



ДИАЛОГ КУЛЬТУР

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*Под общей редакцией заведующего кафедрой иностранных языков,
кандидата филологических наук, доцента
В. В. Кирилловой*

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Редакционная коллегия:

кандидат филологических наук, доцент, заведующий кафедрой иностранных языков
В. В. Кириллова (Санкт-Петербургский государственный университет промышленных технологий
и дизайна, Высшая школа технологии и энергетики);

кандидат педагогических наук, доцент кафедры английского языка № 2
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и дизайна, Высшая школа технологии и энергетики)

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SECTION 1. ECONOMICS AND SOCIAL DEVELOPMENT TRENDS

УДК 621.391

ASSESSING THE INFLUENCE OF 5G TECHNOLOGY ON CHINA'S MEGACITIES

Student **Sirotkina Viktoria Vladimirovna**,

Academic Advisor: Senior Lecturer **Marsheva Nataliia Vladimirovna**,

The Bonch-Bruevich Saint Petersburg State University of Telecommunications,
Saint Petersburg, Russian Federation

Abstract. This article explores the key strategies and outcomes of the deployment of 5G networks in three Chinese cities with populations over 10 million. It examines the technology's applications across various sectors and the socio-economic effects of 5G implementation. The study contributes to a broader understanding of how 5G technology shapes urban environments and highlights China's strategic importance in global 5G leadership.

Keywords: 5G networks, Chinese cities, urban life, socio-economic effects, government policies.

ОЦЕНКА ВЛИЯНИЯ ТЕХНОЛОГИИ 5G НА МЕГАПОЛИСЫ КИТАЯ

студент **Сироткина Виктория Владимировна**,

науч. руководитель: ст. преподаватель **Маршева Наталия Владимировна**,

Санкт-Петербургский государственный университет телекоммуникаций

им. проф. М. А. Бонч-Бруевича,

Санкт-Петербург, Российская Федерация

Аннотация. В статье анализируются основные стратегии и значение развертывания сетей 5G в трех китайских мегаполисах с населением свыше 10 миллионов человек. Особое внимание уделено применению технологий 5G в различных отраслях экономики и их влиянию на социально-экономическое развитие городов.

Ключевые слова: технология 5G, Китай, инфраструктура города, государственная политика, развертывание сетей 5G.

China is leading the world in the rollout of 5G technology. According to the Ministry of Industry and Information Technology of the People's Republic of China, by the end of August 2024, there were more than 4.04 million 5G base stations in the country, which is 60 % of all 5G base stations deployed worldwide. It accounts for 32.1 % of the total number of mobile base stations in the country, and 966 million registered 5G mobile subscribers [1]. In recent years, the expansion of China's 5G network has been rapid and extensive. Now it covers all cities and counties, as well as

more than 90 % of administrative villages. The Chinese authorities have ambitious plans to further enhance the 5G network and extend its coverage to cultural, medical, educational, and transportation facilities across the country.

The research aims to explore the key strategies and outcomes of 5G implementation in major Chinese cities. This study is relevant as it investigates the societal impacts of 5G, including both positive impact and potential challenges, thereby contributing to a broader understanding of how technology reshapes urban life. In order to comprehensively analyze the deployment and results of 5G technology in China, the following tasks were planned: to make the literature review to understand the current landscape of 5G implementation; to choose representative cities known for their 5G initiatives; to examine government policies and regulations that support 5G roll out; to evaluate the socio-economic impacts of 5G technology. The methods include literature review, case study and policy analysis, qualitative and quantitative methods to evaluate socio-economic changes due to 5G deployment.

5G technology is currently one of the most relevant and innovative sectors of mobile communications development. It is characterized by significant improvements over previous generations: the bandwidth is increased by 10-100x, reaching up to 10 Gbit/s for download and 5 Gbit/s for upload, with traffic consumption of up to 500 GB/month per subscriber. The number of simultaneously connected devices increases 10-100 times, accommodating up to 1 million devices/km², while the data transmission delay decreases from 10 to 1 ms. 5G networks are expected to be particularly in demand in industries. They are manufacturing for process automation and remote control, smart home and smart city infrastructure for networking devices, cloud technologies for fast data transfer and processing, virtual and augmented reality for interactive learning and engineering processes, healthcare and medicine for remote consultation and patient monitoring, and transportation and logistics for traffic optimization and use of autonomous vehicles [2].

For the case study, three cities, Beijing, Shanghai and Guangzhou, were selected to explore China's experience in deploying 5G networks in the largest cities with a population of more than one million. The selection of these three cities was based on several key factors:

- These three cities are China's largest megacities, each with a population of more than 10 million. They represent the most developed and densely populated urban centers, creating a high demand for advanced telecommunications technology.
- Beijing, Shanghai and Guangzhou are China's leading financial, business and industrial centers. The successful deployment of 5G in these cities is of great strategic importance in strengthening China's economic leadership.
- As major metropolitan areas, these cities have high-tech infrastructure and skilled human resources, creating favorable conditions for the early and efficient deployment of 5G networks. As of December 2022, 5G networks cover 98 % of the metropolitan area (12 million subscribers) in Beijing, 95 % of the urban area (15 million subscribers) in Shanghai, and 90 % of the urban area (10 million subscribers) in Guangzhou [3].

– The experience of 5G deployment in these giant cities can serve as a template and model for other cities in China and around the world, given their scale and leadership.

Based on the studied sources, the areas of 5G network implementation in the urban structure were analyzed.

In Beijing, for example, 5G technology is making a big difference in the city's infrastructure. It is being used to enhance street lighting, streamline parking, and improve traffic management systems. In healthcare, 5G is helping hospitals share medical information more efficiently and monitor patients remotely. Educational institutions are also benefiting, as 5G makes it easier for students and teachers to access resources and communicate effectively.

Over in Shanghai, 5G is driving innovation in Industry 4.0. The city is using this technology to create smart production lines and automate various processes in manufacturing. Medical facilities are taking advantage of 5G for remote consultations and real-time data sharing. The transportation sector is seeing improvements as well, with smart city initiatives enhancing traffic management and safety measures.

In Guangzhou, 5G is optimizing traffic flow and managing freight logistics through the use of high-resolution cameras and sensors. Telemedicine is gaining popularity here too, allowing patients to consult with doctors remotely. Additionally, city services are utilizing 5G to monitor public safety and manage energy efficiency. Industries are starting to embrace 5G as well, using it to automate operations and monitor equipment performance.

China's experience study demonstrates that 5G technology promises significant benefits in a variety of areas for residents living in urban areas, including transportation, healthcare and smart city initiatives (Table) [4].

