundwater, the salinity of which reaches up to 16 g/l. On average, the mineralization of groundwater in the territories adjacent to the AASO is estimated at 5.2 g/l, and their annual contribution to the salt balance of the lake is 200,000 tons. Thus, as a result of the influence of these factors, fairly high concentrations of pollutants are formed in the lake water for a number of ingredients. They include chlorides, sulfates, magnesium, sodium, calcium, ammonium nitrogen, copper, lead and fluorine. At the same time, low values for BOD5 are found. Water transparency ranges from 1.1 to 1.8 m.

Based on a comparison of water quality in various parts of the lake system, it can be found that the water in the Arnasai reservoir has better indicators, which is mainly due to the inflow of fresh water from the Chardara reservoir, currently located within Kazakhstan.

It should be noted that the chemical composition of collector and lake waters has been studied by a number of authors (Videyeva, 1974; Gorelkin, 1985; Gudalov, 2019; Yearbook ..., 2008; Nurbayev et al., 2004; Tailakov, 2022; Chembarisov et al., 2016). In order to clarify the results obtained by these authors, as well as to assess the current hydrological and ecological situation, we carried out field surveys and observations in 2024.

As is known, Uzbekistan belongs to the category of countries that emerged after the collapse of the USSR. Accordingly, in the sphere of water management and water protection measures, much in common has been preserved, which is also typical for the territory of the Russian Federation. At the same time, the standardization of the scale of the impact of economic activity on the quality of natural waters is carried out on the basis of taking into account the requirements of the fundamentals of water legislation. All chemical substances that have a harmful effect on human health, sanitary condition and fish productivity of water bodies are divided into groups according to the so-called limiting sign of harm (LSH). In the hygienic standardization of water quality, 3 groups of pollutants are distinguished: 1) ***substances of sanitary and toxicological action that have a direct impact on public health*** (toxic substances, pathogens, pesticides, etc.); 2) ***substances of general sanitary action that have an adverse effect on the general sanitary regime of water bodies*** (easily oxidizable organic substances, active chlorine, etc.); 3) ***substances with organoleptic action that give water taste, smell and color*** (iron, manganese, phenol, oil, etc.). In fishery regulation, two more groups of substances are additionally distinguished: toxicological and fishery action. These groups include substances that affect individual fish species both directly and the fishery productivity of the water body as a whole. The limiting sign of harm (LSH) of a substance in water is a sign characterized by the lowest harmless concentration. The total (additive) effect takes into account the superposition of the harmfulness of pollutants belonging to the 1st group of LSH. When several substances with the same LSH enter water bodies, the sum of their multiples of excess over the MAC should not be higher than 1, which is characterized by the expression

$$\sum_{i=1}^{n} \frac{s_i}{\text{ПДК}_i} \leq 1.$$

As is known, in water bodies located in the zones of influence of economic facilities, there is an excess of pollutant concentrations over their MAC for many

ingredients. This requires the need to determine the complex indicators (CI) of water pollution with the allocation of the corresponding pollution classes. Taking into account the above, in the course of this study we have carried out zoning of the total water area of the AASO by complex indicators of water pollution, which is of great importance in determining the possibilities for the future development of types and scales of water use (Fig. 2).

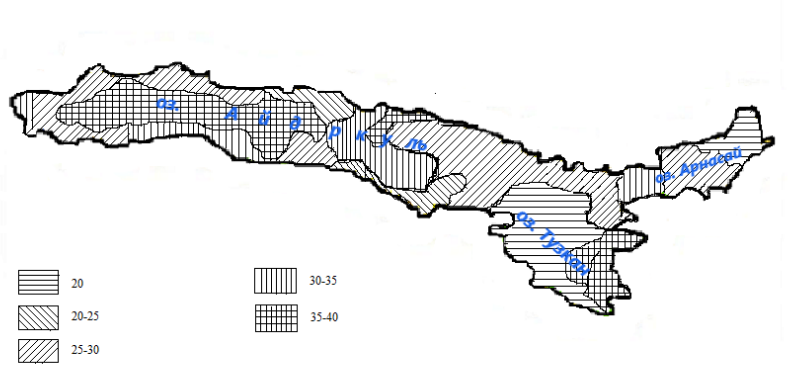

Figure 2. *Zoning of the AASO water area by complex indicators of water pollution.*

As can be seen from Figure 2, the complex indicators of water pollution in the water area of the lake system are very high, reaching 20-25 to 35-40 times the permissible requirements. This indicates that the quality of lake waters, significantly differentiating across the water area of the water body, belongs to the category of dirty and extremely dirty.

From the point of view of assessing the impact of complex indicators of water pollution on hydrobiological and ecological conditions, it should be noted that no serious studies have been conducted on this lake system so far. Accordingly, this requires the need to study the dynamics of changes in the species composition, population characteristics and other indicators of aquatic organisms, which will allow us to justify the optimal parameters for using the studied lake system to solve economic and ecological problems in the near and distant future. The methodological provisions of this study are based on the applicability of the main provisions of previously completed works, which are reflected in the publications of A.M. Gareev, as well as R. Vollenweider, P. Dillon and F. Riegler, etc. It should be emphasized that the trophic level acts as one of the main indicators reflecting

the ecological conditions in lakes. This is due to the fact that due to the low rates of the external water exchange coefficient, respectively, the processes of mixing, dilution and self-purification of water in lake systems, the fundamentals of the water legislation of the Republic of Uzbekistan prohibit concentrated discharge of wastewater into them by industrial enterprises and public utilities. Under these conditions, the increasing scale of influence of factors formed in the catchment area, including agricultural lands (arable land, pastures, livestock farms, etc.), the number of residents in rural areas and recreational loads should be considered as the main factors influencing the ecological conditions and the attractiveness of water bodies for their use for recreation and tourism. In order to substantiate the methodological provisions for the use of water bodies for the development of recreation and tourism, this work took into account the features of the influence of both intra-reservoir (autochthonous) and external (allochthonous) factors that help quantitatively link the state of the lake's trophicity with the influx of biogenic substances (nitrogen, phosphorus) from the catchment area per unit area of the reservoir. In this case, the phosphorus budget model was taken into account, reflecting the level of eutrophication of the reservoir depending on its influx, losses, sedimentation and flow with runoff depending on the flow rate. The formula (Dillon, Rigler, 1975) was used

$$P = P_o (1- R)/(h_{ср}*K_{усл}),$$

where P is the concentration of total phosphorus in the water of the reservoir, g/m^3; Po is the phosphorus load, g/(m^2*year); R is the phosphorus retention coefficient; Kusl. is the coefficient of conditional water exchange; hcp is the average depth, m.

It should be noted that in order to determine the permissible input of nutrients into a reservoir, it is necessary to know the trophic level and the actual specific nutrient load on the water body. In the absence of such, its determination is mandatory. The calculated indicators for each of the lakes are reflected in Table 2.

Table 2.

Lake parameters and phosphorus indicators

Lake	Square km^2	Avg. depth m	Total Phosphorus mg/l (MPC) 0,15)	Average inflow (over the last 10 years)
Tuzkan	705 km^2	9.2 m	0,014	347,51 million m^3
Aydarkul	2400 km^2	12 m	0,017	2083,08 million m^3
Arnasay	408 km^2	4.0 m	0,012	2693,07 million m^3

In order to determine the trophic status of the lakes, a modified Vollenweider diagram (Vollenweider, 1975) was used. The obtained indicators are shown in Fig. 3.

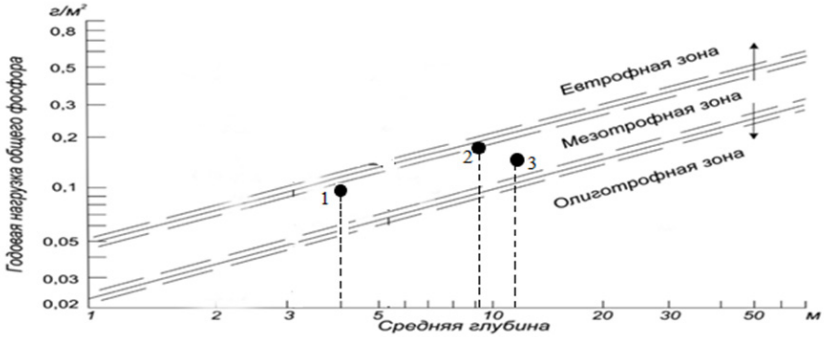

Figure 3. *Trophic status of the AASO lakes*
Note: 1- Arnasai, 2- Tuzkan, 3- Aydarkul

As can be seen from Fig. 3, all lakes are classified as mesotrophic, with the exception of Tuzkan, which is characterized by transitional conditions - from mesotrophic to eutrophic. This occurs under conditions of its saturation with collector-drainage waters, which contain high rates of biogen removal (including phosphorus) from the catchment area, mainly occupied by irrigated areas. Despite the high concentrations of pollutants, this lake system is currently quite actively used in fisheries, recreation, tourism, etc. Taking into account the fact that it is a unique water body for Uzbekistan, stretching over significant areas, has great landscape-forming, ecological significance, in the future it is necessary to conduct a comprehensive study of the prospects for the development of sub-use systems, taking into account economic and ecological criteria in order to prevent the emergence of crisis situations.

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DOI 10.34660/INF.2025.34.71.043
UDC 308: 338. 91

合理利用和保护伊塞克湖地区的自然和休闲潜力
RATIONAL USE AND PROTECTION OF THE NATURAL AND RECREATIONAL POTENTIAL OF THE ISSYK-KUL REGION

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注释。本文探讨了休闲资源的合理利用与人类健康改善过程的关系，以及其具体位置。此外，本文还探讨了保护和维护伊塞克湖地区生态系统的方法，具体包括：空气、地下水和地表水、海滩、森林、山脉和野生动物。

关键词：盆地、山脊、休闲、动物群、植物群。

Annotation. *This article explores the rational use of recreational resources in relation to human health improvement processes, as well as their exact locations. It also considers methods for protecting and preserving the ecosystem of the Issyk-Kul region, specifically: air, groundwater and surface water, beaches, forests, mountains, and wildlife.*

Keywords: *basin, ridge, recreation, fauna, flora.*

Lake Issyk-Kul is called the “pearl of Central Asia”, also a “warm lake”, “Tuz-Kol” - “salty lake”, sometimes called the “Kyrgyz Sea”. The great explorer of Central Asia Semenov-Tyan-Shansky compared it to “a precious aquamarine in a silver frame of snow-capped ridges”. It is located in an intermountain tectonic depression 1608 m above sea level. The total area of the lake is 6236 km2, the maximum depth is 668 m. The length is 177 km, the maximum width is 60 km. The volume of water that does not freeze in winter is 1738 km3, the mineralization of the lake water is sulfate-magnesium. In winter, the water temperature fluctuates between +4.2 C, + 5.0 C, in summer up to +22 C.

The natural wealth and uniqueness of Lake Issyk-Kul pose important problems for researchers in the rational use of natural resources.

Therefore, in 1998, the government of the Kyrgyz Republic adopted a resolution on the creation of the Issyk-Kul biosphere zone within the administrative boundaries of the Issyk-Kul region.

The territory is divided into two parts: the Issyk-Kul basin and the Syrty, spread to the south of the Teskey Ala-Too ridge. In the east, they form a closed intermountain space. The highest peaks of the Central Tien Shan are located there. These are Pobeda Peak (7439 m) and Khan-Tengri Peak (7010 m) and one of the largest glaciers of the Enilchek Valley (length 34.9 km, width 1.5-2 km, area 202.9 km2, thickness 200-300 m).

The flora and fauna of Issyk-Kul also belong to recreational resources.

The nature of the Issyk-Kul region was formed millions of years ago, this is proven by the skeletons, bones of mammoths, bison, rhinoceroses and remains of mollusks in the earth's sediments. At present, modern fauna and flora are represented by a completely different complex of flora and fauna.

The flora of Issyk-Kul includes semi-desert vegetation along the coast, subalpine and alpine meadows at an altitude of over 2500 meters.

1. The coastal vegetation includes sea buckthorn, tussock grasses (feather grass, fescue, slender-footed grass), as well as astragalus, dry-loving plants such as wormwood subshrubs, teresken, tansy, and prickly caragana;

2. Mountain vegetation includes spruce and juniper forests, ornamental shrubs, alpine meadows on the slopes of the Teskey and Kungoy Ala-Too mountains, and shrub forests around lakes and rivers. The woody vegetation consists mainly of Schrenk's spruce. Spruce forests are found in the valleys of the rivers Zhuuku, Chong Kyzyl Suu, Jeti-Oguz, Yrdyk, Karakol, Ak-Suu, Boz-Uchuk, Turgon, Zhyrgalan, the mountains are covered with a large number of colorful flowers, such as geranium and primrose, forget-me-nots and cuffs, wild onions and cobresia form a multi-colored carpet. Even higher there are typical alpine meadows with edelweiss and saxifrage, poppies and tulips, violets and alpine daisies.

The animal recreational resource of Issyk-Kul and the surrounding ridges is diverse. The lake is home to many waterfowl, including mallards, gray ducks, several species of teal, red-crested pochards, various species of gulls and waders. Swans (whoopers, mute swans) also winter on the lake. More than 100 species of birds have been registered in Issyk-Kul, including 34 near-water and waterfowl species.

The lake is also rich in fish, with more than 20 different species living in it, including endemic species (marinka, Issyk-Kul chebak, osman, carp), as well as acclimatized species (trout, pike perch, bream, carp).

Mammals of the Issyk-Kul region include roe deer, brown and Himalayan bears, wolves, lynxes, ibex, argali and snow leopards, as well as the Pallas's cat, long-eared hedgehog, shrew, marmots, gophers, porcupines, ferrets, badgers and steppe cats, etc., many of which are listed in the Red Book.

The natural and recreational potential of the Issyk-Kul region - salt water saturated with radon, numerous healing muds, mountain landscape and clean mountain air - is of great importance for the creation of a resort and recreational complex with a high level of service not only in Central Asia, but also on a global scale.

An important factor is that being more than 1600 m above sea level, the lake does not freeze and affects the formation of the resort and recreational complex and has features of the "sea" and "mountain" climate, which has a beneficial effect on the human body. Moderate temperatures with air humidity of 70% do not create a feeling of stuffiness, combined with a significant altitude above sea level, which creates optimal conditions for long-term and short-term rest and treatment, organization of mass tourism and mountaineering. The most attractive for organizing mountaineering is the high-mountain relief (2700-7439 m) Pobeda Peak (7439) and Khan-Tengri Peak (7010 m).

For recreational purposes, the mountain and forest areas of Karkyra, Altyn-Arashan, Chon-Kyzyl-Suu, Karakol, Barskon and others are especially attractive.

Natural conditions - the terrain, climate conditions, underground and surface waters, flora and fauna - are natural components of recreation development.

The relief features determine different types of recreation. The Issyk-Kul basin is convenient for the construction of recreational facilities (rest houses, boarding houses and camps for children), and is also suitable for auto, motorcycle and bicycle tourism. In the high-mountain relief there are prerequisites for the development of equestrian tourism and skiing.

Together with mountain forests, water bodies soften the negative impact of the hot sun to a more favorable microclimate for the body. Therefore, recreation centers and sanatoriums are created near water. Since water resources are the most important component of recreation. Rivers, waterfalls, etc. decorate the landscape, create a favorable microclimate, allowing vacationers to engage in various types of recreational activities (fishing, educational excursions, water tourism and sports).

Of special importance in terms of health are the waterfalls that spray water, which improves the ionization regime of the atmosphere.

Among the water resources in the region, surface waters occupy a special place, provided by more than 5,400 rivers, streams and creeks, about 600 lakes and more than 3,290 glaciers [1].

Therapeutic muds of the Issyk-Kul region are mainly silt - a product of sedimentation in the coastal part of the alluvial material and transformation, its silt deposits during chemical-physical, biological and other processes. Under favorable conditions (bays, backwaters). Therapeutic muds are low-mineralized, sulphide, sandy, carbonate and are similar to the Crimean muds of Saki, Moinaki and others. Many of these components impregnate the skin and penetrate through it and its fats, glands (sweat, sebaceous), up to the cerebrospinal fluid, which improve the functional state of important body systems (cardiovascular, respiratory system, blood, nerves, etc.). The main reserves are Zhyrgalanskoye, Pokrovskoe, Cholpon-Atinskoye deposits. Reserve (canned) Kurmentinskoye, Tamchinskoye, Karaoyskoye.

The region's balneological resources include mineral waters and therapeutic mud.

All mineral waters of the Issyk-Kul region, depending on their chemical composition, properties and medicinal value, are divided into the following groups [2].

1. water without specific components and properties;
2. siliceous thermal waters;
3. radon waters.

On the northern shore of Lake Issyk-Kul is the city of Cholpon-Ata, which is famous for its resorts and sanatoriums. "Blue Issyk-Kul" and "Cholpon-Ata" (State Residence No. 2), known for their hot springs, therapeutic mud and sandy beaches. There are also other boarding houses: "Kyrgyz Seaside", "Raduga", "Golden Sands", "Almaty Resort", "Rokhat" and others.

The resort "Zhyrgalan" is located at the mouth of the river Zhyrgalan, 10 km northeast of the city of Karakol. Here are excellent conditions for climate treatment, a climatic balneological mud sanatorium, the main therapeutic factor of which is a mild climate, mineral waters and therapeutic mud. It is located at an altitude of 1624 m above sea level and the climate is considered mountainous. It is worth noting another feature of the resort, low atmospheric pressure, dryness and abundant sunshine, the annual amount of which reaches 2646, which is 700 hours more than in the city of Sochi, and 1000 hours more than in the city of Nalchik, which are located at the same altitude.

The Ak-Suu spring is located in the village of Teploklyuchenka in the southeastern part of the city of Karakol. The deposit is the base of a children's sanatorium. It is recommended for the treatment of the musculoskeletal system.

Radon waters of the Zheti-Oguz resort are used in the treatment of the musculoskeletal system, as well as for drinking treatment of chronic diseases of the digestive organs.

Tamga is a mud mid-mountain resort with a mild climate, the main natural healing factor is sulphide silts on the coast of the Chiy Bay, 8 km west of the village of Tamga. The climate is mild, with unique meteorological features, which in terms of treatment are superior to the climate of the resorts of Kislovodsk, the Swiss resort "Davos". Currently, the sanatorium offers more than 20 types of treatment. Treatment of the respiratory system, rehabilitation after COVID-19, musculoskeletal and nervous systems, musculoskeletal system, etc. are carried out.

Barbulak, the deposit was explored in 1979 by a deep well (1100 m) on the southern shore of Lake Issyk-Kul, 40 km east of the city of Balykchy. Water temperature is 43C.

Mineral water Barbulak is recommended for the treatment of chronic gastritis, liver and biliary tract diseases, pancreatitis. And also, for the treatment of skin, nervous, gynecological diseases and pathologies of the musculoskeletal system.

The development and placement of tourism and recreational facilities is subordinated to the achievement of three most important goals:

1. Creation of high-quality conditions for treatment and recreation of people with the peculiarity of maximum spatial-temporal availability of goods and services
2. Creation of preconditions for their rational development and recreational development
3. Protection of the natural environment and rational use of natural resources.

The Issyk-Kul region and its recreational resources have enormous potential for promoting tourism development at the international level with rational placement and use of recreation facilities. The issue of environmental protection occupies an important place in tourism. This is especially true for the mountainous zones of the Issyk-Kul region with their diverse natural complexes, altitude differences in soils, vegetation and landscapes [3].

At the same time, it should be noted that all issues related to the development and use of natural and recreational resources require the development of other acceptable standards for anthropogenic activity. The development of this industry should be closely linked to environmental protection, and the issue of preserving the purity of Lake Issyk-Kul itself should be especially important.

In order to rationally use and protect, first of all, lake water, mineral mud and valuable sandy beaches, it is necessary to regularly monitor changes in their condition. All this should be done not only at the regional but also at the republican level.

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DOI 10.34660/INF.2025.85.60.044

让退伍军人和特别军事行动参与者参与爱国主义教育过程
INVOLVING VETERANS AND PARTICIPANTS IN THE SPECIAL MILITARY OPERATION IN THE EDUCATIONAL PROCESS FOR THE PURPOSE OF PATRIOTIC EDUCATION

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注释：本文探讨了在历史教育背景下对青少年进行爱国主义教育的现实意义，因为历史是培养公民意识和爱国主义的基础。本文还探讨了特种作战老兵在教育过程中所发挥的作用，他们独特的经验和知识可以极大地丰富“国土安全与保卫基础”课程的教学。退伍军人参与青少年爱国主义教育有助于培养批判性思维、尊重历史和捍卫祖国利益的意识。本文强调，这一过程需要科学和方法论的支持，并为退伍军人与学生的互动营造舒适的氛围。

关键词：爱国主义、历史教育、青少年、公民意识、退伍军人、特种作战、批判性思维、文化遗产、教育、安全。

Annotation. *The article discusses the relevance of patriotic education of youth in the context of historical education, since history is the basis for the formation of a civic position and patriotism. The article also discusses the role of veterans of the Special Military Operation in the educational process, their unique experience and knowledge, which can significantly enrich the teaching of the subject “Fundamentals of Security and Defense of the Homeland”. Involvement of veterans in patriotic education of youth contributes to the formation of critical thinking, respect for history and readiness to defend the interests of the Motherland. The article emphasizes the need for scientific and methodological support for this process and the importance of creating a comfortable atmosphere for the interaction of veterans with students.*

Keywords: *Patriotism, historical education, youth, civic position, veterans, Special military operation, critical thinking, cultural heritage, education, security.*

The idea of patriotism has always occupied a special place in the spiritual sphere of society (in ideology, politics, culture, economics, etc.). Today, however, the problem of patriotic education of youth is more relevant than ever. The development of political events in the 1990s and 2000s in Ukraine led to the fact that not all mature people with considerable life experience can clearly define their civic position. Therefore, the future of our society depends on how young people behave, whether they will think only about themselves and their own benefits, or take on a historically shaping role.

History is more than just a chronological sequence of past events. It is the foundation on which the present is built and the compass that points the way to the future. The study of history plays a key role in developing patriotism, a sense of pride in one's country, respect for its cultural heritage, and a willingness to defend its interests.

Patriotism, in its essence, is love for the Motherland, its people, its history and culture. It is not a blind faith in the infallibility of one's country, but presupposes a conscious understanding of its strengths and weaknesses, its achievements and mistakes. It is history that gives us the opportunity to look at our country objectively, to evaluate its contribution to world civilization and to learn from past mistakes.

History is a social science, which forms a number of its features. Thus, the reflection of past social reality and the totality of socio-political changes represent objective history, which is characterized by the unambiguity and immutability of content, independent of human consciousness. Subjective history is characterized by a different approach. Being a reflection of past social reality in the consciousness of contemporaries and historians, it is distinguished by its polysemy [2, p. 46].

History as a social science, unlike natural sciences, has no established laws and requires not only differentiation of patterns, but also their confirmation. The variability of history provides the opportunity for different directions of interpretation and analysis of historical events. Which once again confirms the need for the design of competent historical education and teaching of history [3, p. 128].

Studying historical events, heroic deeds and tragic pages of the past forms a sense of involvement in the fate of their country in the younger generation. The realization that our ancestors fought for the independence and prosperity of the Motherland for many centuries, defended it from enemies, created cultural values, strengthens the connection with the past and gives rise to the desire to contribute to its further development. Knowledge of history allows us to understand that we are part of a continuous historical process and our fate is inextricably linked with the fate of the country.

