



SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

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

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国家协会：一体化的目的、目标和原则
**ASSOCIATIONS OF COUNTRIES: GOALS, OBJECTIVES AND
PRINCIPLES OF INTEGRATION**

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抽象的。 本文对两个国家（其中最大的国家是中华人民共和国、印度共和国和俄罗斯联邦）创建和活动的目的、目标和原则进行了比较分析。 这些国家中有美国位于亚洲的一个联盟——上海合作组织，而另一个联盟——金砖国家，不仅有亚洲国家，还有一些非洲和南美国家。 主要战略目标是在经济等宏观环境中创造共同空间，包括数字、贸易、交通、科学和技术。 基于不干涉各国内政、相互尊重、互利经济的原则。 这样的国家联盟还实现了一个政治目标——建立一个多极世界，在社会经济、科学、技术、文化进一步发展和环境保护等所有事务上不再由一个或几个世界强国占主导地位。

关键词：联盟、国家、协会、上海合作组织、金砖国家。

Abstract. *The article provides a comparative analysis of the goals, objectives and principles of the creation and activities of two commonwealths of countries, the largest of which are the People's Republic of China, the Republic of India and the Russian Federation. These countries have united states located in Asia in one union - the SCO, and in the other - BRICS there are not only Asian, but also some African and South American states. The main strategic goals are to create common spaces in such macro-environments as the economy, including digital, trade, transport, science and technology. Based on the principles of non-interference in the internal affairs of each country, mutual respect, and mutual economic benefit. Such a union of countries also achieves a political goal - to create a multipolar world without the dominance of one or several world powers*

in all matters of further socio-economic, scientific, technical, cultural development and environmental protection.

Keywords: *union, states, association, SCO, BRICS.*

At the beginning of the 21st century, processes of unification of countries located on the same continent began, caused not only by global processes of division of labor and production of goods at lower costs in some countries compared to others, but also with the corresponding need for resources for the production processes of these goods. Moreover, the extraction of material resources, including mainly natural ones, is significantly removed from the places of their use and the production of corresponding goods with their help, on the one hand, and, on the other hand, client markets, including consumer, industry and markets of state and municipal governments, to satisfy the specific needs of which goods are produced, are also significantly removed from the places of production of goods.

The increasing division of labor on a global scale and the increasing distance between the markets of resource suppliers from the markets of goods producers and from client markets has led to the need to improve transport communications, which are characterized by speed and path length. However, these two indicators, in turn, depend on the number of borders between countries and the degree of consistency in procedures for crossing these borders.

The most rational decision of government authorities, in our opinion, is to unite countries located on the same continent and characterized by large volumes of mutual export and import of goods. For example, in 2001, the leaders of several countries created the Shanghai International Organization (SCO), which currently includes eight states. These include such large countries of the European-Asian continent as the People's Republic of China, the Republic of India, the Russian Federation, as well as four republics that are members of the Commonwealth of Independent States (CIS), such as Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. In addition to the listed countries, this organization also includes the Islamic Republic of Pakistan.

Four countries - the Republic of Belarus, Mongolia, the Republic of Afghanistan and the Islamic Republic of Iran - have observer status, which allows us to make an assumption about the possibility of their entry into this international organization in one way or another. Moreover, the Republic of Belarus and the Russian Federation are integrated into a single Union State. And the transport and communications corridor under construction in the Russian Federation called "North-South" will pass through the Islamic Republic of Iran [1].

Interstate communications with the government bodies of Mongolia and the legislative bodies of the Russian Federation are also being strengthened, as evidenced by the recent trip of the delegation of the Federal Assembly of the Russian Federation to Ulaanbaatar [2].

The charter document of this organization since September 19, 2003 has been the SCO Charter. The highest governing body is the Council of Heads of State, which determines the priorities for the joint development of countries and the main directions of the organization's activities in such areas as: politics (legal environment) and security; economic environment, including trade between countries; cultural environment, including humanitarian cooperation.

The Council also resolves fundamental issues of the internal structure and functioning of the organization, as well as the tasks of interaction with other states and international organizations. It should be noted that the Council of Heads of State of the SCO also considers the most pressing international problems.

Currently, the main output documents of this organization can be considered Statements of the Council of Heads of State, which contain resolutions on cooperation in preventing or solving the most pressing problems in almost all areas of activity. These include, first of all, politics and security, economics, demography, environment, scientific, technical and cultural environments.

In the sphere of politics and security, cooperation is being carried out to counter radicalization leading to terrorism, separatism and extremism, and the drug threat. The solution and prevention of such problems are facilitated by joint communiques and statements as the results of meetings of the Ministers of Defense, Justice and Foreign Affairs.

In the economic environment, countries cooperate in the field of ensuring international energy security, global food security, creating reliable, sustainable and diversified supply chains for resources and goods, expanding the digital economy, and facilitating trade procedures.

The solution to demographic problems is facilitated by cooperation in the healthcare sector to jointly combat coronavirus infection.

Further development of the scientific and technical environment is facilitated by strengthening cooperation between countries in the fields of science, technology and innovation. And the joint response of states to climate change makes it possible to prevent the emergence of new problems in the natural environment and the levels of pollution of its components. This is especially true now of the Russian Federation and the People's Republic of China, whose eastern borders are washed by the waters of the Pacific Ocean, into which Japan discharges wastewater contaminated with radioactive substances.

In our opinion, factors of interaction between countries in the cultural environment include such a joint document as "Address to Youth." It is quite obvious that the organization is not a military bloc, and is built on two types of principles. The first includes the principles of external interaction with other countries and associations: openness; not belonging to blocks; not directed against third countries. The second is the principles of internal interaction: respect for the diversity of cultures; equality; mutual economic benefit; mutual trust; desire for joint development.

The long-term strategic goal of creating the SCO should be considered this: to create a new rational, fair and democratic international order in the sphere of politics and economics. To achieve this goal, a program of multilateral economic cooperation has been formed, aimed at creating, first of all, a common economic space.

The main medium-term goals have not changed over the past 22 years and are: to ensure security and stability in the international macro-region; to combat extremism and terrorism; ensure the development of scientific and cultural interaction; create an energy partnership and expand the scope of economic cooperation.

Permanent current tasks, in our opinion, include strengthening mutual trust, friendship and good neighborliness of all states; full encouragement of effective cooperation in all spheres of activity and macro-environments (political, economic, demographic, cultural, scientific, technical and environmental).; implementation of joint ongoing activities to maintain and ensure peace, security and stability of the countries.

However, in June 2006, five years after the creation of the SCO, an interstate association or commonwealth of four states was formed in St. Petersburg at the St. Petersburg Economic Forum, again based on the three main countries located on the Eurasian continent - the People's Republic of China, the Republic of India and the Russian Federation. Federation, as well as the Republic of Brazil, representing South America. Thus, we can judge the expansion of interaction between countries on two continents.

Further, on December 24, 2010, the Republic of South Africa joined the association, which received the abbreviated name BRICS, which indicated the expansion of the influence of this organization on three continents.

From January 1, 2024, several more countries will join this union, and their total number will increase to eleven. So, for example, South America will be represented, in addition to the Republic of Brazil, by the Argentine Republic. The Arab Republic of Egypt and the Federal Democratic Republic of Ethiopia will, together with the Republic of South Africa, represent the interests of the countries of the African continent in a larger composition. The Islamic Republic of Iran, the Kingdom of Saudi Arabia and the United Arab Emirates as countries in Western Asia will also strengthen the political and economic interests of three large countries - the People's Republic of China, the Republic of India and the Russian Federation. Every year the heads of government of these countries meet at summits, in addition, meetings of the heads of the ministries of foreign affairs and finance are held.

One can draw conclusions about the similarities and differences in the goals, principles and objectives of these two associations of countries.

The strategic goal of the SCO is to create a new rational, fair and democratic international order in the sphere of politics and economics. Maintain and strengthen peace, ensure security and stability on the continent, promote the construction of a new democratic, fair and rational political and economic international order.

To achieve this goal, a program of multilateral economic cooperation has been formed, aimed at creating, first of all, a common economic space.

The main medium-term goals have not changed over the past 22 years and are: to ensure security and stability in the international macro-region; to combat extremism and terrorism; ensure the development of scientific and cultural interaction; create an energy partnership and expand economic cooperation; ensure the strengthening of mutual trust, friendship and good neighborliness, and the development of multidisciplinary cooperation.

Table 1 shows the characteristics of both alliances.

Table 1
Characteristics of the SCO and BRICS

| Sign | SCO | BRICS |
|---------------------------|--|--|
| Purpose of creation | 1) to develop cooperation between countries and contribute to the strengthening of peace, security, and development of countries in a multipolar, interdependent and complex global world; 2) to create a new international order in the sphere of politics and economics 3) to create a common economic space and energy partnership | 1) to create an integrated scientific and information space for research and assessment of countries' problems; 2) to develop cooperation and development of countries in a multipolar global world. |
| Tasks | <ul style="list-style-type: none"> to strengthen mutual trust, friendship and good neighborliness between Member States; to develop multidisciplinary cooperation in order to maintain and strengthen peace, security and stability in the region; to contribute to the construction of a new democratic, fair and rational political and economic international order. | <ul style="list-style-type: none"> to coordinate research to determine the degree of importance and influence of the BRICS countries and other so-called "rising powers" on world politics and economics; to form an integrated scientific and information space in the field of research on BRICS issues and its assessments in the world expert community of national and global significance. |
| Principles of cooperation | mutual trust, mutual economic benefit, equality. | |
| | <ul style="list-style-type: none"> an interconnected world without artificial barriers; cultural and civilized diversity [3]; general security and justice; desire for joint development; mutual consultations; non-alliance with other associations; not directed against any states. | <ul style="list-style-type: none"> openness; solidarity (unanimity, community of interests); mutual understanding, non-interference. |

| | | |
|----------------------------------|---|---|
| Number of countries in the union | eight and four observer states | eleven |
| Macro coverage | Political, economic, cultural, scientific and technical | Political, economic, scientific and technical |

As can be seen from Table 1, BRICS covers a larger number of countries, but a smaller number of macro-environments.

Thus, according to 2019 statistics, the population of the BRICS countries was approximately 3.41 billion people or 41.6% of the total population in the world. The total area of the countries is 39,746,220 square meters. km or approximately 26.7% of the land surface.

The four BRICS countries are among the ten largest countries in the world in terms of population, area and gross domestic product. The volume of gross domestic product grew at the fastest pace in 2000–2022 in the People’s Republic of China. This is the fastest growing country in the commonwealth, being the first economy in the whole world in terms of GDP, exported goods, foreign exchange reserves and a population of more than 1 billion people.

The Republics of India and Brazil took second and third places in terms of GDP growth rates. The Republic of India is the third economy in the world in terms of GDP and purchasing power parity of the national currency, has the largest population in the world and differs from other countries in its intellectual labor resources. The Republic of Brazil ranks eighth in the world economy in terms of two indicators (GDP and PPP), and is distinguished by large volumes of production and export of agricultural products.

In fourth place is the Russian Federation. It is the fifth largest economy in the world in terms of GDP and purchasing power parity of the ruble, distinguished by the largest territory in the world and the presence of the largest reserves of natural mineral resources. The SCO also includes these largest countries: the People’s Republic of China, the Republic of India and the Russian Federation, which by 2050, according to experts, will become the largest powers in the world community [3]. Thus, China and India will become global producers of industrial products and services, and the Russian Federation will become a supplier of resources.

And in BRICS, the Republic of Brazil will become a global supplier of resources. These countries will create a second economic circuit in the world and create their own currency for trade payments between participating states.

Despite the similarity of goals, objectives and principles of further development in the countries, economic, social and cultural differences remain.

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区域经济政策数字化背景下数字技术的运用现状
**THE CURRENT STATE OF THE USE OF DIGITAL
TECHNOLOGIES IN THE CONTEXT OF DIGITALIZATION OF
REGIONAL ECONOMIC POLICY**

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抽象的。 本文探讨了区域经济政策数字化背景下数字技术的使用现状。 统计数据的研究是按数字化水平进行的：国家、行业、家庭和公民。 在州一级，随着时间的推移，分析发展数字经济的成本。 在行业层面，通过政府机构和组织之间的在线互动动态来考虑经济数字化发展的动态。 数字基础设施已在家庭层面进行了研究。 在公民层面，分析了人们以电子形式接受国家和市政服务的数据，以及从事与信息通信技术密集使用相关职业的人员的数据。

关键词：数字化、数字技术、区域经济政策、国家、行业、家庭、成本、企业、当局。

Abstract. *The article examines the current state of the use of digital technologies in the context of digitalization of regional economic policy. The study of statistical data is carried out by levels of digitalization: state, industry, households and citizens. At the state level, the costs of developing the digital economy are analyzed over time. At the industry level, the dynamics of the development of digitalization of the economy are considered through the dynamics of online interaction between government authorities and organizations. Digital infrastructure has been studied at the household level. At the citizen level, data on the receipt by the population of state and municipal services in electronic form, as well as those employed in professions associated with the intensive use of information and communication technologies, was analyzed.*

Keywords: *digitalization, digital technologies, regional economic policy, state, industry, households, costs, business, authorities.*

The current stage of global economic and social development is characterized by a significant influence of digitalization. Digital technologies provide regions

with unique opportunities to increase their investment attractiveness and competitiveness. Therefore, the focus of modern scientific discourse is now aimed at studying the phenomenon of digitalization of the economy as the basis for the formation of regional economic policy.

It is proposed to study statistical data according to the levels of digitalization, namely: state, industry, households and citizens [3, p. 50]. At the state level, the digitalization process is proposed to be studied based on measures and programs carried out by the state to support the digitalization of the regional economy, such as financial support for the digital economy. At the industry level - through the dynamics of online interaction between government authorities and organizations. At the household level - digital infrastructure research. At the level of citizens - a study from the perspective of digital competencies of subjects (statistics on the level of digital literacy and competencies of the population in the region: the population receives state and municipal services in electronic form and those employed in professions associated with the intensive use of information and communication technologies (ICT)).

Calculations by the Institute of Statistical Research and Economics of Knowledge of the National Research University Higher School of Economics (NRI HSE) based on Rosstat data of gross domestic costs for the development of the digital economy in the Russian Federation from 2017 to 2021 are presented in Figure 2.1.



Figure 2.1. Costs for the development of the digital economy of the Russian Federation, billion rubles. (compiled by the author based on [2, 4])

According to the data presented, the development trend of the digital economy has growth dynamics, which is reflected in the increase in: gross domestic costs for the development of the digital economy, internal costs of organizations for the creation, distribution and use of digital technologies and related products and services, household costs for the use of digital technologies and related goods and services. Thus, in 2021, gross domestic costs for the development of the digital economy in the Russian Federation amounted to 4,848 billion rubles, which is 785 billion rubles more than in 2020. (or 19.32%), and compared to 2017, gross domestic costs increased by 45.84%.

During the period under study, there was also a dynamics of growth in internal costs of organizations for the creation, distribution and use of digital technologies and related products and services. Thus, in 2021, the studied indicator amounted to 2947 billion rubles, which is 30.28% more than in 2020. It should be noted that during the period under study there was a slight growth trend in household spending on the use of digital technologies and related goods and services (1,901 billion RUB in 2021).

The dynamics of the development of digitalization of the economy at the industry level are considered through the dynamics of online interaction between government authorities and organizations in 2020-2021. (Figure 2.2).

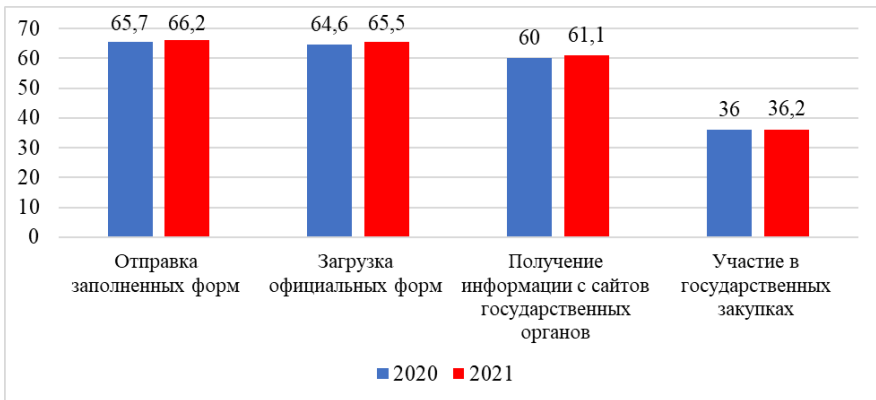


Figure 2.2. Online interaction between business and government authorities, % (compiled by the author based on [2, 4])

For 2020-2021 There is a slight increase in the indicator of online interactions between businesses and authorities, which is confirmed by an increase in all studied indicators in 2021.

The receipt of public services by organizations electronically as a percentage of the total number of organizations is presented in Figure 2.3. In 2021, there is an increase of 3% in organizations that receive government services electronically and by 1.8% entirely electronically.

The use of digital technologies in organizations of the Russian Federation for 2020-2021, presented in Figure 2.4.

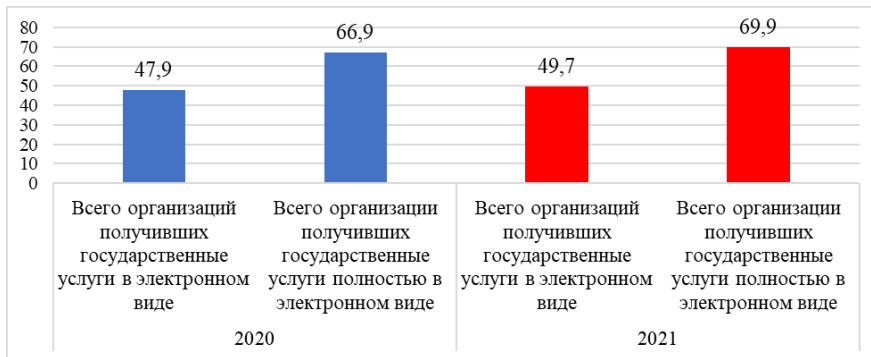


Figure 2.3. Receipt of public services by organizations in electronic form, % (compiled by the author based on [2, 4])

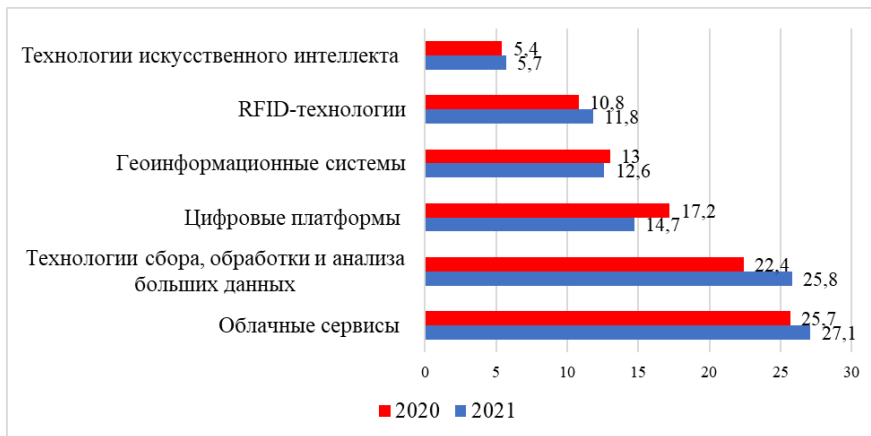


Figure 2.4. Use of digital technologies in organizations, % (compiled by the author based on [2, 4])

Conducting a study on the use of digital technologies in organizations of the Russian Federation, one can notice that more and more companies are aimed at

digitalizing their business processes. Thus, in 2021, 1.4% more organizations use cloud services in their activities, 3.4% more technologies for collecting, processing and analyzing big data, 1% more RFID technologies, 0.3% more artificial intelligence technologies.

Data on the use of the Internet in organizations, presented in Figure 2.5, indicate an increase in indicators over the period under study.

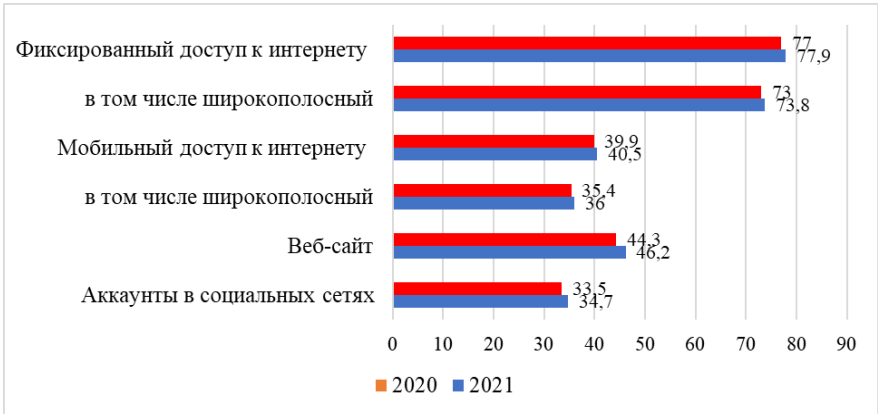


Figure 2.5. Internet use in organizations, % (compiled by the author based on [2, 4])

Figure 2.6 presents data on the receipt by the population of state and municipal services in electronic form; from 2019 to 2021 there is a growth rate of 6.5%.

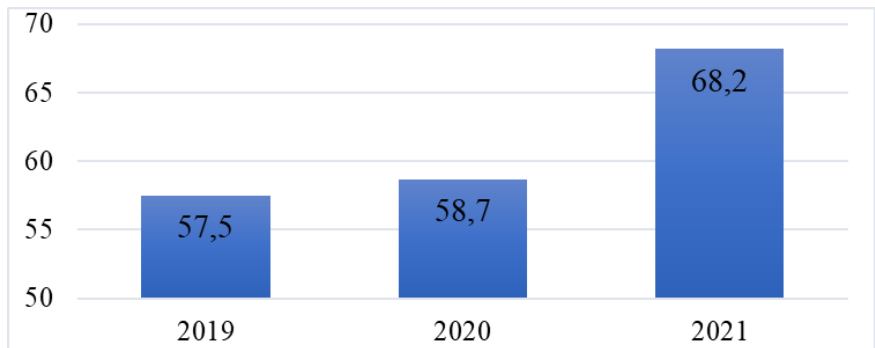


Figure 2.6. Reception of state and municipal services by the population in electronic form, % (compiled by the author based on [2, 4])

A study of those employed in professions associated with the intensive use of ICT in the Russian Federation indicates that, in general, during the period under study the indicators remain at the same level (Figure 2.7).

Employed in professions associated with the intensive use of ICT - employed people whose professional activities require performing tasks with the help of ICT (from simple use of the Internet, working with texts and tables to programming).

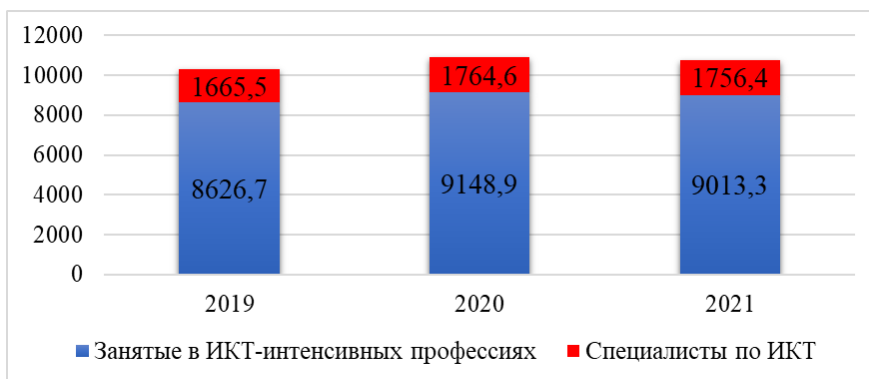


Figure 2.7. Employed in professions related to the intensive use of ICT in the Russian Federation, thousand people. (compiled by the author based on [2, 4])

In turn, ICT specialists include workers capable of developing, operating and maintaining ICT, for whom ICT-related activities constitute the main part of their professional activity [1, p. 90].

Thus, the conducted study of the use of digital technologies in the Russian Federation shows that digitalization at its various levels is one of the priority areas for the development of the national economy. Digitalization is gradually changing all directions, processes, institutions and tools for economic development. Digital technologies and development opportunities contribute to reaching a higher quality global level of the economic and social structure of the state. Consequently, there is a need to study the processes of digitalization of the regional economic policy of the Donetsk People's Republic and the Lugansk People's Republic.

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俄罗斯和中国对外经济活动的主要趋势和问题
**MAIN TRENDS AND PROBLEMATIC ISSUES IN FOREIGN
ECONOMIC ACTIVITY OF RUSSIA AND CHINA**

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抽象的。文章重点介绍了俄罗斯和中国对外经济活动的最新趋势和存在的问题。在欧洲国家间贸易大规模、全球性下滑的背景下，俄罗斯与某些亚洲国家建立和加强合作的问题尤其受到关注。本研究的目的是评估俄罗斯和中国之间的外贸额趋势。使用的方法有统计分析、财务分析和逻辑分析。该研究基于统计分析、分析中心调查、大众媒体和俄罗斯政府官方数据。该研究根据一系列宏观经济统计数据分析了两国之间相互贸易的特征和数量。由此对俄罗斯对外贸易进行了经济分析；突出各类运输方式对外贸易的主要特点；确定了俄罗斯与中国之间贸易关系中的挑战和矛盾。研究过程中获得的结果可以作为为提高对华国际合作有效性和加强贸易关系战略提供资金的方法基础。该研究的实际意义将使改善俄罗斯和中国对外经济活动的管理决策成为可能。

关键词：对外贸易额·俄罗斯经济·国际经济互动·经济因素。

Abstract. *The article highlights the latest trends and problematic issues in the foreign economic activity of Russia and China. In the context of a large-scale and a global decline in trade between European countries, the issue of establishing and strengthening cooperation between Russia and certain Asian countries has particular topicality. The purpose of this research is to assess of trends in foreign trade turnover between Russia and China. Methods used were statistical analysis, financial analysis, and logical analysis. The research is based on the analysis of statistical data, surveys of analytical centers, mass media, and official data of the Russian Government. The study analyzed the features and volumes of mutual*

trade between pairs of countries based on arrays of macroeconomic statistics. As a result, an economic analysis of Russia's foreign trade is carried out; the main features of foreign trade using various types of transport are highlighted; challenges and contradictions in Russia's trade relations between Russia and China are identified. The results obtained in the course of the study can be used as a methodological basis for financing the strategy of increasing the effectiveness of international cooperation with China and strengthening trade relations. The practical significance of the study will make it possible to make managerial decisions on improving foreign economic activity Russia and China.

Keywords: *Foreign trade turnover · Russian Economy · Economic international interaction · Economic factors.*

Modern trends in economic development have made significant changes in foreign economic activity, business processes, financial architecture and technology, information in the foreign trade management system. Changing political directions and transformation processes occurring in the domestic economy determine the need to analyze Russia's foreign economic activity to determine the main trends and problematic aspects of foreign trade activity with China. In the context of the digital economy, the transnationalization of capital is increasing, which allows states and businesses to successfully and effectively use the economic potential based on the awareness of interest in joint and coordinated development. Transnationalization allows for effective capital expansion and limits the scale and capabilities of governments themselves (Kozlov A.N. 2018), however, the multifaceted parameter of globalization processes, starting from the transition of national corporations to international ones, the impact on international economic relations and the policy of states, does not always have a positive effect on international economic space and foreign economic activity.

Analysis of foreign economic activity showed profound changes in the structure of trade between countries. Since the beginning of this century, the share of developing countries in global trade in goods and services has grown from 31.8 to 44.5% (Knobel A.Yu., Aliev T.M. et al. 2019). In this regard, the issue of establishing and strengthening economic cooperation between Russia and individual countries is of particular relevance.

Today, as never before, states need to maintain political and economic ties and develop trade relations with partner countries. According to the Ministry of Economic Development of the Russian Federation, foreign trade turnover in 2022 compared to 2020 increased by 49.7%¹ (figure 1).

¹ Foreign trade statistics. According to the Federal Customs Service of Russia. URL: https://rosstat.gov.ru/storage/mediabank/26_23-02-2022.html (access date: 10/09/2023)

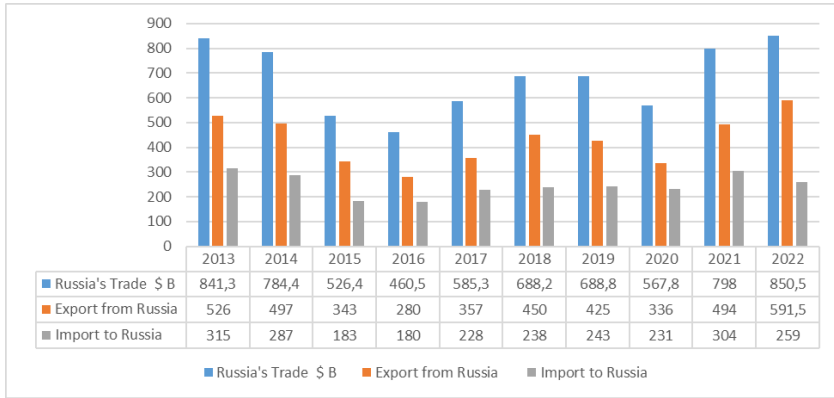


Figure 1. Russia's Trade for the period 2013 – 2022

Source: compiled by the authors.

It is during the crisis period that it is necessary to concentrate on key partners. For the Russian Federation, these are China and Germany, they have been holding leading positions in foreign trade turnover for several years (figure 2).

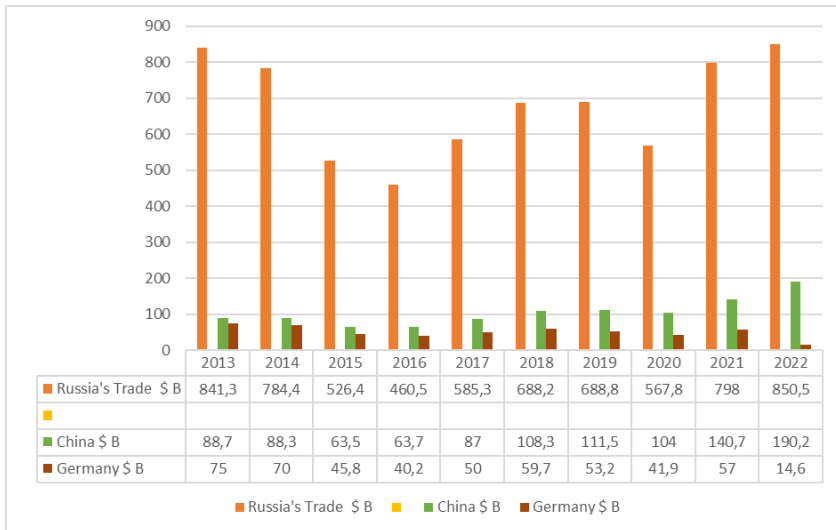


Figure 2. Trade between Russia and Germany and China for the period 2013 – 2022

Source: compiled by the authors.

In the structure of trade turnover by country at the first place China (13%), in second place Germany (9%). It is noteworthy that today China ranks first in terms of foreign trade turnover and the rate of trade between Russia and China is growing every year. The volume and dynamics of trade with the main partners for clarity are presented in a tabular form (table 1).

Table 1.

Russia's trade by product «All products» with other countries

| № | Country | Σ (2013-2019) | Ratio | 2019 | 2020 |
|---|------------------------------|---------------|-------|-----------|-----------|
| 1 | China | \$610.9 B | 13.4% | \$111.5 B | \$104 B |
| 2 | Germany | \$393.9 B | 8.6% | \$53.2 B | \$41.9 B |
| 3 | Netherlands | \$360.7 B | 7.9% | \$48.8 B | \$28.6 B |
| 4 | Italy | \$227.6 B | 5% | \$25.2 B | \$20.2 B |
| 5 | Belarus | \$214.4 B | 4.7% | \$33.9 B | \$28.5 B |
| 6 | Turkey | \$177 B | 3.9% | \$26.1 B | \$20.8 B |
| 7 | United States | \$171.7 B | 3.8% | \$26.2 B | \$23.9 B |
| | The total for all countries: | \$4555 B | 100% | \$668.8 B | \$567.8 B |

Source: compiled by the authors. Export and import of Russia by goods and countries <https://ru-stat.com/date-Y2013-2020/RU/trade/world> (accessed on 29.07.2021).

Let's analyze the trade relations between Russia and the Celestial Empire. Trade and economic cooperation between states went through two stages in its development. The first stage - the beginning of trade and economic relations between Russia and China, from 1992 to 2000. It is characterized by the fact that in this period of time the basis for further partnership was laid: a documentary and legal base was formed, the idea of "Russian-Chinese relations as an equal, trusting partnership aimed at strategic interaction in the XXI century". However, at this stage, there is a decline in the share of Russia in foreign trade with China by 43.6%. The reason for the fall is the implementation of market reforms in Russia and the reorganization of the entire trade structure in the country.

At the beginning of the 21st century, trade and economic relations between Russia and China acquired a positive dynamic of development. In 2001, the Treaty on Good Neighborliness, Friendship and Cooperation was signed. This agreement has secured the legal basis for trust-based cooperation between China and Russia.

With the onset of the new millennium and the emergence of the market, Russia began to increase the overall turnover of foreign trade, including trade with China. The growth dynamics of two-way trade can be analyzed using a graph based on BloombergTerminal data (Figure 3).

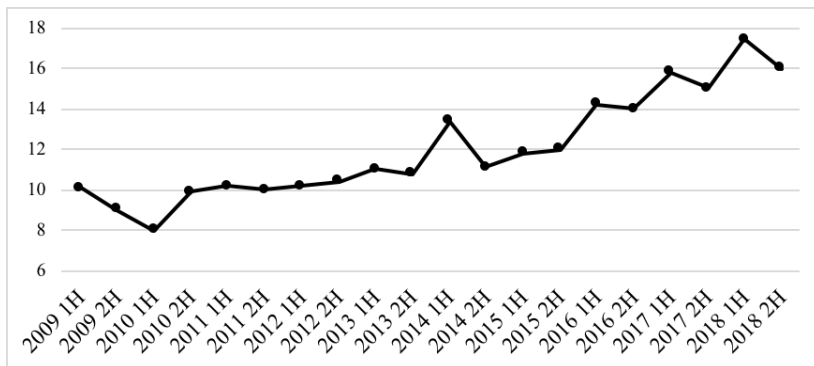


Figure 3. Growth in the volume of trade between Russia and China, %
 Source: compiled by the authors. BloombergTerminal

The Chinese economy began its explosive growth in 1997. In the period from 1997 to 1999, a 6-fold increase in the country’s GDP was recorded (an annual growth of about 10%). In the period from 2000 to 2010, the average annual GDP growth rate of the Celestial Empire, according to World Bank Data, amounted to 10.4% (see table 1.1). It is worth noting that the country’s GDP growth rate is gradually slowing down and in 2018, according to the State Statistical Office of the PRC, it amounted to 6.6% - this is the absolute minimum for the period 2000-2020. According to Premier Li Keqiang, the slowdown in the Chinese economy is primarily due to the fall in domestic consumer demand and investment, as well as the trade war with the United States. For clarity and the possibility of comparison, the trends in China’s GDP are presented in value and percentage terms in Figure 4.

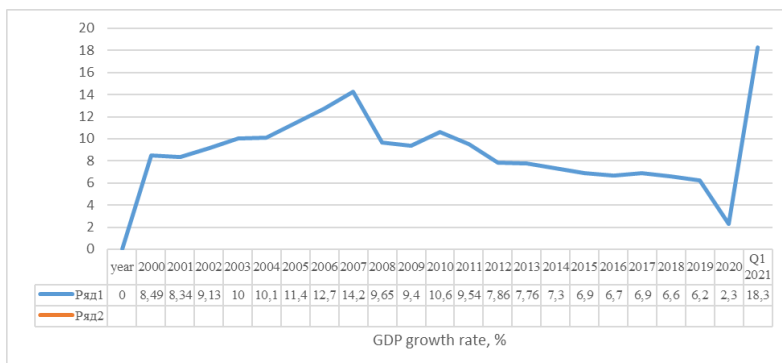


Figure 4. China’s GDP growth rates for 2000-2021
 Source: compiled by the authors based on data from the WorldBankData

Due to the active development of both economies, the expansion of partnership relations in the field of trade has begun. Thus, in the period from 2013 to 2022, interstate trade between Russia and China showed a general tendency to increase trade turnover, which rose by 2.16 times (data comparison of the base 2013 and 2022). The only recorded decrease in trade volume over the past 10 years was in 2014 - the volume of trade turnover decreased by 23% compared to 2013. The largest share in the structure of trade between Russia and China belongs to hydrocarbons (such as gas, oil and products from them) – from 62% to 74%, and since 2009, the supply of nuclear reactors and equipment for their installation and operation has begun. The volume of trade in nuclear energy resources occupies a small part in the structure (about 2% to 8%) of trade turnover.

The structure of the general interstate commodity exchange for 7 years (the period 2013-2022) is presented in Figure 5.

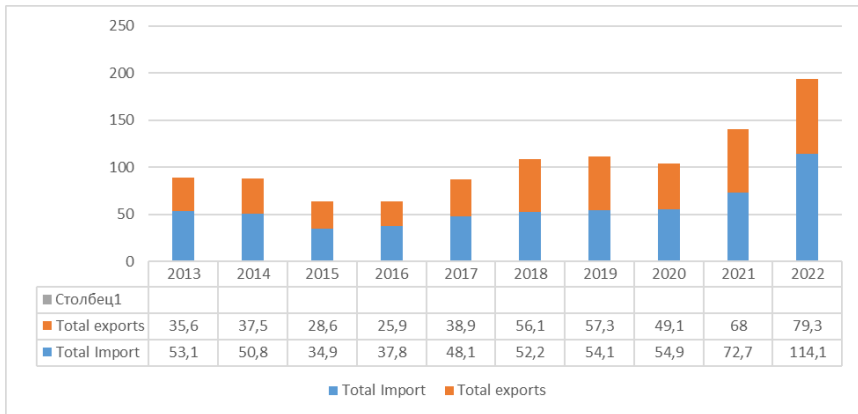


Figure 5. The structure of trade between Russia and China for 2000-2022
Source: compiled by the authors

According to official data, in 2022, an absolute record was set for the volume of trade turnover between Russia and China, which totaled more than 190 billion US dollars, which is 29,4% higher than the same indicator for 2021. Next, it is necessary to pay attention to the structure of imports and exports, since 2018 for the first time the volume of imports of China (from Russia) began to exceed the indicator of China's exports (to Russia): US dollars 59.1 billion against US dollars 48.1 billion. The prolonged trade conflict between China and the United States increases risks to the global economy, disrupting supply chains, discouraging investment and undermining business confidence (Zheng Wei, 2020). However, on the other hand, exports from Russia to China for the period 2013 - 2019 amounted

to \$279.9 Billion. The main exports were “Mineral products” (73%), “Wood and wood products; charcoal; cork and cork products” (7%). In the structure of exports by country, the Netherlands ranks first place (12%), and China ranks second place (10%).

Thus, China is the absolute leader in trade with Russia. The trade turnover between Russia and China has been growing for more than 10 years, and in 2022 it grew despite restrictive measures due to sanctions in both countries and compliance with trade restrictions. «During this time, a lot has changed in the world, and often not for the better, but the main thing has remained unchanged - the strong Russian-Chinese friendship, which is consistently strengthening for the benefit and in the interests of our countries and peoples»². In the last decade, instability and volatility in the development of Russia’s foreign trade has been caused by the influence of both external and internal factors. China and Asian countries are becoming priority areas of Russia’s foreign trade strategy. So, if the share of China in Russian imports was only 3.9% in 2001, then in 2010 it already reached 17%.

Thus, we can notice the trend of building a trade dialogue between Russia and the countries of the Asian direction. Russia and China are very interested in cooperation in the international arena. China agrees with Russia’s views on the future structure of the world, which is reflected in the concept of “multipolarity”. In fact, this means that both countries want to see a world in which one of the great powers is not dominant, but several centers of influence interact with each other in accordance with the norms of international law and the UN Charter.

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新现实背景下教育组织的项目开发

**PROJECT DEVELOPMENT OF EDUCATIONAL ORGANIZATIONS
IN THE CONTEXT OF NEW REALITIES**

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注解。 提出了现代条件下教育组织项目化发展的趋势,在此基础上给出了教育组织项目化过程的结构模型,阐述了将项目技术引入教育领域管理体系的理由: 确定的以及影响项目开发有效性的因素。

关键词: 项目开发、教育组织、新现实。

Annotation. *The trends towards the project development of educational organizations in modern conditions are presented, on the basis of which a structural model of the project process of an educational organization is given, the reasons for introducing project technologies into the management system in the field of education are identified, as well as factors affecting the effectiveness of project development.*

Keywords: *project development, educational organization, new realities.*

The project development of educational organizations in Russia is currently a significant direction contributing to the long-term development of the educational ecosystem of the regions, and as a consequence of the Russian education system.

The project development of educational organizations in modern conditions consists in building a management plan, choosing project directions for more effective work and improving qualitative and quantitative indicators of educational detail. In order to build the most effective project development program, which will bear fruit in the future, it is necessary to work out project ideas, build a target model, a substantive part, and also determine the mechanisms for implementing project activities in the field of education.

Today, educational institutions need to monitor the project processes taking place within the organization, as well as respond to changes in the external en-

vironment. The process of knowledge transfer is unique in its kind and it is impossible not to take this into account when developing programs for the project development of educational organizations.

The project development of educational organizations is determined by environmental factors that have the format of new challenges and requirements (geopolitical, economic, social), supplemented by key trends: digitalization of society; globalization of the economy, knowledge and technology; acceleration of socio-cultural changes; development of integration processes, etc. Moreover, the emphasis is increasingly shifting from the national to the regional level, since it is the regional socio-economic component that can become a catalyst for developing new design solutions and setting new tasks for the project development of educational structures [3].

In the process of project activity, planning and organization in the field of education become more flexible and allow each employee to be actively involved in the pedagogical process. Teachers and parents are allowed to make suggestions in the educational process.