Table – Benefits of 5G for urban residents

Sector	Benefits
Telecommunications Entertainment Media	Ultra-fast internet speeds, ultra-fast downloads and streaming of high-quality content, including VR, AR, and UHD video
Manufacturing	Enhanced smart factory operations, real-time monitoring, predictive maintenance, and cost savings
Healthcare	Facilitates telemedicine, remote patient monitoring, and high-speed data transfer (medical images and diagnostic reports)
Transportation and logistics	Smart transportation systems and autonomous vehicles allow improved safety, reduced congestion, and streamlined supply chains
Retail and e-commerce	Enhanced customer experiences through immersive virtual shopping and personalized recommendations
Education	Distance learning and virtual classrooms Interactive, high-bandwidth educational experiences regardless of location

Financial services	Faster and more secure transactions, improved fraud detection, and enhanced customer service
Energy and utilities	Smart grids and renewable energy systems allow more efficient energy distribution and reduced carbon emissions

The advancements brought by 5G networks provide operators with the opportunity to improve voice calling through unique features. Smart translation allows users to have smooth video conversations with contacts who speak different languages or have hearing impairments. Additionally, AR calling lets users incorporate a virtual background, stickers, and an avatar during video calls.

Mobile operators have been instrumental in establishing the digital infrastructure necessary for accessing online educational resources. They have also aided in creating digital tools for education. For instance, in early 2023, China's Ministry of Education renewed strategic cooperation agreements with China Mobile, China Telecom, and China Unicom. This partnership aims to strengthen collaboration in developing a smart education platform, enhance digital management in education, improve the digital literacy and skills of both teachers and students, and advance reforms in education evaluation, among other initiatives.

For residents of megacities, mobile technology enhances various aspects of water delivery and sanitation services. Efficient metering and revenue collection are essential for a well-functioning water utility. Meanwhile, IoT solutions like smart water meters are assisting utility providers and their customers in understanding consumption patterns, which promotes efficiency in both the energy and water sectors. In China, the mobile industry is leading the way in implementing smart solutions through 5G IoT. For example, China Mobile has been actively working on digital transformation in the water sector, focusing on areas such as sewage treatment, smart metering, and smart video surveillance of water facilities.

However, there is a concern that the growing number of connected devices may lead to security and data privacy issues.

China's success in the active deployment of 5G networks shows the effectiveness of the measures taken by the Chinese Government. China's strategy to foster the growth of 5G networks is rooted in several strategic documents and initiatives aimed at constructing advanced digital infrastructure and stimulating economic growth through the deployment of cutting-edge communication technologies. Adopted in 2016, "National Information Society Development Plan" (2016-2030) outlines strategic directions for creating an environment that promotes the rapid development of the information society. It underscores the significance of introducing 5G technologies as a crucial component of the digital economy. Developed by China's Ministry of Industry and Information Technology, "5G Development Plan" (2018-2030) sets specific goals for 5G deployment, including strategies for infrastructure development, standardization, and security. China's Presidential Decree on the Development of Digital Economy emphasizes the priority of developing the digital economy, which in turn accelerates the implementation of 5G technologies. China's 14th Five-Year Plan (2021–2025) and the Long-Range Objectives through the Year 2035 also plays a significant role in shaping China's 5G strategy. The economic impact

of 5G in China is expected to be substantial. By 2030, 5G is anticipated to contribute nearly \$260 billion to China's GDP, representing 23 % of the total annual economic impact of mobile technology in the country. Additionally, 5G connections in China are expected to comprise almost one-third of the global total, with adoption rates approaching 90 %, positioning China as one of the top markets worldwide for 5G [5].

In order to realize the full potential of 5G, it is necessary to continue to improve infrastructure and services, including improving the quality and reliability of network connectivity. Operators continue to invest heavily in infrastructure improvements, including base station modernization and 5G coverage expansion [6]. This allows operators to optimize costs by improving network efficiency and implementing innovative solutions. However, 5G technologies require significant investments from operators to ensure high levels of service. This creates barriers to entry for smaller players, who may find it difficult to compete with larger players. To reap the full benefits of 5G and its ecosystem, operators must maintain close cooperation with device manufacturers, infrastructure providers and industry partners. This will help create a sustainable and thriving ecosystem architecture that supports innovation and business growth.

The advancements in 5G will be further enhanced by artificial intelligence, increased spectrum support, improved uplink performance, and greater energy efficiency. A robust spectrum strategy is essential for these developments. The ITU's World Radiocommunication Conference 2023 defined new perspectives for 5G, identifying the mid-band spectrum, notably the 6 GHz band, which is crucial for meeting the growing demand for mobile data. China has taken a leading role by being the first country to identify the 6 GHz band for International Mobile Telecommunications in its national legislation, setting a strong foundation for the 6 GHz ecosystem and providing benefits of future technological innovations [7].

To sum up, the Chinese government identifies the development of 5G in China as a factor of critical importance for the country's technology sector and economy. The fact that the government controls all three of the country's mobile operators (China Mobile, China Telecom and China Unicom) is the reason why the companies are actively deploying 5G networks, resulting in China leading the world in 5G. 5G has a potential to transform significantly various aspects of daily life, enhance productivity, and promote sustainable economic expansion. It is followed by increased digital investments that stimulates industrial innovation and expand international market opportunities. For megacities residents it provides numerous high-skilled job opportunities. The implementation of 5G in urban settings transforms various aspects of daily life and creates more connected, safer, efficient, and sustainable environment for city dwellers.

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THE ROLE OF FOREIGN INVESTMENTS IN THE SOCIO-ECONOMIC DEVELOPMENT OF TAJIKISTAN

PhD in Economics, Senior Researcher **Rakhmonov Abubakr Khasanovich**,
Institute of Demographic Research of the Federal Research Sociological Center of the
Russian Academy of Sciences,
Moscow, Russian Federation

Abstract. In the era of globalization, foreign investment plays a crucial role in shaping the economic landscape of countries. For Tajikistan, foreign direct investment (FDI) serves as a catalyst for economic growth, job creation, and technological advancement. This paper explores the impact of foreign investments on various sectors of Tajikistan's economy, including energy, agriculture, education, healthcare, employment, and tourism. It also highlights the challenges and future prospects for foreign investments in the country.

Keywords: foreign investments, Tajikistan, agriculture, education, healthcare, energy, employment, tourism.