Moreover, studying history helps develop critical thinking, which is necessary for conscious patriotism. By analyzing historical events, we learn to see cause-

and-effect relationships, evaluate different points of view, distinguish truth from lies, and draw our own conclusions. This allows us to avoid blind submission to ideological dogmas and to form our own understanding of the past and present of our country, based on knowledge and experience.

One of the most important is the educational function of history, which plays an important role in the formation of a civic position, patriotism and respect for cultural heritage. Studying the heroic pages of the history of one's country, the exploits of ancestors and the achievements of national culture contributes to the formation of a sense of pride in one's homeland. At the same time, critical understanding of the tragic moments of history allows one to avoid repeating the mistakes of the past and to build a more just and humane society.

In this regard, the new experience of involving veterans of the Special Military Operation in the education and training of students of general education institutions, in particular in the process of teaching the recently introduced subject "Fundamentals of Security and Defense of the Homeland" is of particular relevance and importance. In modern realities, our society increasingly turns to the topic of security and defense, which led to the introduction of a new subject for Russian schools.

Preparing young people for such challenges through quality education is becoming a priority. In this regard, the problem of personnel shortage in the implementation of this academic discipline is becoming more pressing. Veterans and participants of the SVO have unique practical experience and deep knowledge that are difficult to obtain within the framework of traditional pedagogical education. Their participation in the educational process contributes to a deeper assimilation of the material and an increase in its applied significance. In turn, providing veterans with the opportunity to engage in pedagogical activity contributes to their social adaptation and integration into a peaceful society, providing an opportunity to use their skills and knowledge in a new peaceful profession.

The broad implementation of this principle, in combination with the use of examples from the historical past, allows us to achieve a range of tasks:

- reconstruct and describe the past in accordance with the principle of objectivism;
- learn to establish cause-and-effect relationships, as well as differentiate history along the fact-event-process trajectory;
- to establish the patterns of development of the state and society;
- to formulate an idea of the value of the Fatherland and the qualities that a patriot possesses.

Involving veterans and participants of the SVO in educational activities has enormous potential for patriotic education of youth. Their personal stories, examples of courage and selflessness serve as a powerful incentive for the younger

generation to develop a sense of pride in their country, respect for its history and traditions. Direct communication with those who directly defended the interests of the Motherland allows students to feel the significance of such concepts as duty, honor and loyalty to the oath.

In addition, the experience of veterans can be extremely useful in career guidance for schoolchildren and students. They can share knowledge about various military and civilian professions, talk about the requirements for them, and about career growth opportunities. This will help young people more consciously choose their life path and prepare for future professional activity.

It is important to note that the process of integrating veterans into the educational system must be carefully thought out and organized. It is necessary to provide them with appropriate methodological support, help them adapt to new working conditions, and create a comfortable atmosphere for interaction with students. It is also important to take into account the individual characteristics of each veteran, their psychological state, and readiness for pedagogical activity.

It is also worth considering the historical experience of involving combat veterans in educational activities, for example, the experience of the Soviet Union in training veterans of the Great Patriotic War. Thus, an important aspect of retraining veterans was their ideological training. In the post-war period, when the country was building a socialist society, teachers had to not only teach children, but also educate them in the spirit of Soviet patriotism and devotion to communist ideals. Therefore, the retraining program included lectures on the history of the CPSU, the basics of Marxist-Leninist philosophy and political economy [4, p. 23]. All students and listeners of retraining courses at pedagogical institutes of Donbass listened to lectures on the history of the CPSU, were involved in thematic events (excursions, conferences, etc.). The ideological education program corresponded to the national idea, which is confirmed by the regular advanced training courses for teachers of the CPSU history departments of higher pedagogical educational institutions of the region at Moscow State University [1]. However, it is worth noting that the ideological component was not always decisive, and the emphasis was on developing professional teaching skills and abilities in veterans.

Involvement of veterans in socially significant activities, including in the field of patriotic education of youth, labor mentoring requires scientific, methodological and methodological support: development of methods for diagnosing the readiness of veterans and participants of the SVO for pedagogical activity, development of professional retraining programs for them, granting the right to conduct a new type of professional activity - pedagogical, methodological training of veterans and participants of the SVO for teaching the subject “Fundamentals of Security and Defense of the Homeland”.

Of course, involving veterans and participants of the SVO in the educational process is an important step towards strengthening patriotic education, improving

the quality of education and successful social adaptation of people who have dedicated themselves to serving the Fatherland. This kind of educational process is optimized by combining the personal experience of defenders with the examples of their predecessors, whose example is imprinted on the pages of history. History is not just a set of dates and events, but a powerful tool for forming an educated, moral and responsible person, capable of critical thinking, analyzing information and actively participating in building a better future.

History allows us to see how certain social and political institutions were formed, what forces drove progress and what obstacles hindered it. Understanding these processes allows us to participate more actively in public life, consciously choose our values and guidelines, and take responsibility for our actions. However, patriotic education should not be limited to studying victories and achievements. It is also important to remember the tragic pages of history, the periods of decline and injustice.

It should be noted that in our professional activities, back in the 2000s, we encountered the problem of interpreting historical truth in teaching history in schools and universities, when, once again since the declaration of independence of Ukraine, textbooks began to rewrite well-known historical facts. In the modern educational process, the system of patriotic education based on the historical and cultural traditions of the "small homeland" is one of the ways to create an educational, upbringing and developing environment. At the same time, history acts both as the basis of moral and patriotic education and as a means of developing the cognitive and creative qualities of the individual.

An honest and unbiased study of the past allows us to avoid repeating mistakes, learn from tragedies, and build a more just and prosperous society. We must not forget the sacrifices made on the altar of the Motherland and those who fought for freedom and justice. An example of this is the feat of our contemporaries. The principle of educating young people using history as an example, as well as involving veterans of the SVO in the educational process, requires a careful and responsible approach from all participants in the educational system, and its results will certainly justify the efforts expended.

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DOI 10.34660/INF.2025.70.57.045

亚美尼亚青年价值观趋势研究
RESEARCH OF THE VALUE CONCEPTS TRENDS AMONG THE ARMENIAN YOUTH

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注释。本文分析了一项具有全国代表性的社会学研究的成果，该研究致力于探讨现代亚美尼亚社会的价值观。

关键词：价值观、青年、社会学研究、亚美尼亚。

Annotation. *The article analyzes the results of a national representative sociological study devoted to the study of value concepts of modern Armenian society.*

Keywords: *values, youth, sociological research, Armenia.*

Introduction

One of the essential characteristics of the ethnic and national identity of a society are the values, value orientations and ideas that have taken root in the public consciousness and that actually constitute the basic narratives of a given society. The study of values and value ideas using sociological research methods and techniques has been widely used since the middle of the last century. Numerous sociological surveys and large-scale international projects devoted to the study of value ideas of various social groups and entire societies have become one of the striking characteristics of scientific research in modern postmodern society. The picture of the socio-cultural identity of modern Armenians would look incomplete without an idea of the traditional life values that underlie national identity. Along with this, special attention to the values of youth and the global processes that occur in the youth subculture of many countries have set before Armenian sociologists the task

of scientifically studying the process of transformation of life values in the ideas of the younger generation.

Methodology of sociological research.

For several decades, we have been conducting sociological research that examined the value orientations and basic life values of the Armenian population of the republic. We have also participated in international sociological projects on the study of European values (EVS 2005, 2011 and 2017). In order to enable a comparative analysis of the dynamics of the population's value perceptions, we used the same set of values in our 2022 study as in the previously conducted studies. The field survey questionnaire was developed taking into account similar sociological studies conducted earlier in Armenia, as well as international projects with the direct participation of the author. The survey questionnaire contained several open and closed questions regarding the value perceptions and orientations of the respondents.[1].For the sociological study, a representative national multi-stage sample was developed, including 1,500 adult respondents (18 years and older) from urban and rural residents of the republic. The field stage of the sociological research was carried out in the summer of 2022 by specialists and surveyors of the Armenian Sociological Association (ASA) under the supervision of the author. The study was conducted in 37 cities and 66 rural areas of the republic. The coefficient of correspondence of the confidence probability of the sample is 97%, the sampling error did not exceed the interval+/-2.5% for the entire sample.

Traditional Armenian values

Values are a fairly stable, basic component in the structure of national identity. In first place in importance, as decades ago, were such values as "Family" (98.7%), "Work" (95.5%), and after them respondents noted such values as "Friends, acquaintances" (93.2%) and "Religion, faith" (84.0%). The importance of such value as "Free time" was assessed by 82.2% of respondents, and the importance of the value "Politics" was noted by only 44.9% of respondents (Table 1).

Table 1.

How important are the following values in life %

No.	Values	Very important	Not important	Difficult to answer
1.	Family	98.7	0.7	0.6
2.	Work	95.5	3.1	1.4
3.	Friends, acquaintances	93.2	6.5	0.3
4.	Religion, faith	84.0	14.9	1,1
5.	Free time	82.2	16.9	0.9
6.	Politics	44.9	54.0	1,1

[1] Poghosyan G.A. Historical memory and national identity. Er., RAU Publishing House, 2023, 134 p.

According to a recent study by VCIOM, traditional family values are also a priority for Russians. The majority of Russians surveyed believe that "it is important to preserve traditional family values, the culture of motherhood and fatherhood, and support having many children (77%)"[2].In Russia, traditional Russian spiritual and moral values are being contrasted with new-fangled Western European values. Thus, in November 2022, the President of the Russian Federation signed a special decree on the preservation and strengthening of traditional Russian values[3].

As we see, in this issue (as in a number of other issues), the Armenian understanding of the important values of life coincides with the ideas of modern Russians. Armenian philosophical thought has long distinguished the family as a kind of sacred element in Armenian culture. The family is the center of sacred power that generates generally significant and unconditional meanings, is the "meaning-generating factor of Armenian statehood"[4]An Armenian deeply understands his importance and value precisely thanks to his family, taking root in it.

The question about the importance of family in a person's life shows that more than 90% of respondents in European countries and in Russia consider it as such. The overall rating of the countries under consideration based on the sum of two indicators ("very important" and "quite important") looks like this (2011).[5]

In Spain - 99.5%, in Armenia - 98.7%, in Ukraine - 98.6%, in Poland - 98.5%, in Sweden - 98.2%, in Belarus - 98.0%, in Estonia - 97.8%, in Russia - 97.7%, in Germany - 95.5%.

These data indicate that the family as the most important of the traditional values prevails both in Western and Eastern European countries. Despite the rapid change in the institution of the traditional family and its replacement by new forms, a person, regardless of the type of culture, correlates it with the most important priorities of his existence. This value can be classified as basic. The crisis of the institution of the traditional family, which European countries are experiencing today, including, although to a lesser extent, Russia, in this regard can have a destructive effect on this most important basis of human existence.

To the next question about the significance of the indicator "Work" for the life of a modern person, the following answers were received by country (2011): a

[2] https://wciom.ru/.../analitich.../tradicii-v-ehpokhu-peremen (date accessed: 23.12.2024)

[3] Decree of the President of the Russian Federation of 09.11.2022 No. 809 "On approval of the Fundamentals of state policy for the preservation and strengthening of traditional Russian spiritual and moral values."

[4] Ruben Kirakosyan. A set of principles and values for self-organization of Armenians.https://realtribune.ru/svod-principov-i-cennostej-dlya-samoorganizacii-armyanstva?fbclid=IwAR1OeNqxW-k-CUcf210enbJpABHkIX4asKMBW_ZLzSyo0Rfh93rQW0lnhhI. (date accessed: 02.03.2025)

[5] World Values Surveyhttp://www.worldvaluessurvey.org/WVSOnline.jsp.(date accessed: 23.12.2024).

combination of two positive values ("very important" and "important").[6]In Armenia - 95.5%, in Sweden - 84.9%, in Spain - 84.7%, in Estonia - 82.3%, in Germany - 79.9%, in Russia - 74.3%.

All indicators are generally close in their values and show that work is part of the basic values of the individual and plays an important role in modern life, regardless of the cultural and political characteristics of modern countries.

The role of religion

Regarding the value of religion in a person's life, respondents gave the following answers (based on the sum of two positive answers):[7]. In Armenia - 84.0%, in Poland - 79.6%, in Ukraine - 60.8%, in Belarus - 48.0%, in Russia - 41.8%, in Germany - 38.0%, in Spain - 32.0%, in Sweden - 26.2%, in Estonia - 25.3%.

In our study the value of family was very important for both men and women. However, the value of work was slightly higher for men (97.4%) than for women (93.8%). The value of religion and faith was much more important for women (86.7%) than for men (80.6%). We also found differences depending on the age of the respondents. The importance of family was noted by respondents of all ages. The value of work was assessed slightly higher by young people and middle-aged people (96.8-98.6%) than by the older generation and elderly people (95.4% and 82.7%). The value of religion and faith was noted by respondents of all ages, but it was comparatively higher among middle-aged respondents (86.3%). The value of politics was generally unimportant (it increased slightly with increasing age of the respondents).[8].

However, in general, one can notice a certain trend in the value ideas of Armenian youth away from the traditional ideas inherent in the generation of their parents. For comparison, we note that Russian sociologists also expressed concern about the fact that "modern youth are distinguished by the denial of the intrinsic value of labor," and based on the generalization of the data obtained, most experts also agree that the majority of young people, primarily urban ones, are united by "an orientation toward quick success (understood as a combination of material well-being, financial independence, high recognition and the opportunity to freely spend leisure time)"[9]. Sociological studies have also recorded a value crisis among Russian youth, which is caused by a reassessment of the cultural, ethical and spiritual values of the parents' generation[10].

[6] World Values Surveyhttp://www.worldvaluessurvey.org/WVSOnline.jsp.(date accessed: 23.12.2024).

[7] Ibid.

[8] Pogosyan G.A. Historical memory and national identity. Er., RAU Publishing House, 2023, 134 p.

[9] Belov S.I., Vanteevsky M.M., Yarosheva D.V. Value preferences of modern Russian youth: results of summarizing expert opinions // Political Science. 2023. No. 2. P. 169.DOI: http://www.doi.org/10.31249/poln/2023.02.07

[10] Lukov Val. A., Lukov Vl. A., Zakharov N. V. Value orientations of Russian youth // Information humanitarian portal "Knowledge. Understanding. Skill". Sociology.2008.№3. http://www.zpu-journal.ru/e-zpu/2008/3/Lukovs&Zakharov/(date accessed: 28.02.2025).

According to the theory of the famous American sociologist R. Inglehard, traditional values emphasize the importance of religion, ties between parents and children, respect for authority and traditional family values. In societies where traditional values prevail, there is a high level of national pride, ties to national culture and traditions[11].

Ronald Inglehart devoted fundamental research to the change of value orientations and life horizons[12]Almost half a century ago, he wrote that transformations were taking place in industrially developed countries that would change the basic values of society, or more precisely, the value priorities of specific generations. The first empirical evidence of such an intergenerational shift was recorded in 1970 in Western European countries, during sociological studies conducted to test the hypothesis of a transition from materialistic values to post-materialistic values.[13]According to his hypothesis, rapid economic growth in developed countries could lead to global cultural shifts.

After World War II, a significant part of the population in European countries began to feel secure about their existence for the first time. As a result, the younger generation began to give preference to such new goals as the possibility and freedom of self-expression, ecological living conditions, etc. From the existential need for survival, they moved to the freedom of self-development and self-expression. This in turn led to a process of intergenerational value change that transformed the politics and culture of high-income countries.[14].

Robust empirical evidence on changes in core values in developed societies signals a shift from materialistic to post-materialistic values. Inglehard believes that economic prosperity favors the spread of post-materialist values. According to his concept (which we do not find unconditionally convincing) each subsequent generation should live in better material prosperity than the previous one. Therefore, it will feel greater socio-economic security and, consequently, will be oriented towards the realization of social and spiritual needs and values of post-materialism. But the process of socialization of youth assumes that the change of values in society does not occur immediately, but gradually with the change of generations[15]. Inglehart claimed that in recent decades, the dominant values in highly developed societies have changed dramatically, transforming many cultural norms that had been in place for centuries. Value shifts, he believed, can transform

[11] Inglehart, R. & Welzel C. Modernization, Cultural Change, and Democracy: The Human Development Sequence. Cambridge: Cambridge UP, 2005.

[12] Inglehart R. Cultural Evolution: How Human Motivations Change and How It Changes the World. Moscow: Misl, 2018. 347 p.

[13] Ibid., p. 38.

[14] Ibid., p. 33.

[15] Ibid., p. 38.

entire societies[16]. Numerous large-scale sociological studies of European Values (EVS) have made it possible to construct a kind of a cartografic representation of the distribution of countries according to the most widespread value system in them, depending on the level of economic development. Armenia on this map was located next to Georgia and Azerbaijan, in the area of countries with low per capita income (Fig. 1).

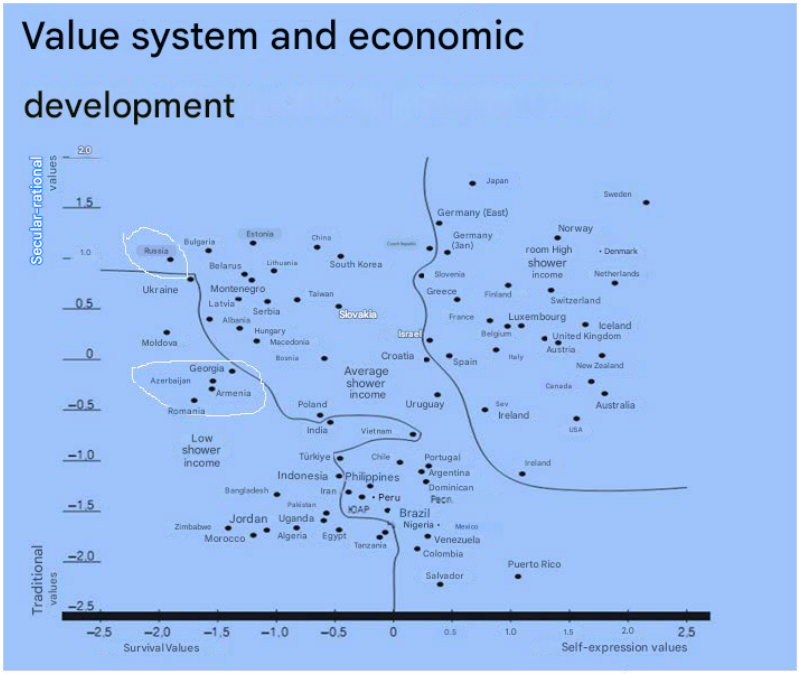

Figure 1. *The system of values depending on the economic development (per capita income) of countries. (On the horizontal axis X, the scales of Survival Values are located at the beginning, and Self-Expression Values at the end. On the vertical axis Y, Traditional Values are located at the beginning, and Secular-Rational Values at the end).*

As can be seen, Armenia in the figure is located closer to Survival Values on the X-axis and to Traditional Values on the Y-axis. Meanwhile, Russia is also located closer to Survival Values on the X-axis, but much closer to Secular-Rational Values on the Y-axis.

[16] Inglehart R. Cultural Evolution: How Human Motivations Change and How It Changes the World. Moscow: Thought, 2018. p. 40.

Thus, although three decades of post-Soviet development have formed new geopolitical and socio-economic realities, however, despite this, the results of our research indicate that modern Armenian society remains traditional in many ways. The main codes of Armenian identity are: blood relationship, Christian faith, Armenian language, family, national culture and national self-awareness. These are precisely the value concepts that closely relate us to Russian society and the basic values of Russian society.

However, along with this, the results of the study also indicate that traditional values experience a noticeable dynamic over time. Thus, in the group of young respondents, the values that form the core of Armenian identity are less emphasized than among representatives of the older generation. This suggests that Armenian youth of the post-Soviet period are gradually moving away from the value system of their parents. For the older generation, blood relationship (nationality of parents) and religious affiliation remain important. While for post-Soviet Armenian youth, self-identification is an important characteristic, so that a person considers himself an Armenian.

In addition, representatives of the older generation noted more closeness of Armenians with Russians and Georgians, while representatives of the youth pointed out more closeness with the French, Greeks and Jews. The differences in the views of the surveyed men and women were less significant than age and generational differences. Nevertheless, the stability of collective ideas revealed in public opinion indicates that basic national characteristics change little over time. Traditional national values of family, work, religion, friends and acquaintances represent a fairly stable element in the structure of Armenian identity.

Conclusion

Three decades of post-Soviet development have created new geopolitical and socio-economic realities. But despite this, the results of our research indicate that modern Armenian society remains traditional in many ways. The main codes of Armenian identity are: blood relationship, Christian faith, Armenian language, family, national culture and national self-awareness.

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DOI 10.34660/INF.2025.85.30.046

BioSimulate 平台上用于科学和农业工业研究的虚拟动物建模：问题的现状
VIRTUAL ANIMAL MODELING ON THE BIOSIMULATE PLATFORM FOR SCIENTIFIC AND AGRO-INDUSTRIAL RESEARCH IN SILICO: CURRENT STATE OF THE PROBLEM

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注释：本文介绍了文献中关于用于药物和生物制药计算机测试的虚拟动物模型的数据。文中探讨了虚拟动物模型的创建，分析了其准确性和可靠性，并列举了其在生物医学领域的应用实例。文中强调，虚拟建模可以提高临床前研究的效率和伦理道德，降低成本，并加速新药的开发。

关键词：虚拟建模、动物模型、计算机测试、生物医学研究、临床前试验。

Annotation. *The article presents the data available in the literature on virtual zoomorphic models for in silico testing of medicines and biopharmaceuticals. The creation of virtual animal models is considered, their accuracy and reliability are analyzed, and examples of applications in biomedicine are given. It is emphasized that virtual modeling makes it possible to increase the efficiency and ethics of preclinical research, reduce costs and accelerate the development of new drugs.*

Keywords: *Virtual modeling, zoomorphic models, in silico testing, biomedical research, preclinical trials.*

Introduction

For a long time, testing of medicines and biopharmaceuticals has traditionally been carried out on animals, which is caused by the need for direct monitoring of the effects of drugs on a living organism. However, it became clear that this approach brings with it many serious problems. First of all, experiments on animals cause a huge resonance in society, raising questions of ethics and humanity. Animals experience stress and suffering, which is sharply criticized by the public and human rights organizations. Further, the physiological differences between animals and humans have led to the fact that

the results of experiments cannot always be transferred to humans, which reduces their scientific value and reliability. Finally, keeping animals for experiments is financially unprofitable, as it is accompanied by high costs for maintenance, nutrition and care.

These circumstances have made us think about the need to find alternative approaches. One of the first steps in this direction was the development of in vitro methods such as the use of cell cultures. They made it possible to conduct research on individual cells, which helped to partially replace experiments on animals. However, the real changes occurred with the advent of the era of information modeling and computer analysis.

It was at the end of the 20th century that scientists came to the conclusion that experiments could be transferred to a virtual plane using computer models. The first major initiative in this area was the Virtual Physiology Human project (vph-institute.org) is the largest European initiative launched in 2005. As part of this project, virtual models of human organs and systems were developed that allowed experiments to be conducted on a computer, bypassing the stage of animal experiments.