It can be noted that the Russian system of providing educational services has the following trends towards project development:

1. accessibility of education. This indicates the implementation of programs and project activities to solve the problems of education for everyone without exception with the use of new educational methods and technologies;
2. the variability of projects for the provision of educational services in educational institutions. This assumes that when providing educational services, the interests of each child who receives knowledge will be taken into account. That is, education will become more personality-oriented. Thus, it will be possible to get the knowledge that they are more interested in, given their personal attitude to the provision of educational services;
3. development of additional education projects. This suggests that additional education can be provided in the form of such forms as leisure centers, clubs, creative houses, fitness sections, etc.
4. continuity of educational services. This trend is also the main problem that needs to be solved in the Russian education system. To solve this problem, it is necessary to participate promptly and actively in the life of society and the provision of educational services to the population. Establishing communication links will allow you to quickly navigate and prevent possible risks even before they occur.

It should be noted that the system of providing educational services is one of the main indicators of the level of socio-economic development of the region. Today, the Russian Federation is actively working on the project development of education, but there is still a need to further improve this area and increase the availability of education.

Project technologies in the field of education are sets of methods and tools that support the stages of implementation of innovations that ensure the activities of these structures.

For successful management of project technologies, it is necessary to remember that innovations are introduced with great difficulty and can quickly become obsolete, that is, they are relevant only in a specific period of time. We will highlight the reasons that encourage the introduction of project technologies into the management system in the field of education (Figure 1).

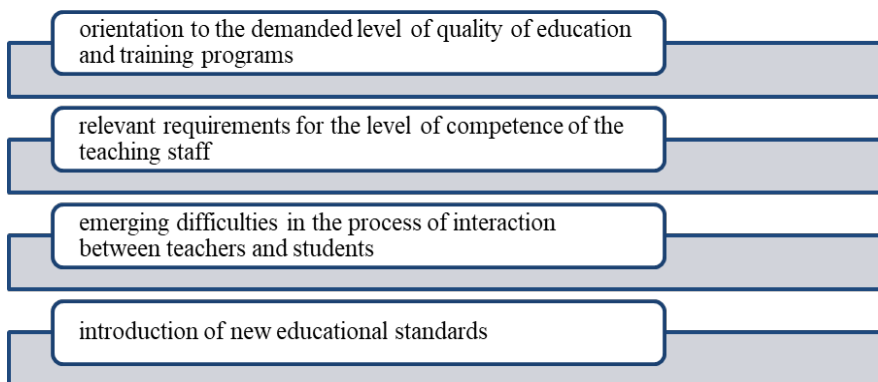


Figure 1. *Reasons for introducing project technologies into the management system in the field of education*

Management of project technologies can take place in parallel in several areas of activity of educational organizations: financial, informational, personnel, methodological and pedagogical, forming a structural model of the project process of an educational organization (Figure 2).

The task of the manager in this situation is to correctly determine the purpose and objectives of the project process, identify the main problems, identify ways of correction, choose ways of influence.

Today, educational organizations need an innovative leader who is able to implement project ideas for the modernization of the educational structure. Such a manager must constantly improve his professional skills and managerial qualities in order to take effective project decisions in a timely manner, create appropriate conditions for students and improve the quality of their training, as well as maintain the functioning of the teacher - student - employer chain at the proper level [2].

A number of factors influence the effectiveness of the project development of educational organizations:

- informational - the presence or absence of information that determines the possibility of making design decisions;
- financial and economic - financial accessibility of education for students;

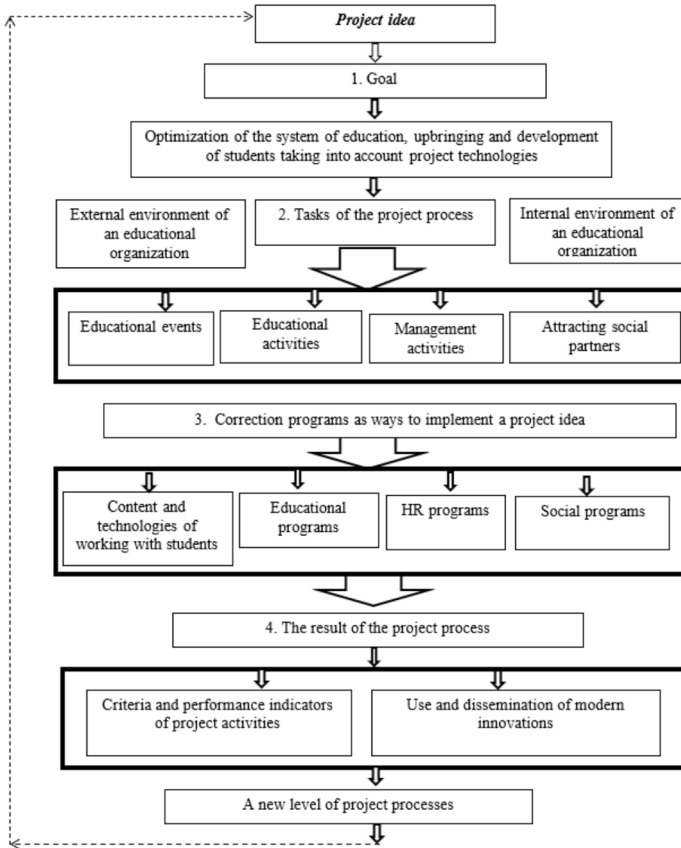


Figure 2. Structural model of the project process of an educational organization

- territorial - territorial proximity, transport accessibility, etc.;
- institutional - the presence of educational organizations implementing modern projects and programs;
- individual–personal - motivational, physiological and intellectual resources of students;

- pedagogical - the professionalism of the teacher, his ability to implement a range of projects, methods, technologies that provide students with a choice and equal opportunities to master general education programs [1].

The system-forming factor of the pedagogical education system is management. The art of project process management in the field of education is project management, i.e. a set of principles, methods, organizational forms, technological methods of project process management that contribute to improving its efficiency and quality.

Project management in an educational organization is based on the following principles shown in Figure 3.

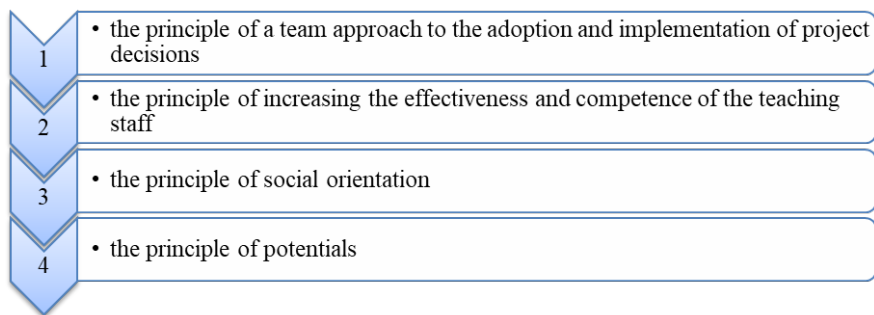


Figure 3. *The principles on which project management in an educational organization is based*

Thus, it can be noted that the introduction of project technologies in the activities of educational organizations contributes to the modernization of educational activities, the systematization of the educational process, the introduction of a modular approach to the development of educational programs, building an individual educational trajectory, which generally affects the improvement of the quality of the functioning of an educational organization and the pedagogical services it provides.

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应对全球挑战的中观经济层面的国际合作：结构和趋势

INTERNATIONAL COOPERATION AT THE MESOECONOMIC LEVEL IN GLOBAL CHALLENGES: STRUCTURE AND TRENDS

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抽象的。 本文致力于国际经济关系的理论方面，研究和构建其发展阶段，确定其转型的关键因素，并评估其对中观经济水平的影响。 重点介绍了俄罗斯国际经济关系的阶段和趋势，反映了该国在区域发展背景下的地缘政治形势和社会经济转型的具体情况。 制裁政策对地区经济的有争议的影响已被揭露。

关键词：国际经济关系、发展阶段、转型因素、制裁政策、区域经济。

Abstract. *The article is devoted to the theoretical aspects of international economic relations, the study and structuring of the stages of their development, identifying the key factors of their transformation, as well as assessing its impact on the meso-economic level. The stages and trends in international economic relations in Russia are highlighted, reflecting the specifics of the geopolitical situation and socio-economic transformations in the country in the context of regional development. The controversial impact of sanctions policy on the regional economy has been revealed.*

Keywords: *international economic relations, stages of development, factors of transformation, sanctions policy, regional economy.*

The growing interdependence of the world, the emergence and aggravation of global problems, the tense geopolitical situation increase the objective needs for expanding multilateral cooperation, changing its directions, as well as changing established international economic relations and contributing to its spread in other spheres of life, and in these conditions the importance of the principle of cooperation with everyone increases every year.

There has long been an objective need in the world to reformat all geo-economic connections and configurations, which is happening today through the differentiation of relations, including towards the countries of Central Asia [1]. International economic relations can develop at the level of regional associations of states and participating countries, transnational corporations, as well as individual entities within the framework of responsible powers (Figure 1) [2].

At the same time, international economic relations at the macroeconomic level have a serious synergistic impact on relations between regions and territorial divisions of various countries, determining, first of all, a corridor of opportunities for interaction with specific states, taking into account the geopolitical situation.

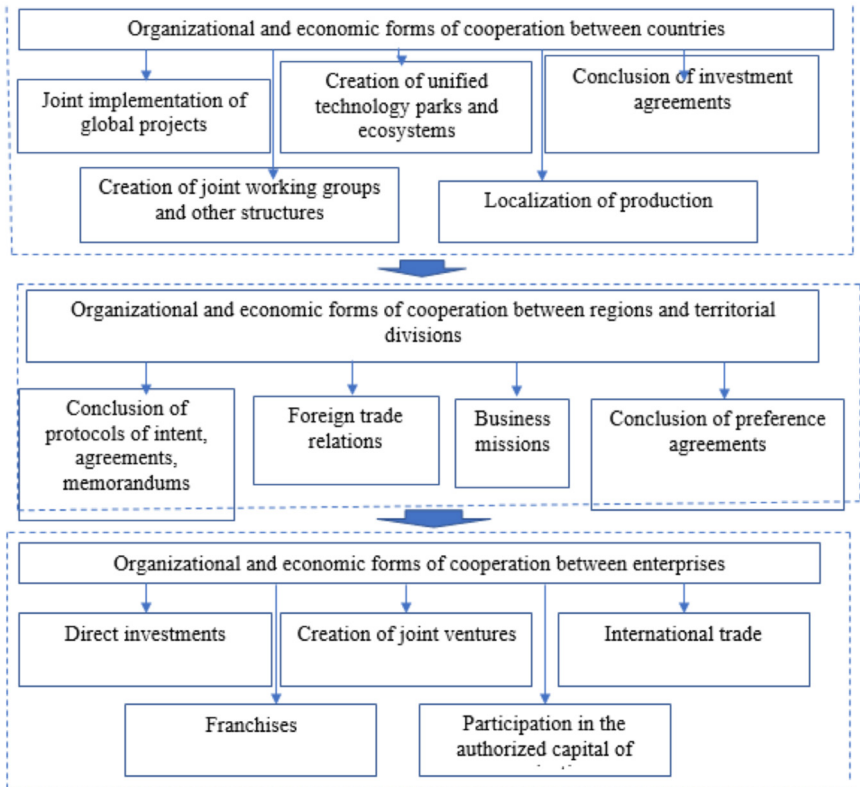


Figure 1. Multi-level system of international economic cooperation.

Source: compiled by the authors

It should be noted that armed conflicts and the formation of new political alliances as one of the key factors in the transformation of forms of international economic relations have a serious impact on the interaction of states in political, military and organizational-economic relations [3]. Of scientific interest in this area is the study of the transformation of international relations in a regional context, taking into account the identification of key transformation factors at different stages of their formation and development.

Synthetic analysis and structuring of the transformation of the system of international economic relations in different time periods, assessment of the evolution of the world economic system allowed the author to identify seven stages of transformation of international economic relations and identify its key factors (Table 1).

Table 1
Factors of transformation of international economic relations and their impact on the regional level

| No. | Stages of development | Transformation factor | Description | Impact on the regional level |
|-----|---|--|---|--|
| 1 | Formation of the modern world economy, globalization (XIV – late XIX centuries) | Education of the world commodity market and world trade | Transition from internal economic systems to interstate socio-economic relations | Concluding trade agreements and dynastic marriages, the main cooperation occurs at the macro-economic level |
| 2 | Development of the world economy (late 19th century - early 20th century) | Politicization of the world economy | The development of new forms of economic relations between countries, and the division of zones of influence between them, the exchange of goods, the movement of individual factors of production, the international division of labor | Cooperation at the meso-economic level is formed due to large companies at the regional level, migration of labor and management personnel |
| 3 | Stage between the first and second world wars | Exacerbation of military conflicts, revolution in Russia in 1917 | The weakening of interstate ties, the development of international corporations, the formation of financial systems at the transnational level, the isolation of Russia from the international economy | Cooperation between regions and states, cities, states is difficult due to isolation and the internal political situation |

| | | | | |
|---|---|---|---|--|
| 4 | From the end of the Second World War until the beginning of the 90s. | Collapse of the colonial system | Globalization of world finance, the emergence of a macrosystem regulating global economic development (UN, IMF, World Bank, World Bank trade organizations) | The emergence of international relations at the level of regions and territorial divisions, the formation of relations with former colonial states |
| 5 | Since the beginning of the 90s before the beginning of coronavirus pandemic | Collapse of the socialist system and transition to a market economy | Creation of the World Trade Organization (WTO), increased openness of markets in former socialist countries, market liberalization, active development of international trade | The emergence of new Western partners, the conclusion of interregional agreements, the start of large international projects, the organization of industrial clusters and institutional structures in the constituent entities of the Russian Federation, the growth of foreign trade turnover of the regions, the growth of GRP |
| 6 | From the beginning of the coronavirus crisis to the implementation of the ADF | COVID-19 pandemic | The crisis state of the world economy and a gradual recovery from it. Search for alternative energy sources (hydrogen technologies), digitalization, focusing on environmental issues and the green economy. | Transition to a remote communication format, active development of international trade within marketplaces, cooperation of regional suppliers with Western pharmaceutical companies and medical equipment suppliers |
| 7 | From the beginning of ADF to the present | ADF, armed conflicts | Increasing influence of military and political factors on the economy, the formation of new geopolitical alliances, Russia's interaction with India, China, Latin America, Central Asia and African countries, the formation of technological | Building relationships with the territorial activities of new foreign partners, forming new supply chains, searching for alternative sales markets, strengthening work in the domestic market, including |

| | | | | |
|--|--|--|--------------------------------|---|
| | | | sovereignty and protectionism. | reorientation to the public procurement market, changing the structure of regional foreign trade turnover |
|--|--|--|--------------------------------|---|

The results presented in Table 1 clearly demonstrate the evolution of international economic relations under the influence of transformation factors, which gives an idea of their key trends, the formation of new geopolitical alliances and the impact on the regional economy. As you can see, the paradigm of international cooperation itself has become much more dynamic and changes almost every 3 years.

The systemic and structural analysis carried out shows the influence of key factors on the transformation of the forms of international economic relations and the main trends in their development at the macro and meso-economic level, and also clearly demonstrates their transition to a fundamentally new stage of international economic interaction, which is expressed not only in new forms of economic interaction, such as the digitalization of economic relations and the creation of large economic ecosystems, but also in the contradictory trends in international economic relations under the influence of key transformation factors. On the one hand, the foreign policy interstate component forms a certain direction and orderliness in the development of international relations. On the other hand, it involves giving special significance to foreign policy, especially sanctions.

The sanctions pressure, which has increased against the Russian Federation since February 2022, inevitably affected the socio-economic state of the regions, especially including single-industry towns. At the same time, the degree of influence varies depending on the industry and regional specifics of the city-forming enterprises (the share of the city-forming organization in the economy of the single-industry town, the ownership structure of the enterprise, supply chains, the role of foreign capital, export activities) [4.5].

The greatest risks from sanctions activities appeared in the forest industry and woodworking, metallurgy, as well as in transport and special engineering, including:

- large metallurgical centers of the country - Magnitogorsk (Chelyabinsk region), Cherepovets (Vologda region), Kamensk-Uralsky (Sverdlovsk region);
- automotive manufacturing centers - Togliatti (Samara region), Naberezhnye Chelny (Republic of Tatarstan), Elabuga (Republic of Tatarstan);
- single-industry towns - large producers of the timber industry and wood processing complex - Oktyabrsky, Novodvinsk, Onega, Koryazhma (all Arkhangelsk region), Sokol (Vologda region), Krasnaya Polyana (Kirov region), Pindushi, Mu-

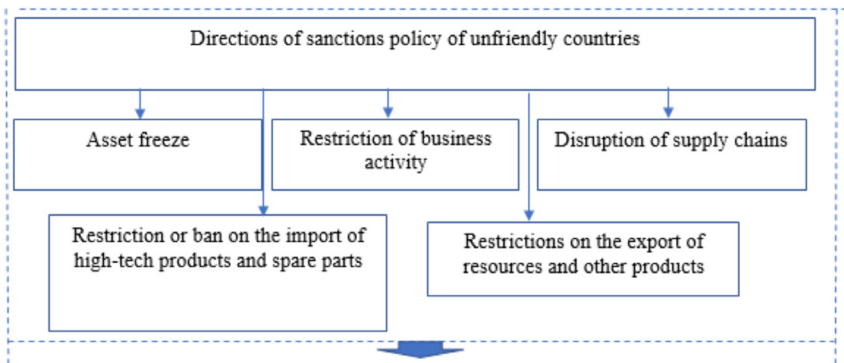
ezersky (Republic of Karelia), Parfino (Novgorod region), Manturovo (Kostroma region).

The most affected producers in the timber industry are organizations in the Northwestern Federal District. It was from these regions that the products of the timber industry were almost entirely exported to the countries of the European Union. The risks of city-forming organizations located in the Primorsky Territory and the Irkutsk Region are significantly lower, since they exported their products mainly to Asian countries that did not impose additional restrictions.

Another category of enterprises is the part that did not fall under direct restrictions, but either due to the characteristics of production cooperation chains, or due to indirect factors, are also at risk (indirect factors mean being included in the sanctions lists of the main suppliers and consumers of products, shareholders of related companies, etc.).

The most stable were city-forming organizations, where the pace of modernization of production and the introduction of modern technologies is low, as well as city-forming organizations that specialize in the production of products of the military-industrial complex, focused on domestic Russian production cooperation chains. Among these cities: Karachev (Bryansk region), Kumertau (Republic of Bashkortostan), Vyazniki (Vladimir region). Also, in the short term, textile enterprises of the Central Federal District (Navtex LLC in the city of Navoloki and Rusa LLC in the city of Kolobovo, both located in the Ivanovo region) turned out to be stable.

The structure of the sanctions policy of Western countries and the degree of their influence on different levels of the economy, depending on the specifics of the regional economy, can be presented in the form of a diagram (Figure 2)



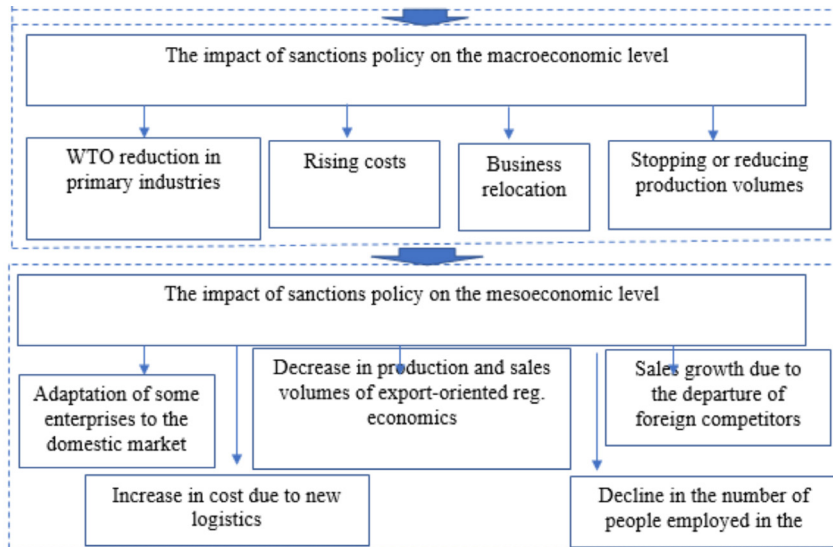


Figure 2. *The impact of sanctions policy on the regional economy.*

Source: compiled by the authors

As shown in Figure 2, the impact of sanctions policy on the regional economy is ambiguous and depends on the characteristics and structure of the regional economy. The main negative consequences of the sanctions largely affected regions with a large share of export-oriented industries. At the same time, part of regional enterprises and, accordingly, regional economies, oriented towards the domestic market or the market of friendly countries, found themselves in a more advantageous position due to the departure of foreign competitors.

A special place in international cooperation is occupied by interaction with China - in January – May 2023, trade turnover between Russia and China increased by 40.7% compared to last year and amounted to \$93.806 billion. First of all, active cooperation has developed on the part of border regions. In particular, the Trans-Baikal Territory is effectively using the opportunity to expand relations with the Chinese province of Henan. Among the advanced regions with the most attractive conditions for Chinese investors are Moscow, Tatarstan and the regions of the Far East. Among the most successful examples of the arrival of Chinese business in Russian SEZs outside the capital is the work of Alibaba and Haier in the Alabuga SEZ in Tatarstan. In total, more than 30 regions of Russia are currently actively developing cooperation with China [6,7,8,9].

Analysis of international economic relations at the present stage of development of relations allowed us to formulate several generalizing provisions:

- the main content of modern transformation processes is revealed, including their impact on the regional economy, the main stages and trends in the development of international economic relations are studied and structured, the features of each stage are established, the main forms of international economic relations at the present stage of their transformation are highlighted, as well as their influence on the regional economy. A synthetic analysis and structuring of the transformation of the system of international economic relations in different time periods, an assessment of the evolution of the world economic system made it possible to propose the author's interpretation, including seven stages of transformation of international economic relations and to identify its key factors - from the formation of the modern world economy (XII - late XIX century - to period of the beginning of the ADF- to the present.

- it was established that the formation of new geopolitical alliances results in a change in the areas of cooperation and subjects of partnerships, which made it possible to distinguish this stage as independent in the chronological system.

- a multi-level structure of international economic relations in Russia has been formed, the main areas of interaction have been identified and detailed: parallel imports, building new supply chains, developing marketplaces, adapting the financing of international operations, localization/relocation or Russification of business, joint implementation of innovative projects, organization of interstate digital platforms, development online business.

- the influence of the sanctions factor on the level and nature of international economic relations of Russia at the macro and meso-economic level is revealed. It has been established that the impact of sanctions policy on the regional economy is ambiguous and depends on the characteristics and structure of the regional economy. Systematization of the features of the regional economy of various constituent entities of the Russian Federation made it possible to establish that the main negative consequences of sanctions largely affected regions with a predominant share of export-oriented industries. At the same time, some of the regional enterprises and, accordingly, regional economies, focused on the domestic market or the market of friendly countries, have improved their socio-economic indicators due to the departure of foreign competitors.

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智力资本、其形式和发展
INTELLECTUAL CAPITAL, ITS FORMS AND DEVELOPMENT

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注解。 文章阐述了“智力资本”概念的本质、发展历史、智力资本的表现形式以及进一步的发展途径。 本文研究了经济学家对“智力资本”一词定义的看法，并比较了不同的观点，研究了智力资本的构建方法。

关键词：智力资本、资源、资产、信息、人力资本、消费资本、结构资本、创新资本、关系资本。

Annotation. *The article deals with the essence and history of the development of the concept of “intellectual capital”, forms of intellectual capital and further ways of development. The article studies the views of economists on the definition of the term “intellectual capital” and compares different opinions, studying approaches to the structuring of intellectual capital.*

Keywords: *intellectual capital, resources, assets, information, human capital, consumer capital, structural capital, innovation capital, relational capital.*

In modern economy the intangible component of business processes, the use of intellectual resources of the organization is becoming increasingly important. In the post-industrial economy, firms are required to be flexible, highly innovative, able to develop promising strategic approaches and build effective relationships with numerous counterparties. In such conditions, relying only on material resources does not allow to achieve significant results, so experts have identified the ability of companies to create and manage the intellectual capital of the firm in the overall asset structure as an important factor of competitiveness. At present, economists' interest cannot but be aroused by such an economic category as intellectual capital.

For the first time the term “intellectual capital” was used by the American economist J. Galbraith in a letter to M. Kalecki in 1969 [1]. There are many variants of the definition of the concept of “intellectual capital”.

V.L. Simonova and A.S. Shakuta in their article “The structure of intellectual capital of the firm” consider the definitions of intellectual capital, which were

given by Professor M.A. Eskindarov and American economist T. Stewart. The definition of intellectual capital as an economic category proposed by Eskindarov is widely spread in the economic literature. According to this approach, intellectual capital is described as a system of relations between different economic entities regarding its rational, sustainable reproduction on the basis of progressive development of science in order to produce specific goods, services, income, improve living standards, solve the problem of uneven global and regional development on the basis of personalized economic interests of subjects. At the same time, the author considers intellectual capital itself through the prism of characteristics that determine human abilities and the quality of labor force. T. Stewart defined intellectual capital as a specific resource in the form of knowledge, information, intellectual property, experience, which can be used to create value [2].

M.G. Lapaeva and J.J. Karabalina in their article entitled “Intellectual capital: forms and evaluation” draw their attention to the definition of economist E. Brooking, who considers intellectual capital as intangible assets, without which an enterprise cannot exist. Under these intangible assets she understands intellectual property, market and infrastructural assets, as well as human assets (a set of collective knowledge of the enterprise’s employees, their leadership skills, creative abilities, managerial and entrepreneurial skills) [3].

O.S. Reznikova in her article “The Essence and Structure of Intellectual Capital” provides definitions of intellectual capital formulated by Russian economists V.L. Inozemtsev and B.B. Leontiev. V.L. Inozemtsev defined intellectual capital as information and knowledge, factors specific in nature and forms of participation in the production process, which within firms take the form of intellectual capital. B.B. Leontiev describes intellectual capital as the value of all available intellectual assets of an enterprise. To these intellectual assets he refers: intellectual property, certain intellectual skills, knowledge, abilities, accumulated knowledge bases. Leontiev believes that at the present stage of development intellectual capital is the most important of the types of capital and that it determines the basis of any enterprise. O.S. Reznikova also notes that from the financial point of view intellectual capital is the difference between the market value and the book value of the organization. She believes that this point of view is largely valid because the market value of the organization suffers from the influence of several factors that cannot be assimilated with intellectual capital, and on the other hand, the book value suffers from the influence of the accounting system and international accounting standards [4].

L.M. Kupriyanova and T.V. Petrusevich in their article “Information-analytical support of sustainable development of the organization” consider the approaches of two teams of authors [5].

Scientists J. Ruus, S. Pike and L. Fernström believe that intellectual capital can be defined as non-monetary and intangible resources that are fully or partially controlled by the company and that play a role in creating value by the company.

L. Edvinsson and M. Malone define intellectual capital as knowledge that can be converted into value. In their opinion, intellectual capital includes applied experience, organizational technologies, customer relations and professional skills that give a company a competitive advantage in the market.

Thus, although more than forty years have passed since the beginning of the development of the concept of intellectual capital, there is still no universally recognized definition. Often there are definitions that are rather general in nature. This is due to the complexity of the object of research - knowledge, the source of which is the intellectual capabilities and personal experience of employees, formed in a certain social environment. V.L. Simonova and A.S. Shakuta talk about it in their article.

We can agree with the opinion of O.S. Reznikova that intellectual capital is one of the most mobile and controversial economic categories, which is why many Russian and foreign economists have paid much attention to the definition of this concept.

V.L. Simonova and A.S. Shakuta note that the three-component structure of intellectual capital by Edvinsson and Maylon, according to which three of its dimensions are distinguished: human capital, internal structures and external structures [2]. Human capital is defined as a set of knowledge, experience, skills, abilities, skills and creativity of an individual. Internal structure includes all those components that have been created by human capital, namely organizational structure, documents, patents, trademarks, copyrights. The external structure is identified with such a concept as attitudinal capital - a combination of different types of relations, such as market relations, economic relations and cooperation. V.L. Simonova, A.S. Shakuta proposed the following detailing of the structural elements of intellectual capital of the firm, dividing intellectual capital into four parts, highlighting also innovation capital:

Human capital:

- Employee competence (employees' ability to train, efficiency of employee training, employees' ability to participate in the development of the company's development strategy, employees' qualifications);
- Employee attitudes (identification with corporate values, level of satisfaction with work in the company, employee turnover, average length of service in the company);
- Employee creativity (employee creativity, ability to work in a team, intellectual flexibility);

Structural capital:

- Corporate culture (creation of corporate culture, identification of the employee with the company’s views);
- Organizational structure (clarifying the relationship between authority, responsibility and benefits, validity of the company’s management system);
- Organizational learning (building and using internal information network, building and using company database);
- Work process (production process, product quality assessment);
- Information system (mutual support and cooperation between employees, provision of corporate information in open access);

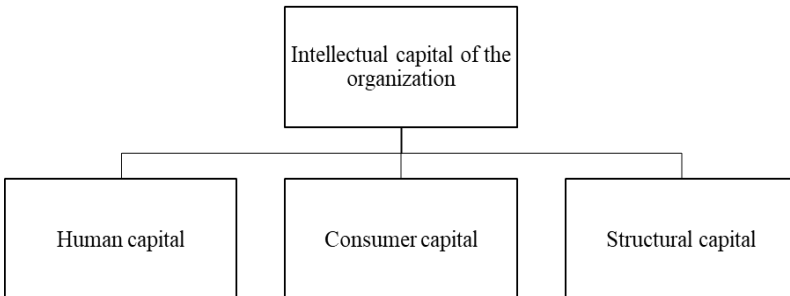
Innovation capital:

- Innovation achievements (average number of patents of employees, percentage of sales of newly developed products in total sales, number of newly developed technologies);
- Innovation mechanism (share of R&D investments, number and quality of R&D employees, cooperation with external innovation companies, ability to manage innovation projects, incentives for innovation, interaction between research, production and marketing departments);
- Innovation culture (company’s focus on process improvement and quality improvement, employee freedom of action, incentivizing employees for innovative proposals);

Relational capital:

- Core marketing capabilities (building and utilizing customer base, level of adaptability to customer needs, effectiveness of distribution channels);
- Market power (market potential, brand and trademark reputation, cooperation with suppliers and competitors);
- Customer loyalty indices (satisfaction, customer complaints and churn, investment in customer relationships).

O.S. Reznikova cites the “traditional” division of individual capital into three types: human capital, consumer capital and structural capital [4].

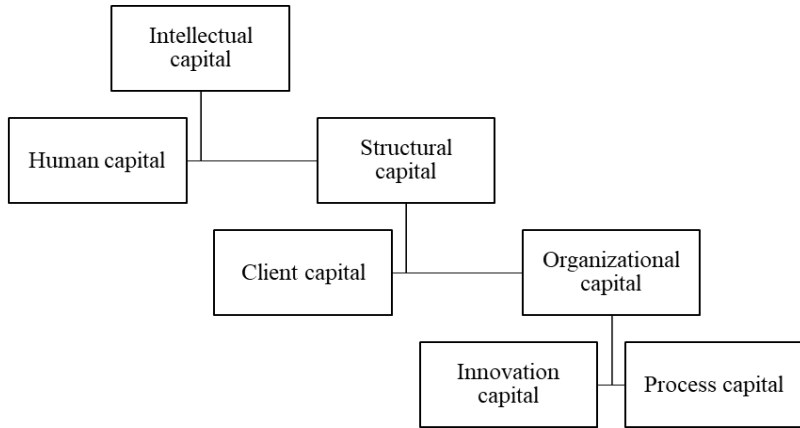


Human capital includes qualifications, practical skills and knowledge, work experience, creative and thinking abilities of personnel, i.e. everything that concerns people. Structural (organizational) capital includes technical and software, patents, trademarks, etc. It is structural capital that is the element that relates to the organization as a whole. Structural capital shows how human capital that transforms information can be used in organizational systems. Consumer capital includes customer relationships, brand name, customer information. Therefore, consumer capital is capital that is made up of certain connections as well as sustained relationships with customers and consumers. The most important task of this part of intellectual capital is to create a structure that could allow the consumer to communicate productively with the company’s personnel.

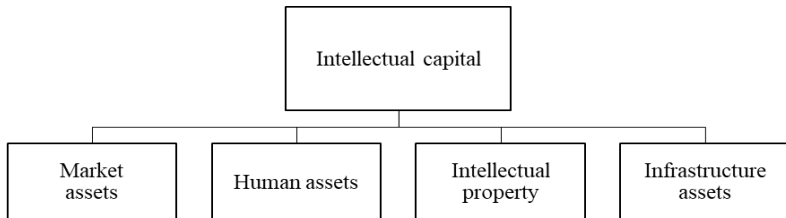
The “traditional” structure takes into account external and internal factors of the economic entity’s development and in this regard, according to Reznikova, is the most convenient for use in practice.

In addition, O.S. Reznikova also draws attention to the intellectual capital structures developed by L. Edvinsson and E. Brooking.

L. Edvinsson’s structure was one of the first structures of intellectual capital.



E. Brooking suggests that intellectual capital should include the following four components.



Market assets include brands, reputation, loyal customers, distribution channels. Human assets include knowledge, professional skills, work-related knowledge, psychometric characteristics, work-related skills, motivation and incentives, self-organized learning. Intellectual property is patents, copyrights, trademarks, know-how, service mark. Infrastructural assets are management philosophy, corporate culture, management processes, information technology, network communication systems, relations with financial circles (investors).

Thus, there are different, although similar, ways of distinguishing forms of intellectual capital and building its structure. Most researchers recognize the presence of independent elements of intellectual capital: human knowledge and skills - human capital or asset, intangible assets belonging to the company - copyrights and patents, etc., connections and relationships with customers - market, consumer or customer asset. The difference in the forms of intellectual capital cited by the authors of scientific works is due, among other things, to the difference in the approach to the definition of the concept of “intellectual capital”.

The sources of intellectual capital, according to M.G. Lapaeva and J.J. Karabalina, are, among others, scientific research, technological development, organizational and economic development, articles, monographs, reports, personal intellectual capital. Therefore, we can say that the development of intellectual capital of each individual company is determined by the development of science in our country and around the world, the introduction of scientific achievements in production and any other activities of companies. Literacy, competence, creativity of its employees play a big role in the successful activity of companies. Consequently, the development of intellectual capital should be associated with improving the quality of professional education, training of future specialists in various fields of activity [3].

The development of science around the world is also associated with the possibility of applying artificial intelligence in the production of tangible and intangible goods, in various branches of human activity.

I.N. Ostapenko speaks about the emergence of a new type of intellectual capital - artificial intellectual capital. The carrier of artificial intellectual capital is a material object endowed with knowledge and information, separated from a person and included in intellectual activity as an object, means and result of labor. To date, artificial intellectual capital is not “reasonable” enough to possess all the properties of capital [6].

The use of artificial intellectual capital in achieving the competitiveness of artificial intellectual capital compared to human capital and, as a consequence, the displacement of human capital from the economy carries with it certain risks that are to be assessed by mankind.

Innovation activity and intellectual capital of companies are closely related to each other. K.V. Sayapina and O.E. Ustinova in their article “The role of intellectual

capital in the formation of innovation potential of the Russian organization” write about “organizational innovation”, “which implies the introduction of innovations in the context of the functioning of the organization and the transformation of its internal business processes. Any changes related to the functioning of the organization’s activities are related to organizational innovation (teamwork, resource planning system, transformation of business processes), and they lead to an increase in the efficiency of human resources” [7]. Consequently, with the application of organizational innovation, human intellectual capital will be used more effectively.

Thus, the point of view of O.S. Reznikova, who says that “in modern society intellectual capital has become the basis of wealth. Since it is intellectual capital that allows determining the competitiveness of enterprises, acting as the main resource in their development”. There is no doubt that companies in the future will rely on creative and educated people, artificial intelligence, innovative activities and opportunities to improve customer and relationship capital, which are represented by social networks and the Internet in general.

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伊斯兰银行负债的形成和投资活动。 穆达拉巴
**FORMATION OF LIABILITIES AND INVESTMENT ACTIVITIES
OF ISLAMIC BANKING. MUDARABA**

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抽象的。 研究的目的是分析伊斯兰银行作为金融中介与传统银行体系之间的根本差异。 研究的主题是伊斯兰银行的投资活动。 考虑形成伊斯兰银行负债余额的来源； 及其融资的基本原则； “伊斯兰融资” 工具之一——投资协议——mudaraba的实施机制被详细披露。 得出以下结论： 1) 现代商业模式完全适应伊斯兰融资工具。 2) 伊斯兰金融有其自身的特点和受伊斯兰教规范监管的条件。 3) 伊斯兰银行业务不应用货币时间价值理论。 交易金额是固定的，不能更改。 4) 伊斯兰银行机制的质量及其对经济发展的影响需要更深入的研究和实际应用。

关键词： 贷款利息、伊斯兰银行、投资、mudaraba、负债、资产、融资。

Abstract. *The purpose of the study is to analyze the fundamental differences between Islamic banking as a financial intermediary and the traditional banking system. The subject of the research is the investment activity of Islamic banking. The sources that form the balance of liabilities of an Islamic bank are considered; and its founding principles in financing; The mechanism for the implementation of one of the “Islamic financing” instrument - the investment agreement - mudaraba is disclosed in detail. The following conclusions are made: 1) modern business models are fully adapted to Islamic financing instruments. 2) Islamic finance has its own specifics and conditions regulated by the norms of Islam. 3) Islamic banking does not apply the theory of the time value of money. The amount of the transaction is fixed and cannot be changed. 4) The quality of Islamic banking mechanisms, as well as their impact on economic development, requires more in-depth research and practical application.*

Keywords: *loan interest, Islamic banking, investments, mudaraba, liabilities, assets, financing.*

Scientific specialty of publication: 5.2.1. Economic theory

**Formation of liabilities and investment activities of Islamic banking.
Mudarabah**

As a result of the collapse of the structured financial market, which resulted in a global crisis in the financial sector, attention from the investment community to Islamic financing instruments has increased significantly. In modern conditions, the segment of Islamic banking mechanisms is one of the fastest growing. The relevance of the topic is related to the development of Islamic banking activities, which is determined by financial, economic, foreign economic, and social reasons. The holding of various round tables, forums, and the launch of pilot projects as an experiment indicate an increased interest in Islamic banking. Since Islamic banks are transforming the concept of financing into an investment one, we will expand on the topic of investment financing using Islamic banking mechanisms.

Many people mistakenly assume that the Islamic economic system functions as a charitable organization that operates without profit. But in fact, if we talk about making payments between economic entities, an Islamic bank (just like a traditional one) charges a commission for the provision of services. But as a financial intermediary, an Islamic bank has its own fundamental differences, and in addition to the already well-known obvious difference about the prohibition of the use of interest on loans, Islamic finance in general places an emphasis on converting funds into real assets, this makes it possible to measure their value. Moreover, this principle is fundamental in Islamic finance: any monetary transaction in Islamic finance must be based on real assets (product, service). And acting as a financial intermediary, the Islamic bank strives to make a profit and cover all costs. Instruments in Islamic finance, which have been known for many centuries, have been modernized over recent years and required adaptation to modern banking practices. Islamic banks began to transform the concept of financing into an investment one. Deposits are invested by the bank in various financial projects, which in turn are associated with the real sector. And it is the results of financing that determine the profit that will be received by investors whose funds were used by the bank. That is, the profitability of investment accounts depends on the profitability of the projects that the bank finances. Before analyzing and analyzing the example of a financing mechanism based on the banking investment mechanism in Islamic banking - *mudaraba*, let's see how the balance sheet of an Islamic bank is replenished. After all, investment activity is impossible without attracting capital, which forms the bank's balance sheet of liabilities.

Sources of funds in Islamic banks are divided into two main and mandatory sources: 1) the bank's own sources of property rights, be it capital, reserves or retained earnings, etc., 2) external sources, which constitute the bulk of the bank's resources and mainly includes deposits clients.

1) Own sources.

The first type of own resources is associated with the beginning of the creation of an Islamic bank. After receiving the approval of the concerned authorities,

which is often the central bank, the Islamic bank offers its shares for subscription, so that the founders of the bank subscribe first, and then the remaining shares are offered by public subscription. This subscription provides further insight into the Islamic Bank's commitment to the provisions of Islamic Shariah since its inception. In this case, when the bank offers its shares for public subscription, they are ordinary shares and not preference shares. In short, the difference between these two types of shares is that ordinary shares provide voting rights in the company, while preferred shares do not. For preferred shares, the payment of dividends is mandatory and has a minimum threshold. The exception is the lack of profit. On ordinary shares, the company is not required to pay dividends, but is often interested in the opposite.

Thus, the *first resource* and the main source of functioning of an Islamic bank and the beginning of its work is the resource of shareholders in the bank. For example, Bank Nizwa¹ has a founding board (consisting of five people) which contributed its resources to form the first bank capital².

The second type of an Islamic bank's own resources is formed through reserves, which the bank builds up over the years at the expense of the profits it receives, as it distributes them among shareholders and retains part of these profits as reserves in order to strengthen the financial position of the bank. Thus, reserves are part of the profit to maintain the bank's capital. And considering reserves as property rights, i.e. owned exclusively by shareholders, they must be deducted from net income of shareholders, and not from total income, which includes funds of investors.

The bank may also resort to freezing part of its profits and transferring them to future years for later use. It is called retained or transferred earnings, is the source of the bank's own resources and belongs only to shareholders and not to depositors. At the same time, the Islamic bank intends to retain the allocated profit in the bank, placing it in different accounts, including:

A) Legal Reserve Account: It is a certain percentage determined in accordance with the applicable banking rules so that it is deducted from the net profit of the bank and the fundamental law of the bank requires it to remain there without distribution.

B) General Reserve Account: This is an account created by the promoters to maintain the capital of the bank. Typically, a bank's founding law provides for a general reserve account and a percentage of profits transferred to it, which may vary depending on several legal or economic factors.

B) Other Reserve Account: Banks can create another reserve account as and when required to reduce the risk of loss and the possibility of loss and to increase the flexibility enjoyed by Islamic banks.

¹ Bank Nizwa is the first specialized Islamic bank in the Sultanate of Oman.

² <https://www.banknizwa.om/> انرودج/الكنبيل-ان-ع-قنبين

Then we move on to another source, which is deductions, where the Islamic bank deducts a portion of the total profit to counter a potential burden or risk, but the amount or time of its occurrence is unknown. In its simpler form, it is a cost or expense that has not yet been paid. Examples of such provisions are those that relate to the bank's firm future obligations and their value cannot be accurately determined, such as the provision for doubtful debts or the provision for bad debts... etc.