РОЛЬ ИНОСТРАННЫХ ИНВЕСТИЦИЙ В СОЦИАЛЬНО-ЭКОНОМИЧЕСКОМ РАЗВИТИИ ТАДЖИКИСТАНА

канд. экон. наук, старший научный сотрудник
Рахмонов Абубакр Хасанович,
Институт демографических исследований Федерального научно-исследовательского социологического центра Российской академии наук,
Москва, Российская Федерация

Аннотация. В эпоху глобализации иностранные инвестиции играют решающую роль в формировании экономического ландшафта стран. Для Таджикистана прямые иностранные инвестиции (ПИИ) служат катализатором экономического роста, создания рабочих мест и технологического прогресса. В данной статье рассматривается влияние иностранных инвестиций на различные секторы экономики Таджикистана, включая энергетику, сельское хозяйство, образование, здравоохранение, занятость и туризм. В ней также освещаются проблемы и будущие перспективы иностранных инвестиций в стране.

Ключевые слова: иностранные инвестиции, Таджикистан, сельское хозяйство, образование, здравоохранение, энергетика, занятость, туризм.

Introduction

In the modern era of globalization, foreign investment plays a pivotal role in shaping the economic trajectory of developing nations. For Tajikistan, a country striving for economic stability and growth, foreign direct investment (FDI) serves as a crucial driver of development. It fosters industrialization, enhances infrastructure, creates employment opportunities, and facilitates the transfer of advanced

technologies. Given Tajikistan's rich natural resources and strategic location, foreign investments have the potential to transform key sectors such as energy, agriculture, education, healthcare, and tourism.

Despite these opportunities, Tajikistan faces significant challenges in attracting and sustaining foreign investments. Political stability, regulatory frameworks, and infrastructure limitations often hinder investor confidence. However, recent economic trends suggest that the country is making strides in improving its investment climate, particularly through incentives for green investments and industrial modernization.

This article explores the impact of foreign investments on Tajikistan's socio-economic development, analyzing their contributions to key sectors, the challenges faced, and the prospects for future growth. By understanding the role of foreign capital, we can assess how it shapes the nation's economic resilience and long-term sustainability.

Results and Discussions

A meaningful definition of foreign direct investment is important for a full understanding of its impact and dynamics [1]. Foreign direct investment is an investment made by a company or individual for commercial purposes in another country [2]. Unlike indirect investments, when foreign institutions only buy shares of companies in the country, foreign direct investments are aimed at establishing permanent ties with the host country [3].

In 2024, Tajikistan's gross domestic product (GDP) reached \$14.1 billion, reflecting a \$2.1 billion increase from 2023. Despite economic challenges, inflation remained low at 3.6 %, ensuring price stability. The country also successfully met its state budget revenue targets, collecting \$4.3 billion – \$0.16 billion more than projected. The Tax Committee collected \$1.9 billion, exceeding the plan by 5.3 %, while the Customs Service generated \$0.89 billion, surpassing expectations by 6.8 % [4].

In 2024, plans for state budget revenues were implemented. Revenues amounted to \$4.3 billion, which is \$0.16 billion more than the projected figures. The country's Tax Committee collected about \$1.9 billion, which is 5.3 % more than planned, and the Customs Service exceeded the plan by 6.8 %, collecting \$0.89 billion, which is \$56.5 million more than expected [5].

Tajikistan experienced significant industrial growth in 2024, with the opening of 740 new manufacturing enterprises, 528 of which were industrial. These establishments created approximately 20,000 new jobs, contributing to economic stability. The country's total production volume reached \$5 billion, a 20 % increase from the previous year.

Foreign investments can have a positive impact, contributing to an increase in gross domestic product (GDP), job creation and infrastructure improvement [6].

According to the committee, 88 state investment projects totaling \$4.65 billion were implemented in the country in the first half of 2024, which is 45.9 % more than in the same period last year.

Direct investments in Tajikistan are mainly directed to the mining sector – 51.2 % or 88.9 million dollars, production and processing – 38.4 % or 66.7 million dollars and other industries – 10.4 % or 18.1 million dollars [7].

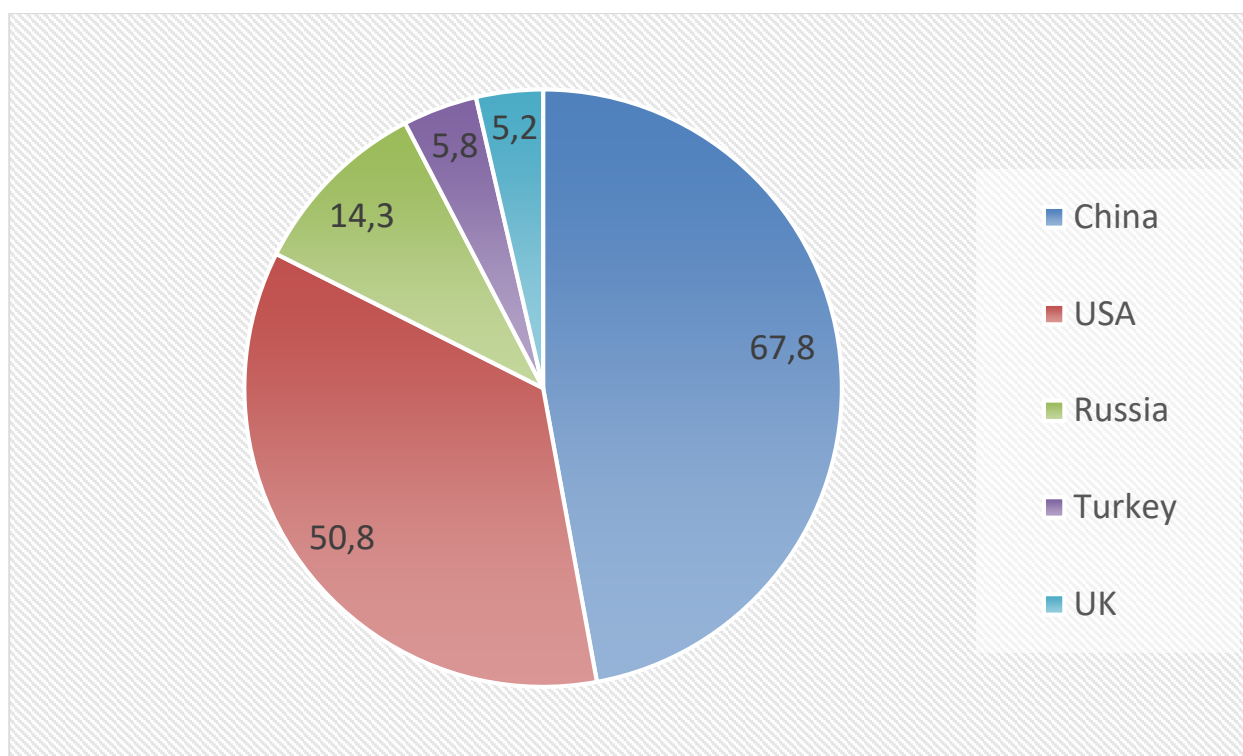


Figure – Foreign direct investment of states in Tajikistan in the first half of 2024, USD million

China became the leader in terms of foreign direct investment, investing \$67.8 million. China is followed by the United States with \$50.8 million in investments. Russia invested \$14.3 million, Turkey – \$5.8 million, and the UK – \$5.2 million (Figure).