Russian scientists have also made a significant contribution to the development of virtual modeling. The Institute of Cytology and Genetics of the Siberian Branch of the Russian Academy of Sciences carried out work that laid the foundations for the development of a domestic approach to in silico drug testing. This allowed Russian scientists to become one of the leaders in this field (1).

The closest analogue is also the ongoing subproject "Physiologically based pharmacokinetic modeling" of the Simurg project, which is interested in the idea of virtual animal modeling, but faces problems with limited data availability, lack of standards, high computational complexity, implementation difficulties and the issue of reliability of results. For the success of the project, it is necessary to resolve these issues and prove the reliability of virtual experiments to official authorities and the industry.

Today, virtual modeling is recognized as one of the most promising methods of testing medicines and biologics. It allows not only to speed up the process of developing new drugs, but also to reduce financial costs, minimize animal suffering and improve the accuracy of the results. Virtual animal models allow you to accurately reproduce physiological processes, predict possible side effects and avoid unnecessary risks. Traditional methods of testing medicines and biopharmaceuticals based on animal experiments have long been recognized as imperfect and limited. Despite the long-term practice of using laboratory animals, this approach has faced a number of serious problems.

One of the main difficulties is that animals and humans differ in many aspects of physiology and metabolism. What is safe and effective for a mouse or a dog is

not necessarily the same for a human. The consequence of this is the low predictivity of the results obtained in animals, which seriously complicates the process of developing new drugs.

Another significant problem is the high cost of conducting experiments on animals. After all, the maintenance of animals, the organization of research and subsequent analyses require significant financial resources. Such costs slow down the development process and complicate the access of small laboratories and research teams to participate in modern scientific projects.

We must not forget about the issues of ethics. It has long been known that experiments on animals cause a public outcry, as they are accompanied by pain and stress, which is absolutely unacceptable from the point of view of humanity. Increasing social responsibility forces researchers to look for alternative methods that do not involve violence against animals.Finally, traditional methods are not effective enough in situations where it is necessary to respond urgently to a threat, such as a pandemic or epidemic. Since animal experiments take a long time, waiting for the results can cost the lives of hundreds and thousands of people.

Today, global trends in biomedicine and drug development are aimed at moving from traditional animal testing methods to safer, faster, and more ethical approaches. The main engine of this process is international regulations and initiatives designed to protect the interests of animals and ensure the high effectiveness and safety of new drugs.

One of the key players in shaping the international drug testing agenda is the European Union. Back in 2010, the European Commission adopted a resolution calling for phasing out animal experiments in favor of alternative methods such as in silico modeling. Later, this line was consolidated in the EU Directive on the protection of animals used for scientific purposes, where special attention was paid to the need to move to humane and effective approaches.

The United States is also actively promoting the idea of using alternative testing methods. The Food and Drug Administration (FDA) has launched an initiative aimed at supporting the development and implementation of in silico methods that will reduce dependence on animal experiments. In 2021, the U.S. Congress approved a bill allowing pharmaceutical companies to voluntarily switch to alternative testing methods if they demonstrate equivalence to traditional approaches.

The international community also pays great attention to the process of standard harmonization. Intergovernmental agreements, such as the Council of Europe Convention on the Protection of Vertebrates used for Experimental and Other Scientific Purposes, form common requirements for the ethical treatment of animals and promote the development of alternative methods.

Finally, the World Health Organization (WHO) and the International Council for the Harmonization of Technical Requirements for Pharmaceutical Registration Documents (ICH) are calling for the early introduction of virtual modeling and

other alternative methods. They believe that such approaches will significantly reduce the number of animal experiments, while maintaining high efficiency and safety of testing.

Thus, the current stage of biomedicine development is characterized by a gradual departure from traditional animal experiments and a move towards virtual modeling. This opens up huge prospects for the development of biomedical research, giving them a new ethical and economic framework.

The main goal of the work is to develop virtual zoomorphic models for in silico testing of medicines and biopharmaceuticals. Such models will make it possible to replace or supplement traditional animal experiments, making research more ethical, economical and accurate.

Approaches to creating virtual zoomorphic models

Approaches to creating virtual zoomorphic models are a combination of knowledge from biology, mathematics, computer science, and physics. Mathematical modeling plays a key role, which makes it possible to formalize the physiological processes of the animal's body. At the first stage, comprehensive information about a particular type of animal is collected, including anatomical features, metabolic processes, nervous system, and other characteristics. These data form the basis of mathematical models, which are then implemented in a virtual environment. The virtual environment reproduces the body's reactions to various stimuli, such as taking medications, exposure to toxins, or changes in environmental conditions. The result is the ability to model the body's reactions step by step, starting from the drug entering the bloodstream and ending with its effect on tissues and organs. The most important aspect is the integration of artificial intelligence and machine learning. Modern algorithms allow us to simulate complex processes such as the immune response, inflammatory reactions and the development of diseases. This allows virtual models to take into account many factors, which increases the accuracy and reliability of forecasts.

Algorithms and mathematical models underlying virtual modeling

Algorithms and mathematical models play a central role in virtual animal modeling. The main approach is to create mathematical models describing the physiological processes of the body. For this, differential equations are used that describe changes in the concentration of substances, blood flow, heat distribution, and other parameters. An important aspect is the choice of the appropriate mathematical apparatus. Nonlinear differential equations are usually used to take into account the interactions of various processes in the body. Additionally, algorithms for numerical solution of equations are used, such as the Euler method or the Runge-Kutta method, which make it possible to obtain numerical solutions for arbitrary time points.

Mathematical models are combined with machine learning algorithms that allow you to automatically train models on a large amount of data. This improves the accuracy and predictive power of virtual models.

Principles of integration of artificial intelligence and machine learning

The principles of integrating artificial intelligence and machine learning underlie the improvement of the accuracy and efficiency of virtual models. One of the key ideas is to use neural networks and machine learning algorithms to approximate complex physiological processes. Neural networks allow you to train models on large amounts of data, extracting patterns and hidden dependencies.

Another important principle is the use of the Bayesian approach, which allows you to take into account uncertainty and a priori knowledge in modeling. This makes it possible to predict the behavior of an organism in conditions of insufficient data or uncertainty of parameters.

The integration of artificial intelligence and machine learning ensures high accuracy and reliability of virtual models, allowing them to be used to predict the effects of drugs and biologics.

Architecture of the virtual testing platform

The architecture of the virtual testing platform is a multi-layered structure that ensures efficient operation of virtual models. The first layer includes the core of the platform, where virtual models are stored and executed. The second layer is responsible for integration with external data sources such as clinical trial databases or laboratory data.

The third layer provides an interface for users to enter data and get results. The last layer is responsible for the administration and management of the platform, including security and data protection issues.

This architecture makes it possible to combine various components of virtual modeling into a single working tool accessible to researchers and developers. The platform supports the parallel operation of several models, which significantly speeds up the testing and analysis process.

Virtual zoomorphic models are computer simulations that reproduce the physiology and behavior of animals with a high degree of accuracy. Each model includes a detailed description of the animal's anatomy, physiology, and metabolism, which allows you to virtually reproduce the body's reactions to various stimuli and drugs.

The greatest attention is paid to the creation of models of small laboratory animals such as mice and rats, which are widely used in biomedical research. These models include detailed descriptions of the cardiovascular system, gastrointestinal tract, nervous system, and other organs and systems. Similar models are being created for larger animals such as pigs and monkeys, which allows for virtual experiments that are close to real conditions.

An analysis of the accuracy and reliability of virtual experiments has shown that virtual models are capable of reproducing the physiological processes and reactions of the body to drugs with high accuracy. Virtual experiments allow you

to obtain results that in most cases coincide with the results of real experiments on animals.

An important aspect is to check the models for adequacy. To do this, a series of virtual experiments are conducted, the results of which are compared with data obtained on real animals. This allows you to assess how accurately virtual models reflect the physiology and reaction of the body.

Examples of the use of virtual models for drug testing

Virtual models have found wide application in the testing of medicines and biologics. For example, virtual rodent models are used to evaluate the effectiveness of antibiotics and antiviral drugs. Virtual models of pigs and monkeys are used for testing vaccines and immunobiological preparations.

Special attention is paid to the use of virtual models to assess the toxicity of drugs. Virtual experiments make it possible to identify possible side effects and determine the optimal doses of drugs, which significantly reduces the risks when transferring drugs to clinical trials.

A comparison of the results of virtual and real experiments has shown that virtual models are able to reproduce the results of real experiments with high accuracy. In most cases, virtual experiments produced results close to those obtained on real animals.

Virtual models can reduce the number of errors and improve the accuracy of forecasts, which makes them an important tool in biomedical research. However, it should be remembered that virtual models cannot completely replace real experiments, especially in cases where accurate data on specific features of the animal's body is required.

Conclusion

It is shown that virtual zoomorphic models are a powerful tool for testing medicines and biological products. Virtual experiments can significantly improve the accuracy and effectiveness of preclinical research, while reducing costs and ethical issues associated with the use of animals.

Virtual models demonstrate high accuracy in reproducing the physiological processes and reactions of the body to drugs. They can reduce the number of errors and increase the reliability of forecasts, which makes them indispensable in biomedical research.

It is necessary to further develop virtual models, improve their accuracy and expand the range of applications. The introduction of virtual models will significantly accelerate the development of new drugs and increase their safety and effectiveness.

1 International Nucleome Consortium , 3DGenBench: a web-server to benchmark computational models for 3D Genomics, *Nucleic Acids Research*, Volume 50, Issue W1, 5 July 2022, Pages W4–W12, https://doi.org/10.1093/nar/gkac396

DOI 10.34660/INF.2025.35.32.047

体力活动对青春期女孩痛经及其严重程度的影响
THE IMPACT OF PHYSICAL ACTIVITY ON DYSMENORRHEA AND ITS SEVERITY IN ADOLESCENT GIRLS

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摘要。目的：评估青春期女孩体力活动水平与痛经严重程度之间的关系，并分析当前将体育锻炼作为非药物治疗痛经的科学方法。

材料与方法：本研究于2023-2024年开展，以585名15-19岁在校女生为研究对象，采用问卷调查法。使用视觉模拟量表（VAS）评估痛经强度，并使用国际体力活动问卷（IPAQ）测量体力活动水平。数据分析包括描述性统计分析和关联检验，采用卡方检验和Mann-Whitney U检验。

结果：与无痛经的受试者相比，痛经女孩的总体体力活动水平更高。中度疼痛患者更常观察到最佳活动水平，而轻度痛经患者更常出现乏力症状，重度疼痛患者则以活动不足为主。体力活动水平与痛经严重程度之间存在统计学显著相关性（$p<0.001$）。然而，使用自我报告工具（VAS和IPAQ）限制了研究结果的客观性，需要谨慎解读。

结论：体力活动可能是与青少年痛经严重程度相关的可改变因素。然而，主观评估工具和横断面研究设计的固有局限性凸显了更客观、多因素研究方法的必要性。未来有希望的研究方向包括整合数字监测、纵向观察以及在青少年痛经研究中应用生物心理社会模型。

关键词：痛经，青少年，体力活动。

Abstract. Objective: *To evaluate the relationship between the level of physical activity and the severity of dysmenorrhea in adolescent girls, and to analyze current*

scientific approaches to the use of physical exercise as a non-pharmacological method for managing menstrual pain.

Materials and Methods: *A questionnaire-based study was conducted in 2023–2024 involving 585 girls aged 15–19 years who were students at schools, colleges, and universities. The intensity of menstrual pain was assessed using a Visual Analog Scale (VAS), and physical activity levels were measured using the International Physical Activity Questionnaire (IPAQ). Data analysis included descriptive statistics and association testing using the chi-squared test and Mann–Whitney U test.*

Results: *Girls with dysmenorrhea demonstrated higher overall levels of physical activity compared to participants without pain. Optimal levels of activity were more frequently observed among those with moderate pain, while hypodynamia was more common in cases of mild dysmenorrhea, and insufficient activity predominated in those with severe pain. A statistically significant association was found between physical activity level and the severity of dysmenorrhea ($p<0.001$). However, the use of self-report instruments (VAS and IPAQ) limits the objectivity of the findings and warrants cautious interpretation.*

Conclusion: *Physical activity may represent a modifiable factor associated with dysmenorrhea severity in adolescents. Nonetheless, the limitations inherent to subjective assessment tools and the cross-sectional study design highlight the need for more objective and multifactorial research approaches. Promising future directions include the integration of digital monitoring, longitudinal observation, and the application of a biopsychosocial model in the study of adolescent dysmenorrhea.*

Keywords: *dysmenorrhea, adolescents, physical activity.*

Background

Dysmenorrhea is one of the most common gynecological conditions among adolescents, characterized by painful menstruation often accompanied by nausea, irritability, sleep disturbances, and a decline in quality of life. According to various data, the prevalence of menstrual pain among adolescent girls ranges from 50% to 90%, with 20–25% experiencing pain that significantly affects physical and psychological well-being, leading to reduced academic performance and social participation [1,2].

Among non-pharmacological interventions, increasing attention in recent years has been paid to physical activity. A systematic review by Armour et al. (2022), covering 15 randomized controlled trials, confirmed that regular aerobic exercise and stretching (such as yoga) significantly reduce the severity of menstrual pain [3]. Similar findings were reported in a meta-analysis by Jingjie Cai and colleagues (2023), which demonstrated that moderate-intensity aerobic activity

performed at least three times per week effectively alleviated dysmenorrhea symptoms [4]. Other recent meta-analyses support these conclusions [5–7].

The mechanisms underlying the effect of physical activity in dysmenorrhea include improved pelvic blood flow, reduced prostaglandin levels, increased endorphin release, and enhanced psychological well-being [8]. This makes exercise particularly attractive in the adolescent population, where pharmacological treatment is often limited by side effects or concerns about long-term use, and where inadequate pain management may contribute to chronic pelvic pain syndromes.

Despite the growing evidence supporting the benefits of physical activity, several methodological limitations hinder the development of unified clinical recommendations. These include small sample sizes, lack of stratification by menstrual cycle phase or baseline fitness level, heterogeneous exercise protocols, and inconsistency in pain assessment tools [9]. Additionally, the duration of interventions in many studies does not exceed 8–12 weeks, limiting the ability to assess the long-term sustainability of effects.

Nonetheless, recent research trends show improvements in study design quality. The work by Armour et al. [3] applied rigorous bias assessment tools, while the meta-analysis by Cai et al. [4] used standardized mean difference calculations. Promising directions for future research include the use of objective measures such as fitness trackers and digital monitoring, as well as integrative biopsychosocial models that account for the psychological status and lifestyle factors of adolescents.

Materials and Methods

This study was conducted via a survey in 2023–2024. The sample included 585 adolescent girls aged 15 to 19 years, enrolled in secondary schools, colleges, and universities. All participants provided informed consent prior to participation.

The intensity of menstrual pain was assessed using a Visual Analog Scale (VAS), with the following classification:

- Mild pain: 1–3 points
- Moderate pain: 4–7 points
- Severe pain: >7 points

Physical activity levels were measured using the International Physical Activity Questionnaire (IPAQ) [10], with scores interpreted as follows:

- <21 points — Physical inactivity
- 21–27 points — Insufficient activity
- ≥28 points — Optimal physical activity

Statistical analysis included descriptive statistics, frequency distributions, and assessment of associations between variables using the chi-squared (χ^2) test and Mann–Whitney U test. The significance level was set at $p<0.05$.

Results

According to the IPAQ questionnaire results, girls with dysmenorrhea demonstrated, on average, a higher level of physical activity compared to participants without pain symptoms.

- Among girls with dysmenorrhea:
  - Physical inactivity: 31.1%
  - Insufficient activity: 30.3%
  - Optimal activity: 38.6%
- Among girls without dysmenorrhea:
  - Physical inactivity: 37.5%
  - Insufficient activity: 37.5%
  - Optimal activity: 25.0%

These findings suggest that the presence of dysmenorrhea is not necessarily associated with a reduction in physical activity; in some cases, it may even coincide with higher activity levels.

Further analysis of the relationship between physical activity level and the severity of pain revealed statistically significant differences ($p < 0.001$). Physical inactivity was most frequently observed among participants with mild dysmenorrhea (42.9%), whereas girls with moderate pain most commonly reported optimal physical activity levels. Those with severe dysmenorrhea demonstrated the lowest levels of physical activity: only 24.4% reported optimal activity, while 46.2% reported insufficient activity.

The findings indicate a statistically significant association between physical activity level and the severity of dysmenorrhea among adolescent girls. Optimal activity levels were more common in those with moderate pain, while both mild and severe dysmenorrhea were associated with higher rates of physical inactivity and insufficient activity. These results align with current evidence suggesting that physical exercise can play a beneficial role in reducing menstrual pain and improving general well-being.

However, interpreting this association requires a comprehensive approach that considers not only physiological but also psychosocial, behavioral, and environmental factors that influence pain perception and motivation for physical activity. As noted in the study by Dixon et al. (2024), adolescent dysmenorrhea remains understudied in real-life community settings, particularly within school environments and primary care, where adolescents often lack structured support systems [11].

Many researchers emphasize that adolescent dysmenorrhea has a significant impact on quality of life, including sleep disturbances, reduced concentration, academic impairment, and social withdrawal. The study by Amza et al. (2024) in a European population found that even moderate menstrual pain can substantially

impair daily functioning, and the impact of severe dysmenorrhea may be comparable to that of chronic pain conditions [12].

It is also important to acknowledge that the intensity of menstrual pain may be mediated by psychological and behavioral factors. The study by Li et al. (2023) identified a complex association between dysmenorrhea and depressive symptoms in adolescents, with additional mediating effects of poor sleep quality and episodes of binge eating [13]. These findings support the need for a biopsychosocial framework in the study and management of dysmenorrhea in the adolescent population.

The methodological limitations of the present study, particularly the reliance on self-report instruments (VAS and IPAQ), warrant careful consideration. Despite their wide use and practical feasibility, such scales are vulnerable to various biases, including recall inaccuracies, influence of current emotional state, and social desirability. These limitations may affect the precision of measurements and introduce both random and systematic errors.

Moreover, the cross-sectional design of this study does not permit causal inference regarding the relationship between physical activity and pain severity. Reverse causation cannot be ruled out: girls with severe pain may reduce their physical activity not due to lack of motivation, but as a result of functional limitations imposed by dysmenorrhea itself.

Additional factors—such as stress, anxiety disorders, levels of social support, and stigma surrounding menstrual symptoms—may also influence both physical activity levels and subjective pain assessment. Consideration of these variables appears essential for future research aimed at understanding dysmenorrhea as a complex phenomenon encompassing biological, psychological, and behavioral components.

Conclusions

The obtained data demonstrate a statistically significant association between the level of physical activity and the severity of dysmenorrhea in adolescent girls. An optimal level of physical activity was more frequently observed among participants with moderate pain intensity, whereas both mild and severe forms of dysmenorrhea were more often associated with physical inactivity and insufficient activity, respectively.

Nevertheless, interpretation of these results requires consideration of limitations related to the use of subjective assessment methods. Although self-reported questionnaires are standardized and widely accessible, they do not provide sufficient accuracy in measuring either physical activity levels or pain intensity. These limitations, together with the cross-sectional study design, restrict the possibility of establishing causal relationships and require caution when extrapolating the findings.

In light of the identified methodological constraints, it appears reasonable to discuss a number of approaches that may enhance the reliability and applied val-

ue of future research. In particular, the use of objective methods for assessing physical activity—such as accelerometers, fitness trackers, or mobile applications capable of recording the frequency and duration of physical movements in real time—should be considered.

Equally relevant is the expansion of pain assessment tools to include indicators reflecting the impact of menstrual pain on daily activities, emotional well-being, and overall quality of life. Such comprehensive evaluation would allow for a more clinically meaningful characterization of dysmenorrhea from the perspective of adolescents.

Moreover, the implementation of a longitudinal study design would make it possible to monitor the dynamics of physical activity and pain intensity over several menstrual cycles. This approach would help to clarify causal relationships between the variables under investigation.

Further refinement of the sampling strategy is also advisable. Stratification according to key modifying factors—including baseline physical fitness, body mass index, psycho-emotional status, and menstrual cycle phase—would allow for the identification of subgroups with differing patterns of pain perception and response.

Thus, more integrated and objective methodological approaches will not only help to confirm the effectiveness of physical activity as a means of managing dysmenorrhea, but also facilitate the development of personalized preventive and therapeutic programs for adolescents. This topic is particularly relevant in the adolescent cohort, as this life stage is critical for the formation of long-term behavioral and treatment strategies. Inadequate management of dysmenorrhea in adolescence increases the risk of developing chronic pelvic pain, menstrual irregularities, and anxiety disorders in adulthood. Furthermore, the presence of menstrual pain at an early age often leads to reduced overall physical activity, thereby reinforcing sedentary behavior and contributing to metabolic and psycho-emotional disorders.

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DOI 10.34660/INF.2025.98.48.048

新生儿成骨不全症III型临床病例

CLINICAL CASE OF OSTEOGENESIS IMPERFECTA TYPE III IN A NEWBORN

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摘要：成骨不全症（"水晶人"病，Lobstein-Vorlik病）是一组异质性遗传性疾病，其发病机制为胶原蛋白的结构和数量发生改变，其特征包括骨脆性增加、骨量减少、易发生不同程度的骨折，部分病例可出现骨骼畸形和生长迟缓、牙本质异常、蓝巩膜和听力损失。成骨不全症已被列为孤儿病，目前是一个具有特殊医学和社会意义的问题，会降低患者的生活质量[1, 2]。

关键词：新生儿，成骨不全症，骨折，骨矿化。

Abstract. *Osteogenesis imperfecta ("crystal man" disease, Lobstein-Vorlik disease) is a heterogeneous group of genetic disorders that develop as a result of changes in the structure and amount of collagen produced, characterized by increased bone fragility, a decrease in bone mass, a tendency to bone fractures of varying severity, the presence, in some cases, skeletal deformities with low growth, dentin abnormalities, blue sclera, hearing loss. Osteogenesis imperfecta included in the list of orphan diseases is currently a problem with a special level of medical and social significance, decrease in quality of life [1, 2].*

Keywords: *newborn, osteogenesis imperfecta, fracture, bone mineralization.*

The global incidence rates of osteogenesis imperfecta are 6-7 cases per 100,000 children, without dependence on the gender and racial component. In Russia, this figure is slightly lower - 1.08 per 100,000 newborns. It is worth noting that mild forms of this disease are often not verified and, accordingly, are not taken into account in statistical data. Therefore, the actual prevalence of osteogenesis imperfecta may differ both globally and in terms of indicators in Russia, which requires further analysis [2]. Polymorphism of the clinical picture, which significantly reduces the quality of life of patients, testifies to the special clinical and social significance of genetically heterogeneous hereditary diseases with polysystemic manifestations, in particular osteogenesis imperfecta [3, 4].

The aim of the work - is to describe a clinical case of osteogenesis imperfecta in a newborn child with a detailed presentation of pathogenetic aspects, diagnostic methods and management tactics.

Materials and methods.

Foreign and domestic publications were reviewed using search engines eLIBRARY.RU, cyberleninka.ru, Medscape, PubMed. The clinical and anamnestic method included the study of the medical history of a child who was in inpatient treatment in the pathology department of newborns and premature babies No 2 of the State Budgetary Institution of State Budgetary Institution of the Rostov Region “City Clinical Hospital No. 20” in Rostov-on-Don, with a gynecological and obstetric history of the mother, a comprehensive physical, clinical laboratory and instrumental examination, consultations with related specialists, as well as consultations in medical federal institutions.