In addition to the above, other resources are available to the Islamic bank, such as "good loans" (interest-free) from shareholders, for example, or insurance contributed by the clients of the Islamic bank, for example, documentary cover of a letter of credit or letters of guarantee.

2) External sources.

Of course, Islamic banking liabilities are formed from customer deposits. A bank deposit is defined as money entrusted to a bank by individuals or legal entities on the condition that the latter undertakes to return it or an equivalent amount on demand or in accordance with agreed terms. Based on this definition, the bank has the right to use and lend a bank deposit, it is also considered a guarantor of the deposit amount in all cases, and the depositor receives an amount in excess of the deposit (interest), directly or indirectly stipulated in the agreement. This is in conventional banks, but in Islamic banks no interest is paid on deposits, rather these are good loans that the client presents to the Islamic bank, and he can manage them. Bank deposits, also called bank accounts, are considered one of the most important sources of funds in banks in general, including Islamic banks, due to their low cost of receipt compared to other sources, in addition to the fact that banks are the only institutions authorized by law to accept bank deposits. This is why banks place great importance on these deposits and compete with each other to obtain the largest number of them. Bank deposits are considered one of the main investment and trading instruments in Islamic banks and form their backbone. An Islamic bank accepts deposits of all types, giving priority to social services, unlike a conventional bank which seeks to profit from this money and sell it with interest through usurious loans, while an Islamic bank uses it in various areas of investment. Deposits include: limited investment deposits and unlimited investment deposits. Deposits can also be divided into: current account deposits, savings deposits and investment deposits.

1 - Demand deposits (current account):

Demand deposits, also called current accounts, are added to the deposits received by the bank and represent money that their owners deposit in Islamic banks for the purpose of safety and to facilitate their day-to-day transactions. And these funds remain at the disposal of their owners, so they have the right to withdraw them, in whole or in part, in exchange for a small commission paid to the Islamic bank for the cost of managing the account.

Lawyers and researchers have agreed to consider current accounts in the loan decision, so the bank undertakes to honor them and guarantee their return upon the client's request. The depositors do not have any interest in this type of account and they are not entitled to benefit from the profits generated from the management of these funds, but rather remain in the share of the Islamic bank, given that it is the guarantor of the return. In case of loss, the bank is solely responsible, according to the Shariah rule "tax is paid on guarantee", the current account should not be entitled to any share in the investment profits.

What distinguishes an Islamic bank from a conventional bank is that it does not seek to manage these accounts for profit, but rather seeks to facilitate short-term financial transactions and serve its customers. In addition, the Islamic bank calculates commissions and expenses for this account based on actual costs without making a profit.

Banks can deposit funds into current accounts in the form of the following types of Islamic loans:

Registration of a demand deposit based on an interest-free loan

In this case, the borrower is a bank to which the lender provided an interest-free loan on the terms of repayment and without charging a fee for it. At the same time, the bank (as the borrower) guarantees the return of funds upon the first request of the lender (client). And as a reward to the client, the borrower (bank) can pay a certain profit (not fixed) or provide discounts on working with its services.

When forming liabilities, the bank uses the balance on clients' current accounts and must return the amount used. Opening current accounts on the basis of an interest-free loan is practiced in Iran, Jordan, and Pakistan.

As for the rewards mentioned above that are sometimes given to these account holders: special gifts for checking account holders that take into account the client's balance. If the customer's balance is large, he is given an important gift, and if the customer's balance is small, he is given a small gift according to his balance.

As for the services provided by the bank, they are not considered gifts, but rather some kind of service that helps the customer and makes it easier for him to access his balance, such as giving him a free checkbook or giving him a bank card, such as a regular ATM card or an Internet service, although the bank incurs a commission for issuing it, it provides it free of charge. These services are of no credit interest and are acceptable because they make it easier for the client to achieve his or her eligibility.

2 - Deposits or joint investment accounts:

As for investment accounts, the Islamic bank invests the depositors' money, which goes to a special investment account, in various financial projects. A bank's authorization to invest deposits directly means granting the bank the right to make investments independently in accordance with certain conditions between the

bank and the owners of the funds. The bank then receives a percentage of the profits as agreed between the two parties.

As for investing indirectly, this allows the bank to invest money in partnership with other businessmen-investors, i.e. financiers, and investors are the owners of money.

Joint investment accounts in Islamic banks include:

Fixed Accounts: These are deposits that are tied to a specific period and their holders cannot withdraw funds from them until the end of the specified period. And the main goal that the investor strives for is profit. In the case of traditional banks, this is a fixed profit (loan). In general, deposit rates average 5-6% per annum³. In the case of Islamic banks, this is the profit that the client receives as a result of this contribution by the bank to finance the project for commercial purposes.

Notifiable accounts: These are also called risky deposits and they are deposits tied to a specific period of time and their owner has the right to withdraw from them before the end of the specified period, but subject to written notice. to the bank before withdrawal for the agreed period.

Savings Accounts: These are accounts through which the depositors maintain a passbook in which all withdrawals and deposits are recorded in the account as per the terms and conditions prescribed by the bank. Its purpose is to encourage small savers to save.

And in the recommendations of the second banking conference in Dubai for the year 1399/1997, it was clarified that profits are not accrued on savings account balances, unless, when requesting to open an account, it is stipulated that the transaction between the depositor and the Islamic bank accepts the rule of the **Mudariba** mechanism. Accordingly, this percentage is guaranteed by the bank. If these deposits are part of an investment business, the owners are entitled to a percentage of the profits earned in accordance with the percentages set by the bank's board of directors. To summarize: savings deposits can be with an investment permit, so that the Islamic bank invests all or part of the deposit amount according to the client's wishes in exchange for the latter receiving an agreed share of the profits. Or the savings account does not have permission to invest, and the deposit remains without the right to receive any profit, so it takes over the decision of the current account.

How is this mudharaba mechanism, which underlies investment accounts, implemented?

Mudaraba is a form of partnership where one party gives capital to the other party for the purpose of investing in a commercial project. The owner of the capital does not interfere in the management affairs of the **mudarib** (the partner

³ https://www.banki.ru/products/deposits/catalogue/vklad_srochnyy/

to whom the funds were provided): the profit that will be distributed between the partners must be specified and agreed upon in proportions (at the discretion). However, they cannot determine the fixed profit (percentage, amount). (*Although, in Iran, investment account holders are charged a fixed commission, while at the same time they guarantee the return of the full amount. This in turn (guarantee and fixed fee) is a violation of the concept of mudaraba*) In this mechanism, the bank also acts as a mudarib, accepting funds clients, and as an owner of capital, investing these funds in various financial transactions. Using this type of partnership, it is implied that the bank, by investing investors' capital in various projects, takes on a share of profits and losses. The object of financing is a group of mutual funds whose activities are permitted by Islamic law (*by conducting a detailed analysis to check the sources of income of companies for compliance with Sharia or companies with large debts*).

There are a number of conditions that must be met in order for a Mudaraba contract to be successful from an investment point of view and acceptable, as well as from a legal point of view. And these conditions can be divided into three parts: there are conditions relating to capital, conditions relating to profit, and finally, conditions relating to labor⁴.

First: conditions regarding capital

1. It is allowed, in addition to money, that the invested asset can be a product or real estate, for example, an airplane, which is transferred to the airline that operates it, and the profit is divided. But any asset must be valued in monetary units.
2. So that the amount of the deposit is known at the time of concluding the contract.
3. Transferring the capital to the Mudarib and giving him financial and legal control over it so that he can invest it and use it in accordance with the agreement.
4. Lack of debt origin of capital. Capital must be available at the time the contract is concluded.

Second: profit conditions

1. The share of each mudarib and owner of money in the profit must be known at the time of concluding the contract.
2. It is prohibited to indicate a fixed amount.
3. The loss is borne by the financier if it is not related to the negligence of the mudarib or his violation of the terms of the contract, otherwise he participates in this loss. If an Islamic bank is a mudarib, then it is obliged to protect depositors' money.

Third: working conditions

⁴ <http://www.arabnak.com/> قيراض مالا/

1. Work (management) is within the competence of only the Mudarib.
2. The financier is allowed to stipulate that the Mudarib performs his work in a certain country, or with a certain type of commodity, or in work in which both parties are interested, without restrictions on the Mudarib, and this is what is known as *limited Mudaraba*.
3. The Mudarib has the right to pay the money received from the financier to someone else and mix this money with other people's money, if the financier has authorized the disposal of the capital.
4. Activities must comply with Shariah.

Mudaraba in Islamic banking can be divided into three main sections:

First: on the freedom of action of the mudarib.

1 Unlimited Mudaraba: When the Mudarib has absolute freedom to invest the money as he wishes, without restrictions on his decisions or interference from the owner of the money. This type of mudariba is considered the dominant form of work of Islamic banks in the field of financing, since the bank is given complete freedom to invest the money of its depositors in appropriate areas.

2 Limited Mudaraba: The owner of the money imposes certain restrictions and conditions, be it regarding the areas of investment, the method of managing the money, the duration of the investment, the place of investment or the persons with whom he will deal. In addition, these terms must be agreed upon before entering into a contract.

It should be noted here that the restriction or freedom of the Mudarib is considered a relative matter, since it is impossible to completely free the hand of the Mudarib (manager) or completely limit his actions with money.

Second: by the number of participants

1 Double or Single Mudaraba: This means that there is one person providing the money and one person doing the work, which means that the contract is between two parties, whether they are individuals or legal entities. It is difficult to use this type of mudaraba in Islamic banks, since the nature of the latter's work requires mixing and mixing of funds, i.e. mixing bank funds with depositors' funds.

2 Collective or joint Mudaraba: This is the predominant contractual formula in Islamic banks, where the latter (as the Mudarib) invites the owners of the funds to invest their savings, and the banks (as the owner of the money or an agent on behalf of the owners of the funds) invite the entrepreneurs or entrepreneurs to invest and most of the funds, which are invested in this way in Islamic banks are time investment deposits and savings deposits.

In a joint mudarabah, three parties are involved: the owner of the capital, the Islamic bank and the mudarib, and in a single mudarabah, two parties are involved: the owner of the money and the mudarib (manager).

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战略审计作为控制战略规划文件实施的工具

STRATEGIC AUDIT AS A TOOL TO CONTROL THE IMPLEMENTATION OF STRATEGIC PLANNING DOCUMENTS

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抽象的。 本文对俄罗斯联邦外部国家财务控制类型之一——战略审计进行了全面分析。 战略规划文件的结构是根据其与战略审计的联系以及战略审计目标实施中的战略规划文件的结构来考虑的。

关键词：战略审计、外部国家财务控制、俄罗斯联邦审计院、战略规划文件、战略审计工具。

***Abstract.** The article presents a comprehensive analysis of one of the types of external state financial control in the Russian Federation - strategic audit. The structure of strategic planning documents is considered in terms of their connection with strategic audit, as well as the structure of strategic planning documents in the implementation of the goals of strategic audit.*

***Keywords:** strategic audit, external state financial control, Accounts Chamber of the Russian Federation, strategic planning documents, strategic audit tools.*

Currently, within the framework of the implementation of external state financial control by the Accounts Chamber of the Russian Federation, there are 7 types of audit, each of which has gone through its own exclusive path of formation, due to the need to create separate types of external state audit.

In particular, strategic audit, and its emergence is associated not only with the need to cover all procedures within the budget process, but also with the need to create a mechanism for strategic support of the state in the framework of the implementation of forecast goals and indicators.

In Russian practice, an audit within the framework of national development goals is called strategic, since this name closely resonates with the goals of sustainable development of the state, which are of a strategic nature.

Within the framework of SGA 105, strategic audit is defined as one of the types of government audit, the purpose of which is a comprehensive assessment of strategic goals by determining feasibility, risks and results in achieving them.

As well as determining the significance of internal and external conditions affecting the level of their achievement. Thus, the standard details the main subject of strategic audit - the top level of strategic documentation - the strategic goals of the Russian Federation.

As part of the interpretation of the category of strategic goals, the category “strategic goals” is paired with the category “national goals”; within the framework of this comparison, national goals are interpreted by Presidential Decree N 474 of July 14, 2020 “On national goals and strategic objectives of the development of the Russian Federation for the period until 2030”.

Monitoring the achievement of strategic goals is the global goal of a strategic audit, while the practical object of control is national projects and state programs of the Russian Federation, as well as other strategic planning documents.

The connection between strategic audit and strategic planning is established as a result of the new edition of Art. 14 of the Law “On the Accounts Chamber of the Russian Federation” dated November 4, 2014. During this period, the purpose of the strategic audit is established as a tool for monitoring the implementation of the goals provided for in strategic planning documents aimed at socio-economic development. The methodology of strategic planning consists in carrying out forecasting activities that ensure socio-economic development, as well as national security, through the implementation of the tasks of sustainable development of the Russian Federation.

As part of the application of strategic audit, the key objects of its application are programs and projects aimed at the development of a specific sphere (socio-economic, scientific-technological, national security), industry (oil production, forestry, electricity and others), territory (territories of priority development), as well as constituent entities of the Russian Federation. These programs together are separate elements of the overall strategic goals of the Russian Federation

Strategic planning documents, the connection of strategic audit with which was outlined in the wording of Federal Law dated November 4, 2014 N 341-FZ “On the Accounts Chamber of the Russian Federation”, are the material embodiment of all aspects of socio-economic development that ensure the harmonious, comprehensive and full-fledged development of the Russian Federation throughout its territory, penetrating into all sectors and areas of government.

In general, the purpose of a strategic audit within the framework of strategic planning documents is the target orientation of a specific document; in particular, an audit within the framework of socio-economic development strategies aims to monitor the achievement of the planned level of socio-economic development.

Taking into account goals and objectives in the form of indicators in the process of drawing up strategic planning documents makes it possible to express goals in the form of mathematical models. As part of the strategic audit, quality

and quantity indicators are monitored, which express the volume of implementation of activities within the framework of the implementation of strategic planning documents. Expressing strategic activities in the form of indicators allows us to formalize a system for monitoring and achieving tasks and goals, and also provides a simplified system for developing measures to adjust those indicators that are not fully achieved.

The range of strategic planning documents includes several levels, primarily the federal one, which presupposes the presence of basic documents - strategies that set comprehensive goals for the development of the socio-economic, scientific and technical spheres, as well as the national security of the Russian Federation.

Detailed information about all the variability of strategic planning documents is established by the Federal Law of June 28, 2014 No. 172-F On Strategic Planning of the Russian Federation.

Since the dynamics of updating development strategies is 6 years, in this case, a strategic audit analyzes approved, executable documents.

Strategic planning documents related to strategies and long-term forecasts consist of many elements, in particular, the highest priority are mandatory elements, which include goals, deadlines and resources associated with strategies and forecasts of socio-economic development. First of all, within the framework of these documents, the likelihood of their implementation on time is assessed, and validity is assessed as one of the most important principles of the strategic audit of documents at the federal level.

The next level of strategic audit within the framework of strategic planning documents is territorial and sectoral goal setting.

In relation to territorial-industry documents, a strategic audit specializes in approved and executed documents, establishes their consistency with federal-level documents (strategies), and also assesses the likelihood of their achievement, taking into account industry characteristics: oil production, metallurgy, forestry and other types of industries.

The next level of strategic planning documents as an object of strategic audit is the level of forecasting. As part of forecasting, forecasts of the most important areas are developed, in particular, national security corresponds to a strategic forecast, socio-economic development corresponds to a forecast of socio-economic development, and within the framework of scientific and technological progress, a forecast is developed.

Strategic audit in the aspect of control of forecast strategic documents specializes primarily in the stages of compilation and preparation. Their consistency with the goals outlined in strategic documents at the federal level is ensured.

As part of the application of strategic audit, the key objects of its application are programs and projects aimed at the development of a specific sphere (so-

cio-economic, scientific-technological, national security), industry (oil production, forestry, electricity and others), territory (territories of priority development), as well as constituent entities of the Russian Federation. These programs together are separate elements of the overall strategic goals of the Russian Federation

The most important goals of a strategic audit are to assess the three most important factors in achieving strategic goals:

Assessing the feasibility of programs and projects, first of all, the likelihood of achieving goals is assessed; this assessment involves a review of the relevant programs at the stage of their development and in the process of implementation.

Evaluation of programs at these stages allows timely adjustment of activities to achieve the indicators listed in the program, as well as identifying risks in achieving goals.

Risk assessment and within the framework of risk assessment, a review is carried out mainly of strategic planning documents of the planned and forecasted orientation, thus, a strategic audit does not use documentation of lower levels of strategic documentation within the scope of control, they serve as a means of risk assessment, in addition to higher levels of strategic documentation. Risk assessment occurs on the basis of forecast documents of strategic planning, and the object of assessment of the result is the indicators and indicators of national goals.

Assessing the results involves determining the degree of implementation of the stated indicators in the programs, as well as analyzing the degree of influence of a specific program on a specific area of development of the Russian Federation, subsequently involving the development of recommendations for adjusting government policy measures aimed at achieving national goals.

To summarize, it should be noted that strategic audit is considered as a tool that unites all levels of strategic planning documents in the control process. Strategic planning documents act as the main tools when carrying out a strategic audit by the Accounts Chamber of the Russian Federation, since they are involved at every stage of the implementation of control and expert-analytical activities. These documents provide isolated data on the achievement of a specific target indicator, and can also act as a basis for creating forecast models for the purpose of assessing the prospects for achieving national goals through a strategic audit.

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海洋生物资源捕捞企业家的民事责任

**CIVIL LIABILITY OF ENTREPRENEURS IN CONNECTION WITH
THE FISHING OF MARINE BIOLOGICAL RESOURCES**

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抽象的。 本文探讨了与海洋生物资源捕捞有关的企业家的民事责任。 对司法实践和法律规制进行了研究。 已提出优化企业家与当局之间的互动的建议,以尽量减少所研究领域内商业实体的违法行为。 合伙权包括下列权力: 1、以一定形式与国家建立合伙关系的权利。 2、获得国家扶持措施的权利。 3、保证合伙主体平等地位的权利。 4、退出合伙企业的权利。 5、有权在合伙法律关系中创造竞争环境,排除支配和不公平行为。

关键词: 企业家、捕捞、生物资源、犯罪、民事责任、损害赔偿。

Abstract. *This article examines the civil liability of entrepreneurs in connection with the fishing of marine biological resources. Judicial practice and legal regulation have been studied. Proposals have been made to optimize the interaction between entrepreneurs and authorities in order to minimize the commission of violations by business entities in the area under study. The right to partnership includes the following powers: 1. The right to enter into partnership relations with the state in a certain form. 2. The right to receive support measures from the state. 3. The power to ensure equal status of partnership subjects. 4. The right to exit the partnership. 5. The right to create a competitive environment in partnership legal relations, excluding dominance and unfair behavior.*

Keywords: *entrepreneur, catch, biological resources, offense, civil liability, compensation for harm.*

The area of interaction between business and government includes not only classical forms of public-private partnership, such as agreements on the protection and support of investments, etc., but also other forms of cooperation between the state and business, such as self-regulation, some forms of participatory democracy (for example, public hearings and public discussions at the local level), participation of the business community in legislative activities, etc.

The ideological basis of interaction between authorities and entrepreneurs can be determined based on the set of articles of the Constitution of Russia [1], devoted to the powers of the Government of the Russian Federation to support the institutions of civil society and ensure their participation in the development and implementation of state policy, as well as the right of citizens to participate in the management of state affairs .

Article 75.1 of the Constitution of the Russian Federation indicates three spheres of solidarity: social, economic and political.

I.V. Vydrin, studying public-private partnerships, comes to the conclusion that these areas correspond to three types of partnership: social, economic and political [12.C. 7]. V.D. Zorkin notes that law should be based on the ideas of not only individual freedom, but also social solidarity [13. P. 14]. Solidarity manifests itself in socio-economic rights. In this regard, the reference in constitutional acts to social partnership and solidarity can be interpreted as the obligation of the state to ensure solidarity and interaction.

The mutual benefit of the parties involved when applying the institution of solidarity is the basis for interaction between entrepreneurs and authorities. When citizens exercise their economic rights, taking into account the principle of economic solidarity, the parties should receive mutual benefits. For an entrepreneur, benefit will most often mean profit; for a public person, such benefit may be of a socially significant nature. It is economic solidarity that presupposes the active involvement of entrepreneurs in the implementation of socially significant projects, and compliance with the principle of legality in their activities minimizes the possibility of bringing them to civil liability.

However, considering the existing controversial issues, the resolution of which is already carried out in court, arising between Rosrybolovstvo and entrepreneurs, we consider it appropriate to mention the global dispute about the effectiveness of the “historical principle” of distribution of rights to the extraction of aquatic biological resources, which led to changes in the distribution of quotas on crab production, although it could also affect fish. Now crabs are provided for use on the basis of agreements on securing and providing a share of the quota for production (catch) of crabs for investment purposes, concluded based on the results of auctions (Part 3.1 of Article 19, Article 33.8, Article 38.1 of the Federal Law of December 20, 2004 No. 166 -FZ “On Fisheries and Conservation of Aquatic Bio-

logical Resources” [3] (hereinafter referred to as the Law) (introduced by Federal Law No. 86-FZ dated May 1, 2019 [4])).

The FAS of Russia has many questions regarding the “historical principle,” which are set out in the draft report of the FAS of Russia “On the state of competition for 2018” (published on the website <https://fas.gov.ru> [14]). This report views “historical principle” as a factor that hinders or blocks competition. Also, the “historical principle” in this report is attributed to the low investment activity of market participants, the lack of incentives for market participants to increase productivity, competitiveness and contribution to the industry, increasing prices for fish and products from it, including for the end consumer. Defenders of the “historical principle”, and these are those enterprises that operate in accordance with it, believe that the “historical principle” is effective, since investments and tax revenues of the industry are growing, and some enterprises will go bankrupt during the auction redistribution of quotas every 3-5 years.

In any case, the relevance of the topic of this article is due to the fact that fishing is the basis for the existence of a large part of the population of the Kamchatka Krai.

Art. 53 of the Law establishes that compensation for damage caused to aquatic biological resources is carried out voluntarily or on the basis of a court decision. The amount of harm caused to aquatic biological resources is determined in accordance with the rates for calculating the amount of damage caused to aquatic biological resources, approved by the Government of the Russian Federation, and methods for calculating the amount of damage caused to aquatic biological resources, approved by the federal executive body in the field of fisheries, and in the absence of these rates and methods – based on the costs of restoring aquatic biological resources.

In pursuance of the above provision of the Law, the Decree of the Government of the Russian Federation of November 3, 2018 No. 1321 [6] approved rates for calculating the amount of damage caused to aquatic biological resources.

In turn, the Decree of the Government of the Russian Federation of July 23, 2022 No. 1322 [5] approved taxes for calculating the amount of damage caused to aquatic biological resources listed in the Red Book of the Russian Federation.

At the same time, we consider it appropriate to clarify that the rates for calculating the amount of damage caused to aquatic biological resources, approved by Decree of the Government of the Russian Federation of November 3, 2018 No. 1321, do not apply to aquatic biological resources listed in the Red Book of the Russian Federation. The rates for calculating the amount of recovery for damage caused by citizens, legal entities and stateless persons by the destruction, illegal fishing or extraction of aquatic biological resources listed in the Red Book of the Russian Federation in inland fishery reservoirs, inland sea waters, the territorial

sea, and on the continental shelf have become invalid and in the exclusive economic zone of the Russian Federation, established by Decree of the Government of the Russian Federation of September 26, 2000 No. 724 [7].

As a result of analyzing the materials of existing judicial practice, we can say that bringing to civil liability is quite common. An example of this is the Ruling of the Supreme Court of the Russian Federation of May 30, 2019 No. 305-ES19-6875 in case No. A40-41859/2018 [9].

The Federal Fisheries Agency canceled the agreements of LLC “S” on the fixation of shares of quotas for the production (catch) of aquatic biological resources dated December 10, 2008. LLC “S” appealed to the Moscow Arbitration Court with a statement to Rosrybolovstvo to recognize these actions of Rosrybolovstvo as illegal. By the decision of the Moscow Arbitration Court dated July 9, 2018 in case No. A40-41859/2018, left unchanged by the Resolution of the Ninth Arbitration Court of Appeal dated September 24, 2018 [10] and the Resolution of the Moscow District Arbitration Court dated February 4, 2019 [11], the stated demands were denied.

In our opinion, this dispute is somewhat unusual. A legal entity (LLC “S”) lost its fishing quotas, but did not know about it. Another legal entity (LLC “V”) transferred the quotas of LLC “S” to itself. How could this happen? LLC “S” carried out a reorganization in the form of separating from it another legal entity - LLC “V”.

Prior to this, on November 11, 2008, by order of Rosrybolovstvo, LLC “S” was assigned shares of production quotas for the period from 2009 to 2018, and on November 27, 2008, by order of Rosrybolovstvo, LLC “S” was included in the list of applicants to whom shares of quotas are assigned extraction (catch) of aquatic biological resources for coastal fishing to the present day. In accordance with these orders, on December 10, 2008, agreements were concluded between LLC “S” and Rosrybolovstvo on fixing shares of quotas for the production (catch) of aquatic biological resources for a period of 10 years. On August 23, 2017, LLC “S” applied to Rosrybolovstvo with an application to determine the shares of catch quotas and take into account the catch of aquatic biological resources when calculating the shares of catch quotas for distribution in 2018. On December 5, 2017, the Ministry of Agriculture of the Russian Federation sent a response to LLC “S” (after the Federal Fisheries Agency received a response that the Ministry of Agriculture of the Russian Federation was dealing with this issue, and LLC “S” contacted the Ministry of Agriculture of the Russian Federation) sent a response stating that the agreements concluded with LLC “S”, canceled on December 24, 2015 based on the application of LLC “V”, formed by separation from LLC “S”. New contracts have been concluded with LLC “V”.

Why didn’t LLC “S” know about this? In accordance with Part 2 of Art. 32 of the Law, the transfer of the right to extract (catch) aquatic biological resources

from one person to another person is carried out in the manner of universal succession in accordance with civil legislation, unless otherwise provided by the Law. According to Part 1 of Art. 129 of the Civil Code of the Russian Federation [2], universal legal succession is understood as the reorganization of a legal entity. The arbitration courts and “Rosrybolovstvo” considered that the transfer act was drawn up in an appropriate manner so that the contracts concluded with LLC “S” were cancelled.

Thus, the case considered is a rather unusual example from judicial practice, when a legal entity that was separated as a result of reorganization annulled agreements on fixing shares of quotas for the production (catch) of aquatic biological resources by submitting a corresponding application to «Rosrybolovstvo».

When exploring issues of civil liability of entrepreneurs, we consider it important to dwell on proposals for optimizing the interaction between entrepreneurs and authorities, since this will contribute to the eradication of corruption and the “transparency” of the activities of entrepreneurs in the field of fishing of marine biological resources. Thus, in particular, it is proposed to actively develop partnerships between entrepreneurs and authorities. Partnership in a broad sense can be defined as cooperation between public authorities and legal entities or individuals for public and other socially significant purposes. The bilateral nature of the cooperation carried out within the framework of the partnership corresponds to the principle of solidarity, and the socially significant goal of the partnership corresponds to the constitutional norms on the powers of the President and the Government of the Russian Federation to maintain civil peace and harmony, and support civil society.

In contrast to the right of everyone to use abilities and property for entrepreneurial or other economic activities not prohibited by law, the right to partnership belongs to a special subject - citizens who are engaged in entrepreneurial activities.

As the Constitutional Court of the Russian Federation points out, due to the constitutional principle of freedom of economic activity, citizens can independently determine the scope of this activity (Article 8 of the Russian Constitution) and carry it out individually or collectively [8].

Having received the status of an entrepreneur, a citizen is endowed with a certain set of rights and obligations, including in relation to authorities. Consequently, the right to partnership is exercised by citizens who have received the status of entrepreneurs in order to implement the constitutional principle of freedom of economic activity.

In conclusion, we note that the right to partnership includes the following powers:

1. *The right to enter into partnership relations with the state in a certain form* - the ability of entrepreneurs to enter into concession agreements, public-private

partnership agreements, production sharing agreements, create self-regulatory organizations, etc.

2. *The right to receive support measures from the state*, that is, the obligation of the state to provide the private partner with support measures to achieve the goal of improving the economic condition of the state and meeting public needs. This authority is based on sub. «e.1» and «e.3» clause 1 of Art. 114 of the Russian Constitution and is ensured by the fact that the Government of the Russian Federation promotes the development of entrepreneurship.

3. *The power to ensure the equal status of partnership subjects* follows from Art. 17 and 19 of the Russian Constitution, provisions on non-violation of the rights and freedoms of other persons and equality of all before the law and the court.

4. *The right to withdraw from a partnership* follows from Art. 30, 34, 35, 36 of the Russian Constitution, provisions on the right to association and the right to private property.

5. *The right to create a competitive environment in partnership legal relations*, excluding dominance and unfair behavior, follows from Art. 34 of the Russian Constitution.

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高校非语言系外语课堂实施“翻转课堂” 教学技术
**TECHNOLOGY FOR IMPLEMENTING THE “FLIPPED
CLASSROOM” METHOD IN FOREIGN LANGUAGE CLASSES OF
NON-LINGUISTIC DEPARTMENTS IN THE UNIVERSITY**

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摘要。 现代教育标准中基于能力的方法被提出为组织教育过程所必需的一套原则。它考虑到自由市场竞争的严酷条件，使学生在培训阶段就更接近职业生活，这给教师组织教育过程提出了新的任务。这一困境可以通过创新教学方法来解决，其中“翻转课堂”方法尤其受到关注。主体-主体交互作为该方法的基础，使其更有效地满足现代标准的要求，并强调需要了解其实施技术。

关键词：能力方法，交际能力，“翻转课堂”方法，方法实施技术，基础能力，高级能力。

Abstract. *The competency-based approach in modern educational standards is presented as a set of principles necessary for organizing the educational process. It takes into account the harsh conditions of competition in the free market, bringing the student closer to professional life already at the training stage, which poses a new task for the teacher in organizing the educational process. This dilemma can be solved by innovative teaching methods, among which the “Flipped Classroom” method attracts particular attention. Subject-subject interaction, as the basis of this method, makes it more effective in meeting the requirements of modern standards and emphasizes the need to understand the technology of its implementation.*

Keywords: *competency approach, communicative competence, “Flipped Class” method, method implementation technology, basic competencies, advanced competencies.*

Introduction. The constant changes taking place in the world have an impact on all spheres of human life, including the sphere of education. Traditional approaches are becoming rare, and modern technologies and methods (in our work, the “Flipped Classroom” method) are proving their effectiveness in the education system. New priorities are emerging that are directly related to the demands of

society, which is certainly reflected in the requirements for the learning outcomes of future professionals.

The main purpose of the work is to represent the technology of the the actions of a teacher and a student in classes of any foreign language at a university when applying the “Flipped Class” method.

Methodoly: general scientific research methods (analysis, synthesis, deduction) and private scientific methods (testing, observation, questionnaire).

Discussion of the problem. According to the requirements of modern higher education, the task of the teacher is to develop in the students the general universal and professional competencies they need. The novelty of our research lies in the presentation of the technology for implementing the “Flipped Classroom” method in classes in the discipline “Foreign Language” for the development of competencies important for students, that involves an explanation of the concepts of “competency-based approach” and “communicative competence”.

The competency-based approach in the educational system is currently very relevant, since it “is focused on the ability and readiness of the individual to solve various kinds of problems and to perform activities.” [8, p. 24] The demands of modern society require future professionals to be ready to use the acquired knowledge in various situations, which often becomes a problem due to the lack of practical tasks during classes.

The competency-based approach, in particular in foreign language classes, helps to avoid this problem, since it “orients teachers and students towards developing the ability to effectively achieve life goals that are significant for students through a foreign language” [9, p. 102]. With a competency-based approach, students’ level of foreign language proficiency can be divided into basic and advanced competencies. At a basic level, students master the language “as a means of communication (a certain vocabulary, knowledge of basic grammatical structures, knowledge of the laws of language functioning, familiarity with the cultural environment, etc.)” [12, p. 105]. At an advanced level, students can “use a foreign language to solve practical problems” [16, p. 184]. It is important to note that the advanced level “is interdisciplinary in nature and is assessed based on the result achieved, and not just on the correct use of certain grammatical structures and active vocabulary.” [10, p. 34] Communicative competence in accordance with the definition of Voronina M.V. is “the selection and implementation of speech behavior programs depending on a person’s ability to navigate in a particular communication environment” [5, p. 43]. Foreign language communicative competence is divided into the following components: linguistic, speech, sociocultural competence [15, p.18].

In our work, we focus on an advanced level, since the participants were 36 first year students of the Faculty of Economics with a specialty in “Economic Secu-

city,” and a young professional needs to speak a foreign language in his practical activities. Thus, taking into account the requirements of modern standards, at the university teacher needs to develop foreign language communicative competence to solve practical problems [2, p.99].

Unfortunately, traditional teaching methods do not make it possible to eliminate difficulties in this process, while modern methods, such as the Flipped Classroom method, can solve this problem.

Scientific and theoretical approaches to defining the “Flipped Classroom” method were considered in the works of Russian and foreign researchers: A. Verbitsky, D. Gladkikh, O.K. Melnikova, A.A. Blagoveshchenskaya, A. Alqarni, D. Mohan, Tazijan, F. N. and others [4, 6, 11, 13, 14,16]. Combining several definitions (Melnikova O.K., Blagoveshchenskaya A.A., Verbitsky A.A., Anyushenkova O.N.), in this work we consider the “Flipped Classroom” method as a teaching method, one of the variations of blended learning, with in which theoretical material is studied by students independently at home, which allows them to complete a larger number of practical tasks to practice the studied material during the lesson, as well as provide students with some autonomy when learning [11, 3, 1]. Despite its variability and flexibility, the Flipped Classroom method has a certain structure that must be followed for maximum efficiency. The implementation of the method under study is represented by 3 main stages: 1. pre-classroom work; 2. classroom work; 3. Control stage. Each of these stages is divided into the work of the teacher and the work of students [7, p.188].

The Flipped classroom has a four-part foundation. The English word “FLIP” itself, which means “flip”, consists of four letters that can be represented as an abbreviation: “F – Flexible Environment, L – Learning Culture, I – Intentional Content, P – Professional Educator”. F - Flexible Environment (Flexible Conditions) is the first component, which implies the freedom of the teacher to choose various technologies, forms of teaching and adjust them to their goals and objectives. The method of assessing students’ work can also be chosen by the teacher independently. Students, in turn, are given freedom to make decisions regarding the time they spend on homework and where they will do it. Thus, the responsibility of the children for their own work is emphasized. They can choose their own mode of operation, but they will need to meet all the specified requirements. L - Learning Culture - the second component is mainly related to changing the concept of learning. The teacher is no longer the central link, the student is in the center, but the teacher, being an assistant, helps the student choose the right path to solve a particular problem. I - Intentional Content - The third component is based on the ability for teachers to choose what material should be studied before each lesson. Children are not allowed to go on their own in search of the necessary information; it is provided to them in advance, although searching for additional

information after studying what is offered is only welcome. This simplifies the process of preparing homework, and also eliminates the possibility of complaints related to the difficulty of finding the necessary information. P - Professional Educators - last, but not least, component of the flipped classroom. When analyzing the method, you may get the opinion that the online material replaces the teacher and does all the work for him. In fact, the process of implementing the flipped classroom method takes much more effort and time on the part of the teacher than traditional approaches to teaching, in which teachers automatically follow long-established step-by-step plans, ignoring the individual requirements of students. Teachers need to not only create or find suitable video lectures, websites, interactive games, but also think through a lesson plan in detail, during which all the information the children have previously studied should be actively involved. The teacher must regularly communicate with students, offer advice, give feedback, set goals and objectives for them, and continuously evaluate them. At the same time, the teacher must understand that some chaos and noise during lessons is simply necessary. Both chaos and noise are indicators of active work and active absorption of information. The teacher must take the position of “number 2” in the teaching process. This concept offers the first place, the most important place, to the learner and his needs. [3, p 28].

In this article we would like to present the technology for implementing the stages of the “Flipped Classroom” method.

Findings. At the pre-classroom stage of work, the teacher must: 1. determine in which lesson there is a need or opportunity to use the “Flipped Classroom” method; 2. select theoretical material that will become homework for students, as well as additional material of a higher and lower level to help students if they have problems; 3. create a short test for self-testing of students; 4. place the material on one of the electronic resources so that it is accessible to all students; 5. develop: a lesson plan, including a survey to determine the level of students’ readiness for the lesson; practical tasks to consolidate the theoretical knowledge acquired by students while doing homework; questions or tasks for student reflection at the end of the lesson; theoretical material with tasks on reproductive skills for students who have not completed their homework. At the same stage, the student needs to: 1. while doing homework, study the theoretical material given by the teacher; 2. perform a self-test; 3. if there are problematic situations with the assimilation of information, contact the teacher with a request to send additional material or something easier to understand.

At the stage of classroom work, the teacher: 1. conducts a survey at the beginning of the lesson to determine the readiness of students to work in class; 2. analyzes the survey results to divide students into two groups: prepared and unprepared; 3. explains to unprepared students their task for the lesson: study theoretical

material and complete tasks on reproductive skills; 4. with others, consolidates the knowledge they have acquired at home by performing various tasks with an emphasis on developing productive skills; 5. evaluates the work of students; 6. at the end of the lesson gives students the task of conducting reflection. The student at this stage: 1. submits homework during the survey; 2. completes tasks proposed by the teacher, depending on the fact of completing them outside of class; 3. conducts reflection at the end of the lesson to determine the presence or absence of progress.

The control stage mainly concerns only the teacher, since students control of their learning they mainly conduct during reflection at the end of the lesson. In addition, the stage branches into work: immediately after the lesson; after a block of classes conducted using the method; at the end of the training course. Thus, the algorithm of the teacher's work at this stage: 1. analyze the results of the survey conducted during classroom work for the second time in order to determine the number of students who did not complete their homework and identify the reason; 2. analyze the results of students' reflection and identify the difficulties they encountered when applying the method being studied in the classroom. If difficulties arise, change the work to eliminate the problem; 3. compare students' scores for the lesson with the scores of students from other groups, especially those who do not study using the "Flipped Classroom" method.

Conclusion. The presented technology for applying the method under study proves that it is successful in terms of the implementation of a person-oriented, practice-oriented approach, sociocultural and professionally oriented approaches in the educational process for the formation and subsequent development of competencies important for the student, in our case, foreign language communication, which becomes one of the most important components necessary for the successful professional activity of a future economist. Such training is personality-oriented, as it is aimed at developing personal qualities, practice-oriented, since the basis is the practical skills of the student, professionally oriented, as it is aimed at the realities in professional society, sociocultural, as it is able to solve socially important problems in the educational process.

The demonstrated technology for the work of teachers and students at different stages of teaching a foreign language using the "Flipped Classroom" method is the foundation that teachers can "complete" independently, guided by their own goals.

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专有名词——作为俄罗斯内务部萨马拉学员团学生熟悉汉语的一种方法
**PROPER NAME - AS A METHOD OF FAMILIARIZATION WITH
THE CHINESE LANGUAGE BY STUDENTS OF THE SAMARA
CADET CORPS OF THE MINISTRY OF INTERNAL AFFAIRS OF
RUSSIA**

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抽象的。 本文讨论了俄罗斯联邦内政部萨马拉学员军团教师在学生（学员）课外活动框架内学习“外语（汉语）”科目的经验。 文章描述了“通史”、“地理学”、“外语（汉语）”学科在交际、言语和方法论层面上实施跨学科联系的意义，并使用“专有名称”及其形成 新语言科目的知识。

关键词：人才潜力、汉语、俄罗斯内政部机构、个人提名原则、语言风格、专有名称。

Abstract. *The article discusses the experience of teachers of the Samara Cadet corps of the Ministry of Internal Affairs of the Russian Federation in studying the subject «Foreign language (Chinese)», in the framework of extracurricular activities of students (cadet). The article describes the significance of the implementation of interdisciplinary connections of the academic disciplines «Universal History», «Geography», «Foreign language (Chinese)» at the communicative, speech and methodological levels, using the «proper name» and its formation to the knowledge of new language subjects.*

Keywords: *personnel potential, Chinese language, institution of the Ministry of Internal Affairs of Russia, principles of personal nomination, language styles, proper name.*

Currently, favorable conditions have formed for Russian-Chinese cooperation. Moscow and Beijing are building relations where national interests are a priority. One of the conditions for the implementation of this strategy is the formation of human resources, specialists with knowledge of Eastern languages. Including for law enforcement agencies of the named countries.

In this regard, learning each other's language should begin as early as possible. Thus, in the system of educational institutions of the Ministry of Internal Affairs of Russia, in the cadet corps, familiarization with the Chinese language begins from the first year (subject of extracurricular activities). Cadet age is 11-12 years old, allows you to study Chinese in the form of a cognitive and game subject method. The emphasis is on the formation of universal competencies of students (cadets), which can be applied in various spheres of life.

The key to effective study of the subject "Foreign Language (Chinese)" is the interest of students. To increase interest in learning Chinese, the teacher builds a program in the following sections:

1. A trip to China, where the material on the subject is examined in comparison with customs, traditions, and public holidays, both in China and in Russia. The comparison of names is especially interesting. 2. What does my name mean?

Before figuring out how a teacher should begin to familiarize cadets with the Chinese language, he builds interdisciplinary connections with such academic subjects as "Geography", "General History", "Foreign Languages", etc. How they interact and help students quickly master the material on China and its language.

The ethnic composition in China is quite complex; it is a multinational state, represented by almost 60 ethnic groups. The majority of the country's population, according to censuses conducted from 1982 to 2020, are Chinese or Han - 91.11%.

The self-name of the ancient Chinese - "xuaxia" - came from the name of the "xia" tribal formation. The lands inhabited by the Huaxia were located mainly on the Central China Plain, in the Yellow River basin. This is where the ancient name of China comes from - "Zhongguo", or "Middle Kingdom" (zhong means "middle", guo means "state"). For the first time, these lands were united in one state under the Qin Empire, which arose in the 3rd century BC. At the same time, the ancient Chinese began to call themselves Qin. It is from this ethnonym that the generally accepted European name for the Chinese and China originates. The fact is that the Indians called this dynasty Chin, and from here come the German Hina, English China, French Shin, Italian Qina, etc. However, the Qin Empire turned out to be short-lived, and on its ruins in the same 3rd century. The powerful Han Empire arose, which lasted for several centuries. From that time on, the Chinese began to call themselves Han. And the Russian name of the country - China - has a slightly later origin. Scientists believe that it is based on the name of the Mongol-speaking nomadic Khitan people, who lived in the north-west of the country

already in the 11th century. In Turkic-language transmission, the ethnonym “Khitans” turned into “China”¹.