Tajikistan is embracing global trends by promoting green investments. The country's abundant natural resources and commitment to renewable energy position it as a potential leader in green investment. This focus aligns with the global push for sustainable development and environmentally friendly economic practices. Investments in solar and hydroelectric projects, for example, have significantly increased, reducing reliance on fossil fuels.

Energy and agriculture

Energy is a fundamental pillar of any economy, and Tajikistan has made substantial progress in modernizing its energy sector with the help of foreign investments. In 2024, the country allocated \$1.7 billion for 18 major public investment projects aimed at enhancing energy infrastructure. These investments were used to build new power plants, reconstruct power transmission lines, and improve electricity metering systems.

A stable and efficient energy sector is vital for industrial growth, attracting businesses, and ensuring a reliable electricity supply for households and industries. The modernization of Tajikistan's energy system reduces power outages, increases production efficiency, and enhances the country's ability to export surplus electricity to neighboring nations. As a result, foreign investment in energy not only strengthens domestic economic growth but also contributes to regional energy cooperation [9].

Investment and trade

Agriculture is another key sector that benefits from foreign investment. In 2024, agricultural production in Tajikistan reached 74 billion somoni, marking a 10.6 % increase compared to the previous year. Crop production saw a notable rise of 13.4 %, while livestock production grew by 4.9 %. These improvements can be attributed to investments in modern farming techniques, irrigation systems, and agricultural infrastructure.

Foreign investors play a crucial role in the agricultural sector by introducing advanced technologies, providing funding for mechanization, and facilitating access to international markets. A well-developed agricultural sector ensures food security, generates employment opportunities, and contributes to economic stability. Moreover, investments in agro-processing industries can further enhance the value chain, allowing Tajikistan to export processed agricultural goods rather than relying solely on raw material exports [9].

Education and healthcare

Education and healthcare are vital components of socio-economic development, and foreign investment has played a role in strengthening these sectors. In 2024, Tajikistan built 273 new secondary schools and additional buildings, providing places for 57,600 students. The number of preschool institutions also increased, reaching 744, with 503 new early childhood development centers established [10].

Investments in education contribute to long-term economic growth by improving human capital. A well-educated workforce attracts more investors, enhances productivity, and fosters innovation. Similarly, the healthcare sector has seen increased funding, with \$0.34 billion allocated in 2024, reflecting a 12.6 % rise from the previous year. These funds aim to improve medical infrastructure, expand healthcare services, and enhance overall public health. A healthier population translates into a more productive labor force, ultimately benefiting the economy [10].

Employment and tourism

Foreign investments have a direct impact on employment, providing new job opportunities for Tajikistan's growing population [11]. In 2024, 247,000 new jobs were created, with 74,000 being permanent positions. Job fairs facilitated employment for 22,500 individuals, demonstrating government efforts to improve labor market conditions [5].

Tourism has also emerged as a key sector for economic growth, supported by foreign investments in infrastructure, hospitality, and cultural heritage preservation. In 2024, Tajikistan welcomed 1.4 million tourists, a significant achievement for the country's developing tourism industry. By improving roads, hotels, and recreational facilities, Tajikistan can attract more visitors, generate foreign exchange earnings, and create additional employment opportunities in the tourism sector [5].

Challenges and Future Prospects

Despite these positive developments, Tajikistan faces several economic challenges. With a population growth rate of nearly 2 % per year, the benefits of economic expansion are often diluted. Additionally, the country remains one of the least developed nations in terms of GDP per capita, underscoring the need for sustained investment and structural reforms [12].

One promising area for attracting additional foreign investment is the mining and mineral extraction industry. Tajikistan possesses 10 of the 12 critical minerals required for the transition to a green economy, with six already being processed. Developing this sector could provide a new revenue stream, support industrialization, and increase exports. However, ensuring environmental sustainability and responsible mining practices will be essential to maximizing the benefits of this industry.

Conclusion

Foreign investments play a transformative role in Tajikistan's socio-economic development, driving progress across key sectors such as energy, agriculture, education, healthcare, employment, and tourism. As a developing nation, Tajikistan relies on foreign capital not only to boost industrial growth but also to enhance infrastructure, create job opportunities, and facilitate technological advancement. The steady influx of investments has contributed to economic expansion, with significant achievements in energy modernization, agricultural productivity, and human capital development.

However, despite these positive outcomes, challenges remain. Regulatory inefficiencies, political uncertainties, and infrastructural limitations continue to pose barriers to attracting and sustaining foreign investments. Additionally, the equitable distribution of investment benefits remains a concern, requiring strategic policies to ensure sustainable and inclusive economic growth.

To harness fully the potential of foreign investments, Tajikistan must focus on improving its investment climate by strengthening governance, enhancing legal protections for investors, and diversifying its economic base. Encouraging green investments and responsible resource management will be crucial in aligning economic growth with long-term sustainability.

In conclusion, while foreign investments have significantly contributed to Tajikistan's economic progress, their long-term success depends on a stable, transparent, and investor-friendly environment. By addressing existing challenges and capitalizing on emerging opportunities, Tajikistan can ensure that foreign investments serve as a catalyst for sustainable development and improved living standards for its people.

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THE PSYCHOLOGY OF COLOR IN MARKETING

Student **Butuzova Elizabeth Evgenievna**,
Student **Shatilov Nikita Sergeevich**,
Academic Advisor: PhD in Pedagogy, Associate Professor
Sukhareva Natalia Alexandrovna,
State University of Management,
Moscow, Russian Federation

Abstract. This article examines the importance of color psychology in marketing, describes the influence of color on brand perception, and presents successful cases of large companies. In the face of high competition and the development of digital technologies, visual content has become a crucial factor, and choosing a color palette is a tool for increasing engagement and sales. Studying the psychology of color helps brands interact more effectively with their audience.

Keywords: consumer perception, color psychology, key colors, consumer behavior, decision-making speed, perceived quality, target audience, brand recognition.