Results and its discussion.

According to the most common classification, type III osteogenesis imperfecta in the main number of cases is characterized by a severe course, with significant bone deformities, pronounced scoliosis. Shortening and curvature of the limbs, trunk, antenatal and intranatal fractures, telescopic fractures are observed, the triangular shape of the face is characteristic, dentinogenesis is impaired, dark blue or gray sclera, hyperplastic calluses [5, 6, 10]. The clinical picture includes increased bone fragility with a high frequency of multiple spontaneous fractures, including rib fractures, including intrauterine (with severe course) or postnatal - in the first 14 days of life. There is a deformation of the chest, shortening and deformation of the limbs with pronounced short stature, the formation of false joints [7, 8, 9]. With a mild course of the disease, clinical manifestations occur postnatally, they are mild and are represented by individual fractures of the extremities without subsequent deformation, formation of false joints. As the child’s age increases, the frequency of spontaneous fractures decreases. However, in all cases of osteogenesis imperfecta, osteopenia and a tendency to progressive deformation of individual bones and the skeleton as a whole will occur. In addition to damage to

the musculoskeletal system, changes will be observed in other organ systems [10]. For example, in many types of imperfect osteogenesis, the presence of blue or gray sclera, diffuse muscle hypotension, impaired dentinogenesis, visceral hernias, congenital heart defects, nephrolithiasis, progressive tooth destruction ("amber teeth"), increasing hearing loss, hypermobility of joints and contractures is noted [6, 11].

Diagnosis of osteogenesis imperfecta is based on a combination of prenatal, postnatal clinical and genetic criteria [7, 8]. Thus, prenatal diagnosis includes data from fetal ultrasound (typical bone changes are visualized from 13-14 weeks of gestation), supplemented by laboratory and histological data (biopsy of chorionic villi with the detection of pathological type I collagen or fetal DNA). Clinical diagnostic criteria include: a burdened hereditary history of osteogenesis imperfecta or recurrent fractures; spontaneous isolated or multiple fractures; vertebral compression fractures; acetabular protrusions, short stature; impaired dentinogenesis; blue or gray sclera; progressive sensorineural hearing loss; various manifestations of connective tissue dysplasia syndrome; additional (wormian) bones located in the area of the sutures between the bones of the cranial vault, up to 6 mm in size; impaired ossification with low bone density, according to densitometry and X-ray examination [11].

Treatment is represented by drug and non-drug therapy, prevention and elimination of complications, rehabilitation measures [7, 8, 9].

Drug therapy includes the use of bisphosphonates (the "gold standard" of NO therapy) in order to increase bone density, reduce the risk of fractures, and reduce the severity of chronic pain syndrome. Pamidronic acid is used as an alternative preparation. Surgical treatment consists in eliminating and preventing fragments, reducing pain syndrome. The use of intramedullary telescopic implants is recommended, which provides constant intraosseous reinforcement. The main goal of surgical treatment is to maintain motor activity, create conditions for the formation or improvement of autonomy, and improve the quality of life of patients [7, 10, 11].

Clinical observation.

The presented clinical case - type III osteogenesis imperfecta is interesting for the rare incidence of the disease, features of clinical manifestations against the background of combined pathology.

Boy Kh. Was born in the maternity hospital of Regional Clinical Hospital No. 20 in Rostov-on-Don from the first pregnancy, which occurred against the background of mild toxicosis in the 1st trimester, colpitis at 6 weeks (sanitation), threats of termination of pregnancy (spotting, treatment - tranexamic acid, Duphaston up to 38 weeks), mild anemia from week 20 (Ferrum-lek - 1 month), in a woman with a history of acute lymphoblastic leukemia (condition after multi-course PCT, per-

sistent clinical and hematological remission). Intrauterine fractures were absent. The delivery was the first, urgent in the gestation period of 38 weeks and 5 days with a birth weight of 2950 gr, 49 cm long, in satisfactory condition, 8/8 points on the Apgar scale. On the 3rd day of life, the child in satisfactory condition was discharged under the outpatient supervision of the district pediatrician.

On the 23rd day of life, the child was taken to the Department of Pathology of Newborns and Premature Babies No. 2 of Regional Clinical Hospital No. 20 in Rostov-on-Don due to complaints of intermittent cyanosis of the skin with anxiety, general psychomotor agitation. According to the results of the physical examination, the child had signs of facial dysmorphism, breathing was weakened in the lungs, it was carried out symmetrically from 2 sides, there were no wheezing, but there was a boxy shade of percussion. Consciousness was preserved, on the Glasgow scale - 15 points, crying - with a painful tint. n neurological status, there was a discrepancy between the sagittal and coronal sutures of the skull, smoothness of the large fontanelle, the severity of the venous network on the scalp, tremor of the chin, upper and lower extremities against the background of diffuse muscle hypotension. This symptom, together with the results of ultrasound scanning of the brain (dilation of the lateral ventricles, diffuse changes in the brain substance with an increase in echogenicity, an increase in the vascular resistance index and blood flow rate in the Galen vein, expansion of the cranio-cortical space and the interhemispheric fissure) was regarded as hypoxic-ischemic encephalopathy, grade 2 cerebral ischemia, hypertension hydrocephalus syndrome. Symptoms of intoxication and respiratory failure (RF) - cyanosis with anxiety without respiratory support, respiratory rate 75/min (2b on the Downs scale) did not allow to exclude the course of community-acquired pneumonia. Decreased motor activity in the right lower limb, local swelling, tenderness on palpation, difficulty in active and passive movements in it, decreased muscle tone were noted, which required further examination to confirm bone-traumatic changes in the right leg.

The child was consulted by a pediatric surgeon, orthopedic traumatologist, neurologist, as well as a comprehensive clinical, laboratory and instrumental examination, according to the results of which a consolidated fracture of the upper third of the femur with an angular deformation was noted on the X-ray of the right femur and right tibia in 2 projections, fracture of the lower third of the femur with a displacement by the width of the cortical layer and a consolidating fracture of the upper third of the right tibia, without displacement, slightly pronounced periosteal callus, signs of osteopenia. A fracture of the right femur and tibia of the posterior plaster langet from the fingertips to the epigastrium was immobilized. For the purpose of anesthesia, ibuprofen suspension was prescribed at 1.8 mL 3 times a day. Chest X-ray showed right-sided pneumonia. In combination with blood biochemistry data: CRP increased to 20 mg/L, antibacterial therapy was prescribed (sulmaceft 50 mg/kg, 3 times a day).

After a medical genetic consultation, as a result of which, taking into account the medical history, clinical observation (shortening of the lower right limb, tenderness during palpation, crepitation, the presence of a small fontanelle, open sutures of the skull, dysplasty: triangular face, broad forehead, exophthalmos, microgenia, blue sclera, soft edges of skull bones), complex laboratory and instrumental examination (radiologically - multiple fractures different in terms of limitation and degree of consolidation) concluded that the child had osteogenesis imperfecta. Cholecalciferol was prescribed 2000 IU 1 times a day, levocarnitine 10 drops (morning, day).

In order to clarify the diagnosis, a molecular genetic study was carried out using the Hereditary Skeletal Diseases gene panel or clinical exome sequencing. The results of which revealed a heterozygous variant of the nucleotide sequence in the COL1A1 gene (17-50187025-G-A), leading to the replacement of an amino acid in 1174 protein positions (p.Ala1174Val, NM_000088.4) described in patients with type 3 osteogenesis imperfecta.

At the age of 1 month and 2 days, the child underwent a control chest X-ray, which revealed the condition after suffering right-sided pneumonia, and antibacterial therapy was canceled. The child spent 10 days in the hospital and was discharged in satisfactory condition with a body weight of 4020 (an increase of 350 g) for outpatient observation, an X-ray of the right lower limb in two projections was prescribed after 1 month and a consultation with an orthopedic traumatologist.

Follow-up showed a favorable course of the disease, no new pathological fractures were observed on the X-ray.

As shown by the results of outpatient observation in the first year of the child's life, there were no repeated fractures. Average monthly body weight gains were 500-600 grams, height - 2-3 cm. Moderate muscle hypotension (less pronounced in dynamics) persisted, but the overall rate of psychomotor development corresponded to post-conceptual age.

A feature of the presented clinical case was a mild course with a favorable early course of the disease, uncharacteristic for type III osteogenesis imperfecta. However, the accompanying features characteristic of all cases of osteogenesis imperfecta were noted - a decrease in the mineralization of bone tissue (osteopenia) and stigmatization. Interesting from a pathogenetic point of view was the combination of bone pathology and diffuse muscle hypotension, hyporeflexia, which at the stage of inpatient treatment was interpreted as clinical manifestations of cerebral ischemia, but obviously had syndromic genesis and was also associated with the pathological type of muscle innervation and electrolyte imbalance in the musculoskeletal system. The pronounced regression of clinical symptoms in this patient in the first year of life indicates the possibility of positive dynamics as the postnatal age increases with a mild course of the disease.

Thus, timely diagnosis, a combination of drug and non-drug treatment, early active rehabilitation can achieve a significant effect in improving the patient's quality of life and preventing long-term undesirable consequences. The possibility of conducting a genetic study in combination with characteristic symptoms and the results of X-ray examination can make it possible to timely verify osteogenesis imperfecta with appropriate therapeutic and corrective measures, which will allow achieving positive dynamics and improving the prognosis of the course of the disease and, accordingly, the patient's quality of life.

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DOI 10.34660/INF.2025.18.69.049
UDC 377.7

克服个人情绪倦怠综合症的医学和心理学方法的概念
THE CONCEPT OF MEDICAL AND PSYCHOLOGICAL APPROACHES TO OVERCOMING THE SYNDROME OF INDIVIDUAL EMOTIONAL BURNOUT

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摘要：本文提出了一个非常重要的问题——预防不同人群神经衰弱的实用方法。这对于当今身处战区的情况尤为重要。

关键词：情绪倦怠综合征，情绪饱和环境，过度紧张症状的医学指征。

Abstract. *The article raises a very important problem - practical approaches to preventing nervous exhaustion of various segments of the population. This is especially important for today's situation - being in a combat zone.*

Keywords: *emotional burnout syndrome, emotionally saturated environment, medical indications of symptoms of overstrain.*

Problem statement. The intense pace of life, no less overloaded work schedule, the environment complicated by military actions - all this contributes to nervous strain, an increase in the number of mental illnesses, cardiovascular complications and other disorders in the human body, which over time cause emotional burnout syndrome. To prevent it in time is an important condition for each person personally. Timely appeal to medical workers and will be the right direction on the path to recovery and further maintenance of an appropriate level of well-being.

Scientific research of the problem. The state of emotional burnout and its prevention were the focus of attention of such scientists as: E. Tarasov, A. Anastasi, S. Urbin, L. Burlachuk, V. Sulimov, V. Makolkin, M. Potashnik, L. Solovey, A. Kolesnikova, S. Morozova, S. Krymsky, S. Ovcharenko, N. Vodopyanova, E. Starchenkova, G. Nikiforov, V. Boyko, D. Raigorodsky, V. Kisova, O. Katushenko, N. Merkulova and others [1-12]. The researchers were interested in different aspects of this serious deviation in human health. After all, in their opinion, the

problem of modern society, especially work in the "person-to-person" spheres – medicine, pedagogy, service spheres, creative workers, managers of various levels. This is excessive emotional and physical overload. Therefore, their main efforts were directed at restoring health, preventing further deterioration of the disease. The most famous description of the syndrome was later given by American psychologists K. Maslach and S. Jackson (1981): emotional burnout is a syndrome of emotional exhaustion, depersonalization and decreased personal achievement, which can occur among specialists engaged in various types of helping professions. According to a study by the health organization (WHO), professional burnout is recognized as a professional phenomenon and is included in the International Classification of Diseases (ICD-11). In 2018, the All-Russian Public Opinion Center (ARPOC), and in 2019, the Institute of Psychology of the Russian Academy of Sciences conducted studies among workers of various professions - teachers, medical workers, social workers, which showed that 42% of the subjects named emotional exhaustion, 25% - depersonalization, 14% - a decrease in the sense of personal achievement. According to the Maslach Burnout Inventory (MBI), the term "burnout" includes three main components:

- emotional exhaustion (Exhaustion);
- Depersonalization;
- Reduced personal effectiveness (Reduceaberaens).

In more detail, the generally accepted components of burnout are the following:

Emotional exhaustion. Refers to a feeling of exhaustion and emotional depletion that can result from persistent stress and negative emotions at work, such as:

- Feeling tired and exhausted, both physically and emotionally;
- Loss of motivation and enthusiasm for work;
- Increased irritability and dissatisfaction.

Depersonalization. This is the process by which a person begins to treat their clients, patients, or colleagues in an alienated and indifferent manner. Instead of empathy and care, indifference or even a negative attitude arises. Contributes to the development of cynicism and negative attitudes towards other people.

Reduced personal effectiveness. A feeling of loss of strength and ability to achieve success at work. People begin to feel that their efforts do not lead to the desired results, which can lead to disappointment and despair.

For example:

- a feeling of unfulfillment, dissatisfaction with one's work;
- loss of a sense of achievement and satisfaction with the results of one's work;
- deterioration in professional self-esteem and confidence in one's abilities.

Professional disappointment. This component of burnout is associated with a loss of satisfaction from work and dissatisfaction with professional achievements. People may feel that their work is meaningless or does not meet their expectations.

Physical symptoms. Burnout can manifest itself through physical symptoms such as: headaches, insomnia, digestive problems, high blood pressure and other manifestations of stress.

Cognitive impairment. Burnout can affect cognitive functions such as concentration, memory and decision-making. People may experience difficulty concentrating on certain tasks and decreased productivity.

Social alienation. This is a feeling of separation and isolation from others, both in the work and non-work environment. People suffering from burnout may feel lonely and unhappy in society.

Deterioration of relationships. Burnout can affect relationships with co-workers, friends, and family. People may become more irritable, argumentative, or avoid social interactions.

Increased stress levels:

- Frequent and unreasonable affective reactions to stressful situations.
- Difficulty concentrating and making decisions.
- Decreased tolerance for failure.

These symptoms can develop gradually and worsen over time if steps are not taken to prevent and treat burnout. It is important to remember that each person is different and symptoms may manifest themselves in different ways.

The main factors that contribute to burnout are:

High workload: This factor is related to the mismatch between the amount of work required and the time available to complete it. In the medical field, this can manifest itself in the form of healthcare professionals such as doctors and nurses being overwhelmed by a large number of patients, long working hours, and an abundance of administrative work. Insufficient time to rest and recover between shifts can lead to overwork, fatigue, and a feeling of helplessness in the face of a workload.

Emotional Exhaustion: This factor is associated with workers' repeated exposure to emotionally demanding situations. Healthcare workers such as doctors and nurses regularly face critical situations such as patient deaths, serious illnesses, and suffering. Emotionally intense interactions with patients can cause significant emotional exhaustion, depression, and a feeling of powerlessness.

Lack of Control and Autonomy: This factor is characterized by the worker's sense of inability to make independent decisions and manage their work process. In the healthcare field, this may manifest as a feeling of helplessness in the face of having to follow established protocols and procedures without the ability to influence them or adapt them to specific situations. The lack of a sense of control can lead to stress and frustration.

Lack of Support: This factor is associated with a lack of emotional and professional support from co-workers and management. In the medical field, this can

manifest itself in feelings of isolation and loneliness, especially in conditions of high workload and emotional stress. A lack of support can exacerbate the worker's feelings of stress and alienation.

These factors are key to understanding the process of professional burnout and can significantly affect professionals in various professional fields.

Researching burnout is an important task because it can have a serious impact on workers' health and productivity. Various diagnostic methods can be used for this purpose, including the Maslach Burnout Inventory (MBI) and burnout indices. Let's look at these methods in more detail:

Maslach Burnout Inventory (MBI). Is one of the most widely used instruments for measuring burnout. It assesses three main aspects of burnout: emotional exhaustion, depersonalization, and decreased personal fulfillment. The MBI is often used in international studies and burnout research in various professional fields. It is widely adapted and translated into different languages. The MBI provides a structured and reliable way to measure burnout, which allows for comparison of research results internationally.

Burnout indices. These are various instruments consisting of questions or statements aimed at assessing the level of burnout in workers. They can be adapted to specific cultural and professional contexts.

These indices are used to study burnout in various professional fields and in different countries, including Russia. They can include questions reflecting specific aspects of work and cultural characteristics.

Burnout indices can be more flexible and adaptable to specific research contexts, which allows for a more accurate assessment of the level of burnout in workers in different fields and working conditions. Both methods have their advantages and disadvantages, and the choice of a specific tool depends on the objectives of the study, the specifics of the professional field, as well as the availability and adaptability of tools to specific research conditions. It is important to take into account that burnout diagnostics should be carried out comprehensively and include not only measuring the level of burnout, but also studying its causes and consequences, as well as developing measures to prevent and manage this condition.

The consequences of professional burnout in specialists can be varied and include the following:

1. Psychological consequences:

- Increased stress and anxiety.
- Decreased satisfaction with work and life in general.
- Mood disorders, including depression and anxiety disorders.
- Decreased self-esteem and self-confidence.
- Increased irritability and conflict in relationships.

2. Physical consequences:
- Fatigue and physical exhaustion.
- Sleep problems, including insomnia.
- Increased blood pressure and cardiovascular disease.
- Headaches, migraines.
- Digestive problems such as heartburn, constipation, or diarrhea.

3. Social consequences:
- Isolation and alienation from co-workers and loved ones.
- Decreased quality of relationships at work and at home.
- Withdrawal from social activities and hobbies.

4. Professional consequences:
- Decreased productivity and quality of work.
- Increased risk of making mistakes and accidents at work.
- Increased number of days missed from work due to illness.
- Loss of interest in career advancement and professional development.

5. Economic consequences:
- Loss of income due to missed work days or job loss.
- Additional costs for medical care and treatment of physical and psychological problems associated with burnout. Effective prevention and intervention for burnout in professionals must take into account a variety of factors, including psychological, social, and organizational aspects. They should be aimed at improving the well-being and well-being of employees, reducing stress levels and preventing the development of burnout.

Let's look at some prevention and intervention strategies in more detail:

1. Awareness-raising and training: training professionals and managers about the signs of burnout, its causes and consequences can help them better understand, recognize and manage their own emotional states. The topic of mindfulness-raising and training includes the following activities:

a) Awareness of burnout signs: training professionals and managers about the characteristic signs of burnout allows them to better recognize and understand their emotional states.

b) Understanding the causes and consequences: training helps to recognize the causes of burnout, such as work overload, conflicts in the team or failure to meet expectations.

c) Developing self-management skills: participating in training in emotion and stress management helps professionals cope more effectively with challenges and maintain psychological balance.

2. Developing stress management skills: training in effective stress management methods includes practices that help cope with tension and increase overall resilience. These include:

a) **Relaxation techniques**: Learning relaxation techniques such as deep breathing, progressive muscle relaxation and yoga can significantly reduce stress and relieve tension.

b) **Meditation**: Regularly practicing meditation and mindfulness can improve concentration, reduce anxiety and improve overall well-being.

c) **Exercise**: Physical activity is a powerful stress reliever as it releases endorphins, which are responsible for a positive mood and overall stress reduction.

3. **Creating a supportive work environment**: Employers play a key role in creating an environment that promotes well-being and support for employees. This may include:

a) **Clear goals and expectations**: Setting clear goals and roles helps remove uncertainty, which reduces stress and creates a comfortable environment in the workplace. b) Work-life balance policies: Providing opportunities for flexible working hours, remote work and holidays support the balance between professional and personal aspects of life.

c) **Access to support and advice**: Creating anonymous and accessible channels for receiving help allows employees to openly discuss their problems and receive the necessary support.

d) **Fostering engagement and autonomy**: Giving employees more freedom to make decisions and control over their work helps to increase their motivation and confidence.

d) **Delegation of authority**: Empowering employees to make decisions increases their job satisfaction and motivation.

e) **Creating a culture of openness and support**: Creating an environment where employees can freely express their feelings and discuss problems helps to identify signs of burnout early and respond appropriately.

g) **Training activities**: Regular sessions on psychological well-being and burnout prevention help to strengthen a culture of openness and support.

g) **Mentoring system**: An effective tool for professional development and employee support, which helps to prevent and intervene in case of signs of burnout. Experienced employees can become mentors for less experienced or new colleagues, based on their professional skills and ability to empathize.

h) **Psychological counseling and support**: Providing access to professional psychological services helps employees cope with emotional difficulties and develop strategies for managing their condition.

Successful implementation of these strategies requires cooperation from all participants in the organization, from management to employees. Creating a healthy and supportive work environment, where everyone feels respected and supported, plays a key role in the prevention and intervention of professional burnout.

Evaluation of the results of prevention and intervention in case of professional burnout includes several stages and methods of evaluation. Here are some ways to check the effectiveness of the interventions:

Evaluation of the level of burnout: The use of standard psychological questionnaires, such as the Maslach Burnout Inventory or other similar tools, can help to evaluate changes in the level of burnout in professionals before and after the intervention.

Feedback from participants: Collecting feedback from participants in the interventions, including their opinions on the quality of the interventions, their perception of their usefulness and effectiveness, can be a useful evaluation tool.

Analyzing statistical data: Analyzing statistical data such as productivity levels, absenteeism rates, job satisfaction levels, etc. can help determine changes in these indicators after the implementation of prevention and intervention activities.

Monitoring changes in organizational culture: Analyzing changes in organizational culture such as employee relationships, levels of trust and support from management can also provide insight into the effectiveness of the interventions.

Process metrics: Using process metrics such as the number of training sessions conducted, employee participation in interventions, and the speed of response to burnout cases detected can provide insight into the progress and effectiveness of prevention efforts.

It is important to use a combination of different evaluation methods to obtain a comprehensive picture of the effectiveness of the prevention and intervention activities in the case of professional burnout. The recommendations below are applicable to a wide range of businesses and organizations, including companies in various industries, the IT sector, financial institutions, educational institutions, healthcare institutions, government agencies and others. They can be useful for companies of all sizes - from large corporations to small and medium-sized enterprises. It is important that businesses are prepared to support their employees in maintaining their psychological well-being and preventing professional burnout. This requires:

1. Conducting regular training on stress and emotional load management.

2. Creating a supportive and empathetic atmosphere in the work environment, where professionals can communicate openly and feel supported.

3. Providing opportunities for professional skill development and career development so that professionals feel confident and competent.

4. Implementing flexible working hours and opportunities for rest so that professionals can maintain a balance between work and personal life.

5. Conducting regular stress and burnout assessments followed by providing individualized support and assistance.

6. Training specialists in self-regulation and emotion management methods to effectively cope with stressful situations.

7. Assistance in forming a support network, including consultations with psychologists and coaches, where specialists can get help and advice.

8. Supporting and encouraging physical activity and a healthy lifestyle, which helps relieve stress and improve overall well-being.

9. Regularly holding training seminars and master classes on burnout management and maintaining psychological health.

10. Creating a system of mutual feedback and opportunities for expressing care and support from management and colleagues.

Conclusions. The ability to regulate the pace of work and rest, promptly prevent complications that arise, and have close ties with health workers will contribute to the timely adoption of measures to restore health, coordinate and provide additional resources for health preservation. Cooperation with medical institutions is the main goal of medical support and the development of the quality of self-support in resolving life situations that arise, one of which is the problem of emotional burnout.