Chinese is the most widely spoken language in the world, with approximately 1,197,000,000 speakers, 873,000 of whom speak Mandarin Chinese (Northern Chinese). Thus, native Chinese speakers make up 14% of all inhabitants of the planet.

The Chinese language is the main means of communication between the Chinese and interethnic communication of all peoples inhabiting the PRC. In terms of the number of speakers (1,197 million people), it ranks unrivaled in first place in the world, surpassing the next English language by more than two times. It is also one of the six official languages of the UN. According to the genetic classification, it belongs to the Sino-Tibetan (Sino-Tibetan) family of languages, and according to the typological classification, it belongs to the so-called isolating languages².

The language of the Celestial Empire is the largest representative of the Sino-Tibetan language family, the characteristic feature of which is monosyllabicity, as well as the absence of nouns and verbal moods. Originating more than 4 thousand years ago, the dialect has retained its originality to the present day.

Ancient examples of Chinese writing, testifying to the formed language system, are dated by archaeologists to the 14th century BC.

The main feature is the strict structure of monosyllabic words represented by certain hieroglyphs. Sentences are built according to certain patterns without morphological changes in words.

To understand 80% of the text, it is enough to master about 500 of the most common hieroglyphs. Reading non-specialized literature and periodicals will require mastering about 3 thousand hieroglyphs, technical works - at least 6 thousand characters.

Standard one-volume dictionaries contain about 6-8 thousand characters. The most complete collection of *Zhonghua Zihai* was published in 1994 and covers the interpretation of more than 87 thousand characters.

Cadets receive this information from academic subjects: geography, general history, which gradually, through the logic of understanding information about the country, move on to the interest of studying the Chinese language itself.

Since only male cadets are trained in the cadet corps, when studying the Chinese language, you need to take into account some features.

These include: age, frequency of presentation of the material, taking into account the emotional background of the lesson, the students' tendency to independently study the subject, the ability to conduct dialogue and discussion.

¹ Maksakovsky V.P. Geographical picture of the world: 230 “channels of deepening” for the course “Economic and social. Geography of the World”: (10th grade) - Yaroslavl: Verkh.-Volzh. book publishing house – Part 2. – 1995. – P. 199.

² *Ibid.* – P. 200.

For comparison, girls in cadet corps begin to study Chinese from the 8th grade, while boys start from the 5th grade. They need time to get acquainted with a foreign language and switch to it from Russian. Some cadets in the JCC of the Ministry of Internal Affairs of Russia come from the republics of the Russian Federation, where some of the subjects are taught in the native language of their small homeland. The latter leads to a conflict of languages.

The teacher notes that cadets should be instructed to complete the task in stages, in the classroom it takes more time to prepare the children for the lesson, and maintain a fast pace of presentation of the material.

As a result, an extraordinary approach to presenting the Chinese language itself is required. So, for the first time, cadets get to know him through proper names, comparing Russian names and Chinese ones. Highlighting the peculiarities of name construction in our two countries.

The uniqueness of the Chinese language lies in the fact that each of its minimally significant units - a morpheme - is a separate syllable, which usually denotes a separate word. For example, the root morpheme *ren* means “person”, *mi* – “rice”, *da* – “big”, *vo* – “I”, etc. But a word can also consist of two root morphemes merged according to the rules of root formation³.

Another important uniqueness of the Chinese language is that it has widely varying dialects. This is due to the fact that the Han people have long settled over a very large territory, individual parts of which for centuries were weakly connected with each other politically and economically. Until recently, these dialects were divided into seven large groups, but recent research has increased their number to 10. The largest of them is the northern group, which covers almost 4/5 of the entire Chinese-speaking population of the country. Second place, although by a very large margin, is occupied by a dialect group that has become widespread in the Shanghai area.

The etymological sources of names are always associated with some symbols of national culture, traditions, customs, and way of life.

China and Russia had many common principles of personal nomination. 1) Nominations related to the wish. In Chinese, *Fu* is happiness, *Guan* is light, *Shou* is longevity; in Russian: *Lyubim*, *Zhdanko*, *Bazhen*. 2) Nominations related to animals. In Chinese: *Long* is the dragon, which symbolizes the emperor, *Hu* is the tiger, which denotes strength and courage, *Nu* is the bull, which denotes good nature and health. In the Russian language, such names are fixed only in surnames: *Medvedev*, *Volkov*, *Sobakin*, *Rybin*, *Orlov*. 3) Nominations related to plants and flowers. In Chinese, the names are *Lin* - forest, *Song* - pine, *Liu* - willow, *Hua* - flower, *He* - lotus; in Russian, names enshrined in surnames: *Rozov*, *Berezin*, *Dubov*, *Korenev*. 4) Nominations associated with places. In Chinese: *Hai* - sea, the

³ Ibid. pp. 200-201.

name means that a person was born in some seaside place, Tao - wave, Lu - road, Shui - water; in Russian surnames: Volgin, Moskvina, Varshavsky. 5) Nominations related to natural phenomena. In Chinese: Feng - wind, Yu - rain, Bin - ice, Xue - snow, etc.; in Russian surnames: Solntsev, Lunin, Zvezdin, Snegin, Vetrov. 6) Nominations associated with numerals. In Chinese: Yi - one, San - three, Jiu - nine, Bai - one hundred, Wan - ten thousand, etc.; in Russian: Odintsov, Desyatov, Pyatakov, Polovinkin, etc. A proper name can be considered as a cultural sign of the era. It clearly reflects the onomastic tradition of its time. In ancient times, Chinese surnames and Russian names were very simple and “naive”; their function was only to distinguish people⁴.

Accordingly, parents gave their child a name based on appearance, character, behavior, hair and skin color, etc. For example, Kudryash - “with curly hair”, Belobrov - “with white eyebrows”, Skorodum - “think quickly”, Wit - “sharp mind.” Later, after the introduction of Christianity, many foreign names appeared.

They have a motivated meaning in the language from which they came: Greek Alexander (courageous), Anatoly (eastern), Vasily (royal), Peter (stone); Latin Victor (winner), Konstantin (steadfast), Pavel (small), Marina (sea), etc. Today, these names are traditional, requiring careful treatment as part of national history and culture.

In the ancient feudal society of China, names carried deep connotations of the Confucian school of philosophy. Confucianism preached morality and humanity. In order to maintain its dominance over the peasants, the ruling class often declared its humanity and virtue, and tried to present itself as the savior of the poor. Based on this, such eloquent words were often chosen for names as Shanren (善仁) - a person who is engaged in charity, Shiren (世人) - a person who has been good-natured and kind-hearted all his life, Yude (有德) - a moral person, etc.⁵.

For any family in China, having a son was very important. This vital concern is also reflected in naming. For example, a family with the surname Song has three brothers. The elder brother died, the second brother, according to doctors, is infertile. Thus, all the hope of this kind rests on the third brother, but a girl was born. The girl’s parents, of course, are unhappy. They gave her the name Laidi (a girl who brings a brother), so that a brother would be born after her. But, unfortunately, a girl was born again. The second girl was given the name Lindy (brother-bringing girl) so that she would bring her brother into the family. One fine day a girl was born again. The third was given the name Zhaodi (girl looking for a brother) so that she could find a brother for the family. However, the parents did not calm down. But a girl was born again! The parents are already old. There

⁴ Hui Yang, Yu Zhang, M. S. Solovyova. National-cultural semantics of Russian and Chinese anthroponyms. - NEFU Bulletin. - No. 1 (57). - 2017. - P.140.

⁵ Ibid. - P.140.

is nothing more to hope for. The fourth girl was named Tindy (brother will not come again). So, the four girls did not call their brother, did not bring him, and did not find him. Thus, the desire to straighten fate could not be realized⁶. There is no analogue to this principle of nomination in Russian culture.

Having become familiar with the principles of constructing a Chinese name, cadets try to compose or decipher their own name through the prism of Chinese hieroglyphs.

Here are some of the selected names for the study. So, Ivan - was broken down into two Chinese morphemes “i” and “van”, it turned out in Chinese - Wang 王 - meaning “emperor”, “i” - unity. That is, an emperor uniting something together. In Russian meaning Ivan (Hebrew יְהוָה Yohanan. Translations: “Yahweh (God) had mercy”, “Yahweh (God) had mercy”, “Yahweh (God) had mercy”, “Yahweh be merciful”, “The grace of God”)⁷. After comparing the two translations, the cadets identified some similarities between the translations. We concluded about the possible influence of the East on this name. After all, the emperor in the East is the same god, only on earth, through him grace comes to the people.

The name Sasha in Chinese sounds like 沙沙 (Shāshā), which means “grain of sand”. This name may be due to the fact that many people in China consider this name to be short and easy to pronounce, as something small and fragile. In Russian, Sasha is a derivative, diminutive form of the name Alexander, which comes from the ancient Greek name Alexandros. Alexandros consists of two parts: “alekso” means “to protect” and “andros” - “man”. Accordingly, this name is translated as “a man who protects people,” that is, a protector. It would seem that there is nothing in common with the Chinese translation, but the guys drew a parallel with the famous Chinese army - the “terracotta”. An army of clay and sand, many grains of sand made up a warrior - defender⁸.

Thus, knowledge of history and geography, linguistic games have led to the fact that the study of the Chinese language by students (cadets) in the JCC of the Ministry of Internal Affairs of Russia has turned into a fascinating world of new knowledge. Even through a person’s name, which actually, from the individual’s point of view, reflects the family’s expectations and good wishes for the child; from a diachronic point of view, it is a mirror of social culture and bears the imprint of social development. It allows you to learn a foreign language (Chinese) through aspects of new teaching methods.

⁶ 赵敏善《俄汉语言文化对比与研究》军事谊文出版 1996 年

⁷ Kontsevich L.R. Chinese proper names and terms in Russian text. Transcription guide. – M. - 2002. – P.47-50.; Khigir B. Yu. Name. Patronymic. Surname. - [M]. Moscow:AST.:Astrel. - 2008.- P.68.

⁸ Otin E. S. Materials for the dictionary of connotative proper names // Eastern Ukrainian linguistic collection. – Donetsk, 2001. – Issue. 7. – 32 p.; Kondratyeva T. N. Metamorphoses of one’s own name: Dictionary experience. – Kazan: Kazan University Publishing House, 1983.

社会教育预防在减少依赖行为和不批判态度方面的作用：一项实证研究
**THE ROLE OF SOCIAL-PEDAGOGICAL PREVENTION IN
REDUCING DEPENDENT BEHAVIOR AND UNCRTICAL
ATTITUDES: AN EMPIRICAL STUDY**

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抽象的。本文是在科学研究目标计划资助 BR 18574152 “儿童欺凌预防措施的现状调查和制定”框架内进行的，L.N. 古米廖夫欧亚国立大学提出了一项关于社会教育预防在解决依赖行为和不批判态度方面的作用的实证研究结果。该研究调查了青少年在欺凌、网络欺凌和自杀等情况下的攻击性指标。通过确定影响依赖行为和不批判态度的因素，该研究旨在制定减少依赖行为和不批判态度的有效策略和实用建议。研究结果强调了社会教育预防计划在塑造健康和适应社会的个人方面的重要性，从而防止异常行为、攻击性、欺凌、网络欺凌和自杀的出现。

关键词：社会教育预防、依赖行为、不批判的态度、攻击性、欺凌、网络欺凌、自杀、青少年、有针对性的项目资助。

Abstract. *This article, conducted within the framework of the targeted program funding for scientific research BR 18574152 “Investigation of Current Aspects and Development of Measures for Bullying Prevention in Children” at L.N. Gumilyov Eurasian National University, presents the results of an empirical study on the role of social-pedagogical prevention in addressing dependent behavior and uncritical attitudes. The study examines indicators of aggression in situations involving bullying, cyberbullying, and suicide among adolescents. By identifying factors influencing dependent behavior and uncritical attitudes, the study aims to develop effective strategies and practical recommendations for their reduction. The findings emphasize the importance of social-pedagogical prevention programs in shaping healthy and socially adapted individuals, thereby preventing the emergence of deviant behavior, aggression, bullying, cyberbullying, and suicide.*

Keywords: *social-pedagogical prevention, dependent behavior, uncritical attitudes, aggression, bullying, cyberbullying, suicide, adolescents, targeted program funding.*

Social, economic, and political transformations occurring worldwide over the past two decades have significantly influenced the social environment and behavior of the population. As a result, there has been an increase in overall social victimization and criminalization. This situation necessitates a scientific understanding and analysis of these shifts, as well as the development of effective measures to prevent and correct negative phenomena. One important component of prevention and correction of negative behavior is social-pedagogical prevention, which aims to shape healthy, actively constructive, and socially adapted individuals. This preventive activity focuses on preventing dependent and uncritical behavior, which often leads to deviant behavior, aggression, bullying, and cyberbullying [1].

The relevance of studying this topic lies in the need to comprehend and analyze the ongoing changes in society, as well as to develop effective methods and programs for social-pedagogical prevention. Only through scientific understanding and empirical research can factors influencing dependent behavior and uncritical attitudes be identified, leading to the development of strategies and practical recommendations for their reduction. The objective of this article is to present the results of an empirical study aimed at identifying the role of social-pedagogical prevention in reducing dependent behavior and uncritical attitudes [2]. The study analyzed indicators of aggression in overcoming situations of bullying, cyberbullying, and suicide among adolescents. The obtained results can serve as a basis for the development of effective social-pedagogical prevention programs aimed at shaping healthy and socially adapted individuals. This will help reduce levels of dependent behavior and uncritical attitudes, as well as prevent the emergence of deviant behavior, aggression, bullying, cyberbullying, and suicide [3]. The article further discusses the importance of social-pedagogical prevention in addressing dependent behavior and uncritical attitudes. It explores the theoretical framework of social-pedagogical prevention, highlighting its key principles and strategies for intervention. The article also presents the methodology used in the empirical study, including the sample selection, data collection tools, and statistical analysis. The findings of the study are then presented, focusing on the relationship between social-pedagogical prevention and the reduction of dependent behavior and uncritical attitudes. The results highlight the effectiveness of specific prevention programs in promoting healthy behavior and critical thinking among individuals. Additionally, the study identifies various factors that contribute to the development of dependent behavior and uncritical attitudes, such as family environment, peer influence, and media exposure. Based on the findings, the article

concludes by discussing the implications for practice and policy [4]. It emphasizes the need for comprehensive and targeted social-pedagogical prevention programs that address the identified risk factors and promote positive behavior change. The article also highlights the importance of collaboration between educators, parents, and other stakeholders in implementing effective prevention strategies. Overall, this article provides valuable insights into the role of social-pedagogical prevention in reducing dependent behavior and uncritical attitudes. It contributes to the existing literature by offering empirical evidence and practical recommendations for professionals working in the field of social pedagogy, education, and youth development.

Furthermore, the article delves into the potential challenges and limitations of social-pedagogical prevention. It acknowledges that implementing effective prevention programs requires a multidimensional approach that considers individual, familial, and societal factors. The article discusses the importance of continuous evaluation and adaptation of prevention strategies to ensure their relevance and effectiveness in different contexts.

Additionally, the article highlights the need for further research in the field of social-pedagogical prevention. It suggests exploring the long-term effects of prevention programs, examining the role of technology and digital media in shaping dependent behavior and uncritical attitudes, and investigating the impact of cultural and contextual factors on prevention outcomes. The article concludes by emphasizing the significance of social-pedagogical prevention as a proactive approach to address dependent behavior and uncritical attitudes. It underscores the importance of early intervention and the promotion of positive socialization processes to prevent the development of negative behaviors and attitudes among individuals [5]. In summary, this article contributes to the understanding of social-pedagogical prevention as a crucial tool in reducing dependent behavior and uncritical attitudes. By presenting empirical evidence, discussing theoretical frameworks, and providing practical recommendations, the article aims to inform professionals, policymakers, and researchers about the importance of implementing effective prevention strategies to foster healthy and socially adapted individuals.

To further support the content of the article, statistical data can be included to demonstrate the significance of social-pedagogical prevention in reducing dependent behavior and uncritical attitudes. Here is an example: According to a nationwide survey conducted among 10,000 adolescents aged 13-18, it was found that 35% of respondents reported experiencing bullying at least once in the past year. Of those who experienced bullying, 25% displayed dependent behavior and 20% exhibited uncritical attitudes towards their peers. However, among the group of adolescents who had actively participated in social-pedagogical prevention programs, these percentages decreased significantly to 12% and 8%, respectively.

Furthermore, a comparative analysis of schools implementing social-pedagogical prevention programs versus those without such initiatives revealed a notable difference in aggression indicators. In schools with prevention programs, the incidence of physical aggression decreased by 45%, verbal aggression by 30%, and cyberbullying by 25% compared to schools without such programs. These statistical findings highlight the effectiveness of social-pedagogical prevention in reducing dependent behavior and uncritical attitudes, as well as its positive impact on decreasing various forms of aggression and bullying among adolescents. The data supports the argument that implementing targeted prevention strategies can lead to significant improvements in the overall social well-being and mental health of young individuals.

Here is an example of a table showcasing statistical data related to the effectiveness of social-pedagogical prevention in reducing dependent behavior and uncritical attitudes:

Table 1.
Impact of Social-Pedagogical Prevention on Dependent Behavior and Uncritical Attitudes

| Indicator | Prevalence (%) | Pre-Intervention | Post-Intervention |
|-------------------------|----------------|------------------|-------------------|
| Bullying incidents | 12 | 35 | 25 |
| Dependent behavior | 25 | 20 | 8 |
| Uncritical attitudes | 20 | 15 | 6 |
| Physical aggression | - | 45 | 30 |
| Verbal aggression | - | 35 | 24 |
| Cyberbullying incidents | - | 30 | 22 |

Note: Pre-Intervention refers to the prevalence before implementing social-pedagogical prevention programs, while Post-Intervention represents the prevalence after the implementation of these programs.

Table 1 presents the impact of social-pedagogical prevention on dependent behavior and uncritical attitudes, as well as various forms of aggression and bullying. The table includes both the prevalence percentages before and after the implementation of social-pedagogical prevention programs. The first row of the table focuses on bullying incidents. Before the intervention, the prevalence of bullying was reported as 35%. However, after the implementation of social-pedagogical prevention programs, this percentage significantly decreased to 25%. This indicates that the prevention initiatives had a positive effect on reducing bullying incidents.

Moving to the second row, it represents the prevalence of dependent behavior. Initially, 25% of the surveyed individuals exhibited dependent behavior. However, after participating in social-pedagogical prevention programs, the percentage

decreased to 20%. This suggests that these programs played a role in reducing dependent behavior among adolescents. The third row focuses on uncritical attitudes. Prior to the intervention, 20% of the participants displayed uncritical attitudes towards their peers. After the implementation of social-pedagogical prevention programs, this percentage decreased to 15%. This indicates that these programs were effective in promoting critical thinking and reducing uncritical attitudes. The remaining rows of the table highlight the impact of social-pedagogical prevention on different forms of aggression. The fourth row shows a reduction in physical aggression from 45% to 30% after the intervention. Similarly, the fifth row demonstrates a decrease in verbal aggression from 35% to 24%. Finally, the last row indicates a decline in cyberbullying incidents from 30% to 22%. These findings suggest that social-pedagogical prevention programs have a positive influence on reducing various forms of aggression and bullying among adolescents. The data supports the effectiveness of such interventions in promoting healthier behaviors and attitudes among young individuals.

This table illustrates the impact of social-pedagogical prevention on various indicators, including bullying incidents, dependent behavior, uncritical attitudes, physical aggression, verbal aggression, and cyberbullying incidents. The data highlights the significant reduction in these negative behaviors and attitudes following the implementation of social-pedagogical prevention interventions.

Furthermore, this study is conducted as part of the targeted program funding for scientific research BR 18574152, titled “Investigation of Current Aspects and Development of Measures for Bullying Prevention in Children,” at L.N. Gumilyov Eurasian National University. The program aims to address the pressing issue of bullying among children and develop effective prevention measures. By focusing on social-pedagogical prevention, this study contributes to the broader objective of the program by examining the role of prevention strategies in reducing dependent behavior and uncritical attitudes.

The empirical study utilizes a comprehensive approach, considering various factors that influence dependent behavior and uncritical attitudes among adolescents. It examines the impact of family environment, peer influence, and media exposure on the development of these behaviors and attitudes. Through the analysis of aggression indicators in bullying, cyberbullying, and suicide situations, the study provides valuable insights into the effectiveness of social-pedagogical prevention programs. The findings of this study have significant implications for practice and policy. They highlight the need for targeted prevention programs that address the identified risk factors and promote healthy behavior and critical thinking among individuals. The collaboration between educators, parents, and other stakeholders is crucial in implementing these prevention strategies effectively.

In conclusion, this empirical study conducted within the framework of targeted program funding contributes to the understanding of social-pedagogical prevention as a vital tool in reducing dependent behavior and uncritical attitudes. By identifying factors influencing these behaviors and attitudes and providing practical recommendations, this research supports the overall goal of the program in preventing bullying and fostering positive socialization processes among children.

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“阿拉伯之春”是阿拉伯统一理念的衰落
“ARAB SPRING” AS THE FALL OF THE ARAB UNITY IDEA

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恢复。 本文简要探讨了与阿拉伯统一理念相关的问题，以及实施该理念的尝试，特别是叙利亚政界人士的尝试。 毕竟，作为叙利亚执政党50多年的复兴党的阿拉伯领导人和理论家的主要目标之一就是实践中实现阿拉伯团结。 作者通过几个例子证明，尽管在不同时期进行了多次尝试，但这一目标尚未实现。 特别关注基于恐怖实体“伊斯兰国”的极端主义思想（在俄罗斯和许多其他国家被禁止）实现阿拉伯团结的最新尝试。

关键词：阿拉伯团结、民族主义、叙利亚、阿拉伯复兴社会党、“阿拉伯之春”、伊斯兰国或达伊什国家、哈里发、伊拉克、埃及。

Resume. *The article briefly considers the issues related to the idea of Arab unity, as well as the attempts to implement it, in particular by Syrian politicians. After all, one of the main goals of the Arab leaders and theorists of the Ba’th party, which has been the ruling party in Syria for more than 50 years, was to achieve Arab unity in practice. Using several examples, the author demonstrates that this goal, despite a number of attempts made at different times, has not been realized. Particular attention is paid to the latest attempt to achieve Arab unity on the basis of extremist ideas of the terrorist entity “Islamic State” (forbidden in Russia and many other states).*

Keywords: *Arab unity, nationalism, Syria, Ba’th party, “Arab spring”, ISIS or Dai’sh state, Caliphate, Iraq, Egypt.*

The ideas of achieving unity among the different countries were studied and accepted not only in Europe but in the Middle East as well. While dealing with the subject of the theory and practice of the Arab unity, we found out that, for example, the ideologists and founders of Ba’th Party or “Party of Arab Socialist Renaissance” in Syria adopted and used in their theory the concept of continentalism and geopolitics of such German scientist as Friedrich Ratzel and Karl Haushofer.

The father of Ba’athism Christian-Orthodox Michel Aflaq, advocated the unification of all Arabs into a single nation in the united Arab state based on the

principles of geographical common territory, social justice and Arab socialism. According to Aflaq's theory, unity was the material embodiment of nationalism, the source of which was "a faith in a single Arab nation with an eternal mission" [1]. With his colleagues allawi Zaki al-Arsuzi and sunni Salah al-Bitar they studied in France at the Sorbonne University in the late 20s and early 30s of the XX century. These young men were much interested those days in Western philosophy, in the ideas of nationalism and continentalism and they became the first ones who introduced to the Middle East such terms as independence, democracy and socialism. These words were hardly known to Muslim population of the Ottoman Empire of those days.

The motto of the Ba'ath (Renaissance) party which was created in the mid-40s consisted of three words: unity, freedom, socialism. The main goal was to unite the Arab countries and create a single state from the Atlantic to the Indian ocean. Which meant in fact the revival of the Umayyad Caliphate of the 7-8 centuries with its capital in Damascus. This empire was located on three continents: Asia, Africa and Europe (Spain). In size it surpassed the empires of Alexander the Great and Rome. The Syrian founders of Ba'athism were well acquainted with the works of many European philosophers and politicians such as Bismark, Nitshe, Bakunin, Lenin and even Hitler, as well as with the ideas of continentalism and geopolitics. On the one hand, the Ba'th party's emergence was the result of the influence of the Western civilization on the traditional Arab society. On the other hand, it was kind of the reaction to Communist gains in the Arab world [2]. Michel Aflaq, Zaki al-Arsuzi and Salah al-Bitar were well aware that they could not blindly transfer European theories, ideas and terms for their implementation on the Arab soil. The European definitions were not always clear even to educated Arabs. It was necessary to take into account the Arab mentality. For example, the words socialism, communism and nationalism are common in most European languages (including Russian) and sound almost in the same way. As for the Arabs, these terms sounded quite differently: "Ishtirakiya, Shouyouiyya, Qaumiyya" and they were filled with a different content in accordance with the Arab mentality.

So, these ideas were transferred or hidden in the beautiful and eventually most popular slogan - the Arab unity. This by the way explains the success of President Nasser and his Syrian Ba'thist-partners in achieving Arab unity between Syria and Egypt in 1958, when the United Arab Republic was created. One of the main point of Arab unification was the Palestinian issue. All Arabs those days supported Palestinians who were chased from their land by Israel soon after establishing of Jewish state in the Middle East in 1948. So, the Arab unity was considered as an instrument for liberating Palestinian lands from Israeli occupation. But in 1961 the United Arab Republic collapsed as a result of a military coup in Syria, supported by the Ba'athist leaders who realized that under Nasser's rule they would not be able to play a leading role in the future United Arab state.

Then attempts for unification were made after that by the Ba'athists of Syria and Iraq when they came to power in both countries in 1963. They decided to create a triple Alliance with Egypt built on the "scientific basis", or "collective leadership and equality of the parties." But this Federal Union lasted less than a year and, according to one of the leaders of Ba'athism Munif al-Razzaz, "his party did not want to sacrifice power in his country in order the Arab unity prevail." [3]. The Ba'thists accused Nasser of separatism and then tried to achieve unity among themselves by announcing the unification of Iraq and Syria. However, as a result of another coup in Iraq in 1964, this plan also failed. The events in Iraq showed that the party neither could act as a pan-Arab leader, nor even as a consolidating leader in its own country.

Since the mid-60s, the idea of Arab unity has become more closely linked to the tasks of the domestic policy, primarily the economic and social development of the country. Under the influence of progressive trends, the Ba'ath leadership at the 8-th Party Congress in April 1965 began to interpret "Arab socialism" as a precondition for achieving Arab unity. In the same year, a new Ba'ath program was approved, as well as so called "Step program" which proclaimed that "the unification of the Arab homeland can be carried out only on a progressive basis, taking into account the reality and experience of previous unionist steps" [4].

In 1970, after the Ba'ath wing led by Hafez al-Assad came to power in Syria, another attempt was made to achieve Arab unity. The idea of creating a Confederate state entity was also suggested by Libyan chief Muammar Gaddafi, who was supported by the leader of the Arab world Gamal Abdel Nasser. In 1971, citizens of Libya, Egypt and Syria approved during the referendums the creation of a Federation of Arab Republics. However, after Nasser's death in September 1970, the new Egyptian President Anwar al-Sadat pursued a different foreign policy and dropped the idea of uniting with "pro-socialist" Arab states.

In October 1973 Egypt and Syria tried to have a revenge over the defeat of 1967 and simultaneously attacked Israel on 6-th of October. They even managed to achieve some successes on the battlefield at the beginning of the war. Some Arab politicians and leaders those days proclaimed that it was a real example and result of the Arab Unity.

But due to the separate peace agreement between Cairo and Tel Aviv relations between Egypt and Libya became so strained that in 1974 Libya withdrew from the FAR. And later, in July 1977, after Anwar al-Sadat rejected the Libyan offer for unification a short war broke out between two states.

Meanwhile Egypt and Syria also unsuccessfully tried to organize their own Alliance. However, the Federation ceased to exist in November 1977 after Sadat's visit to Israel. Gaddafi, disappointed with Arab unity, decided then to lead the African unity movement, implementing so-called "African union" under his own theory and guidance. But his attempt didn't work as well...

Iraqi leader Saddam Hussein did not lag behind other Arab leaders. He believed that it was his Baath party, and not the Syrian one, that had all the rights to a dominant role in achieving Arab unity. After all, the founder of Ba’thism, Michel Aflak, fled from Damascus to Baghdad, which granted him political asylum. The rivalry between Hafez Assad and Saddam Hussein over who had the most right to pan-Arab leadership in the 70-80 years led to a serious aggravation between Syria and Iraq, up to the concentration of troops on the common border.

In the same time leaders of the Syrian Communist Party also tried to exploit the slogan of Arab unity in their own way. The Communists believed that genuine Arab unity should manifest itself in the struggle against common enemies: “imperialism, Zionism and Arab reaction”. Every step towards unity between two or more Arab states, in their opinion, must necessarily lead to “a real deepening of progressive socio-economic and political transformations, to further development of the process, social achievements and anti-imperialist struggle” [5].

The Lebanese civil war of 1975-1990 became a severe blow to the Arab unity. Those years different Arab states supported different fighting groups in Lebanon. Syria, for instance, was changing its position during the war supporting different players and then fighting with them.

In 1990 Saddam Hussein seized Kuwait, declaring that this was the first step towards the liberation of Jerusalem and the achievement of Arab unity. However, the majority of Arab countries condemned the actions of Baghdad and sided with the anti-Iraqi coalition, which was led by the United States and other Western countries. Kuwait was liberated, Iraq was defeated in 2003, and its leader was eventually executed in 2006. Attempts to achieve Arab unity through state associations stopped at that stage.

However, the desire to implement the Arab Unity continued to exist among some religious Arabs. In 2011 the extremist Islamist groups which started terrorizing almost all Arab countries from Tunisia to Iraq in the course of the so-called “Arab spring” also tried to take advantage of the Arab Unity idea. Arab terrorists (some of them were ex-ba’thists from Iraq) launched their “Islamist movement” for the “Arab union”. Naturally, they never used this term and preferred to proclaim in 2014 an Islamic state of Iraq and Sham (ISIS).

Indeed, this terrorist organization operated mainly on the territory of Syria and Iraq. At the same time Qatar, as well as other Arab states of the Persian Gulf region, including the Kingdom of Saudi Arabia (KSA), played the most active role in sponsoring Islamists, especially at the initial stage of the “Arab Spring” [6]. The idea of ISIS leaders was simple. They wanted to attract as many Arabs as possible proclaiming Caliphate. They understood, that any Arab had an association with the glorious past of Umayyad Caliphate, which flourished 13 centuries ago from Spain to India with its capital in Damascus. On the large parts of Syria and Iraq the ISIS (or Dai’sh state) was proclaimed.

Later, this quasi-state even declared as its goal creation of a world caliphate “from ocean to ocean” (from the Atlantic to the Indian Ocean, and maybe to the Pacific – fortunately, Indonesia has the largest number of Muslims among all other states). Then the creators of this formation began to call it shorter – the Islamic State or IS. According to their logic - why should they limit IS’s borders by Syria and Iraq? The IS was supposed to absorb not only Arab, but all Muslim countries... And in this way, the goal of achieving not only Arab, but also broader Islamic unity would be achieved.

Saudi Arabia, whose king bears the title of “Custodian of the Two Holy Mosques” (Mecca and Medina), of course, also fit into the borders of IS. Its self-proclaimed Caliph Abu Bakr al-Baghdadi, threatened not only to seize the kingdom and take Mecca, but also to destroy the Kaaba, which, in his opinion, was not a shrine. Despite this, the well-known Wahhabi sheikhs of Saudi Arabia issued fatwas approving the proclamation of the Islamic State. However, the Grand Mufti of Saudi Arabia Abdel Aziz bin Abdullah bin Muhammad stated that “the ideas of extremism, cruelty and terrorism have nothing to do with Islam, moreover, they are the number one enemies of Islam, and their first victims are Muslims themselves” [7].

Up to 8 million people lived within the borders of this self-proclaimed state in conditions of terror, fear and humiliation, where violence and mass executions took place. On the territory of Syria and Iraq IS destroyed various historical and architectural monuments, primarily Christian ones. Two countries plunged into the abyss of terror. Hostages were taken everywhere and brutal executions were carried out.

At the request of the Syrian government in 2015 Russian Federation sent its air forces to carry out thousands of attacks on the terrorists’ positions. And it took 3-4 years to defeat terrorist groups and so-called Islamic Caliphate. But in general, the war in Syria dragged on for eight years. Many Syrian politicians deny that it was a civil war. They call this war an aggression of “international terrorism” or an undeclared war against the Syrian people by some monarchical Arab states, as well as quite democratic states of Western Europe, the United States and Canada. According to various sources, tens of thousands of mercenaries from about a hundred countries from almost all continents of the world took part in the ranks of the so-called “opposition to the Syrian regime” [8].

Over the years, the number of Syrian Christians has decreased from 15% of the total population in the early 1980s to 4.8% in 2008. Currently, this indicator is estimated at no more than 2%. [9]. According to American data, more than 700 000 Christians left Syria only during one year of 2015 [10].

A curious detail is that the Islamist extremists of IS have borrowed some elements of their theory not only from the Arab history and the Koran, but also from

the Baathist ideology (which they never recognized, because the concept of Arab unity was mixed with ideas of socialism and other elements of the European philosophy).

Thus, the “Arab spring” ruined the idea of Arab unity with its attempts to implement it on the Arab soil. And that due to religious extremism and terror. It appeared that it was not possible neither to unite the Arab countries under the banner of pseudo-Islam, nor to preserve the unity even on the scale of a single state. And it is evident, if one looks at the fruits of the “Arab spring” in Syria, Iraq, Egypt, Yemen and Libya.

As the result of the terrorists’ practice under Islamic slogans, not only the ideas of the Arab unity have been discredited but unfortunately even the noble ideals of Islam itself have been devaluated for many people, including the Arab world itself.

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13世纪至16世纪初北高加索的马穆鲁克：研究高加索和中东人民中世纪历史的新方向

MAMLUKS IN THE NORTH CAUCASUS IN THE 13TH - EARLY 16TH CENTURIES: A NEW DIRECTION IN THE STUDY OF MEDIEVAL HISTORY OF THE PEOPLES OF THE CAUCASUS AND THE MIDDLE EAST

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抽象的。 本文提出了北高加索人民中世纪历史研究的新科学方向，该方向与切尔克斯王朝（1382–1517）期间马穆鲁克苏丹国对该地区的多边影响的研究相关。 对书面、考古、民族志来源和语言数据的综合分析。

关键词：中世纪、北高加索、切尔克斯人、马穆鲁克苏丹国、埃及、叙利亚、奥斯曼帝国、小亚细亚。

Abstract. *The paper presents a new scientific direction in the study of medieval history of the peoples of the North Caucasus, associated with the study of the multilateral influence of the Mamluk Sultanate on the region during the Circassian dynasty (1382-1517) on the basis of a comprehensive analysis of written, archaeological, ethnographic sources and linguistic data.*

Keywords: *Middle Ages, the North Caucasus, Circassians, the Mamluk Sultanate, Egypt, Syria, the Ottoman Empire, Asia Minor.*

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One of the most important areas of fundamental scientific research on the modern peoples of the North Caucasus is the study of their medieval history. It was during this period that the ethnic map of the region was being finalized, the basic features of the peoples' material and spiritual culture were being defined, and the main causes and factors of inter-ethnic contacts and conflicts were being determined for centuries to come.

A striking feature of the socio-political development of certain peoples of the Caucasus and, above all, of the Adygs and Abazins, known since the 13th century

in written sources under the collective name of Circassians, is military mercenarism [Druzhinina I. A., Iliushina M. Yu., Kabardov I. B., 2023]. As a constant source of military mercenaries and / or slaves they were considered by the rulers of ancient Russia, and then the Russian Empire, the Golden Horde, the Mamluk Sultanate, the Trebizond Empire, the Ottoman Empire, etc. This strategy of self-realization outside the native land reached its apogee during the reign of the Circassian dynasty of Burji (1382-1517) in the Mamluk Sultanate. The supply of military slaves - Circassians to the Sultanate was of existential importance for maintaining the ruling power of the Mamluk Burji.

The study of the Mamluk period in the history of Circassians has traditionally been limited to its consideration as part of the history of the Middle East. For a long time it was believed that by leaving their native lands and tribes and becoming Mamluks, Circassians forever severed ties with their relatives, their culture and ancestral faith, adopted new names and converted to a new religion - Islam. However, as recent studies have shown, ties with their native land not only did not cease [Broadbridge Anne F., 2011; Koby Y. 2012; Barker H. 2015], but also were an important factor in the internal political struggle in the Mamluk corporation [Druzhinina I. A., Iliushina M. Yu., Kabardov I. B. 2023a].

The study of multilateral relations between the Sultanate and the Circassians of the North Caucasus, who in the 14th-15th centuries were the main contingent to replenish the Mamluk corps, is one of the main goals of a new direction for both domestic Caucasian and Oriental studies and foreign Mamluk studies. Its basis is a complex analysis of written, primarily Arabic medieval texts and archaeological materials of excavations of elite burials of Circassians of the North-West Caucasus of the XIV-XV centuries, which find direct analogies in the material and spiritual culture of the Mamluk sultanate. These materials are represented by luxury items, elements of costume and everyday life characteristic of the inhabitants of medieval Arabian cities, and a series of finds associated with the Islamic religious tradition [Druzhinina I. A., 2022]. They came to Kuban region not only as goods, but also as gifts to relatives, stipends to trade agents, diplomats and other representatives of the Sultanate living in the Circassian lands, personal belongings of Mamluks arriving in their native lands with various missions [Druzhinina I. A., Iliushina M. Yu., Kabardov I. B., 2023a].

The reasons why Mamluks returned to the Caucasus are reflected in Arabic sources (al-'Aini (d. 1451), Ibn Tagri Birdi (d. 1469), al-Sahawi (d. 1497), al-Malati (d. 1514), and Ibn Iyas (d. 1524) and were related both to the assignments of sultans and high emirs and private, personal interests of individual Mamluks [Druzhinina I. A., Iliushina M. Yu., Kabardov I. B., 2023a].

The most important corpus of archaeological information reflects the existence in the XIV-XVI centuries of special features of the Circassians of Zakubania fu-

neral rites, which have no local roots and find analogies in the funeral practices of the Muslim East, which indicates a picture of interaction between the Circassians of Zakubania and their relatives - the Mamluks of Egypt and Syria, far exceeding only trade relations [Druzhinina I. A., 2022]. It is in this paradigm that the question of the adoption of Islam by a part of Adygs is considered, the reasons for the spread of which among the tribes of the North-West Caucasus were previously linked only to the consequences of the Turks' conquest of the Crimea and the North-East Black Sea region [Kabardov I.B., 2023].

Of particular interest is the layer of Arabic vocabulary in the Adyghe language, connected with the development of their political culture and institutions of power in the XV-XVI centuries [Kabardov I.B., 2023a]. This material is considered for the first time within the framework of an innovative hypothesis about the influence on the formation of political organization and social vertical among Adygs, in addition to the norms of customary law - *Adyghe khabze*, political institutions of the Sultanate, as well as such complex multidimensional phenomena of the culture of the Arab world as *futuwwa* and *furussiya*, the carriers of traditions of which were the Mamluks who returned to their homeland after their defeat in the war with the Ottomans in 1517 [Kabardov I.B., 2022].

The new Mamluk perspective in the study of the medieval history of the North Caucasus allows for a more extensive consideration of key historical processes, events and phenomena that took place in the Black Sea region, Asia Minor and the Middle East in the 13th-16th centuries, such as the organization of the international slave trade in the Black Sea region, the interaction between the Mamluks, Karamanids and Ottomans [Iliushina M. Yu., 2019], the activity of the Italian republics in the Black Sea region, including the creation of an anti-Ottoman bloc, the Mamluk-Ottoman war and the subjugation of the Crimea and the North-Eastern Black Sea region by the Ottomans, the formation of the Kabarda principality in the Central Precaucasus, different in its structure and principles of organization from the Western Adyghe socio-political associations, etc.

The result of our research will be the first scientific concept of the history of mutual relations between the Mamluks of Egypt and Syria and related tribes of North-West Caucasus, which will reflect the multilateral cultural and political influence of the Sultanate on Circassians, revealed the forms of this interaction and the dynamics of its development, conditioned by the political and social processes that took place in the Ulus Juchi and the Sultanate and largely determined the special choice of the historical path of the Adyghe peoples.

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中国演奏和教学实践中的肖邦歌谣
**THE BALLADS OF F. CHOPIN IN THE PERFORMANCE
AND PEDAGOGICAL PRACTICE OF THE PRC**

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注解。 中国钢琴流派在现代世界音乐文化中占有重要地位, 并以其演奏者的特殊技术准备和精湛技艺而著称。 这项工作的目的是确定肖邦民谣在中华人民共和国的表演和教学实践中的应用特点。 其新颖性、科学性和现实意义在于揭示了肖邦民谣的钢琴基础以及中国钢琴家(包括傅聪、李云迪、朗朗)对其演绎的具体情况。 研究方法基于综合方法, 因此肖邦的钢琴民谣被放在音乐家教师专业培训问题的背景下考虑。 对中国表演传统的诉求决定了使用比较方法, 通过比较来识别表演方法的差异。

关键词: 肖邦民谣、演奏诠释、中国钢琴家、中华人民共和国钢琴教育、音乐教育学。

Annotation. *The Chinese piano school occupies a strong position in modern world musical culture and is distinguished by the special technical preparedness and virtuosity of its performers. The purpose of the work was to establish the features of the implementation of F. Chopin's ballads in the performing and pedagogical practice of the People's Republic of China. The novelty and scientific and practical significance lies in the disclosure of the pianistic foundations of F. Chopin's ballads and the specifics of their interpretation by Chinese pianists (including Fu Cong, Li Yundi, Lang Lang). The research methodology is based on an integrated approach, thanks to which F. Chopin's piano ballads are considered in the context of issues of professional training of a musician teacher. Appeal to Chinese performing traditions determines the use of the comparative method, with the help of which differences in performing approaches are identified.*

Keywords: *F. Chopin's ballads, performance interpretation, Chinese pianists, piano education in the PRC, music pedagogy.*

The personality and creative heritage of F. Chopin remain relevant in a variety of aspects in modern musicology and performing practice. The music of F. Chopin

seems to the modern researcher not only to be a symbol of the romantic and national – it traces the universal formula of beauty, the ideal world in its conflict with reality. The creative heritage of the Polish genius is one of the most outstanding phenomenon of world musical classics. In modern performance it is difficult to find a pianist whose repertoire does not include certain works of F. Chopin.