ПСИХОЛОГИЯ ЦВЕТА В МАРКЕТИНГЕ

студент **Бутузова Елизавета Евгеньевна**,
студент **Шатилов Никита Сергеевич**,
науч. руководитель: канд. пед. наук, доцент
Сухарева Наталья Александровна,
Государственный университет управления,
Москва, Российская Федерация

Аннотация. В данной статье рассматривается важность психологии цвета в маркетинге, описывается влияние цвета на восприятие бренда и приводятся успешные кейсы крупных компаний. В условиях высокой конкуренции и развития цифровых технологий визуальный контент стал решающим фактором, а выбор цветовой палитры – инструментом повышения вовлеченности и продаж. Изучение психологии цвета помогает брендам более эффективно взаимодействовать со своей аудиторией.

Ключевые слова: восприятие потребителя, психология цвета, ключевые цвета, поведение потребителя, скорость принятия решений, воспринимаемое качество, целевая аудитория, узнаваемость бренда.

This article is aimed at exploring color in marketing. Research indicates that up to 90 % of a consumer's initial reaction to a product or brand is based on color. Companies actively apply color psychology in logos, packaging, advertising, and store interiors to convey the desired message and differentiate themselves from competitors [1, p. 713].

The way we perceive color is influenced by biological, psychological, and cultural factors. Some colors inspire action, while others build trust or evoke a sense of luxury. A deep understanding of these factors enables brands to better engage with consumers and drive sales [2, p. 784]. Next, we aim to examine how colors affect perception and can even influence taste.

Let us examine the psychological effects of key colors in marketing, starting with red. This color represents energy, passion, and urgency, making it a popular choice in the fast-food industry (McDonald's, KFC), promotional campaigns, and advertisements for discounts and sales. Blue is often linked to trust, stability, and security, which is why it is widely used in corporate and financial branding (IBM, Facebook, Visa). Green reflects nature, health, and sustainability, making it ideal for eco-friendly products and financial institutions (Starbucks, Whole Foods, Sberbank). Yellow is associated with happiness and optimism, enhancing a brand's warmth and inviting appeal. Excessive use may cause concern. (IKEA, DHL, Ferrari). Orange combines the energy of red and the friendliness of yellow. Stimulates activity and creates a sense of affordability (Fanta, Nickelodeon, Harley-Davidson). Black represents elegance, luxury, and status. Often utilized by premium brands (Chanel, Rolex, Apple). White reflects minimalism, purity, and innovation. Applied in medical, technology, and eco-friendly industries (Apple, Tesla, Adidas). Purple associated with wealth, creativity, and mystery. Used in beauty and high-end brands (Cadbury, Hallmark, Twitch).

It was revealed that color forms associations among different audiences. As for the influence of biology on the perception of color, its perception goes back far into the past and has been shaped for a long time. Red is linked to danger and urgency since it often signals poison or blood in nature. Green is perceived as safe because it is associated with vegetation and nature. Blue conveys calmness and stability, as the sky and water are constant elements of the environment.

The next step of our research is to consider the social and cultural characteristics of color. The study revealed that color associations vary based on cultural and regional contexts: in China, red is associated with luck and prosperity, whereas in Western countries, it is connected to passion and urgency. In the U.S., white is linked to purity, whereas in India, it is associated with mourning. In Europe, purple represents royalty, but in Latin America, it is often connected to mourning [3, p. 101]. In conclusion, we reviewed the trends in the development of color. Color associations change over time under the influence of fashion trends and marketing strategies. For example, pink was viewed historically as a masculine shade, but in modern times, it is primarily linked to femininity.

Research has shown that color has a direct impact on consumer behavior. Bright and high-contrast hues such as red, orange, and yellow tend to stimulate quick responses and encourage immediate decision-making. That is why the "Buy now" buttons and discount banners are often made in red or orange. The research led us to the conclusion that dark, saturated shades (black, dark blue, gold) create a feeling of premium quality and exclusivity. Luxury brands often use black and gold colors to emphasize their elite status [4, p. 85].

Another crucial aspect of using color in marketing is its impact on brand

perception in the digital environment. In the era of social media and online sales, the choice of color palette plays a key role in capturing users' attention. Research indicates that specific color combinations can significantly increase engagement and interaction rates [2, p. 787]. For instance, contrasting colors (such as red and white or blue and orange) help highlight content, while pastel and muted tones create a sense of harmony and visual appeal. Skillful use of color in website design and app interfaces enhances user experience and directly influences conversion rates.

Additionally, color can amplify or diminish the effectiveness of an advertising message. Dark shades in luxury product advertisements reinforce their exclusivity, whereas bright, saturated colors make mass-market brands more memorable. The right color combinations are essential, as certain pairings can evoke negative emotions among consumers. Marketers are also increasingly tailoring color schemes to seasonal and holiday campaigns, shaping the audience's mood. For example, during the winter holidays, red, gold, and green dominate, while summer campaigns often feature vibrant and refreshing hues like sky blue, yellow, and turquoise.

Another important factor in color psychology is its role in shaping brand identity and differentiation in a saturated market. With numerous brands competing for consumer attention, a distinctive color scheme helps establish a strong visual identity and enhances brand recall. Studies show that consistent use of color across different marketing channels – such as websites, social media, packaging, and advertising – can increase brand recognition by up to 80 % [5, p. 71]. By carefully selecting colors that align with their values and target audience preferences, companies can create a unique and recognizable brand image that fosters loyalty and trust.

Moreover, the impact of color extends beyond visual aesthetics to influence customer emotions and purchasing behavior at a subconscious level. Colors can trigger specific emotional responses, which brands strategically leverage to create a desired shopping experience. For example, warm colors like red and orange create a sense of urgency, making them effective in clearance sales, while cool tones such as blue and green promote relaxation and trust, making them ideal for financial and healthcare industries. Understanding these psychological effects allows marketers to craft visually appealing and emotionally engaging campaigns that resonate with consumers and encourage them to act.

With the rise of data-driven marketing, brands are increasingly leveraging personalized color strategies to enhance customer experience. Companies analyze consumer preferences, behavior, and even psychological profiles to tailor color schemes in advertisements, product packaging, and online interfaces. For instance, e-commerce platforms may use adaptive color themes that change based on a user's browsing history or demographic data. This approach not only strengthens emotional connections with consumers but also increases engagement and conversion rates by creating a sense of familiarity and personal relevance. By integrating color psychology with advanced analytics, brands can optimize their marketing strategies and deliver more impactful, customized experiences.

In conclusion, we would like to note that young consumers respond well to bright and dynamic colors (neon, saturated shades), older consumers prefer classic and muted shades (blue, burgundy, gray), the female audience is attracted to warm and soft tones

(pastel, pink, purple), the male audience, as a rule, prefers cold and dark tones (blue, black, silver).