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DOI 10.34660/INF.2025.18.40.050

慢性胰腺炎合并胆管结石的外科治疗策略和技术优化
OPTIMIZATION OF TACTICS AND TECHNIQUES FOR SURGICAL TREATMENT OF CHRONIC PANCREATITIS COMPLICATED BY WIRSUNGOLITHIASIS

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Objective of the study: To develop and clinically substantiate an improved approach to the diagnosis and surgical treatment of patients with chronic pancreatitis (CP) complicated by wirsungolithiasis, with a focus on the technical aspects of pancreaticojejunostomy formation using a modified Puestow technique.

Relevance: The prevalence of CP and its complications, including wirsungolithiasis, is steadily increasing. Impaired pancreatic juice outflow due to ductal stones leads to chronic pain, reduced quality of life, and patient disability. Diagnostic difficulties and limited outcomes of traditional surgical approaches necessitate the refinement of tactical and technical treatment strategies.

Materials and methods: The study included 47 patients with CP and wirsungolithiasis treated at the Republican Specialized Scientific and Practical Medical Center of Surgery named after academician V. Vakhidov between 2006 and 2024. Diagnostic methods included ultrasound (US), CT, MRI/MRCP, and laboratory testing. Patients were divided into groups based on treatment type: endoscopic or open surgical intervention. In the main group, the author's modifications of pancreaticojejunostomy suture techniques were applied.

Main results: MRI with MRCP demonstrated the highest sensitivity (97.1%) and accuracy (84.6%) in diagnosing wirsungolithiasis. Three variants of suture techniques were proposed depending on the duct wall condition: U-shaped sutures for rigid walls; continuous sutures for friable tissue; and inverting sutures for elastic duct walls. The use of the modified Puestow procedure reduced the rate of postoperative complications from 16.7% to 10.0%, eliminated the need for repeat interventions (from 16.7% to 0%), shortened hospital stay (from 8.4±0.8 to

6.3±0.5 days), and decreased the recurrence of stone formation and pain syndrome over three years (from 33.3% to 5.0%).

Conclusions: The developed diagnostic algorithm and modified surgical techniques for pancreaticojejunostomy formation in wirsungolithiasis provide high clinical effectiveness, safety, and a reduced recurrence rate. Implementation of this approach is recommended for specialized surgical departments.

DOI 10.34660/INF.2025.40.54.051

实用肿瘤学中肝细胞癌病理形态学诊断的问题

PROBLEM ASPECTS OF PATHOMORPHOLOGICAL DIAGNOSTICS OF HEPATOCELLULAR CACINOMA IN PRACTICAL ONCOLOGY

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摘要。在现代临床肿瘤学中，肿瘤基质的病理形态学验证至关重要，其目的是确定肿瘤的类型和基因型归属，进而决定进一步的治疗策略、现有治疗方法的顺序、治疗敏感性以及疾病的预后。目前，肝癌——肝细胞癌和/或肝胆管癌——的病理形态学验证最为重要且复杂。在肿瘤发病率结构中，肝细胞癌（HCC）位居第八位。当HCC播散至脑结构、骨骼和其他解剖区域时，这一问题尤为重要，根据各种文献数据，这些区域并非HCC血源性和淋巴源性播散的典型特征。我们已描述了几例上述转移类型的病例及其病理形态学诊断特征[1,2]。关键词：肝细胞癌，未分化癌，形态学验证，再次活检。

Abstract. *In modern clinical oncology, pathomorphological verification of the tumor substrate is key, the purpose of which is to determine the type and genotypic affiliation of the tumor process, which in turn determines further treatment tactics, the sequence of existing treatment methods, determination of sensitivity to treatment, and also determines the prognosis of the disease. Today, the greatest interest and complexity in the mentioned verification is caused by liver cancer - hepatocellular carcinoma and/or cholangiocarcinoma of the liver. In the structure of oncological morbidity, HCC occupies the 8th rank place. The issue is particularly relevant in the case of HCC dissemination into brain structures, skeletal bones and other anatomical zones, which are not very typical of hematogenous and lymphogenous dissemination of this pathology according to various literature data. We have described several cases of the above-mentioned types of metastasis and the features of their pathomorphological diagnostics [1,2].*

Keywords: *hepatocellular carcinoma, undifferentiated carcinoma, morphological verification, rebiopsy.*

The aim of the study was to assess the error of quantitative and qualitative indicators of the possibility of pathomorphological diagnosis of hepatocellular carcinoma. Materials and methods. In 2022-2024, 35 patients aged 55 to 70 years underwent morphological and histological verification (including after radical operations with the definition of postoperative verification). All patients had a locally advanced or metastatic form of stage III-III and IV of the process (T3NxM0 - T4N1M1). At the time of the initial visit, all patients had a diagnosis of hepatocellular carcinoma, confirmed by histological verification, as well as based on the AFP indicator, CT of the abdominal organs with contrast. In 5 cases (14.3%), morpho-verification accounted for hepatocellular carcinoma, in 25 cases (71.4) it accounted for undifferentiated carcinoma. All 35 patients underwent specialized treatment. Of these, 29 patients underwent surgical intervention in the amount of right or left-sided hemihepatectomy, in 6 cases patients underwent TACE (trans arterial chemoembolization) in combination with targeted therapy. In all cases of operated patients, relapse of the disease occurred no earlier than 6-8 months and in 40% of cases occurred in mts lesions of the lungs and skeletal bones. For the purpose of morphological verification, a biopsy of the formation was performed. In 24 cases, the morphology of the relapse was described as undifferentiated carcinoma. In 2 cases, the nature of the disease course, the response to the combined therapy (transarterial chemoembolization + immunotargeted therapy) did not correspond to the classical descriptive course of the disease, which initiated additional immunohistochemical clarification caused by doubts about the reliability of the previously established clinical diagnosis. Upon further clarification and revision of the biomaterial, undifferentiated carcinoma was established, which in turn cor-

responds to a different type of malignant disease. Only by receiving the response from the IHC analysis data was it possible to establish the tumor's correspondence to the nature of hepatocellular carcinoma. Depending on the level of histological differentiation, four degrees of malignancy were distinguished. Hepatocellular carcinoma cells were stained for alpha-fetoprotein in 70-90% of cases, which made it possible to exclude cholangiocarcinoma and liver metastases. However, staining was usually partial or focal, and the sensitivity reached no more than 10%, but according to various authors, it varies in the range between 15-70% [1,2]. In addition, according to the same authors, alpha-fetoprotein (AFP) can be detected in small quantities in regenerating hepatocytes in hepatitis and liver cirrhosis, as well as in normal cells located around hepatomas and metastatic nodes. Nevertheless, determination of the alpha-fetoprotein content in the blood serum is currently the most reliable marker of HCC, although the sensitivity and specificity of the method are 39-64 and 76-91%, respectively. The specificity of determining the AFP level depends, in particular, on the etiology of the process and is higher (78%) in HBsAg-positive patients compared to HBsAg-negative patients (50%). The concentration of alpha-fetoprotein over 20 ng/ml or lower figures, but with a tendency to slowly increase, are considered indicators of tumor damage. At the same time, a weak correlation has been established between the level of alpha-fetoprotein in the blood serum and the size of the tumor node [1,2]. Another marker of hepatoid differentiation is considered to be Hep Par-1, diffuse granular expression of which is found in the cytoplasm of normal hepatocytes, as well as tumor cells in 80-90% of HCC observations, however, this method was not applied by us in practice. We provide several materials from the described observation:

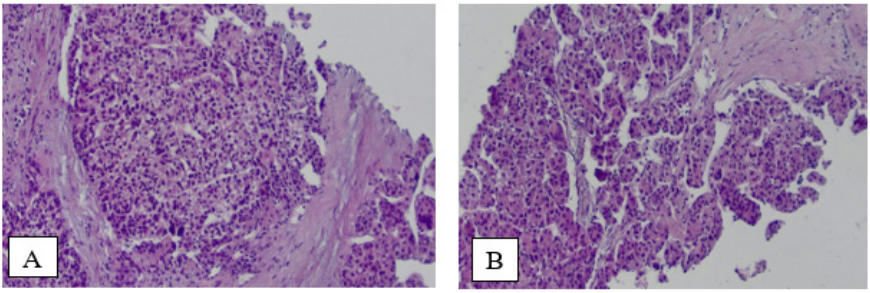

Figure 1. *Morphological picture of hepatocellular carcinoma G II (A, B). (The material contains liver tumor tissue in which tumor complexes of medium and large cells with broad cytoplasm, hyperchromic nuclei form a trabecular structure. Individual fragments of necrotic masses up to 20%)*

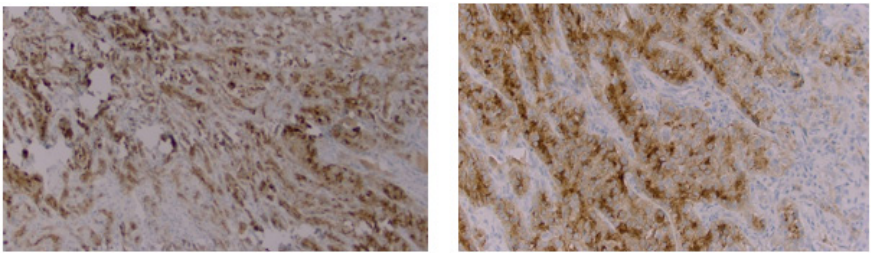

Figure 2. *Morphological picture of hepatocellular carcinoma G II (A, B). (Immunohistochemical study of liver cancer, in the biopsy metastasis of poorly differentiated carcinoma, Glypikan 3 is positive, TTF is negative, NapsinA is negative).*

Results and their discussion. According to the analysis, in 24 cases the morphology of the relapse was described as undifferentiated carcinoma. In 2 cases, the nature of the disease course, the response to the combined therapy (transarterial chemoembolization + immunotargeted therapy) did not correspond to the classical descriptive course of the disease, which initiated additional immunohistochemical clarification caused by doubts about the reliability of the previously established clinical diagnosis. With additional clarification and revision of the biomaterial, undifferentiated carcinoma was established, which in turn corresponds to a different type of malignant disease. Only by receiving the response from the IHC analysis data it was possible to establish the correspondence of the tumor to the nature of hepatocellular carcinoma. The observations described above were also confirmed in a number of other clinical cases in relation to hepatocellular carcinoma. It becomes obvious that the approaches to rebiopsy of the formation in breast cancer, lung cancer with repeated morphological examination by the same analogy, previously recommended in many clinical protocols, are ultimately relevant for hepatocellular carcinoma. Only repeated confirmed morphological verification allowed us to determine the correctness of the previously established diagnosis and continue treatment according to the clinical protocol for the treatment of hepatocellular carcinoma. It was established that out of 24 previously described cases, all 24 were confirmed by an undifferentiated type of hepatocellular carcinoma, the typical affiliation of which was described above, which allowed continuing treatment in 22 cases (91.6%) and achieving a statistically significant median survival of 12 months or more.

Conclusions. Morphological verification of the oncological process remains the main diagnostic technique and does not lose its relevance. In addition, the existing primary histological verification requires additional detailed revision and clarification, which in turn reliably and clinically significantly affects the thera-

peutic treatment option by increasing the frequency of the overall response, the median survival and demonstrating an improvement in the quality of life of patients.

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DOI 10.34660/INF.2025.78.71.052

浊度对水生区域植物和微生物的影响

THE INFLUENCE OF TURBIDITY ON PLANTS AND MICROORGANISMS IN AQUATIC AREAS

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摘要：本文探讨了水体浊度对水生生态系统的多重影响，重点阐述了其温度依赖性机制及其生态后果。悬浮颗粒和微气泡的形成导致浊度升高，从而降低光的穿透力，扰乱营养级联，并改变底栖生物的生境，这一点已在涅瓦湾（波罗的海）和黑海的案例研究中得到证实。临界浊度水平（>12 毫克/升）具有杀藻作用，而中等浊度水平（5–12 毫克/升）则可能刺激浮游植物的生长，呈现出非线性生态响应。悬浮颗粒还会增强污染物的生物利用度和迁移，从而加剧毒性。研究结果强调了浊度作为关键压力源的作用，因此有必要将其纳入水资源管理和保护战略。

关键词：水体、浊度、温度、水生生物。

Abstract. *This article examines the multifaceted impacts of water turbidity on aquatic ecosystems, highlighting its temperature-dependent mechanisms and ecological consequences. Elevated turbidity, driven by suspended particles and microbubble formation, reduces light penetration, disrupts trophic cascades, and alters benthic habitats, as evidenced by case studies from Neva Bay (Baltic Sea) and the Black Sea. Critical turbidity levels (>12 mg/L) exhibit algicidal effects, while moderate levels (5–12 mg/L) may stimulate phytoplankton growth, demonstrating a nonlinear ecological response. Suspended particles also enhance pollutant bioavailability and transport, exacerbating toxicity. The findings underscore the*

role of turbidity as a key stressor, necessitating its integration into water resource management and conservation strategies.

Keywords: *water bodies, turbidity, temperature, aquatic organisms.*

Turbidity in water bodies not only degrades aesthetic quality but can also pose risks to both aquatic ecosystems and human health. Elevated turbidity may result from the presence of suspended particles and organic matter, such as sand, silt, and clay. Temperature also influences water turbidity: as temperature rises, turbidity tends to increase [1, 2]. This phenomenon is attributed to the behavior of dissolved gases in water. As temperature increases, gas solubility decreases, leading to the formation of microscopic bubbles. These bubbles create heterogeneous systems, where pollutants can be adsorbed at phase interfaces. Furthermore, higher temperatures accelerate coagulation processes, further contributing to turbidity changes.

Water turbidity is temperature-dependent due to the formation of microbubbles. When temperature fluctuates, water containing suspended particles with diameters ranging from 0.004 mm to 1 mm becomes turbid first. These microbubbles exceed the wavelength of red light (~620–750 nm), causing light scattering, which increases turbidity. In cold water, such particles exhibit reduced light scattering [3].

Rising temperatures elevate water turbidity, which in turn can significantly disrupt trophic cascades in aquatic ecosystems, particularly affecting phytoplankton and microbial communities. This impact operates through multiple mechanisms. By reducing the penetration of sunlight, the amount of it reaching aquatic plants, which are important for photosynthesis, is reduced. This disruption of plant growth can lead to decreased oxygen levels in the water and affect the entire food chain of the water body.

Suspended particles may sediment in water bodies, modifying benthic habitats. This particularly affects bottom-dwelling organisms (e.g., demersal fish and benthic invertebrates) that rely on substrate composition for survival and reproduction. Turbidity-causing suspended particles can alter aquatic chemistry through: adsorption-mediated transport (particles act as carriers for adsorbed organic/inorganic compounds and heavy metals, facilitating their long-range dispersion) and bioavailability enhancement. This process converts otherwise passive pollutants into biologically active forms, potentially increasing their ecological toxicity [4]. The results [5] showed that increases in turbidity significantly reduce the gross primary production (GPP) and ecosystem respiration (ER).

A slight increase in turbidity (5-8 mg/L) stimulates phytoplankton growth. At moderate turbidity levels (8-12 mg/L), phytoplankton abundance remains stable. However, when turbidity exceeds 12 mg/L in open coastal areas, it exhibits algicidal effects (similar to the action of chemicals used to control algae in both

freshwater and marine environments). Depending on the severity and duration of pollution, these changes can lead to disruption of trophic interactions, elimination of certain components in food webs, overall ecosystem degradation.

Increased turbidity can lead to reduced species diversity in water bodies, as higher concentrations of suspended solids decrease population metrics across all groups of aquatic organisms—most of which form critical components of the fish food base. These impacts are well-documented in several case studies. In Neva Bay (Baltic Sea), ecological surveys conducted since the mid-2000s reveal a four-fold decline in macrozoobenthos abundance accompanied by a 50% reduction in species diversity, with endemic species either disappearing entirely or being displaced by invasive taxa. Similarly, in the Black Sea, long-term monitoring has recorded the progressive shrinkage of habitats dominated by perennial brown algae (Cystoseira spp.), where traditional "underwater forests" are undergoing ecological succession toward Mediterranean and tropical species complexes. These shifts demonstrate how suspended sediments act as both direct stressors (through gill abrasion and light attenuation) and indirect drivers of community restructuring via habitat modification and competitive exclusion [6].

Alterations in species composition emerge even under minimal water pollution levels undetectable by conventional chemical analysis methods. Consequently, the taxonomic makeup and quantitative parameters of benthic invertebrate communities function as reliable bioindicators of both sediment and benthic water layer contamination. Suspended particulate matter adversely affects aquatic ecosystems through multiple pathways: it isolates nutrient-rich bottom strata, buries substrate-dwelling organisms and vegetation, while simultaneously clogging and damaging the specialized filtration, respiratory, and feeding structures of invertebrates. The respiratory compromise stems from dual mechanisms - suspended particles not only impede photosynthetic activity (thereby reducing oxygen production) but may also directly absorb dissolved oxygen from the water column. This oxygen depletion is further exacerbated by water intrinsic viscosity, which imposes greater respiratory challenges compared to terrestrial environments. The resultant hypoxic conditions frequently trigger mass mortality events, commonly referred to as "fish kills" in limnological literature. Persistent turbidity also drives fundamental restructuring of zooplankton communities, characterized by trophic cascade effects where filter-feeding taxa are progressively displaced by predatory species, accompanied by significant reductions in total plankton biomass that exhibit dose-dependent relationships with both the concentration and physicochemical properties of suspended particles.

In turbid water, bacteria multiply faster. Solid particles protect microorganisms, which are present in all water except disinfected water, from ultraviolet radiation, allowing them to reproduce more rapidly. In murky water, bacteria can proliferate faster because suspended particles shield microbes from UV light.

However, it should be noted that the impact of turbidity on aquatic organisms may vary depending on other factors, such as the nature of the sediment in the observation area.

Conclusions

Turbidity affects not only the visual appearance of water bodies but also the plants and microorganisms living in them. Thus, water turbidity can significantly influence ecosystems and food chains, which is important to consider when assessing the state of water resources and their protection.

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DOI 10.34660/INF.2025.24.20.053
UDC 622.235

地下条件下使用散装乳化炸药时的装药作业机械化
MECHANIZATION OF CHARGING OPERATIONS WHEN USING BULK EMULSION EXPLOSIVES IN UNDERGROUND CONDITIONS

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摘要。本文概述了可在地下条件下将乳化炸药 (EE)"Argunit RH"装入钻孔和孔洞的机械化工具。这种EE专为地下采矿而设计，由于其高粘度，装药后可保留在上升的钻孔（孔洞）中。EE"Argunit RH"的显著特点是通过生成过氧化气体进行敏化。为了有效生成过氧化气体，采取措施提高气体发生添加剂的pH值，并使用pH值> 6的基质乳化剂。这有助于降低EE与硫化矿（镍、钴、锌、铜和其他有价金属的主要来源）相互作用的活性，并提高开采过程中爆破作业的安全性。本文介绍了在地下条件下使用EE的装药和混合装置的技术特点。结论是，提出的装药作业机械化方法和使用"Argunit RH"炸药的爆破作业技术值得推荐给矿山企业，尤其是采用地下方法开发硫化矿的企业。

关键词：地下采矿，乳化炸药，装药作业机械化方法，"Argunit RH"炸药。

Abstract. *The paper presents an overview of the mechanization tools that allow loading boreholes and holes with the emulsion explosive substance (EE) "Argunit RH" in underground conditions. This EE is specially designed for use in underground mining, since due to its high viscosity it can be retained in ascending boreholes (holes) after charging operations. A distinctive feature of the EE "Argunit RH" is its sensitization by means of peroxide gas generation. For effective peroxide gas generation, measures are taken to increase the pH of the gas-generating additive and a matrix emulsion with pH> 6 is used. This circumstance helps to reduce the activity of the EE interaction with sulfide ores, which are the main sources of nickel, cobalt, zinc, copper and other valuable*

metals, and increases the safety level of blasting operations during their extraction. The paper presents the technical characteristics of charging and mixing devices for using EE in underground conditions. It is concluded that the presented means of mechanization of charging operations and the technology of blasting operations using the "Argunit RH" explosive can be recommended for use by mining enterprises, especially those developing sulfide ores using the underground method.

Keywords: *underground mining, emulsion explosives, means of mechanization of charging operations, "Argunit RH" explosive.*

Introduction

Currently, the main volume of blasting operations in open-pit mining is carried out using emulsion explosives (EE) [1]. This is due to the high consumer properties of these explosives (EE), as well as the fact that EE can be manufactured at the sites of blasting operations, which significantly reduces the costs of logistics and security measures.

However, in underground mining, the use of safer and more economical EE is limited. This is explained by the peculiarities of underground mining technologies, which are characterized by cramped conditions and the widespread use of rising charges of explosives. The latter narrows the scope of application of cartridge explosives and does not allow blasting operations to completely abandon the standard TNT-containing granulated explosives. The solution to the issue of expanding the use of explosives in underground mining has emerged in the use of bulk explosives with chemical gas generation. The latter ensures both a high level of safety, since the charged emulsion acquires the properties of explosives already placed in the well (borehole), and the lowest economic costs for imparting explosive properties to the emulsion (compared to other sensitization methods). However, for the effective use of bulk explosives, it is necessary to implement a set of technological and technical solutions aimed at providing blasters with:

- various means of mechanization of charging operations, allowing blasting operations to be carried out in a variety of conditions - when sinking shafts and capital workings on the haulage horizon, cutting auxiliary workings, including ascending ones, borehole (borehole) breaking, crushing oversized material and eliminating hang-ups;
- matrix emulsions capable of gas generation in a cold state;
- explosives capable of being retained in ascending wells (boreholes) after charging operations.

During underground mining in the Russian Federation, significant volumes of explosives are consumed, therefore the decision on the transition to explosives instead of standard TNT-containing explosives is an urgent technical and scientific task.

Currently, in the Russian Federation, the most active companies implementing the developed technologies for the use of bulk explosives in underground works are “EVOBLAST” LLC, AO NIPIGORMASH, AO Nitro-Sibir and “RudKhim” LLC. The first three companies use sodium nitrite for chemical gas generation, while OOO RudKhim uses hydrogen peroxide. It is known that for efficient gas generation of explosives using sodium nitrite, it is necessary to lower the pH of the gas-generating additive (GGA) and use a matrix emulsion with pH <4. Increased acidity of the explosives promotes the activation of the exothermic interaction of the explosives with sulfide ores [2-9]. This reduces the safety level of blasting operations due to the increased risk of an uncontrolled explosion of the explosives. To avoid this phenomenon, inhibitors are introduced into the composition of the explosive explosives, which slow down the reactions of interaction of ammonium nitrate, which is the main component of the explosive explosives, with sulfide ores [10-15]. However, the use of inhibitors reduces the explosive characteristics of the explosive explosives [2, 16]. RudKhim LLC, which uses hydrogen peroxide for gas generation of the explosive explosives, on the contrary, takes measures to increase the pH of the GGD for effective gas generation and uses a matrix emulsion with pH> 6 [17]. This circumstance helps to reduce the activity of interaction of the explosive explosives with sulfide ores and increases the safety level of blasting operations [4, 12].