The Chinese piano performing school occupies a strong position in modern world musical culture and is distinguished by the special technical preparedness and virtuosity of its performers. This fact determines the interest of Chinese performers in compositions that provide an opportunity to show the virtuoso technical capabilities of the pianist. The rapid spread of F. Chopin's music in Asian countries, starting from the second half of the twentieth century, is powerfully and dynamically gaining its position. The high performing level of Chinese pianists is evidenced by their victories at prestigious international competitions. For example, the victory of Fou Tong, who won the 3rd prize at the Chopin Piano Competition-1955, and also received a special award from the Polish Radio for the performance of the composer's mazurkas. In 1980, seven Chinese pianists took part in this competition. Chinese pianist Li Yundi, graduated from the Shenzhen Institute of Arts (class of Dan Zhao Yi), won the XIV Chopin Piano Competition in 2000 at the age of 18. His absolute victory in this competition is the first in the musical history of the PRC. In 2015, Li Yundi was invited as a member of the jury of this competition to Warsaw. After Yundi L' s victory , there was a real explosion of interest in F. Chopin's music in China.

At the same time, as Chinese musicologists emphasize, for pianists from the PRC it is especially difficult to intonate Slavic music, which is fundamentally different from national traditions at the mental, linguistic and verbal levels. When they manage to overcome these difficulties, Chinese pianists become competitive on the world music scene.

One of the pressing problems of modern musical art is the understanding of different approaches to the performing interpretation of F. Chopin's piano ballads, which are distinguished by differences in the very understanding of the musical aesthetics of the composer's works. Thus, even during the composer's lifetime, many pianists sought to mark only the virtuosic beginning in the Romantic's opuses, representing the salon-romantic direction. Their interpretations were distinguished by external showiness, excessive sensitivity on the verge of mannerism, but they lacked substance and depth of intonation. A different direction in the interpretation of F. Chopin's musical texts is represented by a direction that originates from the traditions of intonation by the composer himself and his students. This trend is most revealing when assessing the performance of modern pianists.

The purpose of this research is to establish the features of the implementation of F. Chopin's ballads in the performing and pedagogical practice of the People's Republic of China.

Currently, Chopin studies represents a huge layer of literature of various directions in different languages. In relation to Chinese performing arts and pedagogy, the dialogue between the work of F. Chopin and the traditions of piano performance seems particularly relevant.

The novelty and scientific and practical significance of this study lies in the establishment of the features of the poetics of F. Chopin's Ballads based on the totality of the results of their musical theoretical and performance analysis; revealing the pianistic foundations of F. Chopin's ballads and the specifics of their interpretation in world musical performing practice and piano pedagogy.

The research methodology is based on an integrated approach, thanks to which F. Chopin's piano ballads are considered in the context of issues of professional training of a musician teacher. An appeal to Chinese performing traditions determines the use of the comparative method, with the help of which differences in performing approaches and sound production techniques, and the quality of sound production are revealed.

We emphasize that the ballad world of F. Chopin is based on the semantic dominants of romantic culture, including the incomprehensibility of existence, the inextricable connection of the human soul with nature and national history [3]. F. Chopin in his piano ballads reflected two typological varieties of the romantic ballad (taboo and national-historical). The figurative and symbolic world of his opuses is addressed to timeless eternal values, is universal in nature and reveals the deep thought of being / non-being, the idea of spiritual unity, the path of movement towards eternity [2]. As in other musical opuses, in ballads F. Chopin widely uses elements of musical rhetoric of the Baroque era, the musical language and semantics of V.A.'s music. Mozart and L. van Beethoven, as well as general style musical and theatrical vocabulary. His use of the ballad genre demonstrates the scope of his composer's imagination. In choosing a musical form in his ballads, F. Chopin shows himself much more freely than in scherzos, polonaises or sonatas. The dramaturgy and composition of each of F. Chopin's four ballads is unique, determined by the nature of musical images and hidden programmatic intent [2, 3].

In general, F. Chopin's piano ballads are distinguished by a high degree of conceptualization, semantic depth, stylistic individualization, national identity, and originality of artistic expression. F. Chopin's innovation in the field of harmony and form is based on the classical logic of musical thinking, implying a combination of the internal unity of a work with its dynamic and organic development within the framework of form. At the same time, F. Chopin's ballads are characterized by symphonic principles of development. The national flavor is subtly translated by the composer in the melody of ballads, the combination of song and dance beginnings, the expressive rhythmic side, and the characteristic technique of variation.

Turning to the analysis of performance interpretations of F. Chopin's ballads (based on numerous audio and video recordings), we emphasize that in recent decades there has been a significant bias towards intellectualization, a rational approach to their reading. When performing a comparative analysis, it is also necessary to take into account that a musical work is a kind of "variant set", which is realized in a specific performing (single) interpretation. We emphasize that the performing interpretation reflects the general state of musical culture, the aesthetic trends of the time of its creation, the performing individuality and personality traits of the performer.

One of the common performing arguments is the judgment of self-sufficient virtuosity in relation to the works of F. Chopin, in which it acts as a component of artistic content and form. Let us emphasize that indeed, in relation to the piano music of this composer, it is quite natural to think about technique, virtuosity in conjunction with a complex of general musical and specific performing means.

Among the most original and meaningful interpretations of F. Chopin's piano ballads, performances by Arthur Rubinstein, Stanislav Neuhaus, Christian Zimerman . Ballads by F. Chopin were included in the repertoire of representatives of different generations – M. Argerich , N. Petrov, G. Sokolov, D. Alekseev, N. Lugansky, E. Kisin, A. Sultanov. Modern piano culture is characterized by representatives of the "new generation" of pianists with outstanding virtuoso capabilities: Kh. Buanitishvili , Y. Avdeeva, L. Geniushas , D. Trifonov, E. Mechetina and others.

Chinese piano performing art from the second half of the twentieth century to the present day is represented by the names of outstanding virtuoso musicians, winners of prestigious world festivals and competitions. Their names become famous all over the world: Fu Cong, Lang Lang, Li Yundi, Yuya Wong, Chen Sa, Zhang Haochen, Zhang Shengliang (Nunyu) and many others.

The beginning of the 21st century was the peak of the development of the Chinese piano school, which had formed its principles and directions of teaching by this time. Its students over the past two decades have been graduates of Sy Chuan Conservatory, Shanghai Conservatory, School of the Central Conservatory of Music in Beijing, Hong Kong Conservatory, etc. As for methodological ideas, the Chinese system of piano education is distinguished by a pronounced focus on the purposeful formation of technical apparatus, the development of an analytical approach to works in the piano class, the scientific and theoretical culture of teachers, and the study of the work of outstanding performers in audio and video recordings. One of the fundamental pedagogical guidelines in the education of a professional pianist is the inclusion of works by F. Chopin, including Ballads, in his repertoire. The expediency of this pedagogical principle is evidenced by the numerous victories of Chinese pianists. Thus, at the Moscow International

Competition for Young Pianists. Chopin was defeated over the years by: Di I Tan (1996, 3rd Prize); Jia-Yi Song (first prize), Chang Haochen, Jia-Yan Sun (2004); Wang Yijia and Liu Yang (2006).

Let us outline some features of the interpretation of F. Chopin's piano ballads by selected pianists.

Thus, in one of his interviews, Fu Tsun emphasized: "My fate is similar to Chopin's, and in spirit Chopin is me. For me, playing his music is as natural as speaking" [4, p. 119]. His performance of F. Chopin's Third Ballad reflects the emotional and psychological side of the musical text; he subtly and exquisitely performs virtuoso passages, but at the same time does not lose the integrity of musical thought and form [5]. Fu Cong masterfully creates an expressive, semantic musical picture filled with telling musical intonations.

Among the representatives of the younger generation Li Yundi has special professional authority. Today, the pianist admits in an interview that his interpretations and understanding of the great composer have changed significantly over time: "I feel that ten years ago I performed Chopin's works in an academic style. Now I feel more free and play more freely" [1]. He strives for a deep comprehension of every musical intonation, mastery of the idea of tempo rubato, carefully follows all the composer's directions.

For example, in his interpretation of the Fourth Ballad the following nuances are observed [7]. The interpretation of the main theme by Li Yundi reveals its romantic nature to the fullest; he is more emotional in sound production, builds a prominent dynamic line. He creates a feeling of free, almost improvisational development of the material. However, in the same fragment, the Chinese pianist too noticeably, somewhat manneredly, emphasizes the bass line, performing it as if delayed. In general, his playing overcomes the limit of technical complexity of the opus, "virtuosity for the sake of virtuosity." At the same time, the performing skills of Li Yundi are supported by the perfection of technique, harmoniously correlated with the depth of musical content. His performance is distinguished by empathy and romantic sensuality. In some fragments, he allows for a slightly more sentimental sound production, which leads to some romanticization of the Ballad.

Let's denote general approaches to the process of interpretation of F. Chopin's Ballads in Chinese pedagogical practice. The performer's textual searches bring him as close as possible to the original author's written word as a given and create the prerequisites for the idea of its virtual-sound form.

Particular attention is paid to such modifications of arpeggios as the presentation of harmonies in a wide arrangement, which creates an expressive acoustic-overtone effect. However, for F. Chopin's texture this is not just a harmonic background, but a thematic formation. When practicing such fragments, special attention should be paid to pedaling. Chinese universities also consider the con-

cept of tempo rubato in the music of European romanticism, issues of pedalization, agogy, dynamic palette.

Thus, for Chinese students, a certain aesthetic canon and pianistic “matrix” is created, in relation to which the musician has the right to take a certain position – “playing by the rules”, which does not exclude the manifestation of his creative initiative, or “playing with the rules” and even going beyond them limits, including, even if they are significant.

As an example, let’s take a concert performance by Chinese-American musician Lang Lang (1982), which best demonstrates the revival of the taste for virtuoso performance at the turn of the 20th – 21st centuries. The pianist often includes F. Chopin’s Ballades in his programs, giving preference to the First Ballade [6]. Lang’s interpretations Lang amazes with his virtuosity and original artistic inventions. This is a characteristic of Lang’s performing style. Lang Lang manifests himself in his interpretations of Chopin’s ballads of various types, but perhaps with particular conviction – in those of them that presuppose, almost first of all, impeccable mastery of the instrument and pianistic apparatus.

At the end of the work, we will draw the following conclusions.

In modern musical science of the People’s Republic of China, the name of F. Chopin, his piano work, and problems of style are actively studied from different positions, which is confirmed by a number of studies. Chinese universities have developed a solid tradition of studying the piano works of F. Chopin and including them in the educational process. F. Chopin’s ballads are an integral part of the pedagogical repertoire in the PRC, which is reflected in the curricula of various educational levels (colleges, institutes, conservatories, universities). The undoubted didactic value of F. Chopin’s work lies in the fact that his works provide an opportunity to promote the development of understanding of the composer’s style, the features of his musical text and piano technology through reference to his pedagogical principles. Also, the multi-level variations in the presentation of Chopin’s works provide a rich choice of opportunities for realizing the individual performing characteristics of the musician.

Chopin’s piano ballads are deep, filled with multidimensional musical content. Their artistic world is distinguished by universalism: the deepest psychology and intimate lyricism are combined with a sense of objective life reality, subtlety in the transfer of individual moods with a large relief of dramatic development, dreamy contemplation with active effectiveness. In F. Chopin’s Four Ballads, the relationships between their musical content, compositional structure, and a complex of expressive means are traced; they embody the attributive features of romantic musical art (the interpenetration of various types of intonation, improvisation, the significant role of folklore, etc.).

The musical text of F. Chopin’s four ballads gives the performer the opportunity to construct various interpretation options. This process reveals the pianist’s

ability to flexibly read musical signs and symbols embedded in the text, and the performer's level of comprehension of the romantic style. Analysis of the interpretations of F. Chopin's ballads by pianists of different countries and generations allows us to consider some features of the evolution of performing traditions.

Based on a holistic analysis of F. Chopin's piano ballads, including their interpretations by outstanding world pianists, the musician's performance guidelines and pedagogical approaches to the education and professional development of student pianists are identified, and the possibility of using the pedagogical guidelines of F. Chopin himself as a means of in-depth comprehension of his compositional style is considered. F. Chopin's ballads allow you to improve the student's motor potential and his playing skills. Through studying the Ballads of F. Chopin in a piano class at universities in the People's Republic of China, the student comprehends the overall style of romantic pianism and acquires the skills necessary for studying and interpreting romantic opuses. All this allows us to consider F. Chopin's Ballads as an exemplary stylistic model of romantic musical art.

Let us conclude the article with the thought that Frederick Chopin is a true romantic composer, his inner world, reflected in his works, requires a lively response and an emotional image in the soul of the performer, who must breathe life into the musical score and convincingly present it to listeners.

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上海合作组织中亚各成员国间非传统安全合作问题研究
**ANALYSIS OF NON-TRADITIONAL SECURITY COOPERATION
ISSUES AMONG CENTRAL ASIAN MEMBER STATES OF THE
SHANGHAI COOPERATION ORGANIZATION**

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上海合作组织是区域性多边合作组织。自成立以为，始终维持维护地区安全和稳定，组织内的非传统安全合作是近些年来重要任务。从地缘政治角度来看，中亚地区的成员国家所在地区位于欧亚大陆连接点，与阿富汗等地接壤，由于其特殊的地缘区位，成为政治力量激烈角逐的重要地区，安全领域，尤其是非传统安全问题突出。所以上合组织的非传统安全合作主要针对中亚地区。“三股势力”、毒品问题、领土纠纷、民族冲突、宗教问题、能源、水资源等问题一系列非传统安全问题，成为国家安全问题的重要影响因素。本文探讨上合组织框架下中亚地区非传统安全合作问题，作为上合组织重要成员国地区，区域内非传统安全合作对维护上合组织地区稳定和发展具有重要意义。各成员国共同开展跨国多变的非传统安全合作、建立新的合作机制，符合上合组织所有成员国的国家利益。

上海合作组织，中亚安全合作，非传统安全合作，打击“三股势力”

Abstract. *The Shanghai Cooperation Organisation is a regional multilateral cooperation organisation. Since its establishment, it has always maintained the maintenance of regional security and stability, and non-traditional security cooperation within the organisation has been an important task in recent years. From the geopolitical point of view, the member states of the Central Asian region are located in the region of the Eurasian continent connecting point, bordering with Afghanistan and other places, due to its special geographic location, has become an important area of intense competition between political forces, the security sphere, especially the non-traditional security issues are prominent. Therefore, the SCO's non-traditional security co-operation is mainly aimed at the Central Asian region. A series of non-traditional security issues such as "three forces", drug problem, territorial disputes, ethnic conflicts, religious issues, energy, water resources and other issues have become important factors influencing national security issues. This paper explores the issue of non-traditional security cooperation in Central Asia under the framework of the SCO, as an important*

member region of the SCO, intra-regional non-traditional security cooperation is of great significance to the maintenance of stability and development of the SCO region. It is in the national interests of all SCO member States to jointly develop transnational and multifaceted non-traditional security cooperation and to establish new cooperation mechanisms.

Keywords: *Shanghai Cooperation Organisation (SCO), security cooperation in Central Asia, non-traditional security cooperation, combating the “three forces”.*

1. Background of non-traditional security cooperation within the framework of SCO cooperation

The Shanghai Cooperation Organisation (SCO) has developed into an important regional international organisation since its inception. Important co-operation in security, political and military aspects in the Eurasian region provides an important guarantee for stability and development within the region. In particular, it responds to the very complex non-traditional security problems in Central Asia. The importance of non-traditional security co-operation is a core interest at the highest level within the SCO, especially in the development of state relations between China and Central Asian countries.

1.1 The concept of non-traditional security

“Non-traditional security” is a concept of international political science that first appeared in the post-Cold War Western international security research community. “Non-traditional security” is relative to “traditional security”. Both “non-traditional security” and “traditional security” are about a security concept. Traditional security is a concept of security in which national security, political and military security, and the resolution of inter-State conflicts and clashes by force or war are the main focus. Non-traditional security, on the other hand, emphasises a wider range of security beyond geographical and political national entities, such as regional, global and human security, transnational issues arising from non-political and non-military threats and factors and affecting the security of States, insecurity in the regions where they are situated as a result of the spread of internal problems, and the multiplicity of means of solving problems. In summary, the specific concept of “non-traditional security” refers to “non-military threats and violations of the sovereignty and interests of States, as well as the survival and development of individuals, groups and humanity as a whole, emanating from non-State actors, and which are transnational, multifaceted, societal and interrelated”¹

1.2 Non-traditional security problems in Central Asia

Central Asia was once part of the Soviet Union, and after the collapse of the Soviet Union, the five Central Asian countries became independent, but they are

¹ [Anwei: Crossroads]. An Wei, "The World at the Crossroads - Prominent Chinese Scholars Discuss the International Focus of 21st Century", People's University of China Press, 2000.]

still affected by the Soviet period in terms of politics, economy and culture. In terms of political systems Central Asia has a diverse political system, and some countries have problems of political instability, which can lead to political unrest and increased social discontent. As well as a very important influence, the Central Asian region is characterised by multi-ethnic coexistence, and there may be conflicts and contradictions between different ethnic groups. In addition, ethnic problems in Central Asia are subject to interference and influence by international and regional political forces. Therefore, the security problems in Central Asia are affected by the “three forces”, drugs and ethnic conflicts, and all countries need to work together to resolve them as soon as possible in order to maintain regional stability.

The problem of the “three forces” continues to emerge in Central Asia, and the growth and spread of the “three forces” in Central Asia is inextricably linked to the dissemination of the “dual-pan” ideology. The “bipartisan” ideology is the ideological and theoretical foundation of the “three forces”. From its emergence, dissemination and spread, the “double pan” ideology has gone through a process of historical development, and the extremist ideas and violent terrorist activities it has triggered have posed a direct threat to the security of the Central Asian region.² Because of Central Asia’s special geopolitical location and religious background, the “double pan” has been gradually introduced into the region since its creation, and has had a large and direct impact on the region. With the end of the Cold War, under the joint action of external forces and internal factors, the “double pan” spread rapidly in Central Asia, manifested in the rapid increase in the number of mosques and Islamic scripture colleges, the publication of a large number of religious books and magazines, the obvious intensification of religious activities and a sharp increase in the number of people, and the emergence of a strong sense of participation in the politics of Islamic political organisations. Some are more radical and extreme, moving towards armed seizure of power and open confrontation with separatist states, such as the eight-year civil war in Tajikistan. The “Eastern Turkistan” problem in China’s border areas within the SCO and the Chechen problem in Russia are also intrinsically linked to the “dual panarchy”.

The problem of drug trafficking in Central Asia is also an important factor affecting the stability of the region. The Central Asian region is an export corridor for Afghan drugs, which mainly flow through Central Asia (Tajikistan, Uzbekistan and Kyrgyzstan) to Russia and Europe. And this factor involves too many interest groups and even forms a fixed network of interests. The problem of drug trafficking and crime in Central Asia as a whole remains serious, and the increase in the supply of drugs in recent years has made it more difficult to combat drugs

² [Yang Faren: A Study of Pan-Islamism and Pan-Turkism, Xinjiang Academy of Social Sciences, 1997].

in Central Asia. In short, drug trafficking in Central Asia in recent years has remained rampant, and has seriously affected social security and economic development in the region.

In short, drug trafficking has remained rampant in Central Asia in recent years and has seriously affected social security and economic development in the region. This has added new difficulties to non-traditional security cooperation among SCO member States.

Other non-traditional security issues of concern in Central Asia include sovereignty disputes over oil and gas fields in the Caspian Sea, the complex enclave, ethnic and religious conflicts among the three countries of the Ferghana Valley, energy security and pipeline security in Central Asia, the emerging regional cyber-information security, the wave of democratisation in Central Asia and the issue of non-governmental organisations (NGOs), which are all important issues for the expansion of non-traditional security cooperation between SCO member states. This will broaden the scope of SCO's non-traditional security co-operation and at the same time draw attention to the seriousness of the problems of the Central Asian region.

2. Results of non-traditional security cooperation among Central Asian States within SCO

The SCO was originally established to jointly maintain peace, security and stability in the region, and this has been the top priority of the organisation's work since the beginning of the 21st century. Security cooperation in Central Asia within the framework of SCO has focused on non-traditional security issues, with the gradual expansion of the areas of cooperation, the increasingly perfect construction of mechanisms and fruitful cooperation, which not only continues to make steady progress in exploring the construction of a new type of State relations, a new type of security concept and a new type of regional cooperation model, but also effectively maintains security and stability in the region. Through the joint efforts and sincere cooperation of its member States, SCO has become an important regional security community in Central Asia that cooperates in addressing non-traditional security threats.

2.1 Institutional development in the area of non-traditional security cooperation

In recent years, the SCO has established a relatively complete structural system and legal basis for non-traditional security cooperation in the fight against the "three forces", transnational organisations of international drug trafficking and criminal activities.

At the 2001 SCO Founding Conference, the Declaration on the Establishment of the Shanghai Cooperation Organisation was signed, in which the deepening of security cooperation was established as a top priority, and the strengthening and

broadening of cooperation among States on major international and regional issues, first and foremost on security and stability in Central Asia. The signing of the Shanghai Convention and the official declaration on accelerating the establishment of the Joint Counter-Terrorism Structure (JCTS), which are clear legal provisions and pragmatic initiatives, not only lay a solid legal foundation for the cooperation of member states and other countries in the fight against the transnational “three forces”, but also have important historical and practical significance.³

“After the September 11 incident, in the face of the severe situation of counter-terrorism, the SCO member states accelerated the extreme construction of the SCO, set up the Regional Anti-Terrorist Structure (RATS), and important legal documents to guarantee the counter-terrorism actions in Central Asia. In June 2004, the Regional Anti-Terrorist Structure (RATS) was officially established in Tashkent, Uzbekistan. The SCO counter-terrorism mechanism has since been formally established, which is clearly conducive to the SCO’s overall and rapid response capacity to combat the “three forces”, including terrorism, and transnational criminal activities such as international drug trafficking, and provides an effective organisational mechanism to ensure cooperation in non-traditional security matters in the SCO.

2.2 Numerous joint counter-terrorism exercises in the interests of stability in Central Asia.

In recent years, the “three forces” have been expanding in the region, and despite the measures taken by member States to combat them, there has been an overall increase in the number of members of terrorist and extremist forces such as the Salafists, the Uighur-Iranian movement and the Izabouts, and cases of rioting, terrorism and illegal proselytising have continued to occur. As the regional situation changes, the counter-terrorism situation in Central Asia will become even more critical. The SCO’s task of maintaining regional security will become more onerous.

The SCO member States have held many joint counter-terrorism military exercises, including the “Peace Mission - 2005” joint Russian-Chinese military exercise in 2005, which launched the “Peace Mission” series of SCO military exercises. This was followed in 2007 by the “Peace Mission-2007” joint anti-terrorist military exercise of the SCO armed forces, which was held in Urumqi, China, and at the Chelyabinsk training ground in Russia. Armed forces from all six SCO member states took part in the exercise, and the heads of SCO member states and defence ministers of the six countries observed the exercise.

In addition to the “Peace Mission”, a number of counter-terrorism exercises have been held within the SCO, with a focus on counter-terrorism exercises in

³ [Yu Jianhua: Research on Non-traditional Security of the Shanghai Cooperation Organisation. Shanghai: Shanghai Academy of Social Sciences Press, 2009.]

Central Asia. China and Kyrgyzstan held the “Border Defence Joint Determination-2013” joint counter-terrorism exercise in the Sino-Japanese border area in 2013.⁴ The armed or law enforcement forces of the SCO member States have held a number of joint counter-terrorism exercises, which are clearly conducive to deterring the “three forces” and international drug trafficking groups and other transnational criminal organisations in the region, and have effectively improved the capacity of member States to deal with terrorist threats in terms of early warning and preparedness, rapid response and handling of the consequences, and are an important part of international counter-terrorism cooperation on a global scale. It is also an important component of international counter-terrorism cooperation on a global scale.

2.3 Active international cooperation on counter-narcotics by member States

In recent years, the large-scale cultivation of opium poppies in Afghanistan, coupled with the constant emergence of new types of drugs, has led to a serious counter-narcotics situation in Central Asia. Within the framework of the SCO, member States have strengthened their cooperation in tackling the drug problem in Afghanistan and Central Asia. In recent years, leaders at SCO summits have been proposing to strengthen the organisation’s counter-narcotics function, which is a correct decision made by member states in the face of the new situation of the drug crime problem in Central Asia and neighbouring regions.

In June 2014, a meeting of leaders of anti-drug departments of SCO member states was held in Dushanbe, which pushed for the meeting to approve the Action Plan for the Implementation of the Anti-Drug Strategy of the SCO Member States for the period of 2011-2016, and to promote pragmatic anti-drug cooperation in various fields. In October 2014, China and Tajikistan cooperated in launching a joint operation against transnational drug crimes in the framework of the SCO, with the operation’s command centre based at the Xinjiang Public Security Bureau of China. The operation will target airports and ground ports and will continue until November 2014. The operation will be conducted in the Xinjiang province. China and Tajikistan will establish information sharing and focus on major drug production and trafficking cases.

Conclusion

In recent years, SCO has continued to strengthen non-traditional security cooperation as a platform for win-win cooperation and joint development among its member States on an equal footing. In recent years, it has achieved fruitful results in the areas of legal, institutional and military cooperation in non-traditional security cooperation, effectively combating the “three forces” in Central Asia, inter-

⁴ [Anwei: Crossroads]. An Wei, “The World at the Crossroads - Prominent Chinese Scholars Discuss the International Focus of 21st Century”, People’s University of China Press, 2000.]

national drug traffickers and other organised criminal groups, and maintaining the security and stability of SCO member States. Similarly, with the constant changes in the international and regional situation, the SCO's non-traditional security cooperation is still facing many problems, such as the frequent occurrence of terrorism in the region and the inadequacy of the legal mechanism for non-traditional security cooperation, which are also affecting and hindering the further promotion and deepening of the SCO's non-traditional security cooperation. Promoting a breakthrough in SCO non-traditional security cooperation has become an important task before the member states.

The countries of the SCO region need to deepen their non-traditional security cooperation and coordinate their positions in order to jointly respond to the various crises and challenges in the area of non-traditional security that have emerged.

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非洲药物研究和外国人道主义行动
**AFRICAN PHARMACEUTICAL RESEARCH AND FOREIGN
HUMANITARIAN ACTIONS**

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抽象的。非洲的药物研发有着悠久的历史，至少可以追溯到 20 世纪 30 年代。尽管人们认为非洲工业不适合以具有成本效益的方式生产优质药品，但近年来已经取得了进展。非洲联盟的非洲药品制造计划旨在发展非洲制药业，以减轻疾病负担并促进经济增长。艾滋病治疗的引入为当地药品生产创造了机会，增加了公共部门的需求，并提供了新的资金。撒哈拉以南非洲地区制药业的重要性源于该地区未满足的健康需求，因此需要采取持续的以非洲为基础、由非洲主导的举措，以改善基本药物的获取。在南非，药品治理一直是国家创建和制度实践的组成部分，重点是合理化和监督。

外国人道主义援助有效改善了非洲医疗保健系统。虽然一些研究表明援助可以对健康结果产生积极影响，例如降低艾滋病毒感染率和儿童死亡率，但其他研究强调了潜在的负面影响，例如尼日利亚捐助者资助的公共卫生计划表明，援助可能会削弱国家机构并加剧贫困和治理不善。然而，如果有效提供援助，可以减轻贫困造成的一些严重影响。援助对健康指标的影响不是线性的，在卫生支出较低的较贫穷国家中观察到的效果更大。总体而言，外援虽然可以改善非洲的医疗卫生体系，但其效果受到多种因素的影响，应谨慎管理，避免造成意想不到的后果。

这项研究的重点是当地药品生产、尖端制造技术以及基础设施和能力发展的融资机制。可以支持当地生产的政府承诺和财政参与。非洲联盟的药品制造计划促进经济增长、协调法规、解决技能短缺问题，并需要训练有素的专家来促进当地医疗发展和监管。

关键词：制药、非洲联盟、撒哈拉以南非洲、贫困、制药业、人道主义援助。

Abstract. *Pharmaceutical research and development in Africa has a long history, dating back to at least the 1930s. Despite the perception that the*

African industry was not suitable for cost-effective production of quality drugs, progress has been made in recent years. The African Union's Pharmaceutical Manufacturing Plan for Africa aims to develop the pharmaceutical industry in Africa with the potential to reduce the burden of disease and promote economic growth. The introduction of AIDS treatment has created opportunities for the local production of pharmaceuticals, increased public sector demand, and provided fresh funds. The importance of the pharmaceutical industry in sub-Saharan Africa is rooted in the unmet health needs of the region, and there is a need for sustained Africa-based and African-led initiatives to improve access to essential medicines. In South Africa, pharmaceutical governance has been integral to the creation and institutional practices of the state, with a focus on rationalization and oversight.

Foreign humanitarian aid has been effective in improving African healthcare systems. While some studies suggest that aid can have positive impacts on health outcomes, such as reducing HIV prevalence and child mortality rates, other studies highlight potential negative consequences, such as the donor-funded public health program in Nigeria showed that, aid can weaken national institutions and exacerbate poverty and bad governance. However, aid can ameliorate some of the harsh effects of poverty when delivered effectively. The impact of aid on health indicators is not linear, with greater effectiveness observed in poorer countries with lower health expenditure. Overall, while foreign aid can improve the health care system in Africa, its effectiveness is influenced by various factors and should be carefully managed to avoid unintended consequences.

This study focused on local pharmaceutical production, cutting-edge manufacturing technologies, and funding mechanisms for infrastructure and capacity development. Government commitment and financial engagement that can support local production. The African Union's Pharmaceutical Manufacturing Plan promotes economic growth, harmonizes regulations, addresses skill shortages, and requires trained specialists for local medical development and regulation.

Keywords: *Pharmaceutical, African Union, Sub-Saharan Africa, poverty, pharmaceutical industry, humanitarian aid.*

INTRODUCTION

Current trends and advancements in African pharmaceutical research include the development of the African pharmaceutical industry, harmonization of medicine regulation, addressing human capacity and skill shortages, and promoting cooperation and advocacy in the industry (Paul et al., 2018). A focus on generic drug production, especially with the expiration of several blockbuster pharmaceutical patents. Drug discovery activities in Africa are largely governed by international programs and funders, with concentrations occurring in South Africa, Tunisia,

and Egypt (Barthelemy et al., 2012). South Africa is a leader in drug discovery activities in Africa, with capabilities at various stages of drug discovery and development. In South Africa, there has been a rapid expansion of medicinal chemistry programs, particularly in the search for promising agents for infectious diseases. The South African pharmaceutical industry has also experienced enhanced innovation and improved efficiency in medicine registration (Abby, 2016).

Several actions can be taken to help African researchers overcome their challenges and take advantage of the opportunities available to them. First, there is a need for increased research capacity and output in Africa, which can be achieved by addressing barriers to conducting research in the region (Frode et al., 2013). This includes providing more training, raising awareness of the importance of research, encouraging governments to commit to research, and increasing collaboration between researchers in Africa (Giuliano et al., 2015). African governments need to develop initiatives that accelerate and support research and research-based education (RBE) to build a solid foundation for research and increase research capacity. Furthermore, there is a need for improved research funding and training mechanisms as well as recognition and support for self-funding researchers who are assets to the region. By implementing these measures, African researchers can be better equipped to overcome these challenges and make significant contributions to the research landscape (Helena et al., 2019).

There are numerous examples of successful pharmaceutical research programs in Africa. The African Union's Pharmaceutical Manufacturing Plan for Africa has made considerable progress in harmonizing medicine regulations, addressing human capacity and skills shortages, and promoting cooperation and advocacy in the industry (Paul et al., 2018). Some pharmaceutical companies have achieved high scores in their ethical statements regarding clinical trials in developing countries in Africa, whereas others need to improve their policies and statements of commitment. The recent expiration of blockbuster pharmaceutical patents has created new opportunities for generic drug production in Africa (Frederick et al. 2018). African environmental scientists have conducted studies on the presence of pharmaceutical compounds in water bodies and have begun to investigate materials and remediation processes for their elimination. In addition, efforts have been made to improve access to medicines through regulatory harmonization in the East African Community.

Foreign Humanitarian Actions in African Health care.

Foreign humanitarian organizations play various roles in supporting African healthcare. They provide necessary assistance and help meet the health needs of Africans, but at the same time, they can make the continent dependent on handouts and discourage the generation of national resources (Mario, 2017). In humanitarian settings, these organizations contribute to strengthening the health system by

positively influencing national policies, strengthening local coordination mechanisms, capacitating the healthcare workforce, developing the capacity of the Ministry of Health staff, mobilizing the community, and providing quality and affordable services. During epidemics, such as Ebola, these organizations work with hospitals to quickly build or rebuild units for isolation and treatment. However, the intervention of global organizations in African public health systems should be subject to ethical guidelines and good clinical practice. Nigeria, as a crucial country in the African context, has a history of political instability and socioeconomic upheavals that have hindered the health sector.

Foreign humanitarian actions can be coordinated to improve the effectiveness of healthcare in Africa by focusing on several key components. First, health care interventions should address the specific needs of crisis-affected populations, such as family planning and post-abortion care, to increase access to essential services and strengthen the health system (Frode et al., 2013). Second, evidence-based healthcare practices should be adopted considering the African context and the unique challenges it presents, such as co-infections, malnutrition, and limited resources (Michael et al., 2019). Third, domestic institutions and procedures should be more involved in aid delivery to ensure accountability and ownership (Olusola et al. 2020). Finally, pre-deployment training for healthcare personnel should be comprehensive and focus on building competence, confidence, and team cohesiveness to cope with the challenges of humanitarian missions. By implementing these strategies, foreign humanitarian actions can be better coordinated and contribute to improving the effectiveness of healthcare in Africa.

Collaboration between African and Foreign Researchers

The collaboration between African and foreign researchers in pharmaceutical research has several benefits. First, it can help promote local production and reduce dependence on imports in African countries, particularly smaller ones, such as Ghana. Second, international collaboration in research can lead to a more extensive pattern of activity and collaboration, unifying healthcare practices and developing scientific knowledge in newly developing countries. Furthermore, broad multisectoral collaboration and innovative public health approaches to cancer care and control can help close the global cancer divide for women, particularly in gynecological cancer, where treatment is often inadequate in developing countries. Collaborations can enhance understanding of routine clinical challenges and promote the formation of global partnerships between researchers, advocating for an expansion in such alliances.

Successful collaboration and partnerships between African and foreign researchers have been observed in various fields. One example is the collaboration between African countries (Cote d'Ivoire, Senegal, Uganda) and Western investigators (WHO) in global health-research partnerships. These collaborations have

led to important advances in areas such as vaccine development and HIV/AIDS treatment (Katzenstein et al., 2010), (Hugo et al., 2020). Another example is the collaboration between African researchers and international partners in genomics research and biobanking. These collaborations have played a critical role in building the capacity for genomics research and biobanking in Africa while also providing opportunities for networking and collaboration with researchers from other countries (Helena et al., 2019). In addition, researchers who have had the opportunity to study abroad, receive international funding, and collaborate frequently with researchers outside Africa are more likely to engage in successful collaborations. These examples highlight the importance of equitable and transparent partnerships in promoting successful collaboration between African and foreign researchers (Olusola et al., 2020).

Collaboration and partnerships between African and foreign researchers have several benefits and challenges. These collaborations provide access to methodological expertise, valuable new data sources, and opportunities to increase the academic and real-world impacts of research findings (Seyed et al., 2021). They also offer the potential for increased funding and international recognition. However, these collaborations raise challenges related to inequality, such as who sets the research agenda, allocation of research tasks, and distribution of benefits. The historical context of colonialism in Africa shapes the power imbalances in research collaborations, leading to inequitable partnerships. To make these collaborations more equitable, early, and continuous engagement with these issues is necessary throughout the lifecycle of the research project. Policymakers and international organizations should also consider incentives to promote long-term research interactions and avoid unequal partnerships (Daniel, 2001).

Benefits and Impacts of African Pharmaceutical Research and Foreign Humanitarian Action

African pharmaceutical research and foreign humanitarian actions have several benefits. Investing in research and development (R&D) within African countries, such as South Africa, can lead to the growth of a strong local pharmaceutical industry (Ari et al., 2012). This can help address health crises such as the HIV/AIDS epidemic by providing sufficient quantities and types of pharmaceuticals (Carla, 2013). In addition, foreign direct investment (FDI) has been identified as the best driver of future growth in the pharmaceutical industry in South Africa. Foreign pharmaceutical companies are also involved in drug donation programs that integrate corporations into global health efforts (Di Lamb, 2018). These programs can have an impact on local health systems and raise questions about the influence of corporate and biomedical logic on biopower. Overall, although African pharmaceutical research and foreign humanitarian actions can improve healthcare access and address health crises, they have complex ethical and theoretical implications.

Foreign humanitarian actions in Africa have been evaluated for their effectiveness in improving health care outcomes. Studies have shown that health aid has a positive impact on health outcomes in sub-Saharan African countries, including increased life expectancy, decreased HIV prevalence, and reduced infant mortality. However, the magnitude of these effects is relatively small, indicating that additional health aid alone may not be sufficient to achieve the Millennium Development Goals. Furthermore, evaluations of health system strengthening interventions in Africa have revealed shortcomings, with no intervention concurrently strengthening all six health system building blocks and no improvement in all four overall outcomes of health system strengthening. Despite these challenges, carefully designed health care interventions in humanitarian settings can strengthen health systems, increase access to essential services, and improve government capacity, ownership, and accountability. Monitoring and evaluating development projects, including healthcare delivery, is crucial for aid effectiveness and sustainability in Africa (Daniel, 2001).

The factors that contribute to the effectiveness of foreign humanitarian actions in improving healthcare outcomes in Africa include strong leadership, teamwork, peer support, and the positive impact of making a difference (Uchenna et al., 2018). In addition, the cost-effectiveness of new logistics techniques and processes in humanitarian settings plays a crucial role in maintaining supply chains and responding effectively to crises. Furthermore, aid effectiveness in increasing economic prosperity increases in high-growth countries, indicating that they are more likely to benefit from development assistance in terms of general economic growth. It is important to improve the management of aid funds for health and education projects to enhance the aid-human development nexus. Overall, these factors contribute to the success of foreign humanitarian actions in improving health care outcomes in Africa.

Conclusions

The potential future of African pharmaceutical research and foreign humanitarian actions is promising. The African Union's Pharmaceutical Manufacturing Plan for Africa aims to develop the pharmaceutical industry in Africa to reduce the burden of disease and promote economic growth. Collaboration with external organizations is recognized as a key strategy for filling product pipelines and advancing the industry. Additionally, investing in research and development within African borders, particularly through foreign direct investment, is crucial for the growth of the pharmaceutical industry in Africa. In terms of foreign humanitarian actions, behavioral operations research can inform decision-making in humanitarian logistics and supply chain management, helping improve performance in humanitarian operations. Overall, with initiatives to harmonize medicine regulation, address capacity and skill shortages, and promote cooperation, the African pharmaceutical industry can make significant progress in the future.

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根治性前列腺切除术治疗局部晚期前列腺癌的结果 (临床观察)

RESULTS OF RADICAL PROSTATECTOMY IN THE TREATMENT OF LOCAL ADVANCED PROSTATE CANCER (CLINICAL OBSERVATIONS)

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概括。 目前推荐将根治性前列腺切除术作为多模式治疗的阶段之一用于治疗局部晚期前列腺癌。 尽管如此,手术干预的可取性仍然是一个争论的话题: 根据他们自己的研究结果, 治疗局部晚期前列腺癌的手术策略的支持者指出根治性前列腺切除术的有效性和相对安全性, 反对者则指出 手术切缘阳性的概率很高, 并且与手术相关的局部肿瘤复发、淋巴转移和远处转移的形成。

本研究的目的是评估腹腔镜根治性前列腺切除术联合扩大盆腔淋巴结切除术治疗前列腺腺癌 T3a-3bNOMO 的效果。

材料和方法。 考虑了年龄 46 至 71 岁的局部晚期前列腺癌患者 (n=32) 的围手术期、功能和肿瘤学结果。 随访期平均为 9-36 个月 (中位 13 个月)。

研究成果。 手术总时间和术中失血量平均分别为 182.69 ± 3.99 分钟和 253.06 ± 9.80 毫升。 根据手术材料的组织学检查, 6.3% 的患者高估了疾病的临床阶段。 干预后, 65.6% 的男性保留了尿失禁功能, 不需要矫正。 所有患者术后6个月排尿量、最大排尿速度和平均排尿速度均恢复正常, 且残余尿量出现减少趋势。 在整个观察期间, 78.1%的患者没有出现生化复发的迹象。 没有参与者因死亡而退出研究。

结论。 20年来, 在专题医学期刊上, 各国作者团队展示了至少8万例局部晚期前列腺癌根治性手术治疗的近期和长期 (随访期3至20年) 结果 排除标准研究为

辅助治疗的患者总数。作者的结论表明手术治疗局部晚期前列腺癌的有效性和相对安全性,以及扩大盆腔淋巴结切除术的重要性,这可以在必要时优化辅助治疗策略。我们自己的观察结果与文献数据完全可比。目前,科学研究正在进行中,旨在提高局部晚期前列腺癌的手术治疗效果,特别是阐明个体预后因素的作用,改进预测方法并选择合理的治疗方案。

关键词: 局部晚期前列腺癌、手术治疗、腹腔镜根治性前列腺切除术、扩大盆腔淋巴结切除术、功能结果、肿瘤学结果。

Summary. *Radical prostatectomy in the treatment of locally advanced prostate cancer is currently recommended for use as one of the stages of multimodal therapy. Despite this, the advisability of surgical intervention remains a subject of debate: based on the results of their own studies, supporters of surgical tactics for the treatment of locally advanced prostate cancer point to the effectiveness and relative safety of radical prostatectomy, opponents point to the high probability of positive surgical margins and local tumor recurrence associated with the operation, lymphogenous metastasis and the formation of distant metastases.*

The purpose of the study was to evaluate the results of laparoscopic radical prostatectomy, performed in combination with extended pelvic lymphadenectomy, in the treatment of prostate adenocarcinoma T3a-3bN0M0.