In summary, we conducted a comparative analysis of successful brand strategies, where the leading companies in the market were considered. Regarding Coca-Cola incorporates red in its branding, as this color evokes excitement, boosts appetite, and strengthens the brand's lively and festive identity. This connection makes Coca-Cola a symbol of energy and happiness.

As for Facebook, the company uses blue color. Blue instills trust and security, making it the ideal choice for a social network where stability and reliability are key.

Apple uses minimalistic white and silver. White and silver evoke a sense of purity, simplicity, and innovation. The brand's minimalist aesthetic reinforces its focus on high technology and elegance.

The corporate color of Starbucks is green. Green represents nature and calmness, which aligns with Starbucks' commitment to sustainability and premium coffee.

Based on this research, we determined that color is an essential marketing tool that plays a key role in shaping consumer perception, emotions, and behavior. A carefully selected color palette can enhance brand recognition, boost sales, and strengthen customer loyalty.

Understanding color psychology enables marketers to develop more effective campaigns, improve audience engagement, and elicit desired emotional responses. By applying color strategies tailored to their target audience, cultural factors, and psychological impact, brands can significantly boost their competitive advantage.

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INTERNATIONAL PRICING OF TRANSPORT SERVICES: KEY FACTORS AND TRENDS

Student **Kucheriavyi Aleksei Viktorovich**,
Student **Sherstkova Olga Sergeevna**,
Academic Advisor: PhD in Economics, Associate Professor
Osmanova Elnara Useinovna,
Sevastopol branch of Plekhanov Russian University of Economics
Sevastopol, Russian Federation

Abstract. This paper explores the key factors affecting international pricing of transport services. Special attention is given to air transport, where dynamic pricing strategies and global market conditions significantly impact fare structures. The study also examines the role of fuel costs, competition, demand elasticity, and government regulations in shaping transport prices. Through a comparative analysis, authors highlight trends and challenges in international pricing of transport services.

Keywords: international pricing of transport services, tariffs, air transport, cost optimization, fuel pricing, regulatory impact, economic trends, predictive analytics.

МЕЖДУНАРОДНОЕ ЦЕНООБРАЗОВАНИЕ ТРАНСПОРТНЫХ УСЛУГ: КЛЮЧЕВЫЕ ФАКТОРЫ И ТЕНДЕНЦИИ

студент **Кучерявый Алексей Викторович**,
студент **Шерсткова Ольга Сергеевна**,
науч. руководитель: канд. экон. наук, доцент
Османова Эльнара Усеиновна,
Севастопольский филиал РЭУ им. Г. В. Плеханова
Севастополь, Российская Федерация

Аннотация. В данной статье рассматриваются ключевые факторы, влияющие на международное ценообразование транспортных услуг. Особое внимание уделяется воздушному транспорту, где стратегии динамического ценообразования и конъюнктура мирового рынка существенно влияют на структуру тарифов. Также освещается роль затрат на топливо, влияние конкуренции, эластичности спроса и государственного регулирования в формировании цен на транспортные услуги. На основе сравнительного анализа авторы выделяют тенденции и проблемы в области международного ценообразования транспортных услуг.

Ключевые слова: международное ценообразование транспортных услуг, тарифы, воздушный транспорт, оптимизация затрат, ценообразование на топливо, регулирующее воздействие, экономические тенденции, прогнозная аналитика.

The global transport industry serves as the backbone of international commerce, enabling the efficient movement of goods and passengers across vast distances. The cost of transportation services is a crucial factor affecting trade competitiveness, supply chain efficiency, and economic growth. Various factors contribute to the pricing structures of transport services, including fuel prices, regulatory measures, technological advancements, and competitive market forces. The interconnected nature of global transport networks means that fluctuations in one segment – such as air travel – can have ripple effects on logistics, shipping, and even regional economies. Understanding these dynamics is essential for businesses, policymakers, and economists to develop effective strategies for cost management, regulatory compliance, and market adaptation. The complexity of transport pricing requires an in-depth analysis of both microeconomic variables, such as operational costs and service demand, and macroeconomic conditions, including trade agreements and geopolitical influences [1, 2].

Fuel prices are one of the most significant determinants of transport costs. In the aviation sector, fuel expenses can account for up to 30–40 % of operating costs, making fuel price volatility a critical factor in ticket pricing. Similarly, maritime and road transport costs are heavily influenced by fuel price fluctuations, maintenance expenses, and labor costs. Historical data from the International Energy Agency (IEA) indicates that crude oil price changes directly impact transport service costs, with an estimated 70% correlation between global jet fuel prices and airfare rates. To mitigate these effects, companies often employ fuel-hedging strategies, which, while reducing risk, also require careful financial management to prevent potential losses from market fluctuations. Southwest Airlines frequently employs hedging strategies to mitigate fuel price risks. During the energy crisis of the 2000s, the airline's proactive approach to fuel hedging enabled it to circumvent the adverse financial impacts associated with significant fluctuations in oil prices. Between 1999 and 2008, this strategic policy resulted in savings exceeding \$4 billion for the company [3].

Competitive market conditions force transport service providers to adopt flexible pricing strategies. Airlines, for example, use yield management techniques, adjusting fares based on demand, booking windows, and route profitability. Maritime and rail transport, while more regulated, also experience pricing fluctuations due to competing service providers. The elasticity of demand plays a crucial role in pricing decisions – high elasticity means consumers are more sensitive to price changes, forcing firms to adopt dynamic pricing to maintain occupancy and revenue levels [3, 10].

International transport pricing is subject to government policies, including tariffs, taxes, and environmental regulations. Carbon emission policies and safety compliance costs add to operational expenses, influencing final pricing for consumers and businesses. Trade agreements and regional integration initiatives can also affect price-setting by reducing or eliminating tariff barriers. For instance, the European Union's Emissions Trading System (ETS) has significantly influenced airline ticket prices by increasing compliance costs for carriers operating within the region. Data from the European Commission suggests that ETS-related costs have led to an average

5–10% increase in European airfares since 2018. The focus is also on maritime transport, which has been included in the ETS since January 1, 2024. A carbon tax is levied on the CO₂ emissions of ships using EU ports. Operators are required to buy carbon quotas starting at 40 % of their emissions in 2024, with an increase to 100 % by 2026. It is estimated that the carbon tax increases the cost of fuel by more than 3 %, leading to higher prices for transportation services. The average increase in freight cost is estimated at 3.25 % [4].