Sulfide ores are the most important sources of nickel, cobalt, copper, zinc, lead and other valuable metals that play a huge role in the Russian economy. Safe technology for mining these ores is certainly important and in demand by the country’s mining industry, so a detailed examination of the underground blasting technology offered by “RudKhim” LLC is of interest. MAIN CONTENTS This paper presents an overview of the mechanization of charging operations developed and manufactured by “RudKhim” LLC. These devices allow charging boreholes and boreholes with high-viscosity explosive Argunit RH [18, 19]. The explosive Argunit RH is manufactured by “RudKhim” LLC using an original technology specifically for use in underground conditions. The matrix emulsion of “Argunit RH” is capable of gas generation in a cold state, and its high viscosity and stickiness allow it to be retained in ascending boreholes (boreholes) after charging operations without additional shut-off devices and sleeves. This explosive has a high detonation speed (5100-5400 m/s) and can be used to destroy rocks of any strength and water content.

Below in Fig. 1-3 are shown the developed borehole chargers and charging-mixing modules.

The technical characteristics of the presented devices are given in Tables 1-3.

I. Borehole chargers

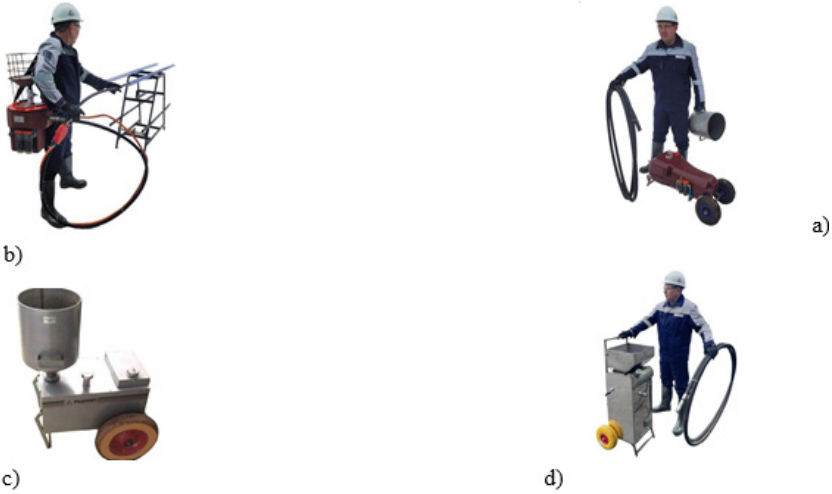


Figure 1. *Borehole loaders: a) RH-1; b) RH-2.001.1; c) RH-2-001.2; d) RH-2.002*

Borehole loaders differ in weight and productivity and are designed for the production of "Argunit RH" explosives and charging boreholes.

They are manufactured in two versions:

- with a pneumatic drive;
- with an electric drive (from a battery).

Loading is done in portions. The portion size for RH-1 is 250 g, and for other loaders - 1 kg.

Table 1.

Technical characteristics of borehole loaders

Indicators	PX-1	PX-2.001.1	PX-2.001.2	PX-2.002
Net weight, kg	16	27	40	35
Emulsion capacity, l	10 or 20	20	20	21
Sensitizer capacity, l	1	2,5-5,0	2,5-5,0	3
Dimensions LxWxH, mm	350x 270x 375	700x 330x 319	700x 550x 900	530x 510x 1155
Length of charging hose up to, m	5	7	7	10

Diameter of charging hose, mm	25	32	32	32
Productivity, kg/min	10-12	15-20	15-20	15-10
Power, W	200	600	600	600
For pneumatic drive min. compressed air pressure, bar	3	3	3	3
For electric drive accumulator, V	24	24	24	24
Density of explosives, g/cm^3	0.8-1.2	0,8-1,2	0,8-1,2	0,8-1,2
Batch charger, batch, g	250	1000	1000	1000
Remote activation on charging hose	Да	-	-	-

II. Transportable mixing and charging modules

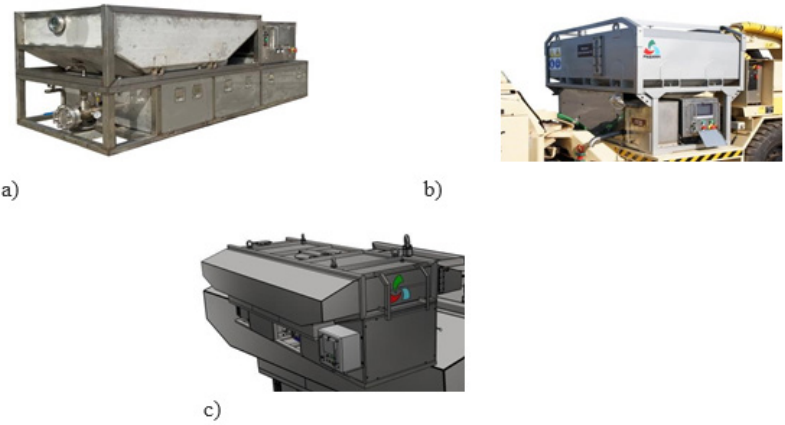


Figure 2. *Transportable mixing and charging modules*
a) on a railway platform -RH – 3; b), c) on a self-propelled chassis – RH-4 and RH-5

Mixing and charging modules are designed for the production of explosive explosives “Argunit RH” and charging boreholes and boreholes.

RH-3 is transported on a railway platform. It has a pneumatic or electric drive.

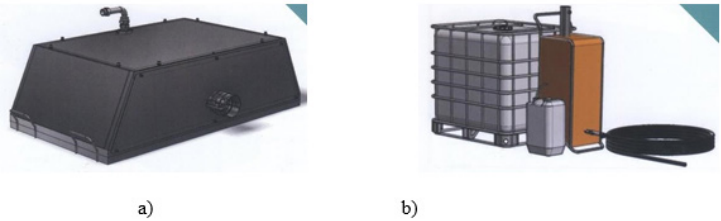
RH-4 and RH-5 are transported on a self-propelled chassis. They have a pneumatic or hydraulic drive.

Table 2.

Technical characteristics of transportable mixing and charging modules

Indicators	**PX-4**	**PX-4**	**PX-5**
Net weight, kg	970	600	1900
Emulsion capacity, l	730	1000	3,3 м3
Sensitizer capacity, l	100	40	180
Water capacity, l	200	80	280
Dimensions LxWxH, mm	2600x 1110x 1100	1906x 1152x 1480	3285x 1950x 1300
Charging hose length up to, m	350	20 для шпуров 50 для скважин	50
Charging hose diameter, mm	32	32	32
Density of explosives, g/cm^3	0.8-1.2	0,8-1,2	0,8-1,2
For pneumatic drive			
Power, kW	8	4	4
Productivity, kg/min	75	45	75
min compressed air pressure, bar	3	4	-
Compressed air consumption, m^3/min	8-10	24	-
For hydraulic drive			
Produces, kg/min		75	75
Oil pressure, bar	-	110	110
Oil flow, l/min	-	90	90
For electric drive voltage, V	380	-	-

III. Mixing and charging modules compatible with IBC containers



a) b)

Figure 5. *Mixing and charging modules: a) RH – 6; b) RH-6R*

Mixing and charging modules compatible with IBC containers are designed for the production of “Argunit RH” explosives and for charging boreholes and holes.

The modules are transported manually on a trolley, on an excavator bucket or on a self-propelled chassis.

RH-6 is manufactured with pneumatic, hydraulic or electric drives.

RH-6R has only a hydraulic drive.

Table 2.

Technical characteristics of the mixing and charging modules RH – 6 and RH-6R

Indicators	PX-6	PX-6P
Net weight, kg	130	85
Emulsion comes from IBC container	1 м3	1 м3
Sensitizer comes from PE canister, l	20-30	40
Dimensions LxWxH, mm	1906x1152x1480	640x425x1400
Length of charging hose up to, m	50	100
Diameter of charging hose, mm	32	32
Density of explosives, g/cm^3	0.8-1.2	0,8-1,2
For pneumatic drive		
Power, kW	4	4
Productivity, kg/min	75	-
min compressed air pressure, bar	5	-
Compressed air consumption, m^3/min	3	-
For hydraulic drive		
Produces, kg/min	75	200
Oil pressure, bar	110	110
Oil flow, l/min	90	90
For electric drive voltage, V	380	-

Conclusions. Analysis of the technical parameters of the developed blasthole chargers and charging and mixing modules shows that they allow effective blasting operations during underground mining of minerals in any conditions. This circumstance allows us to recommend the above-presented means of mechanization of charging operations and the technology of blasting operations using the Argunit RH explosive explosive for use by mining enterprises, especially those developing sulphide ores by underground methods.

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DOI 10.34660/INF.2025.61.47.054

铁路轨道基础设施无损检测的要素
THE ELEMENTS OF NON-DESTRUCTIVE TESTING OF RAILWAY TRACK INFRASTRUCTURE

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摘要。主要铁路干线轨道设施管理统计资料列出了以下参数：首条铺设钢轨的长度和通过吨位，每公里百万吨，250公里以下（251-350公里；351-500公里；501-600公里；601-700公里；701-1100公里和1100公里以上）。钢轨按磨损情况进行分布：轻微磨损和侧向磨损。列出了年内更换的缺陷钢轨、近乎缺陷钢轨和缺陷钢轨数量；B类、T1类、DT350类钢轨长度。DT370IK类钢轨和外国制造钢轨长度。为了确保列车运行安全，实现轨道交通行业的高质量管理，一个重要课题是利用现代方法对轨道交通缺陷进行检测，即无损检测方法。本文将对这一课题的现状进行综述。

关键词：无损检测、诊断、轨道交通、缺陷、缺陷检测仪。

Abstract. *The statistical documents on the management of the rail facilities of the main railway lines indicate the following parameters: the length of the first laid rails with the passed tonnage, million tons gross per 1 km, km up to 250 (251-350; 351-500; 501-600; 601-700; 701-1100 and more than 1100). Distribution of rails by wear is carried out: reduced wear and lateral wear. Defective and approximately defective rails and defective rails replaced individually during the year are indicated; the length of rails of categories: B, T1, DT350. The length of rails of category DT370IK and rails of foreign manufacture. To ensure the safety of train movement, high-quality management of the rail industry, an important issue is the use of modern methods of rail flaw detection, non-destructive testing methods, a review of the current state of this issue is devoted to this article*

Keywords: *non-destructive testing, diagnostics, rails, defects, flaw detectors.*

It is known that non-destructive testing (NDT) is a control of the reliability of the main working properties and parameters of objects (individual elements or units), which does not require the object to be taken out of operation or dismantled.

Such testing is carried out to assess the working properties and parameters and should reflect the objective feature of the object or product, manifested during its creation, operation and consumption, as well as to assess the quality of the product, a set of properties that determine the suitability to meet certain needs in accordance with its purpose.

With non-destructive testing, the quality level is also assessed as a relative characteristic based on a comparison of a set of indicators of its quality with the corresponding set of basic indicators.

In the regulatory documentation, when creating products, nominal (specified) quality indicators and permissible deviations of actual values of indicators from nominal ones are established.

Track measuring car - defectoscope on a section of railways beyond the Arctic Circle

Two-wire flaw detector

Figure 1. *Means of non-destructive testing of rails*

Each individual non-conformity of the product to the requirements established in the regulatory documentation for the product is a defect.

Defects in rails can be formed: at the manufacturing stage at metallurgical plants (MK); during rail welding at rail welding enterprises (RWE); due to violations of the technology of laying and current maintenance of the track.

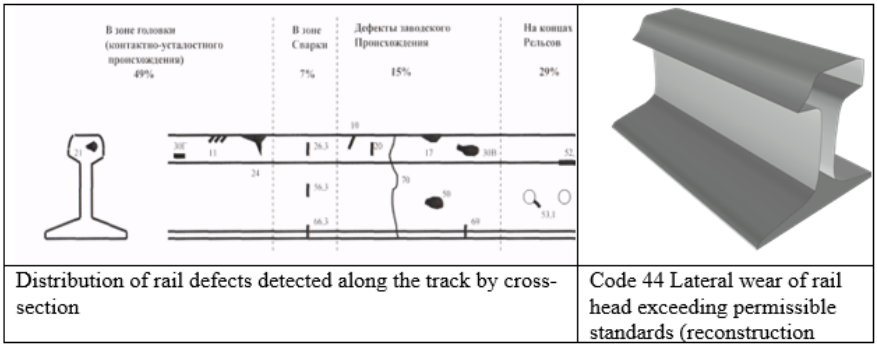
From the beginning of the existence of railways and until the 1930s, only track walkers carried out constant monitoring of the condition of the rails.

In 1928, the ultrasonic flaw detection method (magnetographic method) of rail testing was first proposed; since 1952, ultrasonic flaw detectors have been put into operation to check rails on the track; since 1961, ultrasonic rail testing has been

introduced at rail welding enterprises; since 1986, ultrasonic rail testing has been introduced at metallurgical plants. The single-line rail bicycle flaw detector of the Karpov F.M. system was used in the 1930s. The first generation flaw detection systems based on flaw detectors of the URD-52, UZD-56, URD-58, URD-63 type were used when the fundamental theoretical foundations of the echo and mirror-shadow methods were still absent and for about 20 years were the main means of non-destructive testing of rails on the track. Starting from 1993, specialists in measuring equipment for diagnostics of railway tracks are connected to solving flaw detection problems, double-line and single-line flaw detectors are created, and manufacturers of combined flaw detection cars and railcars are also connected to solving flaw detection problems (2000s).

Code 99.1	Code 27.3	rail defects identified using ultrasonic testing NIIIM 6 M (90e)

Figure 2. *Defects (at the Moscow Infrastructure Directorate testing ground)*



Distribution of rail defects detected along the track by cross-section	Code 44 Lateral wear of rail head exceeding permissible standards (reconstruction

Figure 2. *Determination of rail defects and wear defects*

Structurally, the flaw detector consists of electronic units, acoustic blocks and a scanning device. The ultrasonic multichannel flaw detector unit provides generation of excitation pulses for ultrasonic resonators, amplification and preliminary processing of signals from the resonators. The control and indication unit controls the flaw detector operation, displays and records flaw detection information. Currently, the road network uses new generation removable flaw detectors: RDM-23,

Avikon-31, Chameleon 32 + (on phased arrays), high-speed diagnostic complex "Sprinter"; new mobile diagnostic tools are used: multifunctional railcars of the "Sever" and "Pioneer" projects. Rails of the P50, P65 and P75 types, the nominal dimensions, material and composition of which comply with GOST R 51685, are subject to inspection by flaw detectors. Codes of detected defects according to the classifier of defects and damages to rails include defects: 20.1-2; 21.1-2; 24; 25; 26.3; 27.1-2; ZOV. 1-2; ZOG.1-2; 38.1; 50.1-2; 52.1-2; 53.1-2; 55; 56.3; 60.1-2; 66.3; 69 (in the projection zone of the rail web); 70.1-2; 74 and 79 and others. During operation, various rail defects occur in the form of the following manifestations: chipping, wear, chipping, plastic deformation (crushing, build-up), corrosion, cracks, fractures, mechanical damage.

In the practice of railway track diagnostics, the following structure for designating rail defects is accepted: in the form of a defect code: 38.1.

The first character of the code determines the group of defects by the location of the defect in the elements of the rail section (head, neck, foot, entire section).

The second character of the code determines the type of rail defect taking into account the main reason for its origin and development. The third character of the code indicates the location of the defect along the length of the rail. The first two digits of the rail defect code are separated from the third digit by a period.

Instruction of JSC "Russian Railways" No. 2499r "Rail defects. The "Classification, Catalogue and Parameters of Defective and Acutely Defective Rails" defines a group of defects and the location of their occurrence by elements of the rail section (first character) - Table 1. The second character (digit) in the rail defect code is the type of defect, determined by the main reason for its origin and development - Table 2.

Table 2 does not list the following defects: (4) defects associated with non-standard specific impact of rolling stock on rails and rail operating conditions (skidding, skidding, run-flats, etc.), including due to violation of train driving modes, due to deficiencies in rolling stock, due to violations of current track maintenance standards (5) rail defects resulting from non-standard mechanical impacts on rails (impact with a tool, rail on rail, etc.); (6) defects in the welded joint area associated with deficiencies and violations of rail welding technology and welded joint processing, leading to rail failures after passing the guaranteed tonnage; (7) defects in the welded joint area associated with deficiencies and violations of rail welding technology and processing of welded joints, which led to failures of the rails before the guarantee tonnage was passed; (8) - defects associated with deficiencies and violations of rail surfacing technology, welding of rail connectors and other similar defects; (9) - defects caused by corrosion fatigue, unsuitability of rail inspection, and fractures without fatigue cracks.

Table 1.

Determining the first digit in the rail defect code

First digit	Group of defects and their location by rail section elements
1	cracks and metal spalling on the running surface of the rail head
2	transverse cracks in the rail head
3	longitudinal cracks in the rail head and in the head-to-neck transition area at the joint
4	plastic deformations (crushing), vertical, lateral and uneven wear of the rail head (long waves and short waves-riffles)
5	rail neck defects and damage
6	rail foot defects and damage
7	rail fractures across the entire section
8	rail bends in vertical and horizontal planes
9	other rail defects and damage, including foot and neck corrosion, as well as extra holes in the lining area and indented markings in the joint area

Table 2.

Determining the second digit in the rail defect code

Second digit	Type of defect determined by the main reason for its origin and development
0	defects associated with violations of rail manufacturing technology
1	defects dependent on insufficient metallurgical quality of rail steel and insufficient strength of rail metal, leading to rail failures after passing the guaranteed tonnage (after the end of the warranty period)
2	defects dependent on insufficient metallurgical quality of rail steel and insufficient strength of rail metal, leading to rail failures before passing the guaranteed tonnage (within the warranty period)
3	defects in the area of bolted joints associated with increased dynamic impact of wheels on the track, with violation of the requirements of the instructions for the current maintenance of railway with violations of the technology for processing bolt holes and rail ends with metallurgical

The third digit in the defect code indicates the location of the defect: 0 - along the entire length of the rail; 1 - in a bolted joint at a distance of 750 mm or less from the end of the rail; 2 - outside the bolted joint at a distance of more than 750 mm from the end of the rail; 3 - in a welded joint obtained by electric contact welding; 4 - in a welded joint obtained by aluminothermic welding.

One defect can be attributed to several codes, for example, a rail fracture due to the formation of a transverse contact fatigue crack is designated: 71.2/21.2/

Marking of defective and acutely defective rails.

Acutely defective and defective rails detected by flaw detection or other testing are marked immediately after the defect is detected as follows:

- on the web on the inner side of the track at a distance of about 1 m from the left joint (gap) in the direction of the kilometer, apply with light oil paint: for acutely defective rails - two, and for defective rails - one oblique cross

- on the web next to the defect on the side from which the defect is visible (or always on the inner side of the track, if the defect is detected by flaw detection equipment), the marking is repeated with the defect code.

If the defect is distributed along the entire length of the rail (for example, wear - Figure 3), then the code number of this defect is indicated in the middle of the rail with dashes - respectively before and after the code (-44.0-); if the defect is located at the left end within the joint, then the defect code is placed next to the first marking and the second marking is not made. If the defect is located at the right end of the rail within the joint, in addition to the first marking, it is repeated at the right end with the defect code. When installing safety pads at the defect location, the defect marking (with the letter "H" added) is placed to the right of the pad.

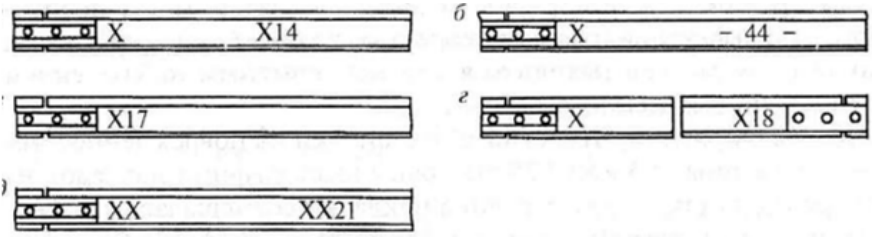


Figure 3. *Marking of defective and acutely defective rails*

Results and its discussion

An assessment of non-destructive testing methods for rails used on Russian railways was carried out.

The underlying trends in the development of rail flaw detection methods used on Russian railways were determined.

The rationale for marking acutely defective and defective rails detected during flaw detection testing was confirmed.

The development trends of flaw detection tools as non-destructive testing tools in the functioning of the track complex were analyzed.

The efficiency of flaw detection tools is determined by formula (1).

$$C = \frac{C_{(деф)}}{N_{(одр)} / (N_{(приборов)} \times S_{(км.пути)})} \quad (1)$$

where: *C* - cost of detecting one ADR; C(def)-price of the flaw detector; N(odr)-number of ADRs found in 10 months; N(devices)-number of devices operating along the route; S(km of route)-actually checked km of route

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DOI 10.34660/INF.2025.73.88.057
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沿外轮廓受集中力作用的旋转极正交各向异性圆环盘的应力-应变状态
STRESS-STRAIN STATE OF A ROTATING POLAR-ORTHOTROPIC ANNULAR DISK OF A POWER PROFILE LOADED WITH CONCENTRATED FORCES ALONG THE OUTER CONTOUR

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摘要。本文计算了具有幂律涡轮轮廓和轮缘的旋转叶片式极正交各向异性环形盘的应力-应变状态。叶片对盘的作用通过在其外缘边界施加N个集中力来建模。盘中的法向应力和剪应力用满足具有变系数非齐次四阶偏微分方程的力函数表示。将力函数分解为以角坐标θ的余弦为偶数的傅里叶级数，我们得到了一个无穷常微分方程组，该方程组具有变系数，表示位置随半径r变化的分量。微分方程组可以通过解析或数值方法求解。给出了沿外部轮廓受集中力加载的旋转各向异性环形盘中应力、变形和位移分量的表达式。给出了轮缘切向应力、切向变形和径向位移的计算公式。关键词：努力函数、傅里叶级数、偏微分方程、极正交各向异性圆盘、径向、切向和剪应力、功率分布、径向和切向位移、常微分方程组。

Abstract. *The article provides a calculation of the stress-strain state of a rotating bladed polar-orthotropic annular disk of a power-law turbine profile and a rim bearing blades. The action of the blades on the disk is modeled by applying N concentrated forces on its outer rim boundary. The normal and* shear *stresses in the disk are expressed in terms of a* effort *function that satisfies an inhomogeneous 4th-order partial differential equation with variable coefficients. Decomposing the* effort *function into Fourier series in terms of the cosines of the angular coordinate θ with even numbers, we obtain an infinite system of ordinary differential equations with variable coefficients for the components of the position depending on the radius r. Systems of differential equations can be solved by analytical or numerical methods. Expressions are given for the components of stresses, deformations, and displacements in a rotating anisotropic annular disk of a power profile loaded with a system of concentrated forces along an external contour. Calculation formulas for tangential stress, tangential deformation, and radial displacement in the rim are given.*

Keywords: *effort function, Fourier series, partial differential equation, polar orthotropic disk, radial, tangential and shear stresses, power profile, radial and tangential displacements, system of ordinary differential equations.*

Introduction

In modern hydraulic turbines, turbochargers, and centrifugal test benches, the flattened discs are the most important parts of these structures [1]. Made of heavy-duty composite materials, they rotate at high angular velocity ω_0 around a normal axis. Consequently, the profiled disc, rim and turbine blades will experience mechanical deformation from the action of centrifugal forces.