Materials and methods. *The perioperative, functional and oncological results of surgical treatment of patients with locally advanced prostate cancer (n=32) aged from 46 to 71 years were considered. The follow-up period averaged 9-36 months (median 13 months).*

Research results. *The total duration of surgical intervention and the volume of intraoperative blood loss averaged 182.69±3.99 minutes and 253.06±9.80 ml, respectively. Overestimation of the clinical stage of the disease, according to histological examination of surgical material, was observed in 6.3% of patients. After the intervention, urinary continence function was preserved and did not require correction in 65.6% of men. In all patients, 6 months after surgery, the volume of urination, its maximum and average speed were normalized, and a tendency toward a decrease in residual urine volume appeared. During the entire observation period, there were no signs of biochemical relapse in 78.1% of patients. No participants dropped out of the study due to death.*

Conclusion. *Over the past 20 years, in special medical periodicals, teams of authors from various countries have shown the immediate and long-term (follow-up period from 3 to 20 years) results of radical surgical treatment of locally advanced prostate cancer in at least 80,000 patients in total, with an exclusion criterion research was adjuvant therapy. The authors' conclusions indicate the effectiveness and relative safety of surgical treatment of locally advanced prostate cancer, as well as the importance of extended pelvic lymphadenectomy, which allows optimizing the tactics of adjuvant therapy if necessary. The results of*

our own observations are fully comparable with the literature data. Currently, scientific research is ongoing aimed at improving the results of surgical treatment of locally advanced prostate cancer, in particular, at clarifying the role of individual prognostic factors, improving prediction methods and choosing a rational treatment regimen.

Keywords: *locally advanced prostate cancer, surgical treatment, laparoscopic radical prostatectomy, extended pelvic lymphadenectomy, functional results, oncological results.*

According to data from the Russian Center for Information Technologies and Epidemiological Research in the Field of Oncology as part of the Moscow Oncology Research Institute. P.A. Herzen, in the Russian Federation in 2020, prostate cancer (PCa) was first diagnosed in 38,223 men, caused the death of 13,456 Russians, among the male population of the Russian Federation it ranked second (14.9%) in the structure of the incidence of malignant neoplasms and third place (8.6%) - in the structure of mortality from malignant neoplasms. Over the period from 2010 to 2020, the average annual rate of increase in the incidence of prostate cancer was 2.62%; over the past 10 years, the number of newly diagnosed cases of prostate cancer has increased by 30.6% [Kaprin A.D. et al., 2021]. The incidence of locally advanced prostate cancer (stage T3a-bN0M0) among all cases of prostate cancer, according to generalized literature data published over the last decade, is approximately 21.5-68.5% [Chissov V.I. et al., 2011; Maslyakova G.N. et al., 2012; Chissov V.I. et al., 2012; Gritskevich A.A. et al., 2017; Kaprin A.D. et al., 2019].

Treatment of locally advanced prostate cancer (RGPG) is aimed at eliminating malignant growth, maximally prolonging the relapse-free period and cancer-specific survival, and ensuring the highest possible level of quality of life for patients. Treatment methods currently used include radical prostatectomy (RP) with mandatory extended pelvic lymphadenectomy (EPLAD), radiation, hormonal and/or chemotherapy (RT, HT and CT, respectively), as well as their combinations used as part of the multimodal concept of treatment for RGPG [Pereverzev A.S. et al., 2006; Heidenreich A. et al., 2015].

Currently, radical prostatectomy for the treatment of locally advanced prostate cancer is considered in the RGPG guidelines (2020) as one of the stages of multimodal therapy for multimodal prostate cancer, subject to sufficient surgical experience and careful patient selection [EAU, 2020]. The criteria for patient selection, according to a very significant number of researchers, remain the subject of debate.

The purpose of the work was to evaluate the results of laparoscopic radical prostatectomy, performed in combination with extended pelvic lymphadenectomy, in the treatment of prostate adenocarcinoma T3a-3bN0M0.

Materials and research methods

The study was carried out at the city center of endoscopic urology and new technologies (CCEUaNT), operating on the basis of the urological departments of the St. Petersburg state budgetary healthcare institution “St. Luke’s Clinical Hospital”. The materials were medical records of patients (n=32) aged from 46 to 71 years who were at various times hospitalized in the urological department No. 2 for prostate adenocarcinoma T3a-3bN0M0 from January 2014 to December 2022. Monitoring the condition patients lasted for 9-36 months after surgery, the median follow-up time was 13 months. Data on the results of pre- and postoperative examination of patients were obtained from the patients’ medical records and became the objects of study.

Immediately after the operation, its perioperative results were examined (duration of the intervention, volume of intraoperative blood loss (VIB), duration of hospital stay after the operation, incidence of intra- and postoperative complications), and intravital pathological and anatomical examination of the surgical material was carried out.

After LRPE and EPLAE, the following was determined:

- the incidence of stress urinary incontinence (SUI), the dynamics of restoration of impaired urinary continence function and the impact of SUI on the quality of life of patients; To solve the last two problems, the International Conférence on Incontinence Questionnaire Short Form (ICIQ-SF,

Research results

All patients upon admission to routine hospital treatment presented fairly similar complaints: sluggishness (weakness) of the urine stream when urinating, a feeling of incomplete emptying of the bladder, frequent urination during the day and the need to urinate at night (up to 2-3 times), reddish coloration of urine. The anamnesis of all patients without exception was burdened with concomitant diseases. Most often (78.1% of patients) hypertension and arterial hypertension with a risk level of cardiovascular complications of 3-4, as well as chronic heart failure (CHF) of functional classes I-II (65.6% of patients) were recorded. Fifteen patients (46.9%) out of thirty-two had coronary artery disease in the form of angina of various functional classes. The results of magnetic resonance imaging and intravital pathological and anatomical examination of prostate biopsy material, obtained as part of the preoperative examination, indicated the presence of locally advanced adenocarcinoma of the prostate in all patients; clinical stage T3aN0M0 was registered in 21.9% of men, T3bN0M0 - in 78,1% of participants. The Gleason scale in 21.9% of patients was 6 (3+3) points, in 43.8% and 21.9% - 7 (3+4) points and 7 (4+3) points, respectively, in 12.5% - 9 (5+4) points.

Also, before surgery, all patients had, firstly, a high risk of metastatic lesions of the pelvic lymph nodes - $44.16 \pm 5.05\%$ (minimum 13%, maximum 84%) ac-

according to the MSKCC nomogram; secondly, very pronounced disturbances in urination, as evidenced by the results of uroflowmetry (a decrease in the maximum and average speed of urination to 8.61 ± 0.18 ml/sec and to 5.91 ± 0.18 ml/sec, respectively, a decrease in the volume of urination to 169.75 ± 4.65 ml, an increase in residual urine volume to 51.78 ± 0.58 ml) and the results of testing according to the IPSS system with a total number of points equal to 22.88 ± 0.65 (minimum - 18, maximum - 27); thirdly, a significant deterioration in the quality of life of participants due to urinary disorders with a decrease in the QoL index of the IPSS scale to 5.66 ± 0.85 points (minimum - 5.00, maximum - 6.00).

The results of computed tomography of the chest, abdominal cavity and retroperitoneal space and osteoscintigraphy indicated the absence of secondary damage to the studied objects.

Based on the results of the preoperative examination for all patients participating in the study, a council of specialists from the State Center of Economics and Technology made a decision on the need and justification in each of the cases under consideration to perform laparoscopic radical prostatectomy (LRPE) in combination with extended pelvic lymphadenectomy (EPLAE) with excision of the obturator, external, internal and common iliac and presacral lymph nodes.

7 days after LRPE and EPLAE, the urethral catheter was removed (profiled, always used by us in order to minimize the risk of infectious complications due to longitudinal grooves running along the catheter), then, the next day after restoration of independent urination and control ultrasound examination, patients were discharged to outpatient treatment stage

Immediately after LRPE and EPLAE, an intravital pathological and anatomical examination of the surgical material was performed for each of the participants. All patients had histological signs of prostate acinar adenocarcinoma.

The next day after performing LRPE in combination with EPLAE, general detailed blood tests of patients showed leukocytosis up to $9.50-13.50 \times 10^9/l$, formed due to absolute neutrophilia up to $7.40-11.20 \times 10^9/l$, which very likely developed in response for damage to tissue structures during intervention. Before surgery, all patients had no abnormalities in the cellular and biochemical composition of the blood.

The results of the postoperative uroflowmetric examination are shown. According to the presented data, the maximum urinary flow rate 6 months after LRPE and EPLAE increased by 22.1% from 8.61 ± 0.18 ml/sec to 10.51 ± 0.04 ml/sec ($p=0.02$) and remained at this level until the end of the observation period. By the end of the first half of the year, the average urination rate also increased - by 28.1% compared to the preoperative level from 5.91 ± 0.18 ml/sec to 7.57 ± 0.28 ml/sec ($p=0.01$). Further, a tendency towards a slow increase in the indicator was noted; at the final measurement 3 years after surgical treatment, the aver-

age urinary flow rate was 9.09 ± 0.01 ml/sec and was statistically significantly higher than that before surgery by 34.9% ($p = 0.001$). The volume of urination, which was 169.75 ± 4.65 ml before the start of surgical treatment, 6 months after LRPE and EPLAE was equal to 225.45 ± 0.12 ml ($p=0.001$), at subsequent stages of monitoring it varied from 238.39 ± 0.40 ml to 253.35 ± 0.08 ml, 2.5-3 years after the intervention was 220.45 ± 0.24 ml, thus exceeding the result of preoperative measurements by 22.9% ($p=0.001$).

During the entire observation period, no deaths were recorded among study participants.

Discussion

We assessed the results of surgical treatment (LRPE in combination with extended pelvic lymphadenectomy) of locally advanced (T3a-bN0M) prostate cancer as satisfactory and these results were fully comparable with the corresponding literature data for the observation period under consideration [Volchenko N.N. et al., 2016; Brockman J.A. et al., 2015; Joniau S. et al., 2015].

Over the past twenty years, the demand for surgical treatment of locally advanced prostate cancer, both as monotherapy and as the first stage of multimodal treatment, has been steadily growing. At the same time, when treating patients with this profile, the use of external beam radiation and hormonal therapy is gradually being reduced [Cooperberg M. et al., 2015]. The reason is the fairly high oncological effectiveness of LRPE: according to summarized literature data, in persons who underwent surgery without adjuvant therapy, 5- and 10-year disease-free survival was 55.2-64.7% and 39.6%, 5- and 10-year cancer-specific survival rate – 96.4-98.5% and 79.7-95.4% [Gritskevich A.A. et al., 2017; Alekseev B.Ya. et al., 2020; Briganti A. et al., 2015; Joniau S. et al., 2015].

Conclusion

Over the past 20 years, in special medical periodicals, teams of authors from various countries have shown the immediate and long-term (follow-up period from 3 to 20 years) results of radical surgical treatment (LRRP in combination with EPLAE) of locally advanced prostate cancer in at least 80,000 patients in total. , while the exclusion criterion from the studies was adjuvant therapy. The authors' conclusions indicate the effectiveness and relative safety of surgical treatment of RGPG, as well as the diagnostic significance of EPLAE, which allows optimizing the tactics of adjuvant therapy if necessary. The results of our own observations are fully comparable with the literature data. Currently, scientific research is ongoing aimed at improving the results of surgical treatment of RGPG, in particular, at clarifying the role of individual prognostic factors, improving prediction methods and choosing a rational treatment regimen.

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慢性EB病毒感染患者外周血免疫学参数

IMMUNOLOGICAL PARAMETERS OF PERIPHERAL BLOOD IN PATIENTS WITH CHRONIC EPSTEIN-BARR VIRAL INFECTION

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抽象的。EB 病毒 (EBV) 是一种嗜淋巴细胞疱疹病毒 4 型,也是传染性单核细胞增多症 (IM) 的病原体,可导致患者出现慢性或复发性传染性单核细胞增多症样症状,并长期持续存在。EBV 对免疫系统细胞有明显的趋向性,并导致免疫系统发生明显的变化。对 90 名患有慢性 Epstein-Barr 病毒感染的患者进行了检查。患者的平均年龄为 38.37 ± 1.15 岁 (CI: 36.34 - 40.53)。从患者出现首次主诉到实验室检查并确认 EBV 感染和诊断的 CEBVI 病程持续时间为 3.73 ± 0.22 年 (CI: 3.30 - 4.16)。所有患者均接受外周血免疫学参数研究 (唾液样本中 EBV DNA 拷贝数、干扰素 $\text{INF-}\alpha$ 和 $\text{INF-}\gamma$ 的产生、NK 细胞的含量和细胞的细胞毒活性)。研究时患者未接受抗病毒或免疫治疗。结果显示,本组患者未检测到 NK 细胞含量、细胞毒活性以及干扰素 $\text{INF-}\alpha$ 和 $\text{INF-}\gamma$ 产生的变化。这可能是由于慢性 EBV 感染病程较长 (三年以上) 且血液中病毒缺乏复制活性。

关键词: 慢性 EBV 感染、NK 细胞、细胞毒活性、干扰素、EBV DNA 拷贝数。

Abstract. *Epstein-Barr virus (EBV) is a lymphotropic herpes virus 4 and the causative agent of infectious mononucleosis (IM), causing the development of chronic or recurrent infectious mononucleosis-like symptoms that persist in the patient for a long time. EBV has a pronounced tropism for cells of the immune system, and leads to the development of pronounced changes in the immune system. 90 patients suffering from chronic Epstein-Barr viral infection were examined. The mean age of the patients was 38.37 ± 1.15 years (CI: 36.34 - 40.53). The duration of the course of CEBVI from the appearance of the first complaints in the patient to laboratory examination and confirmation of EBV infection and*

diagnosis was 3.73 ± 0.22 years (CI: 3.30 - 4.16). All patients underwent a study of immunological parameters of peripheral blood (the number of EBV DNA copies in saliva samples, the production of interferons $INF-\alpha$ and $INF\gamma$, the content of NK cells and the cytotoxic activity of cells). Patients were not receiving antiviral or immunotherapy at the time of the study. It was shown that changes in the content of NK cells, cytotoxic activity, and the production of interferons $INF-\alpha$ and $INF\gamma$ were not detected in this group of patients. This may be due to the long course of chronic EBV infection (more than three years) and the lack of replicative activity of the virus in the blood.

Keywords: chronic EBV infection, NK cells, cytotoxic activity, interferon, EBV DNA copies.

Introduction. Epstein-Barr virus (EBV) or infectious mononucleosis virus is a lymphotropic herpes virus 4 and the causative agent of infectious mononucleosis (IM), has a pronounced tropism for the cells of the immune system, and leads to the development of pronounced changes in the immune system. In immunocompetent individuals, EBV causes the development of chronic or recurrent infectious mononucleosis-like symptoms that persist for a long time [1]. Infection occurs during childhood or adolescence and results in persistent, largely latent EBV infection [2, 3]. The virus is transmitted orally by contact with the saliva of an infected person and penetrates the epithelium that lines the nasopharynx. EBV then infects epithelial cells, replicates, is released, and subsequently infects resting B cells in nearby areas by activating latent proteins, resulting in the cell becoming a proliferating lymphoblast (lymphoblast burst). Thus, memory B cells are the site of long-term viral persistence, where the virus can remain throughout the patient's life, because immunological memory is formed and the virus ceases to be pathogenic for the host [4]. The level of infected B cells in the population has been shown to range from 5 to 3000 in every 107 memory B cells, both in peripheral blood (average 110/107) and in Waldeyer's ring (average 175/107), then the virus is evenly distributed throughout the ring. Thus, the level of infected cells is similar between peripheral blood and Waldeyer's ring, but 20 times lower than in other lymphoid tissue [4]. The virus constantly leaks into the oral cavity, where it mixes with saliva for about 2 minutes before swallowing. The oral cavity and peripheral blood are important anatomical sites of localization and persistence of EBV infection. EBV-infected B cells can re-migrate to the tonsils, where memory lymphocytes express adhesion receptors through which they are able to return to target organs [5].

There are two types of Epstein-Barr virus: type 1 (type A) and type 2 (type B). The main type of EBV is type 1 (B95-8, GD1 and Akata), which is widespread throughout the world, type 2 (AG876 and P3HR-1) is found with higher frequency

in sub-Saharan Africa [6]. A person can be infected with two types, as they have different replicative properties [7].

It has been suggested that the chronicity of EBV infection does not depend on time or B cell expansion, but on the severity of the immune response [8, 9, 10, 11]. EBV infection leads to expansion of NK cells in the peripheral blood and increased cytotoxic activity to kill EBV-infected cells. The expansion of differentiated NK cells persists for at least 6 months; during this period of time, the cells stop proliferating and acquire the aging marker CD57 [2, 12]. With an increase in the content of NK cells in the blood, a decrease in the content of EBV DNA copies is observed, that is, the severity of the NK cell response determines the severity of the clinical disease. It has been shown that induction of lytic replication in EBV-infected B cells leads to increased death of NK cells, that is, EBV-infected cells are a target for NK cells [13]. Thus, the NK cell population does not have any effect on the viral load during lytic or latent infection. NK cells play an important role in the control of primary EBV infection by eliminating infected B cells and enhancing antigen-specific T cell responses through the release of immunomodulatory cytokines [14].

The purpose of the study was to study immunological blood parameters (the number of EBV DNA copies in saliva samples, the production of interferons $INF-\alpha$ and $INF\gamma$, the content of NK cells and cytotoxic activity of cells) in patients with chronic Epstein-Barr viral infection (CEBVI).

Material and methods. Patients. The study was conducted on 90 patients suffering from chronic Epstein-Barr viral infection. The group consisted of 66 women and 24 men. The mean age of the patients was 38.37 ± 1.15 years (CI: 36.34 - 40.53). The duration of the course of CVEBI from the appearance of the first complaints in the patient to laboratory examination and confirmation of EBV infection and diagnosis was 3.73 ± 0.22 years (CI: 3.30 - 4.16).

All patients underwent a differential diagnosis of CVEBV with other viral infections (cytomegalovirus infection, viral hepatitis, human immunodeficiency virus), toxoplasmosis, helminthic infestations, and autoimmune diseases associated with EBV infection. The diagnosis of “chronic EBV infection” was made and confirmed in the laboratory during examination by appropriate specialists at the previous stage, and the patients were referred for treatment to an immunologist. Patients who received antiviral or immunomodulatory therapy within the last 6 months were not included in the study.

Clinical research methods included collecting anamnesis, data on previously administered antiviral and immunotherapy, and the presence of concomitant diseases. The clinical condition of the patients was assessed using a generally accepted method, including objective data and the patient’s complaints at the time of examination. Complaints were recorded using a subjective rating scale on a

3-point scale: 0 – no symptoms, 1 – mild symptoms, 2 – moderate symptoms, 3 – significant symptoms.

The clinical study was carried out in compliance with the World Medical Association Declaration of Helsinki “Ethical Principles for Conducting Scientific Medical Research Involving Human Subjects” (WMA Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects, 2013), the protocol of the 1999 Council of Europe Convention on Human Rights and Biomedicine . and articles 20, 22, 23 of the Federal Law “On the fundamentals of protecting the health of citizens in the Russian Federation” dated November 21, 2011 No. 323-FZ (as amended on May 26, 2021). The clinical study was conducted according to a protocol approved by the local ethics committee at the St. Petersburg Dialysis Center LLC FRESINIUS MEDICAL CARE. All study participants signed voluntary informed consent. When included in the study, the patients did not have any other infections, chronic diseases or changes in the immune system that could affect the results of the study.

Examination methods. To confirm the viral etiology of the disease in patients, viral DNA was detected by PCR in saliva samples, since it is known that in chronic forms of infection, PCR testing in blood samples does not give a positive result and analysis of saliva samples is more informative in determining EBV DNA in chronic and atypical forms [5].

The patients were tested for viral DNA in saliva samples *using polymerase chain reaction (PCR) with hybridization-fluorescence detection in real time*. The test systems “AmpliSens EBV/CMV/HHV6-screen-FL” from the Central Research Institute of Epidemiology (Russia) were used. The unit of measurement used to estimate the viral load when extracting DNA from saliva is the number of copies of EBV DNA per 1 ml of sample (CCDNA). According to the instructions, this indicator is calculated using the formula: $CDNA = CDNA \times 100$, where CDNA is the number of copies of viral DNA in the sample. The analytical sensitivity of the test system is 400 copies/ml.

The content of IFN α and IFN γ in the serum was determined, as well as the spontaneous and induced production of these cytokines in the culture medium. Newcastle disease virus (obtained from the L.A. Tarasevich State Research Institute, St. Petersburg) with an infectious titer of 8 Ig EID/0.2 ml in a volume of 8 μ l per well was used as an inducer of IFN α production; FHA-P (PanEko, Russia) at a dose of 10 μ g/ml. The content of cytokines in the serum and supernatant of a 24-hour whole blood culture was determined using enzyme-linked immunosorbent assay (ELISA) using the alpha-Interferon-ELISA-BEST and gamma-Interferon-ELISA-BEST test systems (Vector Best, Russia). Reference values are provided by the manufacturer.

Determination of the number of NK cells. Determination of the relative number of NK cells was carried out using multicolor flow cytometry as part of a study

of the subpopulation composition of peripheral blood lymphocytes. Blood from the cubital vein was collected into vacutainers containing EDTA. Sample preparation was carried out according to the manufacturer's instructions. Monoclonal antibodies used: anti-HLADR-FITC, anti-CD4-PE, anti-CD3-ECD, anti-CD56-PC5.5, anti-CD25-PC7, anti-CD8-APC, anti-CD19-APC-AF700, anti-CD45-APC-AF750. VersaLyse was used to lyse red blood cells. Samples were analyzed on a Navios flow cytometer (device and reagents from Beckman Coulter, USA). 5000 events were accumulated in the CD45+brightSSdim lymphocyte region. NK lymphocytes were defined as CD3-CD56+ CD45+ brightSSdim events. The absolute number of NK cells was calculated using the results of a clinical blood test.

The cytotoxic activity of killer cells is assessed by the spontaneous and induced expression of CD107a – LAMP (Lysosomal-associated membrane protein), the appearance of which on the cell membrane of lymphocytes indicates degranulation of lysosomes. Assessment of CD107a expression is carried out after co-cultivation of peripheral blood mononuclear cells (PBMCs) with target cells, which use the K562 cell line (human chronic erythromyelosis). K562 cells express a number of ligands (MICA, MICB, ULBP2, ULBP4) for the cytotoxic lymphocyte receptor NKG2D. The interaction of NKG2D with ligands leads to degranulation of lysosomes of NK cells, TNK cells and lymphokine-activated CD8+ T cells and the appearance of CD107a on their membranes. Thus, the test allows us to assess the ability of killer cells to participate in NKG2D-dependent cytolysis of target cells. Blood is taken for testing in a vacutainer with lithium heparin as an anticoagulant. Sample preparation includes isolation of a suspension of peripheral blood mononuclear cells on a density gradient, followed by washing, cocultivation of PBMCs and K562 in a ratio of 10:1 in a CO2 incubator for 20 hours in the presence of monoclonal antibodies anti-CD107a-AlexaFluor 647 (BioLegend), staining with monoclonal antibodies anti-CD3-FITC/CD(CD16+56)-PE and anti-CD45PC5 (Beckman Coulter). To assess spontaneous cytotoxic activity, RPMI nutrient medium (Biolot) in an appropriate volume was added to the PBMC suspension instead of K562. Samples were analyzed on a Navios flow cytometer (Beckman Coulter). Accumulation was carried out up to 1000 events in a minimal subpopulation of cells (NK- or TNK-). The lymphocyte population was defined as CD45+brightSSdim cells. The relative number of cells expressing CD107a (CD107a+) in the subpopulations of NK, TNK and T lymphocytes was assessed. The stimulation index was calculated as the ratio of induced to spontaneous expression of CD107a.

Statistical analysis. Statistical processing of the obtained data was carried out using the IBM SPSS Statistics software package, version 26 (Armonk, NY: IBM Corp.). Group results are presented as the arithmetic mean \pm standard error (M \pm Standard Error). Statistical comparison of data between groups of patients

was carried out using the nonparametric Mann–Whitney U test. Differences in continuous variables were assessed using the independent sample Student’s t test and were considered significant if $p \leq 0.05$. For statistical processing, parametric (Pearson’s method) and non-parametric (Spearman’s method, Kendall’s tau (τ) method) were used. The critical level of significance for the difference in indicators was taken equal to 0.05.

Results. Chronic Epstein-Barr viral infection is characterized by a long course and frequent relapses of the clinical and laboratory picture of the viral infection [15]. Patients are concerned about prolonged low-grade fever (37.1-37.3°), weakness, unmotivated fatigue, increased sweating (especially at night), lymphadenitis, discomfort and/or pain in the throat, severe postnasal drip, frequent exacerbations of stomatitis and gingivitis, possible skin rashes, arthralgia, myalgia. Neurological disorders often develop - headaches, memory impairment, sleep disturbances, irritability, tearfulness, and a tendency to depression. Patients also complain of frequent colds over the past 6–12 months and the addition of other herpesvirus infections. In a clinical blood test, patients exhibit leukopenia, neutropenia in combination with lymphocytosis, and, less commonly, monocytosis. Patients often have a history of prolonged stressful situations, psycho-emotional and physical overload, against the background of which the patient’s condition worsens. Based on the above, we analyzed the frequency of occurrence of the described clinical complaints in patients (Table 1).

Table1.
Frequency of main clinical complaints (%) in patients CEBV infection

| Frequency of clinical complaints % | Patients group (n=90) |
|---|------------------------------|
| Low-grade fever | 83,33 |
| Lymphadenitis | 50,00 |
| Sore throat | 86,66 |
| Weakness | 75,55 |
| Chills | 66,66 |
| Sweating | 83,33 |
| Postnasal drip | 50,00 |
| Stomatitis | 42,22 |
| Irritability and tearfulness | 60,00 |
| Headaches, dizziness | 33,33 |
| Decreased concentration and memory | 40,00 |
| Sleep disturbance | 44,00 |

All patients (n=90) underwent EBV DNA copy number testing using PCR in saliva samples. The EBV DNA copy number was 135898.61±23196.21 cop/ml (95% CI: 93489.67 - 189261.78).

Next, we analyzed the dynamics of INF- α and INF- γ production (spontaneous, serum and induced) in cultured lymphocytes in patients with CVEB. The results are presented in Table 2.

Table 2.
Dynamics of IFN- α production in patients with CVEBI (n=90)

| Indicator under study | IFN- α level (pg/ml) | Reference values IFN- α (pg/ml) | IFN- γ level (pg/ml) | Reference values IFN- γ / (pg/ml) |
|-----------------------|--|--|---|--|
| Spontaneous | 8,38±0,99 95%CI:6,72 – 10,46 | 3 - 30 | 10,69±2,00 95%CI: 7,40 – 15,25 | 0 - 6 |
| Whey | 6,86±0,89 95%CI: 5,40 – 9,01 | 0 - 5 | 6,97±2,00 95% CI: 3,61 – 11,42 | 0 - 10 |
| Induced | 357,48±86,28 95% CI: 233,69 -556,62 | 112 - 482 | 2012,06±200,56 95% CI: 1620,15 - 2414,12 | 281 - 4335 |

The table data shows that the production of INF- α is within normal limits. The level of serum INF- γ is slightly increased compared to the reference values, and the production of spontaneous and induced INF- γ remains within the reference values.

When analyzing the content of NK cells in peripheral blood, an increase in only T cells (CD3 + CD16 + CD56-) was detected, which exceeded the reference value. The content of NK cells (CD3-CD16+ CD56+) and NKT cells (CD3+CD16+ CD56+) was not increased (Table 3).

Table 3
Content of NK cells (%) in the blood of patients with CVEBI

| Content of NK cell subpopulations in the blood (%) | Reference values (%) |
|--|------------------------------------|
| NK-cells (CD3-CD16+ CD56+) | 10,95±0,78 95% CI: 9,53 - 12,58 |
| NKT-cells (CD3+CD16+ CD56+) | 6,97±0,63 95% CI: 5,81 - 8,16 |
| T-cells (CD3+CD16+ CD56-) | 2,97±0,33 95% CI: 2,34 -3,66 |

Next, the dynamics of the cytotoxic activity of NK cells was assessed (Table 4).

Table 4

Dynamics of expression of the cytotoxic granule degranulation marker CD107a by NK cells in patients with CVEBI

| CD107a expression | | Reference values |
|---|------------------------------------|-------------------------|
| <i>Expression of the degranulation marker CD107a on NK cells (CD3-CD16+CD56+)</i> | | |
| Spontaneous | 2,94±0,35 95% CI: 2,31 -3,72 | 0,9 – 3,3 |
| Stimulated | 19,20±1,12 95%CI:16,98-21,39 | 11,0 – 24,0 |
| Stimulation index | 11,05±0,91 95% CI: 10,20 -16,47 | 5,5 – 17,0 |
| <i>Expression of the degranulation marker CD107a on NKT cells (CD3+CD16+CD56+)</i> | | |
| Spontaneous | 1,46±0,15 95% CI: 1,16 -1,78 | 0,4 – 1,6 |
| Stimulated | 2,50±0,26 95% CI: 2,02 -3,02 | 0,5 – 3,0 |
| Stimulation index | 2,27±0,30 95% CI: 1,75 -2,95 | 1,0 – 2,5 |
| <i>Expression of the degranulation marker CD107a on T cells (CD3+CD16+CD56-)</i> | | |
| Spontaneous | 0,31±0,02 95% CI: 0,25 - 0,37 | 0,1 – 0,4 |
| Stimulated | 0,34±0,03 95% CI: 0,26 – 0,42 | 0,1 – 0,4 |
| Stimulation index | 1,14±0,06 95% CI: 1,02 -1,28 | ≤ 1,0 |

From the presented results it is clear that the expression of the degranulation marker CD107a on NK cells in patients with CEBV infection is not changed.

The correlation analysis showed the following results.

1. The number of EBV DNA copies correlates with the level of induced INF- α :
R=0.335 p=0.003;
2. The number of EBV DNA copies correlates with the level of induced INF- γ :
R=0.274 p=0.026;
3. The level of induced INF- γ correlates with the number of NK cells (CD3-CD16+ CD56+): $\tau = 0.281$ p = 0.0001; r = 0.416 p = 0.001;

Next, a correlation analysis of the relationship between the number of EBV DNA copies in saliva samples and the severity of clinical complaints in patients was carried out. The results are presented in Table 5.

Table 5.

The influence of the number of EBV DNA copies on the severity of clinical complaints in patients with chronic EBV infection (n=90)

| Complaints | Correlation coefficient |
|-------------------|---|
| Weakness | $\tau = 0,463$ $p = 0,002$ $r = 0,526$ $p = 0,001$ |
| Sore throat | $\tau = 0,612$ $p = 0,001$ $r = 0,624$ $p = 0,001$ |
| Fever | $r = 0,568$ $p = 0,001$; $\tau = 0,463$ $p = 0,001$ |

No other correlations were identified.

Discussion.

It has been shown that EBV infection causes an expansion of NK – cells in the blood, which precedes the peak of the T-cell response, and also induces long-term differentiation of mainly CD16+NKG2A+KIR-NK cells, which indicates an early differentiation phenotype [17]. Williams Hilary et al. in their work showed that increased viral load inversely correlated with the percentage of NK cells in peripheral blood, the Pearson correlation coefficient (r) was -0.87 ($p < 0.001$) [18]. The expansion of NK cells in the blood and increased cytotoxic activity to destroy EBV-infected cells is a consequence of EBV infection. It has been shown that the number of NK T cells increases in the first month of EBV infection, simultaneously with an increase in the content of CD56(bright) with a high ability to destroy EBV-infected cells. As a result, the antigen-specific T cell response is increased through the release of immunomodulatory cytokines [18]. NK cells play an important role in the early stages of the host immune response to primary EBV infection by controlling lytic virus replication and limiting the amount of virus entering the B cell pool. NK cells also reduce the production of lytic antigens, which are the main factors of the primary CD8 + T cell response [19]. In persistently infected individuals, the pool of EBV-specific T cells contains resting antigen-expressing T cells that do not activate or proliferate. In our work, the study was carried out in patients whose duration of infection was 3.73 ± 0.22 years. Also, the diagnosis of “chronic EBV infection” was made and confirmed in the laboratory during examination of patients by relevant specialists at the previous stage. The content of NK cells and cytotoxic activity in patients was found to be within the reference values. Apparently, these results confirm the absence of pronounced changes in the level of NK cells and cytotoxic activity in patients with CEBVI during prolonged infection.

In patients with acute infectious mononucleosis, the level of EBV replication in saliva samples has been shown to have no correlation with the severity of symptoms [8]. It has also been shown that levels of viral replication in the nasopharynx

of patients are not related to the severity of symptoms [20]. However, our study demonstrated the presence of a significant correlation between the number of EBV DNA copies in saliva samples and the development of fever ($r = 0.568$ $p = 0.001$; $\tau = 0.463$ $p = 0.001$), sore throat ($r = 0.624$ $p = 0.001$; $\tau = 0.612$ $p = 0.001$) and weakness ($r = 0.526$ $p = 0.001$; $\tau = 0.463$ $p = 0.002$) in patients with chronic EBV infection. It is not possible to detect EBV DNA in blood samples due to the chronic course of infection, when EBV replication occurs in the oropharynx and the virus is released into saliva for a long time [20]. This can probably be explained not only by the duration of EBV infection, but also by the fact that clinical complaints persist for more than two to three years.

Interferons (IFNs) belong to the family of cytokines, that is, molecules that regulate cell proliferation, differentiation and motility, are mediators of the body's defense reactions and are involved in the regulation of hematopoiesis, and have antiviral and cell-modulating properties [21, 22]. EBV infection can activate various cellular signaling pathways, leading to the induction of type I IFN production, which inhibits EBV infection and virus-induced B cell transformation [23, 24]. However, lytic EBV replication and EBV-depleted B cells have increased resistance to the antiproliferative effects of type I IFN. This is associated with the replication of latent proteins such as EBV nuclear antigen-2 (EBNA-2) and EBV membrane proteins (LMP1), [25, 26]. Under experimental conditions, treatment of EBV-infected cells with IFN I was shown to inhibit viral reactivation, while expression of the EBV envelope protein BGLF2 reduced the ability of IFN I to inhibit viral reactivation. Thus, the protein delivered into cells during viral infection inhibits the host antiviral response and promotes viral reactivation in latently infected cells. Therefore, the BGLF2 protein may protect virus-infected cells from the IFN I response in cells undergoing lytic viral replication [27, 28, 29]. The antiviral activity of IFN- γ is to block the synthesis of viral proteins and inhibit the proliferation of virions. In addition, IFN- γ enhances the expression of MHC class I and II molecules. This cytokine also has an antiproliferative effect, which consists of the induction of macrophages and endothelial cells [30]. Our study revealed a correlation between the number of EBV DNA copies and the level of induced INF- α ($R=0.335$ $p=0.003$) and induced INF- γ ($R=0.274$ $p=0.026$). It has also been demonstrated that there is no increased level of INF- α and INF- γ production in patients with long-term chronic EBV infection. However, a significant correlation was found between the level of induced INF- γ and the number of NK cells (CD3-CD16+ CD56+) in the blood ($r = 0.416$ $p = 0.001$; $\tau = 0.281$ $p = 0.0001$).

Conclusion.

Thus, a study of the immunological parameters of peripheral blood in patients with chronic Epstein-Barr viral infection showed the absence of pronounced disorders in the immune system, which is probably due to persistent chronic infection and the lack of replicative activity of the virus in the peripheral blood. It is also

important that the patients were not receiving antiviral or immunotherapy at the time of the study.

In the future, it is planned to study the production of pro-inflammatory cytokines in this category of patients.

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糖尿病肾病的进展机制

MECHANISMS OF PROGRESSION OF DIABETIC NEPHROPATHY

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抽象的。目前,研究促炎细胞因子在糖尿病肾病发病机制中的作用备受关注。细胞因子通过细胞因子相关信号通路的参与调节炎症免疫反应,并对肾组织损伤具有多效性作用。该研究纳入了50名并发DN的糖尿病患者;平均年龄 66.58 ± 3.27 岁。所有患者均对通过活体穿刺活检获得的肾组织活检进行光学和免疫荧光显微镜检查。除了光学显微镜和免疫荧光显微镜之外,还测定了所有患者肾组织中TNF- α 的表达——分别在肾小球和间质中。TNF- α 的肾小球表达已被证明在肾小球系膜基质扩张的发展和结节性Kimmelstiel-Wilson病变的形成中发挥作用。TNF- α 的间质表达有助于肾组织间质硬化和小动脉透明变性的进展。综上所述,TNF- α 的肾内表达是DM和DN患者肾组织形态学变化的主要机制之一。

关键词:糖尿病、糖尿病肾病、肿瘤坏死因子- α 、形态学变化、临床和实验室参数。

Abstract. *Currently, much attention is paid to studying the role of proinflammatory cytokines in the pathogenesis of diabetic nephropathy. Cytokines regulate the inflammatory immune response with the participation of cytokine-associated signaling pathways and have a pleiotropic effect upon damage to renal tissue. The study included 50 patients with diabetes complicated by the development of DN; the average age was 66.58 ± 3.27 years. All patients underwent light and immunofluorescence microscopy of kidney tissue biopsies obtained by intravital puncture biopsy. In addition to light and immunofluorescence microscopy, the expression of TNF- α in the renal tissue was determined in all patients - separately in the glomerulus and in the interstitium. Glomerular expression of TNF- α has*

been shown to play a role in the development of mesangial matrix expansion and the formation of nodular Kimmelstiel–Wilson lesions in the glomerulus. Interstitial expression of TNF- α contributes to the progression of interstitial sclerosis and hyalinosis of arterioles in renal tissue. Taken together, intrarenal expression of TNF- α is one of the main mechanisms for the development of morphological changes in renal tissue in patients with DM and DN.

Keywords: *diabetes mellitus, diabetic nephropathy, tumor necrosis factor- α , morphological changes, clinical and laboratory parameters.*

Introduction. Diabetes is the most common metabolic disease worldwide, and its complications are among the most important public health problems [1]. According to the International Diabetes Federation, 537 million patients with diabetes mellitus (DM) were diagnosed worldwide in 2021, accounting for 10% of the total population. By 2030, it is estimated that the number of patients will reach 643 million, and by 2045 - 783 million [2].

Diabetic nephropathy (DN) is one of the most common and serious microvascular complications of diabetes and is associated with increased morbidity and mortality in patients with diabetes [3]. 30–50% of patients develop end-stage renal disease, and 40% of patients require renal replacement therapy [4, 5]. Despite the widespread use of targeted therapies to lower glucose levels and antagonize the renin-angiotensin system (RAS), the prevalence of DN remains stable [6, 7]. Clinical trials have shown that multifactorial interventions can slow but not stop the progression of DN. Even initial manifestations of DN are correlated with a markedly increased risk of cardiovascular disease and death [8].

The morphological changes observed in kidneys with DN affect almost all nephron structures: the glycocalyx and glomerular endothelial cells, the glomerular basement membrane, podocytes and slit membranes, the mesangial matrix, the renal interstitium and renal tubules [9]. The earliest signs of DN are thickening of the glomerular basement membrane (GBM), soft mesangial expansion, and arteriolar hyalinosis. Mesangiolysis and severe mesangial damage ultimately lead to severe mesangial expansion, formation of nodular Kimmelstiel-Wilson lesions, hyalinosis of afferent and efferent arterioles, and severe thickening of the GBM. A major contribution to the development of segmental sclerosis is made by the separation of podocytes from the GBM; as a result, the outflow from the glomeruli is disrupted and the so-called atubular glomeruli develop, which are characteristic of DN. Morphological damage to renal tissue in types 1 and 2 diabetes is identical, although there is a point of view that the heterogeneity of type 2 diabetes plays an additional role [10].

The key pathophysiological mechanism for the development of DN is inflammation, which induces insulin resistance, hyperglycemia, oxidative stress, endo-

thelial dysfunction with microalbuminuria, which lead to the development and progression of renal tissue damage in diabetes [10]. The ability of endothelial, mesangial, glomerular and tubular cells to synthesize proinflammatory cytokines and damage renal tissue was first demonstrated in 1991 by G. Hasegawa et al. [eleven]. Increased production of TNF- α plays a major role in the development of microvascular complications of diabetes, including neuropathy, retinopathy and nephropathy [12]. TNF- α is a pleiotropic cytokine that is produced by monocytes, macrophages and T cells, as well as mesangial, glomerular, endothelial, tubular and dendritic cells [13]. TNF- α induces the production of reactive oxygen species in mesangial cells, which leads to changes in the barrier function of the glomerular capillary wall with increased albumin permeability. TNF- α also induces the production of cytokines, growth factors, cell adhesion molecules, acute phase proteins and the major histocompatibility complex. TNF- α is cytotoxic to glomerular, mesangial and epithelial cells and induces direct damage to renal tissue, apoptosis and cell necrosis. The cytokine is able to change intraglomerular blood flow, glomerular filtration rate (GFR) due to hemodynamic imbalance between vasoconstrictor and vasodilator mediators, and also change endothelial permeability.

The purpose of this study is to study the role of the expression of intrarenal production of the proinflammatory cytokine TNF- α in patients with different morphological classes of DN and to assess its effect on the development and progression of histological changes in renal tissue.

Patients and research methods. The study was conducted in 50 patients suffering from type 2 diabetes mellitus (average age 66.58 ± 3.27 years), complicated by the development of DN. The patients had a serum creatinine level of no more than 0.13–0.14 mmol/l, as well as the initial stage of chronic renal failure with a serum creatinine level of no more than 0.20 mmol/l (CKD classification by S. I. Ryabov and B. B. Bondarenko, 1975). The duration of DM was 17.70 ± 0.35 years, the duration of DN from the moment of detection of microalbuminuria to the morphological examination of renal tissue and diagnosis was 1.65 ± 0.34 years.