Economic downturns, geopolitical tensions, and global crises (e. g., pandemics, trade wars) can disrupt supply chains and alter demand patterns. The COVID-19 pandemic, for instance, caused unprecedented price volatility due to sudden demand shocks and regulatory restrictions. Similarly, conflicts affecting major oil-producing regions have led to fuel shortages, forcing transport operators to pass on additional costs to consumers. A report by the International Monetary Fund (IMF) highlights that transport costs rose by an average of 25 % during the height of the pandemic due to supply chain disruptions and surging fuel prices. Such fluctuations necessitate adaptive pricing strategies to manage risks and ensure financial sustainability [5].

Airlines employ various pricing strategies to optimize revenue. Firstly, there is dynamic pricing. Here, prices fluctuate based on demand, time before departure, and competitor pricing, with AI-driven algorithms refining pricing models in real time. Airlines like Delta and Lufthansa have invested heavily in machine learning models to improve revenue management systems. Secondly, there is route-based pricing, where ticket prices vary depending on distance, airport fees, and demand levels, often influenced by hub-and-spoke models employed by major carriers. The International Air Transport Association (IATA) has noted a rising trend in these expenditures over the past decade, a development likely influenced by global events and heightened security apprehensions. There is also seasonal and promotional pricing. Here, discounts and premium pricing strategies adjust to seasonal demand shifts, aligning with consumer travel patterns and economic cycles. For example, Christmas and summer holiday periods typically see a 30–40 % increase in airfare prices due to high demand [3, 6, 9].

The rise of low-cost carriers (LCCs) has intensified competition, leading to more granular pricing models that factor in baggage fees, seat selection, and ancillary services. Airlines also use fare segmentation, offering economy, premium economy, and business class options with varying pricing structures.

A comparative study of pricing across air, sea, and land transport reveals several key differences. Air transport is characterized by high volatility, primarily due to factors such as fuel costs, fluctuations in demand, and regulatory fees. According to industry data from IATA, there is an average annual fare variation of 15–20 %. In contrast, maritime transport tends to be more stable, although it is still affected by freight rates, port fees, and global shipping demand. The Baltic Dry Index serves as a crucial indicator for pricing trends in this sector, with rates typically fluctuating by an average of 10–15 % annually. Rail and road transport pricing is influenced by infrastructure costs, toll fees, and cross-border regulations. A study conducted by the

International Transport Forum found that toll pricing structures can add up to 30 % in additional costs for international road transport [7].

Despite advancements in predictive analytics and AI-driven pricing models, transport pricing faces several challenges. One issue is the rising fuel costs and environmental compliance expenses, with estimates suggesting a 10–15 % increase in transport costs due to stricter emissions policies. Additionally, market disruptions from geopolitical and economic instability require businesses to implement robust risk assessment frameworks. Furthermore, there is an increasing consumer demand for transparency and fair pricing practices, with regulatory bodies introducing stricter guidelines on hidden fees and price surcharges [8].

Future pricing strategies must incorporate sustainability measures, technological innovation, and data-driven decision-making to enhance efficiency and competitiveness. Companies must also consider geopolitical forecasting models to anticipate potential disruptions and maintain price stability.

Overall, international transport pricing is a multifaceted process shaped by fuel costs, market competition, regulatory policies, and geopolitical factors. While air transport demonstrates high volatility, maritime and land transport pricing remains relatively stable. Companies must adopt adaptive, technology-driven pricing strategies to navigate these complexities and remain competitive in an evolving global market. As digitalization and artificial intelligence continue to transform pricing mechanisms, businesses will need to leverage real-time data analytics to optimize pricing structures and maximize profitability.

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ANALYSIS OF THE INTERACTION OF MODERN FINANCIAL TECHNOLOGIES AS A TOOL FOR IMPROVING FINANCIAL LITERACY AMONG THE POPULATION

Student **Gunko Valeria Maksimovna**,
Academic Advisor: PhD in Philology, Associate Professor
Vershitskaya Elena Rustemovna,
V. I. Vernadsky Crimean Federal University,
Simferopol, Russian Federation

Abstract. The paper examines the role of financial technologies in increasing the level of financial literacy among the population. Modern financial technologies, including mobile applications, online platforms, and digital banking tools, are significantly changing approaches to personal finance management, making the process more accessible and intuitive. Special attention is paid to adapting financial technologies for different age and socio-economic categories of citizens and improving the general welfare of the population.

Keywords: financial technologies, financial literacy, population, fintech, education, sustainable economic development.

АНАЛИЗ ВЗАИМОДЕЙСТВИЯ СОВРЕМЕННЫХ ФИНАНСОВЫХ ТЕХНОЛОГИЙ КАК ИНСТРУМЕНТА ПОВЫШЕНИЯ ФИНАНСОВОЙ ГРАМОТНОСТИ СРЕДИ НАСЕЛЕНИЯ

студент **Гуныко Валерия Максимовна**,
науч. руководитель: канд. филол. наук, доцент **Вершицкая Елена Рустемовна**,
Крымский федеральный университет имени В. И. Вернадского,
г. Симферополь, Российская Федерация

Аннотация. В работе исследуется роль финансовых технологий в повышении уровня финансовой грамотности среди населения. Современные финансовые технологии, включающие мобильные приложения, онлайн-платформы и инструменты цифрового банкинга, значительно изменяют подходы к управлению личными финансами, делая процесс более доступным и интуитивно понятным. Особое внимание уделяется адаптации финансовых технологий для различных возрастных и социально-экономических категорий граждан и повышению общего уровня благосостояния населения.

Ключевые слова: финансовые технологии, финансовая грамотность, население, финтех, образование, устойчивое экономическое развитие.

In the digital age, financial literacy has transcended traditional boundaries and become a dynamic field where technology plays a key role. The integration of financial innovation and digital banking has revolutionized the way people interact with

financial concepts, making personal finance education more accessible, engaging, and effective than ever before. This transformation is not just about the convenience of managing your finances through financial management tools or mobile apps. It is also about fundamentally changing the way we understand, interact with, and expand our financial knowledge.

Technology has a significant impact on financial literacy, with technology platforms becoming an integral part of everyday life. These platforms offer a variety of tools and resources that can greatly improve financial knowledge and decision-making skills. From mobile apps that make budgeting and saving easier to online courses that cover complex financial concepts, technology has made financial education more accessible and interactive.

The importance of financial literacy cannot be overstated in today's complex economic environment. It serves as the foundation for making informed and effective decisions about personal and business finances. Financial literacy provides people with the knowledge and skills needed to manage money wisely, understand and use a variety of financial products, and make decisions that lead to financial stability and growth.