In this paper, we consider a turbine rotor in the form of a profiled anisotropic annular disk, which on the outer contour of radius *R* is connected to a rim bearing an even number of *N* equidistant identical blades. The disk is rigidly connected to the shaft, so that there is no displacements of the points of the inner contour of the disk.

The action of the blades on the disk is modeled by the application of *N* concentrated forces on its outer boundary. Here, the concentrated force is the inertia force F_i^b of the i–th blade, which occurs when the disk rotates with an angular velocity ω_0 equal to: $F_i^b = m_b \omega_0^2 R_{c.g.}^b$, where m_b is the mass of the blade, $R_{c.g.}^b$ is the distance from the axis of rotation to the center of gravity of the blade. These forces are applied to small areas of the rim's outer surface. Many works have been devoted to calculations for the strength and dynamics of turbine blades, for example in [1], and we will not consider this problem here.

The stress-strain state in such a flattened anisotropic annular disk of a power profile will be flat and non-axisymmetric. The thickness of the disk varies according to a power law: $h(r) = h_0 \left(\frac{r_0}{r} \right)^{\alpha}$ where $\alpha \in \mathbb{R}$, h_0 is the thickness of the disk on the inner contour of the radius r_0.

In this paper, we consider the mode of stationary rotation of a turbine disk at a certain operating frequency rotating, which does not coincide with any of the proper oscillation frequencies of the disk or the oscillation frequencies of other structural elements of a turbo machine.

Formulation of the problem and basic equations of the plane problem of elasticity theory for a rotating polar-orthotropic disk of a power profile

Let the disk material have cylindrical anisotropy, and the axis of anisotropy coincides with the geometric axis of the disk, and at each point of the disk there are three mutually orthogonal planes of elastic symmetry. The flattened disk rotates uniformly with an angular velocity ω_0 around the axis of rotation coinciding with the axis of anisotropy and perpendicular to the median plane of the disk. On the outer contour of radius *R*, the disk is connected to a rim carrying a system of *N* identical concentrated forces $F_i^b \ \left(i = \overline{1, N}\right)$. There are no radial and tangential displacements on the inner contour of the disk radius r_0.

It is required to find the distribution of stresses, deformations, and displacements in a given rotating polar-orthotropic annular disk of a power profile, as well as in the rim.

We introduce a cylindrical coordinate system (r,θ,z), placing the origin at the intersection of the anisotropy axis with the median plane of the disk. Let's point the z-axis vertically upwards.

The normal radial $\sigma_r(r,\theta)$, tangential $\sigma_\theta(r,\theta)$ stress components and $\tau_{r\theta}(r,\theta)=\tau_{\theta r}(r,\theta)$ shear stresses in the disk are expressed in terms of the effort function $F(r,\theta)$ according to the formulas [2]:

$$\begin{cases} \sigma_r(r,\theta)=\dfrac{1}{h(r)}\left(\dfrac{1}{r}\dfrac{\partial F(r,\theta)}{\partial r}+\dfrac{1}{r^2}\dfrac{\partial^2 F(r,\theta)}{\partial\theta^2}\right), \\ \sigma_\theta(r,\theta)=\dfrac{1}{h(r)}\dfrac{\partial^2 F(r,\theta)}{\partial r^2}+\rho\omega_0^2 r^2, \\ \tau_{r\theta}(r,\theta)=\dfrac{1}{h(r)}\left(\dfrac{1}{r^2}\dfrac{\partial F(r,\theta)}{\partial\theta}-\dfrac{1}{r}\dfrac{\partial^2 F(r,\theta)}{\partial r\partial\theta}\right), \end{cases} \tag{1}$$

where ρ is the density of the composite material of the disk.

The effort function $F(r,\theta)$ satisfies the following inhomogeneous differential equation of the 4th order in partial derivatives with variable coefficients [2], in which it is necessary to substitute a specific expression for the thickness $h(r)$ of the disk and set the temperature terms to zero on the right side of the equation. As a result, we get:

$$\begin{aligned} &\frac{\partial^4 F}{\partial r^4}+\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)\frac{1}{r^2}\frac{\partial^4 F}{\partial r^2\partial\theta^2}+\frac{k^2}{r^4}\frac{\partial^4 F}{\partial\theta^4}-\frac{2(1+\alpha)}{r}\frac{\partial^3 F}{\partial r^3}-\frac{(1-\alpha)}{r^3}\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)\frac{\partial^3 F}{\partial r\partial\theta^2}+ \\ &+\frac{\left[\alpha(1+\alpha)-\left(k^2+\alpha\nu_{\theta r}\right)\right]}{r^2}\frac{\partial^2 F}{\partial r^2}+\frac{\left\{(1-\alpha)\left[\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)+\left(k^2+\alpha\nu_{\theta r}\right)\right]+k^2\right\}}{r^4}\frac{\partial^2 F}{\partial\theta^2}+ \\ &+\frac{(1-\alpha)\left(k^2+\alpha\nu_{\theta r}\right)}{r^3}\frac{\partial F}{\partial r}=-2\left(3+\nu_{\theta r}\right)h(r)\rho\omega_0^2, \end{aligned} \tag{2}$$

where E_r, E_θ are the elastic modulus under tension (compression) of a cylindrical anisotropic body in the radial and tangential directions, respectively, $k^2=E_\theta/E_r$, $\nu_{r\theta},\nu_{\theta r}$ are the Poisson coefficients, and $G_{r\theta}$ is the shear modulus.

For a cylindrical anisotropic body, the following equality holds:

$$\frac{\nu_{r\theta}}{E_r}=\frac{\nu_{\theta r}}{E_\theta}.$$

Since an even number N equally spaced identical and symmetrical concentrated forces F_i^b $\left(i=\overline{1,N}\right)$ are applied to the outer contour of the disk with the rim, mod-

eling the blades, we decompose the effort function $F(r,\theta)$ into a Fourier series along the cosines of the angular coordinate θ with even numbers:

$$F(r,\theta)=\Phi_0(r)+\sum_{n=1}^{\infty}\Phi_{Nn}(r)\cos Nn\theta. \tag{3}$$

Substituting expansion (3) into equation (2), we obtain an infinite system of ordinary differential equations for the coefficients of the series $\Phi_0(r),\Phi_{Nn}(r)$:

$(n=0)$

$$\frac{d^4\Phi_0}{dr^4}+\frac{2(1+\alpha)}{r}\frac{d^3\Phi_0}{dr^3}+\frac{\left[\alpha(1+\alpha)-\left(k^2+\alpha\nu_{\theta r}\right)\right]}{r^2}\frac{d^2\Phi_0}{dr^2}+\frac{(1-\alpha)\left(k^2+\alpha\nu_{\theta r}\right)}{r^3}\frac{d\Phi_0}{dr}= \tag{4}$$
$$=-2\left(3+\nu_{\theta r}\right)h(r)\rho\omega_0^2.$$

$(n\geq 1)$

$$\frac{d^4\Phi_{Nn}}{dr^4}+\frac{2(1+\alpha)}{r}\frac{d^3\Phi_{Nn}}{dr^3}+\frac{\left\{\alpha(1+\alpha)-\left[\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)(Nn)^2+\left(k^2+\alpha\nu_{\theta r}\right)\right]\right\}}{r^2}\frac{d^2\Phi_{Nn}}{dr^2}+$$
$$+\frac{(1-\alpha)\left[\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)(Nn)^2+\left(k^2+\alpha\nu_{\theta r}\right)\right]}{r^3}\frac{d\Phi_{Nn}}{dr}+(Nn)^2\left\{(\alpha-1)\left[\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)+\right.\right. \tag{5}$$
$$\left.\left.+\left(k^2+\alpha\nu_{\theta r}\right)\right]+\left((Nn)^2-1\right)k^2\right\}\frac{1}{r^4}\Phi_{Nn}(r)=0.$$

Thus, the solution of the plane elasticity problem for a rotating bladed polar-orthotropic annular turbine disk with a system of concentrated forces on the outer surface of the rim was reduced to integrating a system of ordinary differential equations (4), (5) with boundary conditions of the form:

$$\begin{cases} u(r_0,\theta)=0, \quad v(r_0,\theta)=0, \\ u(R,\theta)=u^{(r)}(\theta), \quad v(R,\theta)=0. \end{cases} \tag{6}$$

The system of ordinary differential equations (4), (5) with boundary conditions (6) can be solved by analytical or numerical methods.

Let's find the radial displacement $u^{(r)}(\theta)$ of the rim with the blades. Let a rim in the form of a ring with a width δ_r and thickness h_r on the outer surface be loaded with an even number N of equidistant identical concentrated forces $F_i^b\ \left(i=\overline{1,N}\right)$ and symmetrical with respect to the diameter of the disk. Decomposing this load into a Fourier series in terms of the cosines of the angular coordinate θ with even numbers, we obtain the expression [2] for a distributed load with intensity $q_N(R,\theta)$:

$$q_N(R_1,\theta)=\frac{NF^b}{2\pi R_1 h_r}\left(1+2\sum_{n=1}^{\infty}\cos Nn\theta\right),$$

where R_1 is the outer radius of the rim.

Considering the rim as a ring loaded with centrifugal forces, as well as radial stresses $\sigma_{r,e}^{(r)} = q_N(R_1,\theta)$ on the outer and $\sigma_{r,i}^{(r)} = \sigma_r(R,\theta)$ inner surfaces of the rim connected to the disk, we calculate the tangential stress $\sigma_\theta^{(r)}(\theta)$ arising in it. From the equilibrium condition of the half of the ring, we have [2]:

$$\sigma_\theta^{(r)}(\theta) = \frac{1}{S_r}\left(q_N(R_1,\theta)h_r R_1 - \sigma_r(R,\theta)h_1 R + \frac{1}{3}h_r\rho\omega_0^2\left(R_1^3 - R^3\right)\right), \tag{7}$$

where $S_r = h_r\delta_r$ is the cross-sectional area of the ring, h_1 is the thickness of the disk on the outer contour, and $\sigma_r(R,\theta)$ is the radial stress in the disk on the outer contour.

Knowing the tangential stress $\sigma_\theta^{(r)}(\theta)$ in the rim, and considering the stress state in the rim to be uniaxial, we first determine the tangential deformation $\varepsilon_\theta^{(r)}(\theta)$ from Hooke's law:

$$\varepsilon_\theta^{(r)}(\theta) = \frac{1}{E_\theta}\sigma_\theta^{(r)}(\theta). \tag{8}$$

Then the radial displacement $u^{(r)}(\theta)$ of the points of the inner surface of the rim is found:

$$u^{(r)}(\theta) = R\varepsilon_r^{(r)}(\theta) = \frac{R}{E_\theta S_r}\left(q_N(R_1,\theta)h_r R_1 - \sigma_r(r,\theta)h_1 R + \frac{1}{3}h_r\rho\omega_0^2\left(R_1^3 - R^3\right)\right). \tag{9}$$

In addition, it is necessary to take into account the stress concentration at the junction of the disc with the rim (the so-called galtel) and at the attachment points of the blades on the rim [2].

Solving systems of ordinary differential equations of a plane problem of elasticity theory for a rotating polar-orthotropic disk of a power profile loaded with concentrated forces along an external contour

We introduce a new variable $t = \ln x$, where $x = \frac{r}{R}$, $x \in [\delta;1]$, $\delta = \frac{r_0}{R}$. The system of ordinary differential equations with variable coefficients (4), (5) is transformed into a system of ordinary differential equations with constant coefficients:

$(n = 0)$

$$\frac{d^4\Phi_0}{dt^4} + 2(\alpha-2)\frac{d^3\Phi_0}{dt^3} + \left[\left(\alpha^2 - 5\alpha + 5\right) - \left(k^2 + \alpha\nu_{\theta r}\right)\right]\frac{d^2\Phi_0}{dt^2} - (\alpha-2)\left[(\alpha-1) + \left(k^2 + \alpha\nu_{\theta r}\right)\right]\frac{d\Phi_0}{dt} = \tag{10}$$

$$= -2\left(3 + \nu_{\theta r}\right)h_1\rho\omega_0^2 R^4 \cdot e^{(4-\alpha)t}.$$

$(n \geq 1)$

$$\frac{d^4\Phi_{Nn}}{dt^4} + 2(\alpha-2)\frac{d^3\Phi_{Nn}}{dt^3} + \left\{\left(\alpha^2 - 5\alpha + 5\right) - \left[\left(\frac{E_\theta}{G_{r\theta}} - 2\nu_{\theta r}\right)(Nn)^2 + \left(k^2 + \alpha\nu_{\theta r}\right)\right]\right\}\frac{d^2\Phi_{Nn}}{dt^2} - \tag{11}$$

$$-(\alpha-2)\left\{(\alpha-1) + \left[\left(\frac{E_\theta}{G_{r\theta}} - 2\nu_{\theta r}\right)(Nn)^2 + \left(k^2 + \alpha\nu_{\theta r}\right)\right]\right\}\frac{d\Phi_{Nn}}{dt} + (Nn)^2\left\{(\alpha-1)\left[\left(\frac{E_\theta}{G_{r\theta}} - 2\nu_{\theta r}\right) + \right.\right.$$

$$\left.\left. + \left(k^2 + \alpha\nu_{\theta r}\right)\right] + \left((Nn)^2 - 1\right)k^2\right\}\Phi_{Nn}(t) = 0.$$

The characteristic equation for a homogeneous ordinary differential equation corresponding to equation (10) is:

$$\lambda^4+2(\alpha-2)\lambda^3+\left[\left(\alpha^2-5\alpha+5\right)-\left(k^2+\alpha\nu_{\theta r}\right)\right]\lambda^2-(\alpha-2)\left[(\alpha-1)+\left(k^2+\alpha\nu_{\theta r}\right)\right]\lambda=0.$$

His roots:

$$\begin{cases}\lambda_1=0, \quad \lambda_2=(2-\alpha),\\ \lambda_3=\left(1-\dfrac{\alpha}{2}\right)+\sqrt{\left(\dfrac{\alpha}{2}+\nu_{\theta r}\right)^2+\left(k^2-\nu_{\theta r}^2\right)},\\ \lambda_4=\left(1-\dfrac{\alpha}{2}\right)-\sqrt{\left(\dfrac{\alpha}{2}+\nu_{\theta r}\right)^2+\left(k^2-\nu_{\theta r}^2\right)}.\end{cases}$$

The general solution of a homogeneous ordinary differential equation has the form:

$$\Phi_0^{homogen.}(t)=C_1^{(0)}+C_2^{(0)}e^{(2-\alpha)t}+C_3^{(0)}e^{\lambda_3 t}+C_4^{(0)}e^{\lambda_4 t}, \tag{12}$$

where $C_I^{(0)}\left(i=\overline{1;4}\right)$ are arbitrary constants.

The partial solution of the inhomogeneous ordinary differential equation (10) is:

$$\Phi_0^{partial}(t)=-\frac{(3+\nu_{\theta r})h_1\rho\omega_0^2R^4}{(4-\alpha)\left[\left(9-k^2\right)-\alpha(3+\nu_{\theta r})\right]}e^{(4-\alpha)t}, \tag{13}$$

where $h_1=h_0\left(\dfrac{r_0}{R}\right)^{\alpha}$ is the thickness of the disk on the outer contour.

The general solution of an inhomogeneous ordinary differential equation (10) is equal to the sum of the solutions of a homogeneous differential equation (12) and a partial solution of an inhomogeneous differential equation (13):

$$\Phi_0(t)=\Phi_0^{homogen.}(t)+\Phi_0^{partial}(t)=$$

$$=C_1^{(0)}+C_2^{(0)}e^{(2-\alpha)t}+C_3^{(0)}e^{\lambda_3 t}+C_4^{(0)}e^{\lambda_4 t}-\frac{(3+\nu_{\theta r})h_1\rho\omega_0^2R^4}{(4-\alpha)\left[\left(9-k^2\right)-\alpha(3+\nu_{\theta r})\right]}e^{(4-\alpha)t}. \tag{14}$$

In the variable *r*, the solution (14) has the form:

$$\Phi_0(r)=C_1^{(0)}+C_2^{(0)}\left(\frac{r}{R}\right)^{(2-\alpha)}+C_3^{(0)}\left(\frac{r}{R}\right)^{\lambda_3}+C_4^{(0)}\left(\frac{r}{R}\right)^{\lambda_4}-\frac{(3+\nu_{\theta r})h_1\rho\omega_0^2R^4}{(4-\alpha)\left[\left(9-k^2\right)-\alpha(3+\nu_{\theta r})\right]}\left(\frac{r}{R}\right)^{(4-\alpha)}. \tag{15}$$

The characteristic equation for a homogeneous ordinary differential equation (11) is:

$$\mu^4+2(\alpha-2)\mu^3+\left\{\left(\alpha^2-5\alpha+5\right)-\left[\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)(Nn)^2+\left(k^2+\alpha\nu_{\theta r}\right)\right]\right\}\mu^2- \tag{16}$$

$$-(\alpha-2)\left\{(\alpha-1)+\left[\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)(Nn)^2+\left(k^2+\alpha\nu_{\theta r}\right)\right]\right\}\mu+(Nn)^2\left\{(\alpha-1)\left[\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)+\right.\right.$$

$$\left.\left.+\left(k^2+\alpha\nu_{\theta r}\right)\right]+\left((Nn)^2-1\right)k^2\right\}=0.$$

The roots of the algebraic equation of the 4th order (16) are equal to:

$$\begin{cases} \mu_1(Nn)=\left(1-\dfrac{\alpha}{2}\right)+\sqrt{\chi_1(Nn)}, & \mu_2(Nn)=\left(1-\dfrac{\alpha}{2}\right)-\sqrt{\chi_1(Nn)}, \\ \mu_3(Nn)=\left(1-\dfrac{\alpha}{2}\right)+\sqrt{\chi_2(Nn)}, & \mu_4(Nn)=\left(1-\dfrac{\alpha}{2}\right)-\sqrt{\chi_2(Nn)}, \end{cases}$$

where $\chi_1(Nn), \chi_2(Nn)$ are the roots of the quadratic equation:

$$\chi^2-\left\{\left(\frac{1}{2}\alpha^2-\alpha+1\right)+\left[\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)(Nn)^2+\left(k^2+\alpha\nu_{\theta r}\right)\right]\right\}\cdot\chi+\left\{(\alpha-1)\left[\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)+\right.\right.$$

$$\left.\left.+\left(k^2+\alpha\nu_{\theta r}\right)\right]+\left((Nn)^2-1\right)k^2\right\}(Nn)^2+\left(\frac{\alpha}{2}-1\right)^2\left\{\frac{\alpha^2}{4}+\left[\left(\frac{E_\theta}{G_{r\theta}}-2\nu_{\theta r}\right)(Nn)^2+\left(k^2+\alpha\nu_{\theta r}\right)\right]\right\}=0.$$

Below, we will omit the *Nn* roots argument.

The general solution of the homogeneous ordinary differential equation (11) is:

$$\Phi_{Nn}(t)=C_1^{(Nn)}e^{\mu_1 t}+C_2^{(Nn)}e^{\mu_2 t}+C_3^{(Nn)}e^{\mu_3 t}+C_4^{(Nn)}e^{\mu_4 t}, \tag{17}$$

where $C_i^{(Nn)}\ \left(i=\overline{1;4}\right)$ are arbitrary constants.

$$\Phi_{Nn}(r)=C_1^{(Nn)}\left(\frac{r}{R}\right)^{\mu_1}+C_2^{(Nn)}\left(\frac{r}{R}\right)^{\mu_2}+C_3^{(Nn)}\left(\frac{r}{R}\right)^{\mu_3}+C_4^{(Nn)}\left(\frac{r}{R}\right)^{\mu_4}. \tag{18}$$

Let's decompose the components of stresses and displacements into Fourier series:

$$\begin{aligned} \sigma_r(r,\theta)&=\sigma_r^{(0)}(r)+\sum_{n=1}^{\infty}\sigma_r^{(Nn)}(r)\cos Nn\theta, \\ \sigma_\theta(r,\theta)&=\sigma_\theta^{(0)}(r)+\sum_{n=1}^{\infty}\sigma_\theta^{(Nn)}(r)\cos Nn\theta, \\ \tau_{r\theta}(r,\theta)&=\sum_{n=1}^{\infty}\tau_{r\theta}^{(Nn)}(r)\sin Nn\theta, \\ u(r,\theta)&=u_0(r)+\sum_{n=1}^{\infty}u_{Nn}(r)\cos Nn\theta, \\ v(r,\theta)&=\sum_{n=1}^{\infty}v_{Nn}(r)\sin Nn, \end{aligned} \tag{19}$$

where $\sigma_r^{(0)}(r)=\dfrac{1}{h(r)}\dfrac{1}{r}\dfrac{d\Phi_0}{dr}$, $\sigma_r^{(Nn)}(r)=\dfrac{1}{h(r)}\left[\dfrac{1}{r}\dfrac{d\Phi_{Nn}}{dr}-\dfrac{(Nn)^2}{r^2}\Phi_{Nn}(r)\right]$,

$$\sigma_\theta^{(0)}(r)=\frac{1}{h(r)}\frac{d^2\Phi_0}{dr^2}+\rho\omega_0^2r^2,\ \sigma_\theta^{(Nn)}(r)=\frac{1}{h(r)}\frac{d^2\Phi_{Nn}}{dr^2},\ \tau_{r\theta}^{(Nn)}(r)=\frac{Nn}{h(r)}\left[\frac{1}{r}\frac{d\Phi_{Nn}}{dr}-\frac{1}{r^2}\Phi_{Nn}(r)\right],$$

$$u_0(r)=\frac{r}{E_\theta h(r)}\left(\frac{d^2\Phi_0}{dr^2}-\frac{\nu_{\theta r}}{r}\frac{d\Phi_0}{dr}\right)+\frac{\rho\omega_0^2r^3}{E_\theta}, \tag{20}$$

$$u_{Nn}(r)=-\int\frac{1}{E_\theta h(r)}\left[\nu_{\theta r}\frac{d^2\Phi_{Nn}}{dr^2}-\frac{k^2}{r}\frac{d\Phi_{Nn}}{dr}+(Nn)^2\frac{k^2}{r^2}\Phi_{nN}(r)\right]dr,$$

$$v_{Nn}(r)=-\frac{u_{Nn}(r)}{(Nn)}+\frac{r}{(Nn)E_\theta h(r)}\left[\frac{d^2\Phi_{Nn}}{dr^2}-\frac{\nu_{\theta r}}{r}\frac{d\Phi_{Nn}}{dr}+(Nn)^2\frac{\nu_{\theta r}}{r^2}\Phi_{Nn}(r)\right].$$