To confirm the morphological lesions of the renal tissue, all studied patients underwent light and immunofluorescence microscopy of kidney tissue biopsies obtained by intravital puncture biopsy. Morphological changes in tissue were assessed in accordance with the latest international classification of diabetic nephropathy developed by the Scientific Committee of the Pathology Society, USA [14]. Light microscopy of the biopsy was assessed according to the following indicators: the presence of global and segmental sclerosis of the glomeruli, cellularity of the glomerulus, the severity of expansion of the mesangial matrix (less than and more than 25%), thickening of the GBM, nodular Kimmelstiel-Wilson formations, the presence of hyaline caps, periglomerular sclerosis, sclerotic changes in the interstitium, the presence and severity of mononuclear inflammatory infil-

trates in the interstitium, the presence of protein masses in the lumens of the tubules, atrophy and dystrophy of the epithelium of the urinary tubules (thickness of the apical edge and height of the epithelium of the tubules), hyalinosis of afferent and efferent arterioles. The severity of morphological changes was assessed using a semi-quantitative method in points (0–3). Global and segmental glomerular sclerosis was assessed as the percentage of globally and segmentally sclerotic glomeruli from the total number of glomeruli in the nephrobiopsy section. Interstitial fibrosis and tubular atrophy (IFTA) was scored (0–3) as a percentage of the total interstitial and tubular area in the biopsy specimen. Mononuclear infiltration (MI), afferent and efferent hyalinosis (AH) were also scored (0–2 and 0–2, respectively) according to the criteria for the international classification of DN [14].

According to light microscopy, class IIa (mild mesangial expansion) was detected in 12 patients, class IIb (severe mesangial expansion) in 14 patients, class III (nodular Kimmelstiel-Wilson lesions) in 19 patients, and class IV in 5 patients (advanced diabetic glomerulosclerosis). In addition to light and immunofluorescence microscopy (expression of IgA, IgM, IgG, fibrinogen, λ - and κ -light chains), the expression of TNF- α deposits in the glomerulus and interstitium was determined in all patients using monoclonal antibodies labeled Fitc (Dako, Germany). An indirect method was used with Fitc-labeled mouse serum. The intensity of expression in points (0–3), the nature and location of TNF- α expression in the glomeruli (capillary loops, mesangial matrix, glomerular capsule) and in the interstitium (epithelium of the convoluted urinary tubules, basement membrane of the urinary tubules, interstitial cells) were assessed.

Statistical analysis. Statistical processing of the obtained data was carried out using the IBM SPSS Statistics software package, version 26 (Armonk, NY: IBM Corp.). Group results are presented as the arithmetic mean \pm standard error ($M \pm$ Standard Error). Statistical comparison of data between groups of patients was carried out using the nonparametric Mann–Whitney U test. Differences in continuous variables were assessed using the independent sample Student's t test and were considered significant if $p \leq 0.05$. For statistical processing, parametric (Pearson's method) and non-parametric (Spearman's method, Kendall's tau (τ) method) were used. To verify compliance with the condition of independence of observations, linear regression analysis was carried out (with the calculation of the coefficient of determination (R Square) and the Durban–Watson test) and analysis of variance (ANOVA Analysis of Variance) with the calculation of the Fisher test (F) to test the significance of the model. The standardized β coefficient with 95% confidence intervals was calculated. The critical level of significance for the difference in indicators was taken equal to 0.05.

Research results. Analysis of biopsy tissue from DN patients showed that TNF- α expression was detected both in the glomerular zone and in the interstitial space (Table 1).

Table 1.

Intensity of TNF- α expression in the glomerular zone and interstitial space in patients with type 2 diabetes with DN

| Expression of TNF- α in the glomerular zone | |
|---|--------------------------------|
| Capillary loops (1) | 1,426 \pm 0,17 |
| Mesangial matrix (2) | 0,021 \pm 0,02; P1,2 < 0,001 |
| Glomerular capsule (3) | 0,192 \pm 0,09; P1,3 < 0,001 |
| Expression of TNF- α in the interstitial space | |
| Epithelium of urinary tubules (4) | 1,213 \pm 0,15 |
| Tubular basement membrane (5) | 0,135 \pm 0,07; P4,5 < 0,001 |
| Interstitial cells (6) | 0,170 \pm 0,08; P4,6 < 0,001 |

Next, we analyzed the frequency of TNF- α expression in renal tissue depending on the morphological class of DN. The results obtained are presented in Table 2.

Table 2.

Frequency of detection (%) of TNF- α expression in the glomerular zone and interstitial space of biopsy tissue in patients with type 2 diabetes with DN

| TNF- α expression zone | IIa class (n = 12) | IIb class (n = 14) | III class (n = 19) | IV class (n = 5) |
|-------------------------------|-----------------------|-----------------------|-----------------------|---------------------|
| Capillary loops | 19,7 | 69,2 | 63,2 | 0,0 |
| Mesangial matrix | 75,0 | 46,2 | 42,1 | 20,0 |
| glomerular capsule | 50,0 | 23,1 | 15,8 | 20,0 |
| Epithelium of urinary tubules | 83,3 | 84,6 | 63,2 | 60,0 |
| Tubular basement membrane | 0,0 | 30,7 | 38,5 | 40,0 |
| Interstitial cells | 50,0 | 30,8 | 26,3 | 60,0 |

The analysis showed that the severity and frequency of TNF- α expression in renal tissue depends on the morphological picture of the tissue in patients with type 2 diabetes with DN. In patients with IIb and III classes of DN, the frequency of detection of TNF- α expression in the glomerular region decreases. In patients with class IV, cytokine expression along the capillary loops was not detected, but in the area of the mesangial matrix and along the glomerular capsule decreased to 20%. As tubulointerstitial changes progress, with the development of classes III and IV DN, an increase in TNF- α expression is observed along the basement membrane of the proximal tubules. In parallel, severe atrophy and detachment of epithelial cells develop, followed by exposure of the tubular basement membrane.

To identify the prognostic significance of the expression of intrarenal TNF- α and its role in the progression of morphological changes in renal tissue during the development of DN, a linear regression analysis was carried out with calculation

of the determination coefficients R2 (R Square) using the Durbin–Watson test and analysis of variance (ANOVA Analysis of Variance) using the F test and calculating the standardized coefficient β with a 95% confidence interval. The obtained values of the F criterion and coefficient β , indicating the significance of the regression models, are presented below.

- 1). Expression of TNF- α in the glomerular zone is a contributing factor to:
 - progression of expansion of the mesangial matrix (F = 4.817, p = 0.033; β = -0.311; CI: -0.506; -0.22, p = 0.033);
 - formation of nodular Kimmelstiel–Wilson lesions in the glomerulus, determining the severity of morphological changes in the glomerulus (F = 5.383, p = 0.025; β = -0.327; CI: -1.375; -0.97, p = 0.025),
- 2.) TNF- α expression in the interstitial space plays a role:
 - in the progression of hyalinosis of arterioles of renal tissue (F = 4.349, p = 0.043; β = 0.297; CI: 0.009; 0.497, p = 0.043);
 - in the development and progression of interstitial sclerosis (F = 9.541, p = 0.003; β = 0.422; CI: 0.101; 0.479, p = 0.003).

The results of linear regression demonstrated that the expression of TNF- α in the glomerular zone plays the role of a predictor of the development and progression of the expansion of the mesangial matrix and the formation of nodular Kimmelstiel–Wilson lesions in the glomerulus. The severity of TNF- α expression in the interstitial space contributes to the progression of hyalinosis of arterioles of the renal tissue and the further formation of interstitial sclerosis.

Discussion. Numerous literature data indicate the involvement of many components of the immune system in the progression and even initiation of the development of DN in patients with diabetes, which is an inflammatory disease [15].

GBM thickening is the earliest morphological sign of DN and can be observed within one to two years after the onset of diabetes, preceding clinically apparent albuminuria. Next, mesangiolytic and intensive mesangial repair develop, which ultimately leads to expansion of the mesangial matrix. The most characteristic histological changes in DN are the combination of mesangial matrix expansion and GBM thickening with podocyte damage, which play a fundamental role in disrupting the balance between GBM synthesis and degradation pathways. These changes develop as a result of the accumulation of extracellular matrix (ECM) components, an increase in deposits of types IV and VI of collagen, laminin, fibronectin due to an increase in their production, a decrease in degradation, or a combination of these factors [16]. In the late stage of development of glomerulosclerosis, collagen types I, III, V and fibronectin are expressed in the mesangial matrix, which form nodular Kimmelstiel–Wilson formations. Loss of podocytes plays a significant role in the development of progressive sclerosis [16].

Macrophages, dendritic cells, and mast cells constitute the renal mononuclear phagocytic cells (MPCs) that form the macrophage infiltrate characteristic of the

glomeruli and interstitium of patients with DN. A pronounced infiltrate in the glomeruli leads to the development of glomerulosclerosis, and in the interstitium to a decrease in GFR, which can quickly progress to end-stage kidney disease [17]. The cellular component of adaptive immunity involved in the development of DN are T cells (Th1, Th17) and limited involvement of B cells, which are associated with proteinuria [18]. The primary regulators of the inflammatory response in renal tissue are the cytokines IL-1, IL-6, IL-18 and TNF, which can act in an autocrine, paracrine and juxtacrine manner [19].

It has been shown that TNF- α significantly correlates with the severity of chronic kidney disease (CKD) in diabetic patients with DN and is significantly higher in the blood serum compared to the control group. These associations are independent of established risk factors for CKD, history of cardiovascular disease (CVD), and use of antihypertensive, antidiabetic, and lipid-lowering medications. [20, 21]. TNF- α production is associated with a persistent inflammatory response, which can lead to connective tissue destruction in DN. As a result, TNF- α has a direct effect on altering intraglomerular blood flow, reducing glomerular filtration rate, inducing renal cell cytotoxicity and production of local reactive oxygen species [22], tissue repair, parenchymal cell regeneration and fibrous tissue accumulation [17, 23]. It was shown that the expression of glomerular TNF was inversely correlated with GFR in patients with DN and microalbuminuria [24]. Albuminuria may be due to the influence of TNF- α on the development of changes in the wall of glomerular capillaries and an increase in albumin permeability. However, it is possible that albuminuria selectively activates cytokines and increases TNF- α levels. It has previously been suggested that DN patients with CKD may experience decreased clearance of TNF- α [25]. Our study shows that in patients with class IIb and III, the maximum expression of TNF- α along the capillary loops is determined, and in the development of class IV, expression of the cytokine is not detected. This may confirm the data of other authors on damage to the capillary wall by expressed TNF- α . Using linear regression, we showed that the expression of TNF- α in the glomerular zone is a predictor of the rate of progression of mesangial expansion and the formation of nodular Kimmelstiel–Wilson lesions in the mesangial matrix, that is, a factor determining the rate of progression of glomerulosclerosis. Experimental animal models have shown that intrarenal production of TNF- α by renal parenchyma cells plays a role in the development of local inflammatory response and the formation of endothelial dysfunction, disrupting the distribution of adhesion receptors involved in intercellular adhesion and preventing the formation of F-actin stress fibers (F-actin). actin stress fibers). As a result, a restructuring of the intercellular junction and loss of endothelial permeability occurs [26]. The analysis by linear regression showed that the expression of TNF- α in the interstitial space plays a role in the development and progression

of hyalinosis of renal tissue arterioles and interstitial sclerosis. Our data confirm previously published research results that apoptosis of tubular cells is one of the main causes of the development of DN [27]. In 41.2% of patients with type 2 diabetes at the stage of microalbuminuria, pronounced tubulointerstitial changes develop [28]. Morphological tissue damage develops simultaneously in the arterioles, tubules, and interstitium and includes thickening of the tubular basement membrane, tubular atrophy, interstitial fibrosis, and atherosclerosis. It has therefore been hypothesized that the pathological reactions leading to DN may first develop in the peritubular microcirculation, where they induce oxidative damage with subsequent development of tubulointerstitial damage [29]. That is, the production of profibrogenic cytokines in the glomerulus and interstitium is an independent product. The results of our work are consistent with generally accepted ideas about the role of intrarenal TNF- α production as a predictor of the progression of tubulointerstitial sclerosis.

Conclusion. Glomerular expression of TNF- α plays a role in the development of mesangial matrix expansion and the formation of nodular Kimmelstiel–Wilson lesions in the glomerulus. Interstitial expression of TNF- α contributes to the progression of interstitial sclerosis and hyalinosis of arterioles in renal tissue. Taken together, intrarenal expression of TNF- α is one of the main mechanisms for the development of morphological changes in renal tissue in patients with DM and DN.

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细胞游离DNA水平对慢性心力衰竭患者的诊断意义
**DIAGNOSTIC SIGNIFICANCE OF THE LEVEL OF CELL FREE
DNA IN PATIENTS WITH CHRONIC HEART FAILURE**

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抽象的。该研究的目的是分析慢性心力衰竭患者血液中的无细胞 DNA 水平，并根据患者的临床特征确定所研究标记物的差异。

材料和方法。该研究包括 67 名被诊断为“慢性心力衰竭”的患者和 23 名健康志愿者组成的对照组。对患者中是否存在冠心病 (CHD) 以及射血分数 (EF) 和功能分级 (FC) 水平进行了分析。此外，还考虑了急性心肌梗塞 (AMI) 病史的存在。游离 DNA (cfDNA) 水平由 P.P. 测定。拉克季奥诺娃, S.N. 塔姆科维奇, E. Yu. 里科娃。

结果。该研究揭示了 CHF 患者和健康志愿者血浆 cfDNA 水平的差异。在不同 EF 和 FC 的患者中也发现了显著差异。在冠心病患者中，有心肌梗死病史导致 cfDNA 水平比冠心病稳定病程患者增加近 2 倍。此外，cfDNA 水平还受急性心肌梗死持续时间的影响，在恢复早期达到最大值。

结论。所揭示的模式使得将血浆中的 cfDNA 水平视为心血管疾病的生物标志物成为可能，从而提高了各种临床情况下的诊断准确性。

关键词: 无细胞 DNA、慢性心力衰竭、生物标志物、心肌梗死、心血管疾病。

Abstract. *The aim of the study was to analyze the level of cell free DNA in blood in patients with chronic heart failure and to identify differences in the studied marker depending on the clinical characteristics of the patient.*

Materials and methods. *The study included 67 patients with a diagnosis “chronic heart failure” and 23 healthy volunteers who made up the comparison group. Among the patients, an analysis was carried out for the presence of coronary heart disease (CHD), as well as the level of ejection fraction (EF) and functional class (FC). In addition, the presence of a history of acute myocardial infarction (AMI) was taken into account. The level of cell free DNA (cfDNA) was determined by P.P. Laktionova, S.N. Tamkovich, E.Yu. Rykova.*

Results. *The study revealed differences in plasma levels of cfDNA in patients with CHF and healthy volunteers. Significant differences were also found in*

patients with different EF and FC. Among patients with CHD, a history of MI leads to an increase in the level of cfDNA by almost 2 times compared with patients with a stable course of coronary artery disease. Also, the level of cfDNA is affected by the duration of acute myocardial infarction, reaching maximum values in the early recovery period.

Conclusion. *The revealed patterns make it possible to consider the level of cfDNA in blood plasma as a biomarker of cardiovascular diseases, which increases diagnostic accuracy in various clinical situations.*

Keywords: *cell free DNA, chronic heart failure, biomarkers, myocardial infarction, cardiovascular disease.*

Chronic heart failure (CHF) is a clinical syndrome that develops as a consequence of many cardiovascular diseases. Being the final stage of the cardiovascular continuum [1], CHF significantly worsens the patient's prognosis, increases the risk of hospitalization due to decompensation of CHF itself and, thus, remains an important social and economic problem. It is obvious that optimal treatment of diseases leading to the development of CHF such as arterial hypertension (AH) and coronary heart disease in order to prevent decompensation remains among the highest priorities in the healthcare sector [1,2].

The main laboratory indicator used to verify the diagnosis is brain natriuretic propeptide (NT-proBNP) [2]. However, it should be remembered that this marker does not have absolute specificity and can change in a number of other non-cardiovascular pathologies [3]. Therefore, the active search for new biomarkers of CHF continues at the present time. Indicators such as stimulating growth factor sST2 and galectin-3 have been known for a long time and are included in the clinical guidelines for the management of patients with CHF of the American Society of Cardiology [4]. One of the latest trends has been the study of cell free DNA in cardiovascular diseases. There are studies showing the diagnostic significance of cfDNA levels in the blood of patients with AH, CHD and CHF [5,6]. There are interesting results that show the level of cfDNA in patients with acute myocardial infarction more accurate for assessing the prognosis than the dynamics of troponins [7]. Works on studying the level of cfDNA in the blood of patients with CHF are few [8] and do not take into account such important criteria as the etiological factor in the development of CHF, whether the course of the underlying disease is stable or whether there has been, for example, an acute coronary event.

Thus, the study of the diagnostic potential of the cfDNA level, as one of the potential biomarkers of CHF, is certainly relevant.

Purpose of the study: to compare the level of cfDNA in the blood plasma of patients with CHF and in a group of healthy volunteers, as well as to analyze changes in the level of cfDNA depending on the clinical characteristics of the patient.

Materials and methods

The study included 67 patients with a previously established diagnosis of CHF, who were under follow-up care by a cardiologist. Of these, 26 were women and 41 were men (average age 68 ± 4.1 years). Verification of the diagnosis of “CHF” was carried out on the basis of a set of clinical, laboratory and instrumental criteria of the disease, according to the Russian clinical guidelines for the management of patients with CHF [2]. The control group consisted of 23 healthy volunteers (Control) without established chronic diseases (average age 21.5 ± 4.4 years).

Inclusion criteria: signed informed voluntary consent of the patient to participate in the study, age from 50 to 80 years, established diagnosis of CHF.

CHF IV FC according to the New York classification (NYHA), CHF stage III according to the classification of N.D. Strazhesko, V.Kh. Vasilenko, obesity degree 2 or more (BMI >35 kg/m²), underweight (BMI <18.5 kg/m²), as well as a history of malignant neoplasm, acute cerebrovascular accident or transient ischemic attack less than 6 months old, chronic kidney disease stage 3B or more, diseases of the immune system, any chronic pathology in the acute stage were exclusion criteria.

All subjects underwent a gender and age assessment, analysis of risk factors, anthropometric indicators with calculation of body mass index (BMI). In patients with CHF, general and biochemical blood tests were performed to determine NT-proBNP, lipid profile, glucose and creatinine, as well as a general urine test. In addition, an instrumental examination was performed, including electrocardiography (ECG), echocardiography (ECHO-CG), fundus examination, renal ultrasound, chest X-ray, and a 6-minute walk test to assess functional class.

Among all patients, a subgroup with the presence of CHD was identified. The diagnosis of CHD was confirmed by non-invasive imaging methods (stress-echocardiography or multislice-computed tomography coronary angiography) or invasive coronary angiography. The choice of method was carried out taking into account the clinical situation: stable patients with a presumptive diagnosis of coronary artery disease were referred to non-invasive methods of examination, and the choice of a specific procedure depended on the individual characteristics of the patient, while in the event of an acute coronary event, patients were hospitalized in the hospital for invasive coronary angiography. After discharge from the hospital, patients continued outpatient monitoring with a cardiologist. Thus, it was also possible to analyze this subgroup for a history of AMI.

CfDNA was isolated from blood serum according to the method of P.P. Laktionova, S.N. Tamkovich, E.Yu. Rykova [9]. To quantify DNA, 75 μ l of DAPI (1 μ g per 1 ml in McLavain buffer, pH = 6.8) was used; fluorescence was measured on a Spekol spectrofluorimeter (excitation wavelength 360 nm, emission wavelength 480 nm). The calibration curve was constructed using a standard solution of fragmented calf thymus DNA (Sigma-Albrich) from 20 to 500 ng.

The research results were processed using Microsoft Office Excel (2007) and Statistica SPSS 17. The normality of the distribution of variation series was assessed using the Kolmogorov-Smirnov test. For parameters not subject to normal distribution, statistical hypotheses were tested using nonparametric tests: the Mann-Whitney U-test (pairwise comparison of independent samples) and the Kruskal-Wallis test (for comparison of multiple samples). For variation series subject to normal distribution, statistical hypotheses were tested using ANOVA analysis of variance and Student's parametric t-test for unrelated samples. Quantitative data in the study are presented with calculation of the median and interquartile range – Me [25L; 75U], as well as as the arithmetic mean value \pm error of the mean (M \pm m). For multiple comparisons, differences were considered statistically significant at $p < 0.01667$, taking into account the Bonferroni correction; in all other cases, statistical significance was taken into account when the probability of statistical error was less than 5% ($p < 0.05$).

Results

According to the results obtained, a significant increase in the level of cfDNA was established in the group of patients with CHF relative to healthy volunteers (Control) ($p = 0.00$). The average cfDNA level among patients with CHF was 273.5 ± 25.26 ng/ml, in the control group 53.7 ± 3.5 ng/ml. Thus, the cfDNA level in patients with CHF is 5 times higher than that in the control group.

To assess exercise tolerance and establish FC, all patients underwent a 6-minute walk test according to the standard method [10]. The results obtained are presented in Table 1.

Table 1
CfDNA in patients with CHF with different FC

| FC | Amount (n) | cfDNA ng/ml (M \pm m) | p |
|-----|------------|-------------------------|----------------|
| I | 16 | 141,9 \pm 26,3 | |
| II | 30 | 221,1 \pm 24,8 | 0,023* |
| III | 21 | 447,7 \pm 51,7 | 0,00* 0,00# |

Note:

* – differences are statistically significant compared with group of FC I, $p = 0,03$

– differences are statistically significant compared with group of FC II, $p = 0,00$

When assessing the level of cfDNA in patients with CHF, it was revealed that the level of this indicator increases with a decrease in exercise tolerance.

According to the EF level, all patients were divided into three groups: with preserved ($\geq 50\%$), intermediate (40–49%) and reduced ($< 40\%$) ejection fraction. Within each of these groups, a division was made taking into account the ischemic

and non-ischemic etiology of CHF. The results of cfDNA levels in each group are presented in Table 2, Table 3.

Table 2

The level of cfDNA depending on EF in patients with ischemic CHF

| EF | Amount (n) | cfDNA ng/ml |
|---|------------|--|
| ≥50 % | 14 | 125[81,5;125] |
| 40-49 % | 14 | 195[173;250] * U=21,5 p=0,00048 |
| <40 % | 10 | 507,5[500;818,7] * U=0 p<0,00001 # U=1 p<0,00001 |
| Kruskal-Wallis (differences between all groups in EF) | | H=28,09 p<0,00001 |

Table 2

The level of cfDNA depending on EF in patients with non-ischemic CHF

| EF | Amount (n) | cfDNA ng/ml |
|---|------------|---|
| ≥50 % | 11 | 77[70,25;125] |
| 40-49 % | 11 | 220[195;335] * U=3 p= 0,00028 |
| <40 % | 8 | 500[500;515] * U=0,5 p= 0,00052 # U=0,85 p= 0,00386 |
| Kruskal-Wallis (differences between all groups in EF) | | H=21,58 p<0,00002 |

Note:

* – differences in comparison with the EF group ≥50%:

in patients with CHF of ischemic etiology (for EF=40-49%: U=3, p=0.00, for EF<40%: U=0, p=0.00; H=28.09, p=0.00);

in patients with CHF of non-ischemic etiology (for EF=40-49%: U=21.5, p=0.00, for EF<40%: U=0.5, p= 0.00; H=21.58 p=0.00);

- differences in comparison with the group EF = 40-49%:

in patients with CHF of ischemic etiology U=1, p=0.00; H=28.09, p=0.00;

in patients with CHF of non-ischemic etiology U=0.85, p=0.00; H=21.58 p=0.00.

The identified values allow us to conclude that there is a significant difference within the studied groups. Statistically significant differences were found between the subgroups according to the EF-criterion both in patients with ischemic etiology of CHF and in patients with non-ischemic origin, namely, a decrease in EF is accompanied by an increase in the level of cfDNA.

Among patients belonging to the CHD subgroup, an analysis of cfDNA levels was carried out depending on the presence of a history of AMI. In the group with AMI, 25 patients were examined, the average cfDNA value was 328.8 ± 52.3 ng/ml. There were 14 people in the group without a history of myocardial infarction, the average cfDNA level was 183.4 ± 31.7 ng/ml (the differences are statistically significant compared to the AMI group, $p=0.02$).

The results obtained reflect a significant difference in cfDNA levels among patients suffering from coronary artery disease, depending on the presence of a history of AMI. Thus, an acute coronary event leads to an increase in cfDNA levels by almost 2 times compared to the group with a stable course of coronary artery disease.

An important characteristic is the duration of myocardial infarction. According to this criterion, all patients with AMI were divided into 2 groups: less than 6 months ($n=12$, average duration 3.75 ± 0.3 months), 6 or more months ($n=13$, average duration 12.46 ± 1.09 months). The average cfDNA level in the first group was 440.8 ± 87.6 ng/ml, in the second one 225.5 ± 46.5 ng/ml (the differences are statistically significant compared to the group with AMI less than 6 months old, $p=0.04$). Thus, it was revealed that in the earlier recovery period the cfDNA indicator is 2 times higher than that in the period of 6 months or more.

The discussion of the results

The initial stage of this work was to compare cfDNA values in groups of patients with CHF and controls, with the aim of initially assessing the diagnostic potential of this biomarker, since even in the absence of any pathology, the level of cfDNA in the blood may increase. Normally, cfDNA is present in biological fluids (plasma, urine, cerebrospinal fluid), and its content increases under certain physiological conditions (during physical activity, with age). Moreover, fluctuations in the level of cfDNA in a healthy body are in the range of 10-100 ng/ml [11]. However, in various cardiovascular pathologies, as a result of apoptotic death of cardiomyocytes, a massive release of cfDNA into the bloodstream occurs [12], which leads to a significant increase in its level. In the study, the control group was represented mainly by individuals in the age range of 20-22 years, whose cfDNA level was within the established physiological values. The analysis revealed a significant difference in the level of cfDNA between healthy volunteers and people with cardiovascular pathology, while the presence of an older group of patients with an established diagnosis of CHF is consistent with the available data on the onset of heart failure in people over 60 years of age [1].

The level of EF and the FC indicator significantly influence the concentration of cfDNA in the patient's blood. The study found an increase in the levels of both biomarkers against the background of a decrease in cardiac output and exercise tolerance.

The etiology of CHF plays an important role in choosing the optimal treatment tactics. It is known that the main causes of the development of CHF are CHD and AH [1], and in approximately one third of cases their combination occurs [2]. In the study group, patients with coronary artery disease (n=39) prevailed over patients without established coronary atherosclerosis (n=28).

It should be noted that the presence of AMI is an additional aggravating factor, the importance of which has increased in recent years [13]. The data obtained during the study also indicate that the level of cfDNA in the subgroups of post-AMI significantly exceeds the level in the comparison groups.

The duration of AMI is of particular importance. It is known that the maximum death of cardiomyocytes occurs on the first day from the onset of the acute process, which leads to a sharp increase in the levels of the main markers of myocardial necrosis in the blood: MB fraction of creatine phosphokinase (CPK-MB), myoglobin, high-sensitivity troponins T, I [14]. Further, their concentration gradually decreases, and each of the indicators has its own dynamics of decline. A study conducted by A. Shimony et.al (2010) found that the value of cfDNA in patients with AMI correlates with the level of troponin and CPK-MB, while the level of cfDNA more accurately reflects the severity of myocardial damage. Obviously, the most pronounced damage occurs in the early post-infarction period, therefore the levels of cfDNA in these patients are higher than in patients in late recovery periods. The average cfDNA values identified during the analysis of patients by duration of AMI demonstrate that the studied indicator in patients with a duration of AMI up to 6 months compared to the subgroup of a later post-infarction period - 6 or more months - is 2 times higher.

Conclusion

The study revealed a significant difference between the level of cfDNA in patients suffering from CHF and the control group. In addition, it was determined that an increase in cfDNA content is accompanied by a deterioration in objective indicators, namely a decrease in EF and exercise tolerance - FC. Differences in cfDNA levels have been established in patients who have suffered a myocardial infarction, and the cfDNA level is also affected by the duration of the acute coronary event: a shorter duration of myocardial infarction is accompanied by a higher cfDNA content.

Conflict of interest. The authors state that this work, its theme, subject and content do not affect competing interests.

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连续法炉加热过程中轧钢温度状态的建模

MODELING OF THE TEMPERATURE STATE OF ROLLED STEEL DURING HEATING IN CONTINUOUS METHODICAL FURNACES

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抽象的。 本文提出了一种有限元模型来计算轧机5000连续热炉热处理过程中轧制板的温度状态。 已确定金属加热到950°C的时间可以从1.5h缩短到0.8h, 860°C的时间可以从1.5h缩短到0.85h, 同时保证中心所需的温度。 轧制产品的层数。 在热处理模式的设计和调整中使用所提出的模型将通过最小化金属在炉中的加热时间来提供最大的工艺能源效率。

关键词: 钣金、钢材热处理、热场、有限元计算机建模、DEFORM-3D。

Abstract. *The paper proposes a finite element model for calculating the temperature state of rolled sheets during heat treatment in continuous thermal furnaces of mill 5000 was performed. It has been established that the time of metal heating to a temperature of 950 °C can be reduced from 1.5h to 0.8h, and at a temperature of 860 °C from 1.5h to 0.85h, while ensuring the required temperature of the central layers of rolled products. The use of the proposed model in the design and adjustment of heat treatment modes will provide maximum energy efficiency of the process by minimizing the metal heating time in the furnace.*

Keywords: *sheet metal, heat treatment of steel, thermal field, finite element computer modeling, DEFORM-3D.*

Introduction

To control the processes of heat treatment, carried out in heating furnaces, first of all, it is important to objectively evaluate the heat transfer processes in the working space of individual zones of the furnace and obtain information about the

temperature of the metal. In through-type units, the temperature regime is controlled using zonal thermocouples that measure a certain average temperature in the furnace zone. The temperature of the metal is measured at the exit from the furnace superficially, and with insufficient heating time, the temperature of the inner layers can be significantly lower. A correctly chosen rate of sheet movement through the furnace zones will ensure uniform heating, achieve the required mechanical properties at the furnace outlet [1], ensure uniform distribution of heat loads over the furnace zones, and maximize the energy efficiency of the heat treatment process. However, the selection of these parameters using an industrial experiment requires significant costs of materials and time.

Thus, the aim of the study is to develop a finite element model of metal heating in continuous thermal furnaces of plate mill 5000 to ensure maximum energy efficiency of the heat treatment process.

Methodology

When metal is heated in furnaces, a non-linear non-stationary process of heat conduction takes place, when the temperature field in the body changes not only in space, but also in time. The mathematical description of thermophysical processes occurring inside a heated solid is carried out by differential equations of heat conduction taking into account the uniqueness conditions (geometric, physical and boundary) [2]. The main parameter characterizing the intensity of heat transfer between the surface of the body and the environment, as well as taking into account the specific conditions for this process, is the heat transfer coefficient. Determining its value is the main task of heat transfer calculation.

Analytically, the heat transfer coefficient is determined from the criterion equations obtained by transforming the differential equations of heat conduction and various types of heat transfer. According to studies [3-13] the heat transfer coefficient by convection can be calculated by the formula:

$$\alpha_{\text{conv}} = \frac{\text{Nu} \cdot \lambda_{\text{air}}}{l}$$

where Nu – Nusselt criterion which is characterizing the similarity of heat transfer processes; λ_{air} - thermal conductivity of air; l - characteristic size.

The heat transfer coefficient by radiation can be calculated through the heat flux density by the formula:

$$\alpha_{\text{rad}} = \frac{Q}{F * (T_{\text{g}} - T_{\text{Me}})}$$

where Q – thermal flux; F – radiating surface area; T_{g} and T_{Me} – gas and metal temperatures, respectively.

The total heat transfer coefficient in the working space of the furnace will be equal to the sum of the heat transfer coefficients by radiation and convection from the heating devices and the furnace lining [14-19]:

$$\alpha_{tot} = \alpha_{rad.p} + \alpha_{conv.p} + \alpha_{rad.l} + \alpha_{conv.l}$$

where $\alpha_{rad.p}$ and $\alpha_{conv.p}$ - heat transfer coefficient by radiation and convection of radiant tubes; $\alpha_{rad.l}$ and $\alpha_{conv.l}$ - heat transfer coefficient by radiation and convection of lining.

The material under study is low-carbon low-alloy steel of original chemical composition developed at the Nosov Magnitogorsk State Technical University.

The duration of metal heating in thermal furnaces was calculated in accordance with the formula used in the mill 5000 of PJSC «Magnitogorsk Iron and Steel Works»:

$$\tau = (k * h) + b$$

where k – coefficient of metal heating time to a given temperature; h – sheet thickness, mm; $(k * h)$ – the time for the metal to reach the set temperature; b – metal holding time at a given temperature, min.

As a result of the calculation, the temperature distribution fields were obtained, the evaluation of which was carried out for the cross section of the sheet.

Results

The initial temperature of the furnace in the simulation is assumed to be 860 and 950 °C. The metal temperature before heating was 20 °C. Simulation parameters are presented in Table 1.

Table 1
Initial parameters of the model

| № regime | Heating temperature, °C | Sheet dimensions | | | Specific heating time |
|----------|-------------------------|------------------|-----------|------------|-----------------------|
| | | thickness, mm | width, mm | length, mm | |
| 1 | 950 | 10 | 2000 | 6000 | 1,5h+5 |
| 2 | 860 | | | | 1,5h+5 |

The change in the temperature of the sheet along the length of the furnace at different heating times is shown in Figure 1. The vertical dotted line indicates the calculated point of the beginning of steel holding.

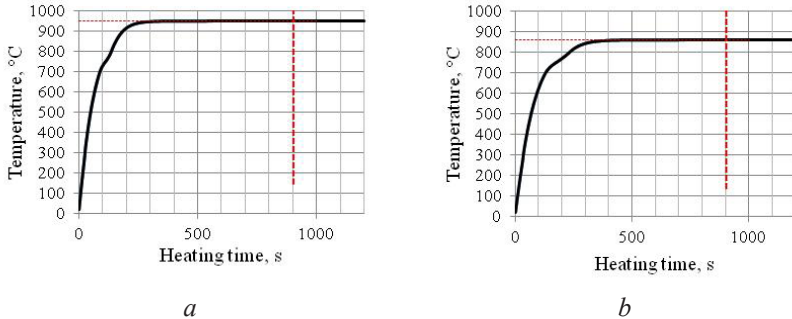


Figure 1. Change in temperature of the rear end of the sheet along the length of the furnace, depending on the heating time:
a - scheme №1 (temperature 950 °C in furnace zones, specific heating time 1.5h + 5)
b - scheme №2 (temperature 860 °C by furnace zones, specific heating time 1.5h + 5)

As a result of modeling, it was found that the output of the central layers of the metal to the specified heating temperature occurs approximately after 300 s at a furnace temperature of 950 °C and after 400 s at 860 °C, which is 35-45% of the total specified heating time ($k = 1.5$). It can be noted that at a higher temperature of the working space of the furnace, the output of the central layers of metal to a given temperature occurs at a high speed (all other things being equal).

When searching for the minimum coefficient k , it was assumed that the estimated heating time should ensure that the central layers reach the heat treatment temperature by the time the metal is held at a given temperature. Simulation parameters are presented in Table 2.

Table 2
Simulation parameters

| № regime | Heating temperature, °C | Sheet dimensions | | | Specific heating time |
|----------|-------------------------|------------------|-----------|------------|-----------------------|
| | | thickness, mm | width, mm | length, mm | |
| 3 | 950 | 10 | 2000 | 6000 | 0,80h+5 |
| 4 | 860 | | | | 0,85h+5 |

The change in the temperature of the sheet along the length of the furnace with the corrected heating time is shown in Figure 2. The vertical dotted line indicates the calculated point of the beginning of steel holding.

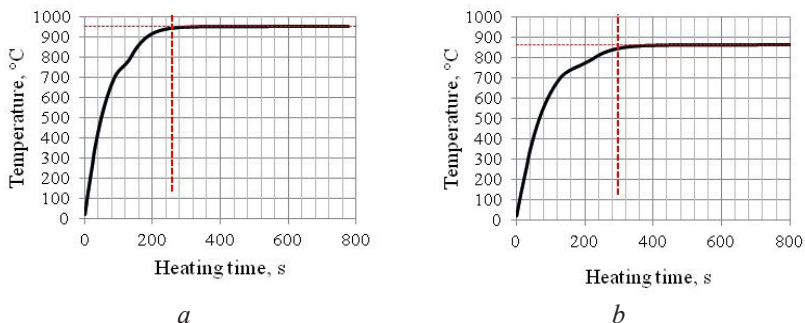


Figure 2. Change in the temperature of the rear end of the sheet along the length of the furnace, depending on the heating time:

- a* - scheme №3 (temperature 950 °C by furnace zones, specific heating time 0.80h + 5)
- b* - scheme №4 (temperature 860 °C in furnace zones, specific heating time 0.85h + 5)

By varying the coefficient k , it was found that its minimum value at a heating temperature of 950 °C was 0.80h, and at a temperature of 860°C - 0.85h.

Conclusions

1. A finite element model has been developed for calculating the thermal field of a sheet formed in the process of metal heating for heat treatment.
2. Simulation of the steel heating process at different values of the coefficient k showed the possibility of reducing the total heat treatment time and, as a result, increasing the energy efficiency of the process.
3. It has been established that the time of metal heating to a temperature of 950 °C can be reduced from 1.5h to 0.8h, and at a temperature of 860 °C from 1.5h to 0.85h, ensuring that the required heating temperature of the central layers of the metal is reached.

The work is carried out at the Nosov Magnitogorsk State Technical University with the financial support of the Ministry of Science and Higher Education of Russia as part of the implementation of a comprehensive project to create high-tech production (Agreement with the Ministry of Education and Science of Russia No. 075-11-2021-063 dated 06/25/2021).

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淬火方式对钢板应力状态影响的研究
**STUDY OF THE INFLUENCE OF HARDENING MODES ON THE
STRESS STATE OF SHEET STEEL**

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抽象的。 本文致力于研究淬火加热温度对冷却金属截面内应力分布的影响。作为建模的结果，显示了减小内部温度应力梯度的可能性，并且因此增加了淬火轧制金属的平整度。

关键词：金属板材、热处理、淬火、计算机建模、内应力、平整度。

Abstract. *The article is devoted to the study of the effect of heating temperature for quenching on the distribution of internal stresses over of the cross section of the cooled metal was made. As a result of modeling, the possibility of reducing the gradient of internal temperature stresses and, as a consequence increasing consequence increasing consequence increasing the flatness of quenching rolled metal is shown.*

Keywords: *sheet metal, heat treatment, quenching, computer modeling, internal stresses, flatness.*

Introduction

In the context of the increasing use of high-tech cutting methods, sheet metal should be characterized not only by a stable level of mechanical characteristics but also by high surface quality, geometry, and shape. The edges of the sheets during cutting can be deformed due to the relaxation of residual stresses, which are unevenly distributed over the volume of the metal. This leads to a significant distortion of the obtained parts and reduces the quality of metal processing in the conditions of machine-building enterprises. In this regard, the leading manufac-

turers of thick steel are solving the important problem of increasing the flatness of heat-treated rolled metal.

One of the effective ways to increase the flatness of rolled sheets subjected to quenching is to minimize the gradient of internal stresses that occur when the metal is cooled in a roller-quenching machine. Thus, it is relevant to study the effect of heating temperature on the level of stresses formed in the metal during quenching.

Methodology

For the study, a model of changes in the thermal state of rolled sheets during the cooling process, previously proposed by the authors, was used [1-3]. The elementary volume of the metal located on the longitudinal axis of the sheet was taken for calculations. The thickness of the reference sample was 10 mm. The number of elements of the tetrahedral mesh was 8000. Heat exchange with the cooling medium was specified for the upper and lower surfaces of the volume in the form of a heat transfer coefficient calculated depending on the metal temperature, water temperature, and water volume flow in the collector.

The duration of metal cooling with heat transfer coefficients specified for zones was calculated depending on the speed of metal passage through the corresponding section of the roller-quenching machine. As a result of the calculation, stress distribution fields were obtained, the evaluation of which was carried out for the cross section of the sheet. The material of the processed sheet is micro-alloyed steel. Poisson's ratio is 0.3. The type of the modeled object is elastoplastic. The calculation step was 5°C.

The range of temperatures under study (950, 900 and 850°C) was selected based on the analysis of the operating modes of production, as well as the technical characteristics of the equipment of mill 5000 of PJSC «Magnitogorsk Iron and Steel Works».

The water flow rates for the sections required to calculate the heat transfer coefficient are presented in Table 1. The temperature of the cooling water and the environment was 23°C. The speed of moving the sheet through the roller-quenching machine was 15 m/min.

Table 1
Water consumption by cooling sections

| Section number | Water consumption, m ³ /h | | | | |
|----------------|--------------------------------------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 |
| Top | 700 | 1200 | 750 | 1150 | 1000 |
| Bottom | 800 | 1300 | 1150 | 1150 | 1000 |

Results

The influence of the quenching temperature on the temperature distribution over the cross section of the cooled metal is shown in Figure 1. When the quenching temperature decreases from 950 to 850 °C (all other conditions are equal) the nature of the change in the temperature of the surfaces and the center of the sheet does not change. In this case, there is a general decrease in the temperature level in sections. So, for example, the temperature difference of the inner layers of the sheet when the temperature drops from 950 to 850°C at the outlet of the first collector is 70°C.

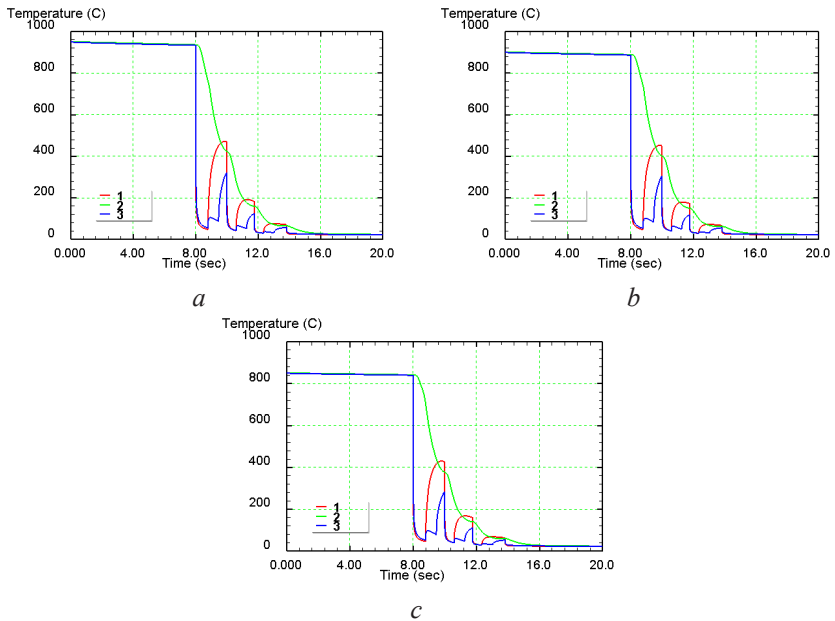


Figure 1. Temperature change of the metal during the quenching process:
a - 950 °C; *b* - 900 °C; *c* - 850 °C
 (1 - bottom surface; 2 - center; 3 - top surface)

Simulation of the stress state of sheets quenched from temperatures of 950, 900 and 850°C showed that lowering the heating temperature of the metal makes it possible to reduce the internal thermal stresses arising during the heat treatment of steel by about 30 MPa. At the same time, the nature of the stress distribution over the sheet section remains similar (Figure 2).