Substituting expressions for the components $\Phi_0(r),\Phi_{Nn}(r)$ of the expansion of the effort function $F(r,\theta)$ into the Fourier series into formulas (20), we obtain:

$$\sigma_r^{(0)}(r)=\left[\lambda_3\tilde{C}_3^{(0)}\left(\frac{r}{R}\right)^{\lambda_3+\alpha-2}+\lambda_4\tilde{C}_4^{(0)}\left(\frac{r}{R}\right)^{\lambda_4+\alpha-2}\right]-\frac{(3+\nu_{\theta r})\rho\omega_0^2R^2}{\left[(9-k^2)-\alpha(3+\nu_{\theta r})\right]}\left(\frac{r}{R}\right)^2,$$

$$\sigma_r^{(Nn)}(r)=\left[\mu_1\tilde{C}_1^{(Nn)}\left(\frac{r}{R}\right)^{\mu_1+\alpha-2}+\mu_2\tilde{C}_2^{(Nn)}\left(\frac{r}{R}\right)^{\mu_2+\alpha-2}+\mu_3\tilde{C}_3^{(Nn)}\left(\frac{r}{R}\right)^{\mu_3+\alpha-2}+\mu_4\tilde{C}_4^{(Nn)}\left(\frac{r}{R}\right)^{\mu_4+\alpha-2}\right],$$

$$\sigma_\theta^{(0)}(r)=\left[\lambda_3(\lambda_3-1)\tilde{C}_3^{(0)}\left(\frac{r}{R}\right)^{\lambda_3+\alpha-2}+\lambda_4(\lambda_4-1)\tilde{C}_4^{(0)}\left(\frac{r}{R}\right)^{\lambda_4+\alpha-2}\right]-\frac{(k^2+3\nu_{\theta r})\rho\omega_0^2R^2}{\left[(9-k^2)-\alpha(3+\nu_{\theta r})\right]}\left(\frac{r}{R}\right)^2,$$

$$\sigma_\theta^{(Nn)}(r)=\left[\mu_1(\mu_1-1)\tilde{C}_1^{(Nn)}\left(\frac{r}{R}\right)^{\mu_1+\alpha-2}+\mu_2(\mu_2-1)\tilde{C}_2^{(Nn)}\left(\frac{r}{R}\right)^{\mu_2+\alpha-2}+\mu_3(\mu_3-1)\tilde{C}_3^{(Nn)}\left(\frac{r}{R}\right)^{\mu_3+\alpha-2}+\right.$$

$$\left.+\mu_4(\mu_4-1)\tilde{C}_4^{(Nn)}\left(\frac{r}{R}\right)^{\mu_4+\alpha-2}\right],$$

$$\tau_{r\theta}^{(Nn)}(r)=(Nn)\left[(\mu_1-1)\tilde{C}_1^{(Nn)}\left(\frac{r}{R}\right)^{\mu_1+\alpha-2}+(\mu_2-1)\tilde{C}_2^{(Nn)}\left(\frac{r}{R}\right)^{\mu_2+\alpha-2}+(\mu_3-1)\tilde{C}_3^{(Nn)}\left(\frac{r}{R}\right)^{\mu_3+\alpha-2}+\right.$$

$$\left.+(\mu_4-1)\tilde{C}_4^{(Nn)}\left(\frac{r}{R}\right)^{\mu_4+\alpha-2}\right],$$

$$u_0(r)=\frac{R}{E_\theta}\left[\lambda_3(\lambda_3-\nu_{\theta r}-1)\tilde{C}_3^{(0)}\left(\frac{r}{R}\right)^{\lambda_3+\alpha-1}+\lambda_4(\lambda_4-\nu_{\theta r}-1)\tilde{C}_4^{(0)}\left(\frac{r}{R}\right)^{\lambda_4+\alpha-1}\right]-$$

$$-\frac{(k^2-\nu_{\theta r}^2)}{\left[(9-k^2)-\alpha(3+\nu_{\theta r})\right]}\frac{\rho\omega_0^2R^3}{E_\theta}\left(\frac{r}{R}\right)^3, \qquad (21)$$

$$u_{Nn}(r)=\frac{(-R)}{E_\theta}\left\{\frac{\left[\nu_{\theta r}\mu_1^2-(k^2+\nu_{\theta r})\mu_1+(Nn)^2k^2\right]}{(\mu_1+\alpha-1)}C_1^{(Nn)}\left(\frac{r}{R}\right)^{\mu_1+\alpha-1}+\frac{\left[\nu_{\theta r}\mu_2^2-(k^2+\nu_{\theta r})\mu_2+(Nn)^2k^2\right]}{(\mu_2+\alpha-1)}\times\right.$$

$$\times C_2^{(Nn)}\left(\frac{r}{R}\right)^{\mu_2+\alpha-1}+\frac{\left[\nu_{\theta r}\mu_3^2-(k^2+\nu_{\theta r})\mu_3+(Nn)^2k^2\right]}{(\mu_3+\alpha-1)}C_3^{(Nn)}\left(\frac{r}{R}\right)^{\mu_3+\alpha-1}+\frac{\left[\nu_{\theta r}\mu_4^2-(k^2+\nu_{\theta r})\mu_4+(Nn)^2k^2\right]}{(\mu_4+\alpha-1)}\times$$

$$\left.\times C_4^{(Nn)}\left(\frac{r}{R}\right)^{\mu_4+\alpha-1}\right\},$$

$$v_{Nn}(r)=\frac{R}{(Nn)E_\theta}\left\{\frac{\left[\mu_1^3+(\alpha-2)\mu_1^2-\left[(\alpha-1)+\left(k^2+\alpha\nu_{\theta r}\right)-(Nn)^2\nu_{\theta r}\right]\mu_1+(Nn)^2\left(k^2+(\alpha-1)\right)\nu_{\theta r}\right]}{(\mu_1+\alpha-1)}\times\right.$$

$$\times\tilde{C}_1^{(Nn)}\left(\frac{r}{R}\right)^{\mu_1+\alpha-1}+\frac{\left[\mu_2^3+(\alpha-2)\mu_2^2-\left[(\alpha-1)+\left(k^2+\alpha\nu_{\theta r}\right)-(Nn)^2\nu_{\theta r}\right]\mu_2+(Nn)^2\left(k^2+(\alpha-1)\right)\nu_{\theta r}\right]}{(\mu_2+\alpha-1)}\times$$

$$\times\tilde{C}_2^{(Nn)}\left(\frac{r}{R}\right)^{\mu_2+\alpha-1}+\frac{\left[\mu_3^3+(\alpha-2)\mu_3^2-\left[(\alpha-1)+\left(k^2+\alpha\nu_{\theta r}\right)-(Nn)^2\nu_{\theta r}\right]\mu_3+(Nn)^2\left(k^2+(\alpha-1)\right)\nu_{\theta r}\right]}{(\mu_3+\alpha-1)}\times$$

$$\times\tilde{C}_3^{(Nn)}\left(\frac{r}{R}\right)^{\mu_3+\alpha-1}+\frac{\left[\mu_4^3+(\alpha-2)\mu_4^2-\left[(\alpha-1)+\left(k^2+\alpha\nu_{\theta r}\right)-(Nn)^2\nu_{\theta r}\right]\mu_4+(Nn)^2\left(k^2+(\alpha-1)\right)\nu_{\theta r}\right]}{(\mu_4+\alpha-1)}\times$$

$$\left.\times\tilde{C}_4^{(Nn)}\left(\frac{r}{R}\right)^{\mu_4+\alpha-1}\right\},$$

where $\tilde{C}_3^{(0)}=\frac{1}{h_1R^2}C_3^{(0)}$, $\tilde{C}_4^{(0)}=\frac{1}{h_1R^2}C_4^{(0)}$, $\tilde{C}_i^{(Nn)}=\frac{1}{h_1R^2}C_i^{(Nn)}$ $\left(i=\overline{1;4}\right)$ are arbitrary constants determined from the boundary conditions (6).

Conclusion

The formulas (20) and (21) obtained fully describe the stress-strain state of rotating polar-orthotropic annular disks of a power profile loaded with a system of concentrated forces on an external contour. The results of this work can be used in designing and calculating the strength of disks of turbomachines and turbochargers, as well as rotors of centrifugal stands.

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DOI 10.34660/INF.2025.53.57.055

阿尔汉格尔斯克州梅津区卡缅卡村建筑与规划中的苏联建构主义
SOVIET CONSTRUCTIVISM IN THE ARCHITECTURE AND PLANNING OF THE KAMENKA VILLAGE IN THE MEZEN DISTRICT OF THE ARKHANGELSK REGION

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摘要：本文介绍了二十世纪二十至三十年代苏联建构主义建筑风格的特点及其在阿尔汉格尔斯克地区的体现。并描述了完全采用这种风格的卡缅卡村的建筑和规划方案。这项研究的意义在于，当时城市发展遗迹和住房建筑的消失，以及几乎完全缺失的历史设计资料，对这一主题的研究也少之又少。本文基于阿尔汉格尔斯克州国家档案馆、梅津斯基区“卡缅斯科耶”市政管理部门的档案、家庭档案照片以及村民的口述故事。分析了当时住房建设状况的历史、经济和社会前提条件。在20世纪20年代和30年代，解决北方地区住房危机的方法之一是建设工厂城镇和工厂聚落。梅泽斯卡亚•卡缅卡是典型的工厂聚落。

关键词：苏联建构主义、城市建设企业、建筑和规划方案及特点、营房、公共住宅、专家和突击工住房。

Abstract. *The article presents the characteristics of the style of the 20-30s of the twentieth century Soviet Constructivism and its features in the Arkhangelsk region. A description of the architectural and planning solutions of the village of Kamenka, built entirely in this style, is given. The relevance of the study is due to the disappearance of the remains of urban development and the architecture of the housing stock of that time, as well as the almost complete absence of historical design materials with absolutely little study of the topic. The article is based on materials from the State Archives of the Arkhangelsk Region, the archive of the administration of the MO “Kamenskoye” of the Mezensky District of the Arkhangelsk Region, photographs from home archives and oral stories of village residents. Historical, economic and social prerequisites for the existence of the situation with housing construction were analyzed. One of the ways to solve the housing crisis in the 1920s and 1930s in the Northern Territory was to create factory towns and factory settlements. Mezenskaya Kamenka is a classic example of a factory settlement.*

Keywords: *Soviet Constructivism, city-forming enterprise, architectural and planning solutions and features, barracks, communal houses, houses for specialists and shock workers.*

Soon after the Civil War in Russia, the acute issue of restoring the national economy and the availability of currency arose. In the 1920s and 1930s, the main source of its income was the forests of the Russian North. At the RCP(b) faction of the VIII Congress of Soviets on December 21, 1920, V.I. Lenin said: “If we want to exchange goods with foreign countries, ..., our main interest is ... to receive from the capitalist countries those means of production (steam locomotives, machines, electrical apparatus), without which we will not be able to restore our industry .... In order to get the best machines, etc., we must pay. What to pay with? ... And here there is no object more convenient for us economically than the forests in the far north, which we have in incredible quantities, ... Meanwhile, the forest is of enormous value on the international market” [1, p. 110].

Later, in 1929, when organizing a new administrative division of the Soviet country, the Northern Territory was created with its center in the city of Arkhangelsk by uniting the Arkhangelsk, Vologda and Northern Dvina provinces and the autonomous region of Komi. Thus, the huge taiga zone of the European North turned into a “timber export plantation”. All logging was concentrated in the timber export ports that had been established before the revolution - Onega, Arkhangelsk, Mezen, Pechora [2].

For the efficient operation of the “currency workshop” of V.I. Lenin signed the regulation on the management body of the forest industry of the Severo-Belomorsky district, on the basis of which the Severoles trust was created. Its goal was to develop the logging and timber processing industry and subordinate it to export tasks. The Severoles trust was given a timber raw material base and 42 sawmills, including the Ruzhnikov brothers’ plant and the Rusanov plant, located on the Mezen River. The plants were assigned numbers No. 48 and 49. Both sawmills became enterprises of state importance, working for the export of timber. Ships from Germany, Norway, Sweden and other countries arrived at the Mezen port.

In 1927, on the banks of the Mezen River, at the mouth of the Kamenka River flowing into it, 38 km from the White Sea, a large construction project began. A new sawmill and a village were built at the same time.

In the 1920s, the main direction of culture and technology in the USSR was Soviet Constructivism - an avant-garde movement in art that considered the basis of the artistic image not composition, but construction. The purpose of construction was to organize the optimal connection between the elements of the composition. Architecture was no exception. It was in this avant-garde style that all the buildings of Kamenka were designed and built, from the large city-forming (sawmill) to the smallest infrastructure facility.

The main material of Soviet Constructivism was concrete, but in the conditions of the North, with vast areas of forests, such a building material as wood was widespread. Wooden buildings built in the style of Soviet constructivism were practically no different from stone ones. Protruding volumes of staircases with ribbon glazing, large windows, flat or flattened roofs, shapes reminiscent of machines or mechanisms.

The settlement was designed at the Arkhangelsk Institute of Architecture and Construction. The settlement being created was of national importance (timber import through the seaport), so the main state architectural style was also chosen. Pine and larch served as building materials.

According to the General Plan of the settlement, the principle of row development formed the basis of the layout. Such a layout provides the best insolation conditions, because the objects are located meridionally, and the sun evenly illuminates both of their sides.

Unlike the small winding streets of the Mezensky district, the streets of the new settlement were wide with wooden paving. The roads of Kamenka had different designs. The "plate" pavement is a multilayer structure in which the boards were laid perpendicular to each other in 5-6 layers (Fig. 1, a). On the road leading to the plant and at the sorting site, a "timber" pavement was used (Fig. 1, b). Later, the "Popov system" pavement was used - 100*50 mm boards placed on an edge (Fig. 1, c) [4].

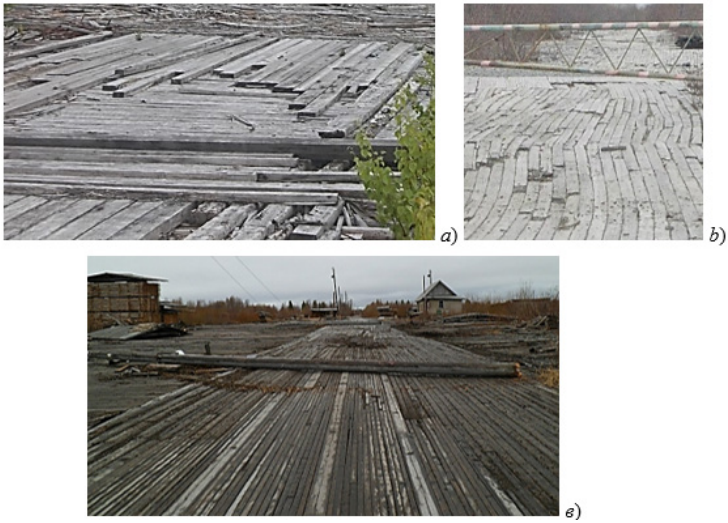

Figure 1. *Wooden pavement:*
a) Pavement "made of slabs"; b) pavement "made of timber";
c) pavement "of the Popov system".

The city-forming enterprise was Sawmill No. 48, built on the site of the Ruzhnikov brothers' sawmill (Fig. 2) [5].

Figure 2. *Mezen sawmill No. 48. Photo from 1930.*

The main object of the sawmill was the sawmill barn with eight sawmill frames, an elevator overpass, a pilot house and a small wood cutting department (Fig. 3). The architecture of the barn is typical of the style of that time. All facades of the sawmill barn are glazed. Additionally, a skylight of the Boileau system is provided (Boileau is a horizontally elongated rectangular skylight with vertical glazing, above the roof of the industrial workshop). A swimming pool was specially created for the plant. Due to the lack of special equipment, it was opened manually. The sawmill barn, built in 1927, completely burned down on June 1, 1989.

Figure 3. *Sawmill barn. Photo from 1931.*

Along with the plant, a village with a developed infrastructure was being built.

For construction, rails were laid along the location of future streets for the delivery of materials and equipment (Fig. 4) [6].

Figure 4. *Railroad track during construction of a settlement. Photo from the 1930s.*

To ensure uninterrupted timber export, a workforce was needed. Simultaneously with the creation and reconstruction of the sawmill, the population grew and, as a result, the need for housing. All the workers needed to be housed, but the Soviet government attached secondary importance to settlement construction after the organization of production [2]. During the first years of Soviet power, there was an urgent need for housing for permanent and seasonal workers at the sawmills. Initially, "beds" were built for "seasonal workers". This type of living space was described in the "Inventory of Buildings and Structures" compiled when the Ruzhnikov brothers' timber plant was transferred to Severoles. "Plank on posts, covered with boards. Length 33.75 fathoms, width – 2.3 fathoms, height 1 fathom. (71.89m x 4.9m x 2.13m). A total of 20 booths, each with its own separate entrance." [7, p.11ob.]. Later, starting around 1932, frame-fill barracks were built for seasonal workers.

Over the course of several years, barrack-type houses were built for permanent workers in the settlement of sawmill #48. These were 1-2-story houses with a corridor layout. For example, residential building #20 on Fedorkova Street (built in 1928) (Fig. 5). 20 living rooms with an area from 9.4 to 20.0 m^2 have an exit to one common corridor 2.5 m wide. With a total living area of 297.1 m^2, the corridor area was 184.2 m^2.

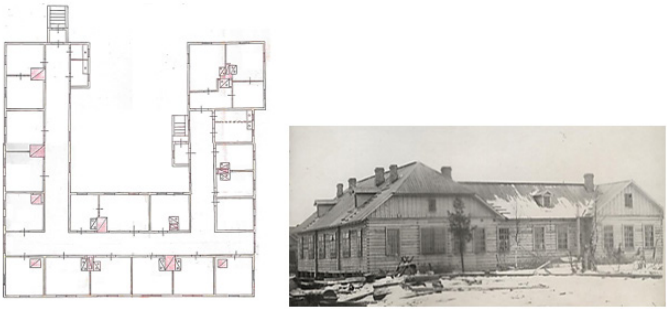

Figure 5. *"Barrack" on Fedorkova Street, 20 (floor plan and external appearance) (photo from the 1930s))*

A special feature of the settlement in the village was the settlement by profession. For example, the Fire House (a residential building for members of the fire brigade and their families), the Grooms' House (for grooms working at the sawmill), etc.

On June 23, 1931, at the Conference of Business Executives, I.V. Stalin set the task for the Boards of Industrial Enterprises. "In each branch of industry, at each enterprise, in each workshop ... skilled workers ... should be assigned to production ... But how can they be assigned to an enterprise? They can only be assigned by ... raising their wages ... and further improvement of the workers' supplies and housing conditions is necessary ..." [8, p. 58]. Stalin's words gave privileges to leading specialists and qualified personnel in the form of larger and better equipped apartments in the so-called Houses of Specialists. In the center of the village, Houses for Engineering and Technical Workers were built. These were small cottage-type houses with 2 apartments. The apartments had 3 rooms with a living area of 46.5 m^2 and an auxiliary area of 26.6 m^2. The house had an adjacent territory with the possibility of using it as a garden plot (Fig. 6).

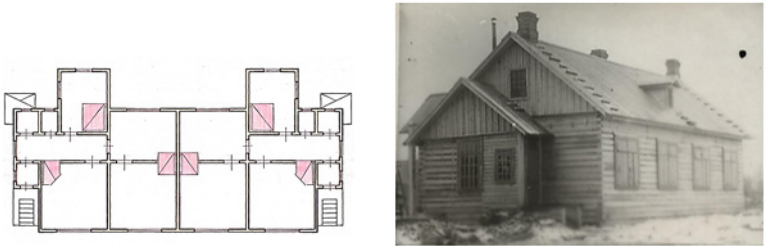

Figure 6. *Houses for engineering and technical workers (plan and appearance (photo from the 1930s))*

In the aforementioned speech, I.V. Stalin also spoke about shock workers. “Do not forget that we ourselves ... demand from the worker labor discipline, hard work, competition, shock work. ... The vast majority of workers accepted these demands of the Soviet government, the workers now ... have the right to demand from it the fulfillment of obligations to ... improve the material and cultural situation ...” [8, p. 59]. In this vein, houses were built for shock workers in Kamenka along Basseyny Lane (Fig. 7). 2-story 8-apartment wooden houses - 4 apartments 2-room ($S_{жил.}$ = 29,0m^2, $S_{общ.}$ = 52,2m^2), and 4 – 3-room ($S_{жил.}$ = 43,0m^2, $S_{общ.}$ = 68,9m^2)

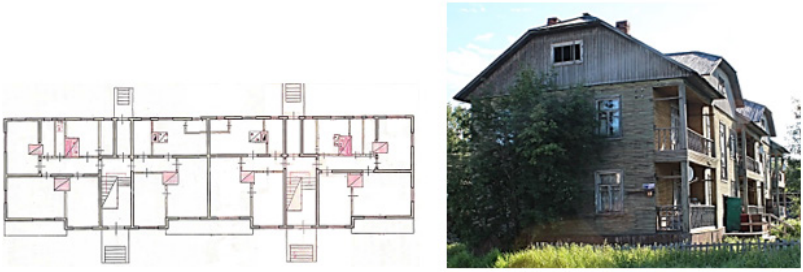

Figure 7. *House for drummers. lane. Basseyny, 5 (plan of the 1st floor, external appearance (photo 2012)*

In 1928, the First Conference of the Association of Modern Architects (OSA) was held in Moscow, where a Resolution was adopted on the report of the housing planning section: “The First All-Union Conference of the OSA notes the urgent need for the design and construction of new housing to transition from an individual apartment to new communal housing with a clear distribution of individual and public functions with a course towards maximum socialization and collectivization of everyday processes” [9, p. 23]. Soon, so-called communal houses appeared in Kamenka. They were built for family workers. One of them is a 2-story residential building No. 28 on Molodezhnaya Street (built in 1923). Military personnel and their families lived in this house. Due to the large number of local residents, the house was called “Bata-lion”. There were 6 apartments on two floors: Apartment No. 1 - 15 rooms with living space from 6.7 to 21.4 m2; Apartment No. 2 - 6 rooms from 8.2 to 21.7 m^2; Nos. 3, 6 - 7 rooms from 8.6 to 22.5 m^2; No. 4 - 12 rooms from 5.4 to 21.7 m^2; No. 5 - 11 rooms with space from 5.6 to 23.2 m^2 (Fig. 8). Residents also had common household services: a dining room, a bathhouse, a laundry.

Figure 8. *"Battalion", Molodezhnaya Street, 28 (exterior and 1st floor plan). Photo from the 1960s.*

In 1929, a school was built in Kamenka. The school building is 2-story wooden with small (8x6m), but very bright classrooms. The large corridor on the 1st floor (20.8 x 4.78m) allowed for school-wide events to be held without going outside (Fig. 9).

Figure 9. *School (exterior, school corridor.)*

Along with the school, a Community Center (built in 1929) was built in the village. The main building has brick walls and round timber walls installed on strip brick foundations, the community center extensions are made of timber on wooden chairs. The staircases are monolithic reinforced concrete supported by the load-bearing brick walls of the stairwell. The building is designed to include: a spacious foyer (105.4 m^2), a cloakroom (46.1 m^2), an auditorium with a stage

(279.2 m^2 + 97.3 m^2), a dance hall (201.5 m^2), dressing rooms and other rooms (Fig. 10).

Figure 10. *The House of Culture (Original and current appearance – the right wing was lost in a fire)*

The village of Kamenka was built in the best traditions of wooden architecture. Today the village is not at all what it was almost 100 years ago. The wooden pavement has been dismantled, the sawmill is standing and being sold. Many houses built in 1923-1930 are still standing. Some are living out their days without residents and are about to fall down, others are standing and, thanks to the high-quality work during construction and their residents, will last for many more years. To preserve its uniqueness, the village of Kamenka requires a large investment and a thrifty owner.

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科学出版物

上合组织国家的科学研究：协同和一体化

国际科学大会的材料

2025年7月2日，中国北京

编辑A.A.Siliverstova
校正A.I.尼古拉耶夫

2025年7月2日，中国北京
USL。沸点：98.7。 订单253.流通500份。

在编辑和出版中心印制
无限出版社