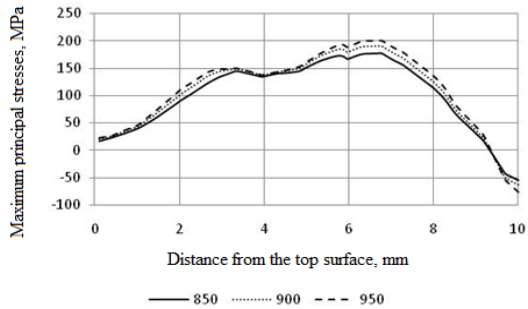
As follows from Figure 2, at the exit from the 1st cooling zone, the maximum temperature gradient across the sheet thickness is observed. This leads to the

formation of corresponding tensile stresses in the inner layers and compressive stresses on the surface. Thus, tensile stresses reach 200 MPa at a metal heating temperature for quenching of 950°C, and compressive stresses are minus 76 MPa, and at 850°C - 170 and minus 55 MPa, respectively.

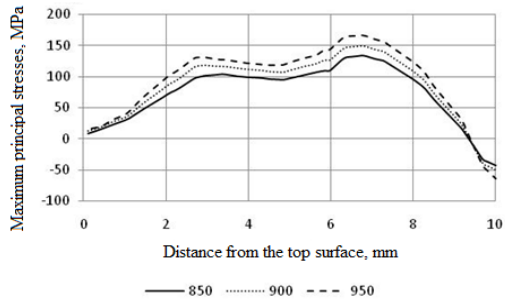
The considered parameters for collectors of the 2nd cooling zone are as follows:

- for a metal heating temperature of 950 ° C - tensile 140 MPa, compressive minus 50 MPa;
- for metal heating temperature of 850°C – tensile 110 MPa, compressive minus 27 MPa.

Compressive stresses are present only on the lower surface of the sheet. This can be explained by the fact that the upper layers of the metal have a relatively low temperature, while the level of tensile stresses in them is quite high. The lower layers, due to the absence of water on the surface, are heated to sufficiently high temperatures, and thus the resistance to deformation in them will be lower. The upper layers, due to high tensile stresses, compress the lower ones, which forms additional compressive stresses in them. This distribution of stresses leads to the formation of a longitudinal “hump” in industrial conditions.



a



b

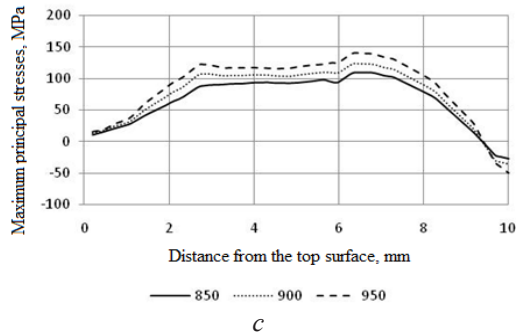


Figure 2. Distribution of maximum principal stresses over the sheet section:
a - at the outlet of collector № 1; *b* - at the outlet of collector № 2_1
c - at the outlet of the collector № 2_2

Conclusions

1. The influence of heating temperature for quenching on the level of stresses in the metal was assessed using finite element modeling in the DEFORM-3D software package.

2. It is shown that lowering the metal heating temperature for quenching makes it possible to reduce the internal thermal stresses arising in the process of steel cooling by approximately 30 MPa. At the same time, the maximum tensile stresses arising in the inner layers and the maximum compressive stresses arising on the metal surface are 200 and minus 76 MPa for the metal heating temperature of 950°C, respectively, and for 850°C, 170 and minus 55 MPa, respectively.

The use of the proposed model in the design of heat treatment modes will provide an opportunity to study the influence of various technological factors on the process of stress formation in the metal during cooling.

The work is carried out at the Nosov Magnitogorsk State Technical University with the financial support of the Ministry of Science and Higher Education of Russia as part of the implementation of a comprehensive project to create high-tech production (Agreement with the Ministry of Education and Science of Russia No. 075-11-2021-063 dated 06/25/2021).

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基于力学原理的交通事故模拟
**SIMULATION OF A TRAFFIC ACCIDENT BASED ON
MECHANICAL PRINCIPLES**

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抽象的。在这项工作中，考虑了创建数学模型的示例，并根据影响理论进行了计算：“人滑板车”和静止障碍物被视为交互对象

关键词：“人滑板车”、固定障碍物、车辆行为的数学建模、研究车辆运动过程的概率方法、复杂运动、不可改变的“人滑板车”系统、固定障碍物、直接、中心碰撞、绝对弹性碰撞、冲击冲量、冲击力、运动速度、冲击时间、恢复系数。

Abstract. In this work, an example of creating a mathematical model is considered and its calculation is carried out based on the theory of impact; “man-scooter” and a stationary obstacle are taken as objects of interaction

Keywords: “man-scooter”, stationary obstacle, mathematical modeling of vehicle behavior, probabilistic approach to studying the process of vehicle movement, complex movement, unchangeable “man-scooter” system, stationary barrier, direct, central impact, absolutely elastic impact, impact impulse, impact force, speed of movement, impact time, coefficient of restitution.

Nowadays, road accidents are the main problem associated with the increase in the number of cars, besides the problems of traffic management. The process of investigating a vehicle accident is an important task. Very often there is a need to determine a mechanical description of the behavior of a vehicle at each stage of its movement in order to determine the degree of responsibility of its participants in the process of investigating an accident. However, this is not always possible due to the lack or incompleteness of information about the characteristics of the route, on which modern analysis models are currently based. Acquiring a general and comprehensive model of vehicle movement in a crash is a major challenge at present. The proposed model will make it possible to predict the movement of a vehicle, taking into account a large array of variables based on a probabilistic approach, at each stage of complex movement based on the fundamental principles of mechanics.

To date, a large number of studies have already been carried out, however, the issues of mathematical modeling of the behavior of a vehicle during a traffic accident have not been fully studied, since this is associated with significant time and material costs. Agureev I.E., Afanasyev M.B., Babkov V.F., Borovskoy B.E., dealt with the issues of identifying the interrelations of the elements of the “Driver-Car-Road-Environment” system and signs of places of occurrence of road accidents. Gittis V.Yu., Evtyukov S.A., Evtyukov S.S., Zhankaziev S.V., Zyryanov V.V., Ilarionov V.A., Novikov A.N., Novikov I.A., Kravchenko P.A., Korchagin V.A., Klyavin V.E., Ryabokon Yu.A., Silyanov V.V., Suvorov Yu.B., Byatt R., Wong J., Collins D., Morris D., Watts R. et al. Analyzing the above works, the authors noted that there have been no studies related to mathematical modeling of the process of vehicle movement during a traffic accident based on a probabilistic approach.

The purpose of this work is to identify promising ways to improve the efficiency of using scientific knowledge in the investigation of road accidents based on a probabilistic approach to mathematical modeling of the vehicle movement process.

At the initial stage, the task is to develop a mathematical model of vehicle movement. As an example, consider the interaction of a person moving on a scooter at a certain speed \bar{v}_1 , with immovable barrier. We consider the “person-scooter” system to be unchangeable, where the masses of the person and the scooter are $m_{1.1}$ and $m_{1.2}$, respectively, therefore we consider it as body 1, the mass of which is $M_1 = m_{1.1} + m_{1.2}$. Body 2 is a stationary obstacle with a mass M_2 , that body 1 collides with, interacting with it at some point A. Let us take into account the forces acting on each of the bodies: $\bar{G}_{1.1}$, $\bar{G}_{1.2}$, \bar{G}_2 - the force of gravity applied to a person, a scooter, a fixed support, respectively. We will show the effect of gravity on the “man-scooter” system in the form of a vector \bar{G}_1 . Also, a driving force is applied to body 1 \bar{F} . It is necessary to determine the speed of body 1 \bar{u}_1 after a collision with a resting plate 2 as a result of interaction at point A, as well as the shock impulse \bar{S}_1 .

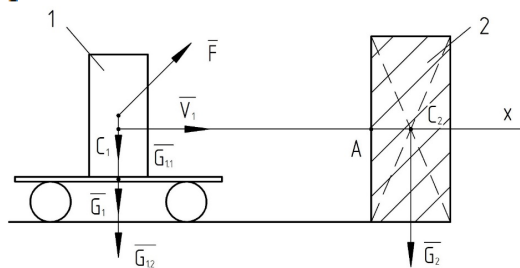


Figure 1. Mathematical model: scooter man and stationary obstacle

Considering the interaction of bodies as a direct, central impact, according to the theorem on the change in momentum upon impact

$$\overline{Q}_1 - \overline{Q}_0 = \Sigma \overline{S}_k^e \tag{1}$$

in projection onto the coordinate axis C_1x , taking into account that

$$\overline{Q}_0 = M_1 \overline{v}_1, \text{ a } \overline{Q}_1 = M_1 \overline{u}_1, \text{ we get}$$

$$M_1(u_{1x} - v_{1x}) = S_{1x}.$$

Because direct blow, then $u_{1x} = -u_1, v_{1x} = v_1, S_{1x} = -S_1$. Hence,

$$M_1(u_1 + v_1) = S_1. \tag{2}$$

The resulting equation contains 2 unknown quantities, so to solve the problem we apply the equality

$$k = \frac{u_1}{v_1}, \tag{3}$$

where k is the coefficient of recovery upon impact. In the case of a direct impact of a body on a stationary obstacle, the value of k is equal to the ratio of the velocity module at the end of the impact to the velocity module at the beginning of the impact. For bodies made of various materials, the recovery coefficient is determined experimentally and is given in the relevant reference books.

From the resulting equations, knowing M_1, v_1, k , we find the unknown quantities u_1 and S_1 . Applying equality (3), we obtain

$$u_1 = kv_1.$$

Wherein

$$S_1 = M_1(1 + k) v_1$$

To determine the average value of the impact force (reaction), it is necessary to additionally know the impact time τ , which can be found experimentally.

Let us add to the condition discussed above that the impact is absolutely elastic, i.e. $k=1$, then according to equality (3) the velocity modules of body 1 before and after interaction with the obstacle will be equal $u_1 = v_1$. It is necessary to determine the direction of the velocity vector of body 1 after the collision. Let us take into account that the impact forces acting between the bodies will be internal and $\Sigma \overline{S}_l^e = \mathbf{0}$, we apply equality (1). In projections onto the axis we get C_1x we get $Q_{1x} = Q_{2x}$, i.e.

$$M_1 u_{1x} + M_2 u_{2x} = M_1 v_{1x} + M_2 v_{2x}.$$

Since the support against which the moving body 1 hits is stationary, i.e. $v_{2x} = \mathbf{0}, u_{2x} = \mathbf{0}$, then $u_{1x} = v_{1x}, u_1 = -v_1$. The “-” sign indicates that the direction of the velocity vector of body 1 before the interaction is opposite to the direction of the velocity vector after it.

1 shock impulse acting on the body according to expression (3) is equal to

$$S_1 = -S_{1x} = -2 M_1 v_1.$$

From the resulting equality it is clear that the shock impulse is opposite to the direction of the velocity vector of body 1 before the collision.

Solving an extensive problem of constructing mathematical models of the process of vehicle movement and analyzing them on the basis of a probabilistic approach, relying on the fundamental principles of mechanics, we move “from simple to complex”: in this work, the author presents the simplest mathematical model of the interaction of a moving vehicle and a stationary obstacle as a direct central absolutely elastic impact. At the next stage of solving the problem, the author intends to consider other more complex models of interaction between road users, taking into account, among other things, the coefficient of friction of a moving vehicle on a surface, which can be soil, gravel, asphalt pavement, etc.

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数量乘积乘法函数的行为, 简单除数位于给定区间内
**BEHAVIOURS OF THE AMOUNTS PRODUCT MULTIPLICATIVE
 FUNCTION ON NUMBER, WHICH SIMPLE DIVISORS LIES IN
 GIVEN INTERVAL**

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抽象的。 在坚持的文章中, 找到了数量乘积乘函数的渐近公式, 其中简单除数位于给定区间内。

关键词: Amount 广义函数 Mangolidta、函数乘法、简单除数、积分方程、乘积、给定区间。

Abstract. *In persisting article is found asymptotic formula for amounts product multiplicative function on number, which simple divisors lies in given interval.*

Keywords: *The Amount generalised function Mangolidta, multiplicative to functions, simple divisors, integral equations, product, given intervals.*

In [1], the problem of the asymptotic behavior of sums of the form is solved

$$m_f(X^t) = \sum_{n_1 \cdots n_k \leq X^t} \frac{f_1(n_1) \cdots f_k(n_k)}{n_1 \cdots n_k},$$

where n_i – that part whose prime factors are all contained in the interval

$$[X^{\beta_{i-1}}, X^{\beta_i}], \quad 0 < \beta_1 < \beta_2 < \cdots < \beta_{k-1} < \beta_k = t, \quad \beta_i \text{ – are fixed } (i = \overline{1, k})$$

(dependence on $\beta_1, \beta_2, \dots, \beta_k$ not studied).

On the other hand, in [2] the sum was studied

$$M(X, Y_1, Y_2) = \sum_{\substack{n \leq X \\ p/n \rightarrow Y_1 < p \leq Y_2}} 1.$$

For $M(X, Y_1, Y_2)$ asymptotics is obtained

$$M(X, Y_1, Y_2) = \sigma(t_1, t_2) \frac{X}{\ln Y_1} + O\left(\frac{X}{\ln^2 Y_1}\right)$$

where $t_1 = \frac{\ln X}{\ln Y_1}$, $t_2 = \frac{\ln X}{\ln Y_2}$, $\sigma(t_1, t_2)$ satisfies the equation

$$t_2 \frac{\partial}{\partial t_2} \sigma(t_1, t_2) = -\sigma\left(t_1 \left(1 - \frac{1}{t_2}\right), t_2 - 1\right) \text{ for } t_2 > 1, t_2 \neq \frac{t_1}{t_1 - 1}, t_2 \neq 2.$$

This work is devoted to studying the behavior of the sum

$$m_f(X, Y_1, \dots, Y_{k-1}) = \sum_{n_1 \dots n_k \leq X} \frac{f_1(n_1) \dots f_k(n_k)}{n_1 \dots n_k}$$

where $1 = Y_0 < Y_1 < \dots < Y_{k-1} < Y_k = X$, n_i – a number whose prime factors all lie in the interval $(Y_{i-1}, Y_i]$, $i = \overline{1, k}$.

Let's put $Y_i = X^{\frac{1}{t_i}}$. Then in the notation [1] $\beta_i = \frac{t_i}{t}$.

Our main task is to study the sum $\text{mf}(X, Y_1, \dots, Y_{k-1})$ depending on X, t_1, \dots, t_{k-1} . It is not possible to apply the results of [1] because β_i now there is no fixed and unlimited.

We will consider sums of the form (1) $p/n_v \rightarrow X^{\frac{1}{t_{v-1}}} < p \leq X^{\frac{1}{t_v}}$,

$$Y_v = X^{\frac{1}{t_v}}, \quad t_v = \frac{\ln X}{\ln Y_v}, \quad v = \overline{1, k}, \quad \frac{1}{t_v} = 0, \quad t_k = 1, \quad t_1 > \dots > t_{k-1} > t_k = 1 \text{ and}$$

$1 = Y_0 < Y_1 < \dots < Y_{k-1} < Y_k = X$. It can be considered that when

$$t_1 > \dots > t_{v-1} > 1 > t_v > \dots > t_{k-1}, \quad m_f(X, Y_1, \dots, Y_{k-1}) = m_f(X, Y_1, \dots, Y_{v-1}).$$

Moreover, $f_1(n) = \varepsilon(n) = \begin{cases} 1, & \text{если } n = 1, \\ 0, & \text{если } n \neq 1 \end{cases}$, i.e. summation is carried out over

numbers all of whose prime factors are greater than Y_1 . It is assumed that there are complex numbers τ_v and also function $\rho_v(X)$ such that

$$\sum_{\substack{p^r \leq X \\ p \leq Y}} \frac{\Lambda_{f_v}(p^r)}{p^r} = \tau_v \ln \min(X, Y) + B_v + O(\rho_v(\min(X, Y))), \quad (2)$$

$$\prod_{Y \leq p \leq X} \left(1 + \sum_{r=1}^{\infty} \frac{|f_v(p^r)|}{p^r} \right) = o\left(\left(\frac{\ln X}{\ln Y} \right)^{A_v} \right). \quad (3)$$

Here $\rho_v(X) \rightarrow 0$ при $X \rightarrow \infty$, for $v = \overline{1, k}$, a $\Lambda_{f_v}(n)$ – generalized Mangold function defined by the relation

$$f_v(n) \ln n = \sum_{d|n} \Lambda_{f_v} \left(\frac{n}{d} \right) f_v(d).$$

Theorem 1. If $\rho_v(n)$, ($v = \overline{1, k}$) meet the conditions (2), (3) and

$$f_1(n_1) = \varepsilon(n_1) = \begin{cases} 1, & \text{если } n_1 = 1, \\ 0, & \text{если } n_1 \neq 1, \end{cases}$$

i.e. summation is carried out over numbers all of whose prime factors are greater than Y_1 . Then

$$\begin{aligned} & t_1 m_f(Y_1^{t_1}, Y_1, \dots, Y_{k-1}) - \int_0^{t_1} m_f(Y_1^{t_1}, Y_1, \dots, Y_{k-1}) du - \\ & - \sum_{v=2}^k \tau_v \int_{t_1 \left(1 - \frac{1}{t_v}\right)}^{t_1 \left(1 - \frac{1}{t_{v-1}}\right)} m_f(Y_1^u, Y_1, \dots, Y_{k-1}) du = o\left(\frac{\rho(Y_1)}{\ln Y_1} t_1^{A_2} \dots t_{k-1}^{A_k - A_{k-1}} \right). \end{aligned} \quad (3)$$

Proof. Let's use the definition $\Lambda_j(n)$ and transform the resulting amounts:

$$\sum_{n_1 \dots n_k \leq X} \frac{f_1(n_1) \dots f_k(n_k)}{n_1 \dots n_k} \ln n = \sum_{d_1 \dots d_k \leq X} \frac{f_1(d_1) \dots f_k(d_k)}{d_1 \dots d_k} \sum_{v=1}^k \sum_{\substack{p^\alpha < \frac{X}{d_1 \dots d_k} \\ Y_{v-1} < p \leq Y_v}} \frac{\Lambda_{f_v}(p^\alpha)}{p^\alpha},$$

because $\Lambda_j(n) = 0$ at n , not equal to the power of a prime number i.e.

$$\Lambda_f(n) = \begin{cases} \ln p^\alpha \sum_{m=1}^{\alpha} \frac{(-1)^{m-1}}{m} \sum_{k_1 + \dots + k_m = r} f(p^{k_1}) \dots f(p^{k_m}), & \text{if } n = p^\alpha, \\ 0, & \text{if } n \neq p^\alpha. \end{cases}$$

Based on (2), taking into account that $\tau_1 = 0$ at $f_1(n) = \varepsilon(n)$ and that $n = n_1 \dots n_k$, $f(n) = f_1(n_1) \dots f_k(n_k)$, we get

$$\begin{aligned} \sum_{n_1 \dots n_k \leq X} \frac{f_1(n_1) \dots f_k(n_k)}{n_1 \dots n_k} \ln n &= \sum_{v=2}^k \tau_k \left[\sum_{d \leq \frac{X}{Y_{v-1}}} \frac{f(d)}{d} \int_{Y_{v-1}}^{\frac{X}{d}} \frac{du}{u} - \sum_{d \leq \frac{X}{Y_v}} \frac{f(d)}{d} \int_{Y_v}^{\frac{X}{d}} \frac{du}{u} \right] + \\ &+ O \left(\sum_{v=2}^k |\tau_v| \rho_v(Y_{v-1}) \sum_{d \leq \frac{X}{Y_v}} \frac{|f(d)|}{d} \right). \end{aligned}$$

Using (2) and what $1 = Y_0 < Y_1 < \dots < Y_{k-1} < Y_k = X$, we get

$$\begin{aligned} \sum_{n_1 \dots n_k \leq X} \frac{f_1(n_1) \dots f_k(n_k)}{n_1 \dots n_k} \ln n &= \\ = \sum_{v=2}^k \tau_k \int_{Y_{v-1}}^{Y_v} m_f \left(\frac{X}{u}, Y_1, \dots, Y_{k-1} \right) \frac{du}{u} &+ O \left(\sum_{v=2}^k |\tau_v| \rho_v(Y_{v-1}) \sum_{d \leq \frac{X}{Y_v}} \frac{|f(d)|}{d} \right). \end{aligned} \tag{5}$$

Let's calculate the remainder separately.

$$\sum_{v=2}^k |\tau_v| \rho_v(Y_{v-1}) \sum_{d \leq \frac{X}{Y_v}} \frac{|f(d)|}{d} \ll \rho(Y_1) t_1^{A_2} \cdot t_2^{A_3 - A_2} \dots t_{k-2}^{A_{k-1} - A_{k-2}} \cdot t_{k-1}^{A_k - A_{k-1}}$$

because $f_1(n) = \varepsilon(n)$. Substituting the latter in (5) we find

$$\begin{aligned} \sum_{n_1 \dots n_k \leq X} \frac{f_1(n_1) \dots f_k(n_k)}{n_1 \dots n_k} \ln n &= \sum_{v=2}^k \tau_k \int_{Y_{v-1}}^{Y_v} m_f \left(\frac{X}{u}, Y_1, \dots, Y_{k-1} \right) \frac{du}{u} + \\ &+ O(\rho(Y_1) t_1^{A_2} \cdot t_2^{A_3 - A_2} \dots t_{k-2}^{A_{k-1} - A_{k-2}} \cdot t_{k-1}^{A_k - A_{k-1}}). \end{aligned}$$

For convenience, we introduce the notation $\overline{Y_1} = (Y_1, \dots, Y_{k-1})$.

By Abel summation we find

$$\sum_{n_1 \dots n_k \leq X} \frac{f_1(n_1) \dots f_k(n_k)}{n_1 \dots n_k} \ln n = m_f(X, \bar{Y}) \ln X - \int_1^X m_f(u, \bar{Y}) \frac{du}{u}.$$

Taking into account the latter we have

$$\begin{aligned} m_f(X, \bar{Y}) \ln X - \int_1^X m_f(u, \bar{Y}) \frac{du}{u} - \sum_{v=2}^k \tau_v \int_{Y_{v-1}}^{Y_v} m_f\left(\frac{X}{u}, \bar{Y}\right) \frac{du}{u} = \\ = O(\rho(Y_1) t_1^{A_2} \cdot t_2^{A_3 - A_2} \dots t_{k-2}^{A_{k-1} - A_{k-2}} \cdot t_{k-1}^{A_k - A_{k-1}}). \end{aligned}$$

After replacing the variable in the integrals, substituting for X the equal $Y_1^{t_1}$ and dividing both sides by $\ln Y_1$ and also taking into account that when $u \leq 1$

$$m_f(Y_1^u, \bar{Y}) = \sum_{n_1 \dots n_k \leq Y_1^u} \frac{f_1(n_1) \dots f_k(n_k)}{n_1 \dots n_k} = 1, \tag{6}$$

because $f_1(n) = \varepsilon(n)$, We arrive at the statement of Theorem 1.

Theorem 2. Let $f_\nu(n)$, $(\nu = \overline{1, k})$ satisfy the conditions of Theorem 1, then

$$m_f(X, Y_1, \dots, Y_{k-1}) = Z_{k-1}(t_1, \dots, t_{k-1}) + O\left(\frac{\rho(Y_1) t_1^{r_k-1}}{t_{k-1} \ln Y_1} \ln^\delta t_1\right),$$

where the function $Z_{k-1}(t_1, \dots, t_{k-1})$ is at $t_{k-j} > 1$ solving the equation

$$\begin{aligned} t_1 Z_{k-1}(t_1, \dots, t_{k-1}) - \int_0^{t_1} Z_{k-1}\left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}\right) du - \\ - \sum_{v=2}^k \tau_v \int_{t_1(1-\frac{1}{t_v})}^{t_1(1-\frac{1}{t_{v-1}})} Z_{k-1}\left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}\right) du = 0 \end{aligned} \tag{7}$$

with initial conditions

$$Z_{k-1}(t_1, \dots, t_{k-1}) = \begin{cases} Z_{k-2}(t_1, \dots, t_{k-2}) & \text{at } k \geq 3, t_{k-1} \leq 1, \\ 1 & \text{at } 0 < t_1 \leq 1, \\ 0 & \text{at } t_1 < 0, \end{cases} \tag{8}$$

that $Z_{k-1}(st_1, \dots, st_{k-1})$ continuous with s at $0 < s \leq 1$.

We will seek $m_f(Y_1^{t_1}, \bar{Y})$ as

$$m_f(Y_1^{t_1}, \bar{Y}) = Z_{k-1}(t_1, \dots, t_{k-1}) + \frac{\rho(Y_1)}{\ln Y_1} R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y}), \tag{9}$$

where $Z_{k-1}(st_1, \dots, st_{k-1})$ is at $t_{k-j} > 1$ continuous in s at $0 < s \leq 1$ solution of equation (7) with initial conditions (8). When we search $m_f(Y_1^{t_1}, \bar{Y})$ in the form (9), ball the difficulty is transferred to the problem of determining $R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y})$ and Z_{k-1}

(t_1, \dots, t_{k-1}) and can be chosen as you like. We choose $Z_{k-1}(t_1, \dots, t_{k-1})$ so that $Z_{k-1}(st_1, \dots, st_{k-1})$ is continuous in s at $0 < s \leq 1$ when solving equation (7). Then the equation for $R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y})$ will be simpler and easier to study $Z_{k-1}(st_1, \dots, st_{k-1})$

The initial conditions for $R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y})$ are determined as follows: from (9) at $f_1(n) = \varepsilon(n)$ we have

$$m_f(X, Y_1, \dots, Y_{k-1}) = m_f(Y_1^{t_1}, \bar{Y}) = Z_{k-1}(t_1, \dots, t_{k-1}) + \frac{\rho(Y_1)}{\ln Y_1} R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y}).$$

At $t_{k-1} \leq 1$ or $\frac{\ln X}{\ln Y_{k-1}} \leq 1$ or $X \leq Y_{k-1}$ we have

$$m_f(X, Y_1, \dots, Y_{k-2}) = Z_{k-2}(t_1, \dots, t_{k-2}) + \frac{\rho(Y_1)}{\ln Y_1} R_{k-2}(t_1, \dots, t_{k-2}, \bar{Y}).$$

If $t_{k-1} \leq 1$, to $Z_{k-1}(t_1, \dots, t_{k-1}) = Z_{k-2}(t_1, \dots, t_{k-2})$ and

$R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y}) = R_{k-2}(t_1, \dots, t_{k-2}, \bar{Y})$ at $k \geq 3$

If $0 < t_1 \leq 1$, then $Z_{k-1}(t_1, \dots, t_{k-1})$ and $R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y}) = 0$.

Substituting (9) into the statement of Theorem 1 and taking into account (7) (8) with $t_{k-1} > 1$ we get

$$t_1 R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y}) - \int_0^{t_1} R_{k-1}\left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}, \bar{Y}\right) du - \sum_{v=2}^k \tau_k \int_{t_1(1-\frac{1}{t_v})}^{t_1(1-\frac{1}{t_{v-1}})} R_{k-1}\left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}, \bar{Y}\right) du = O(t_1^{A_2} \cdot t_2^{A_3-A_2} \dots t_{k-1}^{A_k-A_{k-1}}) \quad (10)$$

with initial conditions $R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y}) = R_{k-2}(t_1, \dots, t_{k-2}, \bar{Y})$ at $k \geq 3$, $t_{k-1} \leq 1$ and $R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y}) = 0$ at $0 < t_1 \leq 1$

Now from (10) with $t_{k-1} > 1$ we get

$$t_1 |R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y})| \leq (1 + |\tau_2| + \dots + |\tau_k|) \int_0^{t_1} \left| R_{k-1}\left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}, \bar{Y}\right) \right| du + O(t_1^{A_2} \dots t_{k-1}^{A_k-A_{k-1}}).$$

Designating $r_k = 1 + |\tau_2| + \dots + |\tau_k|$, we get

$$t_1 |R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y})| - r_k \int_0^{t_1} \left| R_{k-1}\left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}, \bar{Y}\right) \right| du = O(t_1^{A_2} \dots t_{k-1}^{A_k-A_{k-1}}). \quad (11)$$

Replacing t_v with st_v ($v = \overline{1, k}$), dividing both parts by s^{r_k+1} and integrating from $\frac{1}{t_{k-1}}$ up to 1 s , we get

$$t_1 \int_{\frac{1}{t_{k-1}}}^1 \frac{|R_{k-1}(st_1, \dots, st_{k-1}, \bar{Y})|}{s^{r_k}} ds - r_k \int_{\frac{1}{t_{k-1}}}^1 \frac{1}{s^{r_k+1}} \int_0^{st_1} \left| R_{k-1}\left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}, \bar{Y}\right) \right| du ds =$$

$$= O \left(t_1^{A_2} \dots t_{k-1}^{A_k - A_{k-1}} \int_{\frac{1}{t_{k-1}}}^1 s^{A_k - r_{k-1}} ds \right).$$

Hence, at $t_{k-1} > 1$ we get

$$\int_0^{t_1} \left| R_{k-1} \left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}, \bar{Y} \right) \right| du = t_{k-1}^{r_{k-1}} \int_0^{\frac{t_1}{t_{k-1}}} \left| R_{k-1} \left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}, \bar{Y} \right) \right| du + O(t_1^{A_2} \cdot t_2^{A_3 - A_2} \dots t_{k-2}^{A_{k-1} - A_{k-2}} \cdot t_{k-1}^{r_{k-1} - A_{k-1}} \ln^{\delta_k} t_{k-1}).$$

Substituting this value into (11) and dividing by t_j , at $t_{k-1} > 1$ we get

Now let's make an induction assumption: if $r_{\mu} \geq A_{\nu}$, for $2 \leq \nu \leq \mu \leq k$, then

$$R_{\mu-1}(t_1, \dots, t_{\mu-1}, \bar{Y}) \ll t_1^{r_{\mu}-1} \ln^{\delta'} t_1 \quad \text{at } t_1 > 1, \tag{13}$$

$$\delta' = \left\{ \begin{array}{l} 1, \quad \text{if there is } \mu, \text{ that } A_{\mu} = r_{\mu}, \quad 2 \leq \mu \leq \kappa - 1, \\ 0, \quad \text{otherwise} \end{array} \right\}$$

At $\mu = 1$, $R_{\mu-1}(t_1, \dots, t_{\mu-1}, \bar{Y}) = 0$, $r_{\mu} = 1$ and that means (13) is satisfied.

Let us assume that (13) is satisfied for $\mu \leq \kappa - 1$.

Let us show that it is true at $\mu = \kappa$. To do this, we estimate the integral in (12):

$$\int_0^{\frac{t_1}{t_{k-1}}} \left| R_{k-1} \left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}, \bar{Y} \right) \right| du \ll \ln^{\delta'} t_1 \sum_{\mu=2}^{k-1} \left(\frac{t_1}{t_{\mu}} \right)^{r_{\mu}} \ll \frac{t_1^{r_{k-1}}}{t_{k-1}^{r_{k-1}}} \ln^{\delta'} t_1 \ll \frac{t_1^{r_k}}{t_{k-1}^{r_k}} \ln^{\delta'} t_1,$$

because $r_{\mu} \leq r_k$, $t_{\mu} \geq t_{k-1}$ at $\mu \leq k - 1$. Substituting this into (12) at $t_{k-1} > 1$ we get

$$R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y}) \ll \left(t_1^{r_{k-1}} \ln^{\delta_k} t_1 \right).$$

Before using this result, let us represent (10) in the form

$$\begin{aligned} & t_1 R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y}) - (\tau_k + 1) \int_0^{t_1} R_{k-1} \left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}, \bar{Y} \right) du = \\ & = \sum_{\nu=2}^{k-1} \tau_{\nu} \int_{t_{\nu} \left(1 - \frac{1}{t_{\nu}}\right)}^{t_1 \left(1 - \frac{1}{t_{\nu-1}}\right)} R_{k-1} \left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}, \bar{Y} \right) du + \\ & + \tau_k \int_{t_1 \left(1 - \frac{1}{t_{k-1}}\right)}^{t_1} R_{k-1} \left(u, \frac{ut_2}{t_1}, \dots, \frac{ut_{k-1}}{t_1}, \bar{Y} \right) du + O(t_1^{A_2} \cdot t_2^{A_3 - A_2} \dots t_{k-1}^{A_{k-1} - A_{k-2}} \cdot t_{k-1}^{A_k - A_{k-1}}). \end{aligned}$$

Solving the last equation, we get

$$R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y}) \ll \frac{t_1^{r_k-1} \cdot \ln^\delta t_1}{t_{k-1}}.$$

Substituting this estimate into (9) we obtain

$$\begin{aligned} m_f(Y_1^t, \bar{Y}) &= Z_{k-1}(t_1, \dots, t_{k-1}) + \frac{\rho(Y_1)}{\ln Y_1} R_{k-1}(t_1, \dots, t_{k-1}, \bar{Y}) = \\ &= Z_{k-1}(t_1, \dots, t_{k-1}) + \frac{\rho(Y_1)}{\ln Y_1} \cdot \frac{t_1^{r_k-1} \cdot \ln^\delta t_1}{t_{k-1}} \end{aligned}$$

or

$$m_f(X, \bar{Y}) = \sum_{n_1 \dots n_k \leq X} \frac{f_1(n_1) \dots f_k(n_k)}{n_1 \dots n_k} = Z_{k-1}(t_1, \dots, t_{k-1}) + O\left(\frac{\rho(Y_1)t_1^{r_k-1}}{t_{k-1}\ln Y_1} \ln^\delta t_1\right).$$

Theorem 2 is proven.

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纳米颗粒对提高采收率注入流体流动性的影响

EFFECT OF NANOPARTICLES ON THE MOBILITY OF INJECTED FLUID FOR ENHANCING OIL RECOVERY

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抽象的。二次采油过程中石油生产面临的主要挑战包括石油截留和高水流动性。因此,目前,提高石油采收率(EOR)被认为是进入第三次生产阶段后提高石油产量的关键解决方案。但EOR仍存在油藏条件下使用的化学品(聚合物和表面活性剂)降解、化学品用量大、成本高等缺陷。最近,纳米颗粒(NP)在EOR过程中的潜在应用受到了更多的关注,因为它们能够改变石油采收机制并释放油藏孔隙系统中被困的石油。本文概述了使用纳米粒子通过增加注入流体的粘度来提高石油采收率。

关键词: 纳米颗粒, 提高石油采收率, 流度比, 粘度。

Abstract. *The major challenges facing oil production during secondary recovery include oil entrapment and high water mobility. Hence, currently, Enhanced Oil Recovery (EOR) is considered a key solution for increasing oil production upon reaching the tertiary production phase. However, EOR still has its defects including the degradation of the chemicals (polymers and surfactants) used under reservoir conditions, large required volumes of chemicals, and their high cost. Recently, more attention has been focused on the potential applications of nanoparticles (NPs) in EOR processes due to their ability in changing oil recovery mechanisms and unlocking the trapped oil in the reservoir pore system. This paper provides an overview about the use of nanoparticles to enhance oil recovery by increasing the viscosity of injected fluids.*

Keywords: *Nanoparticles, Enhancing Oil Recovery, Mobility ratio, Viscosity.*

Most oil fields in Russia are developed by artificial water flooding of reservoirs. But even with all its effectiveness, more than half of the oil reserves remain unrecovered. The main reason behind the low sweep efficiency of injected water is the mobility ratio. Various EOR technologies have been applied and proven to significantly increase hydrocarbon recovery. These include thermal, raz and chemical methods, as well as some new technologies (microbial, low salinity flooding). More recently, nanoparticles have been proposed as a promising EOR agent. Owing to their unique characteristics from ultra-small size to very high surface to volume ratio, ending up with low cost and ecology, nanoparticles can penetrate the pore throat (porous media) and change the reservoir properties considerably to enhance oil recovery [1]. NPs are defined as particles formed by group of molecules bounded together with size ranges from 1 nm to 100 nm, and added to the injected base fluids such as water and gas as novel EOR agents. The most frequently used NPs, are SiO_2 , TiO_2 , NiO and Al_2O_3 (Figure 1).

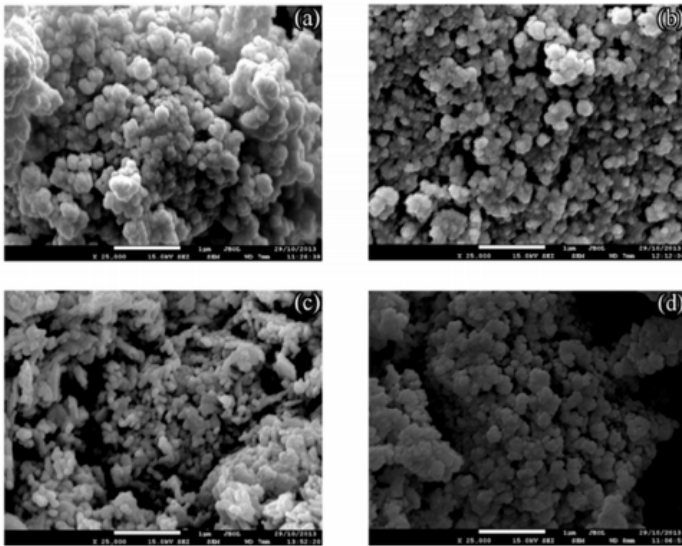


Figure 1. FESEM FESEM images of some commonly used NPs: (a) TiO_2 ; (b) Al_2O_3 ; (c) NiO ; (d) SiO_2 [2].

Recently, numerous studies have shown promising results of NPs application for enhancing hydrocarbon recovery. Laboratory experiments have shown that silica nanoparticles can stabilize emulsions and improve mobility control in the EOR process [3].

An important parameter for monitoring the mobility of the injected fluid is the “Mobility ratio”, one of the most critical factors to influence oil recovery efficiency. The Mobility ratio, M , is defined as the ratio of the mobility of the displacing fluid to that of the displaced fluid. This is represented mathematically in the following equation [4]:

$$M = \frac{\lambda_i}{\lambda_o} = \frac{\frac{K_i}{\mu_i}}{\frac{K_o}{\mu_o}} = \frac{K_i \mu_o}{K_o \mu_i},$$

where λ_i and λ_o are the mobilities of the injected fluid and oil, respectively. K_i and K_o are the relative permeabilities of the injected fluids and oil, respectively; μ_i and μ_o are the effective viscosities of the injected fluids and oil, respectively.

In a displacement process, a mobility ratio that is greater than 1 is considered unfavorable, while a mobility ratio that is less than 1 is considered favorable. The high mobility ratio easily causes viscous fingering of injected fluids within oil, poor conformance, poor sweep efficiency and early water breakthrough (Fig. 2).

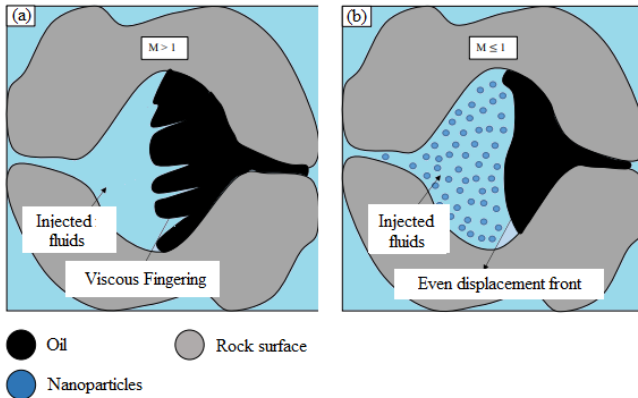


Figure 2. Effect of nanoparticles on the viscosity of the injected fluid. (a) injected fluid (water) without nanoparticles leads to an uneven displacement front (viscous fingering; $M > 1$). (b) nanofluids gives an even displacement front ($M < 1$) [5].

The mobility ratio can be decreased by viscosity reduction of oil phase or viscosity enhancement of injected fluids. Historically polymers are used to increase the viscosity of the displacing fluid (typically water) which reduce the mobility ratio. But this is limited when a high-salinity and high-temperature reservoirs are

encountered since the polymer hydrolyzes in these conditions leading to lower viscosity of the polymer solution. NPs can be employed as alternative additives to improve performance of injected fluid under harsh conditions. For instant, the results of the study by Shah and Rusheet [6] revealed that combining 1% CuO nanoparticles with CO₂ increased the viscosity of the resulting nanofluid 140 times of the normal CO₂. Jafari [7] also investigated the effect of combining silica nanoparticles with polymer on oil recovery in comparison with conventional water and polymer floodings and the highest recovery was observed with the combined process. The main reason behind the increasing in the viscosity of injected fluid can be explained in terms of a reduction in the mobility of adjacent fluid molecules around the nanoparticles.

The viscosity of a nanofluid is influenced by several factors, such as shear rate, temperature and NP concentration. For example, the viscosity of the SiO₂ nanofluid increases with decreasing shear rate. The increasing rate of its viscosity at lower temperature is higher than that at higher temperature [8].

Furthermore, the viscosity of nanofluids increases with increasing NP concentration and brine salinities. The type of NPs also affects the viscosity of nanofluids. At the same concentration, the viscosity of the SiO₂ nanofluid is higher than that obtained by the Al₂O₃ nanofluid [9]. Iron oxide also can increase the viscosity of the injected fluids causing the increase in the sweep efficiency [10].

Nanofluids can be used as a tertiary recovery technique to increase oil recovery of water or gas flooding. The mechanisms of the nanoparticle-enhanced oil recovery process however remain debatable, and more studies are required for a better understanding of the process.

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