In the consumer sector, there is an increase in non-cash transactions - purchases of goods and services, as well as money transfers using:

- mobile banking applications;
- electronic wallets (Qiwi, Yandex-money, YooMoney and others);
- electronic services (online banking and others);
- debit cards (for transferring wages, paying for goods and services, card to card transfers);
- credit cards and other services [1, p. 176].

It is worth understanding what “financial literacy” means. Financial literacy is knowledge about how to manage money, cope with crises, and reduce stress related to finances. It includes the ability to plan a budget, create a safety net, deal with risks and fraud, understand tax laws, and make informed financial decisions [2, p. 211].

It's important to note that when it comes to financial literacy, it can be passed down from generation to generation. Without the basic financial education that their predecessors gave them, today's youth may struggle to manage their finances effectively and risk financial disaster due to high debt, poor credit, and lack of savings. In turn, they may pass on their lack of financial literacy to their children, and the cycle continues.

The Central Bank of the Russian Federation is actively engaged in financial education and improving the financial literacy of the population. The regulator participates in the development and updating of educational materials for schools and universities, holds webinars and face-to-face events, and also produces informational videos and educational games.

The Bank of Russia is constantly introducing modern formats. For young people, these are podcasts, speeches on social networks and collaborations with popular financial bloggers. For older people, online classes "PensionFG" and conversations during city and rural events, in social service centers, libraries and post offices are offered. Financial education volunteers trained by the Bank of Russia, including

students, postmen, social workers and pensioners from financial institutions, are actively involved in this. Audio lectures, videos in sign language, books and brochures on financial literacy in Braille and other adapted materials are available for people with disabilities [3].

Improving the financial literacy of the population directly depends on technology. Financial tools available through mobile applications and online platforms make personal finance management more accessible and understandable. Otherwise, without technology, it would be difficult for people to carry out all manipulations and operations with financial flows. Thanks to modern technologies, each of us has the opportunity to study, work and invest without leaving the comfort of our home. These innovative tools open up new horizons and make financial transactions more accessible and convenient for everyone.

It's worth considering how this process works. Financial technology (fintech) plays a key role in shaping financial literacy education by providing access to a variety of resources and tools that help people manage their finances more effectively in the following ways:

1. Mobile banking and apps: With the rise of digital tools and apps in the financial industry, users are able to enjoy convenient and cost-effective services. Mobile banking apps and financial platforms make it easy for people to track their spending, plan their budget, and make informed financial decisions. Learning how to use these technologies is becoming an important part of financial education.

2. Streaming and social media. Younger generations are increasingly using streaming and social media, creating new opportunities to influence financial behavior. Influencers and targeted advertising can shape spending habits, so it is important to teach young people to think critically about the information they receive through these channels. Understanding the impact of digital messages on spending behavior helps to create a more conscious attitude towards money.

3. Webinars around the world. Global webinars and online courses provide access to knowledge and resources that can significantly improve financial literacy. These learning formats allow people from different parts of the world to share experiences and receive information from financial experts.

Financial technologies significantly improve access to financial literacy training by providing users with convenient tools to manage their finances. Through mobile apps, social networks, and online courses, people can develop their skills and critically evaluate information, which contributes to more conscious financial behavior.

Next, it is worth paying attention to the level of financial literacy of Russians, which is presented in Table.

Table – Shares of Russians by levels of financial literacy, in %

Year	2018	2020	2022	2024
Low level (1 – 11 points)	44	41	28	30
Medium level (12 – 15 points)	46	47	57	54
High level (16 – 21 points)	10	12	15	16

Source: [3].

According to a study conducted by the NAFI Research Centre in February 2024, the share of Russians with high and medium literacy levels reached 70 %, indicating a steady increase in correct financial attitudes and knowledge among the population, but money management skills have somewhat worsened compared to previous measurements. The financial literacy index, which ranges from 1 to 21 points, demonstrated steady growth from 2018 to 2022. This year, it has generally remained at the same level, although an analysis of individual indices included in the overall indicator shows an improvement in some skills and behavioral attitudes of citizens [4].

Therefore, in the modern world, financial technologies play a key role in increasing the level of the population financial literacy. Thanks to the mobile applications development, online platforms and digital banking tools, personal finance management is becoming more accessible and intuitive. These technologies not only simplify the process of financial planning, but also contribute to a deeper understanding of financial concepts, which is especially important in a difficult economic environment. Financial literacy becomes the basis for making informed decisions that lead to financial stability and growth. However, despite the progress in this area, there are challenges, such as the need to adapt financial technologies for different age and socio-economic groups, as well as combating the lack of basic financial knowledge among the younger generation. The Bank of Russia is actively involved in improving financial literacy by developing educational materials, conducting webinars and introducing modern training formats, such as podcasts and social networks. These efforts are already bearing fruit: the level of financial literacy of Russians is gradually growing, although it requires further improvement of money management skills.

In addition, the National Project "Efficient and Competitive Economy" is being implemented in the Russian Federation, by decision of Russian President Vladimir Putin from 2025. One of the goals of the project is to increase the knowledge of Russians in the field of finance and business.

As part of the national project, for example, the All-Russian Online Olympiad on Financial Literacy and Entrepreneurship is being held for students in grades 1-11. Participants learn how to plan a budget, gain knowledge about investing, and develop critical thinking and leadership skills. In addition, Russia has a "Strategy for improving financial literacy and financial culture until 2030", approved by the Government of the Russian Federation in 2023. The main objective of the strategy is to form a system of values and attitudes that will help people make financial decisions more consciously and rationally and teach them how to resist financial fraud [5].

The formation of a financial culture in Russia is essential for the well-being of citizens, business development and the achievement of national goals. The main results of this process can be as follows:

First, the planning horizon will be extended. Citizens will be able to consciously set and achieve their financial and investment goals, which will lead to more rational management of personal finances.

Secondly, the acceptability of risks will increase. This means reducing unjustified risky behavior and increasing trust in financial institutions, which will create a more stable financial environment.

Third, income and savings are expected to grow. An increase in real incomes

and long-term investments in the economy will contribute to structural transformation and financial stability in the country. Citizens' trust in financial institutions directly depends on the development of the financial market, protecting the interests of participants and improving financial literacy. It is also important to focus on civic responsibility and active participation in the budget process. The strategy for improving financial literacy is aimed at expanding long-term investments, supporting savings formation, developing life insurance and increasing citizens' involvement in pension programs. It takes into account the needs of different population groups and is focused on their life stages, which makes it more effective and relevant.

To achieve this goal, it is necessary to solve the following interrelated tasks of the Strategy [6]:

- promotion of values and formation of financial culture attitudes among economically active adults in order to develop conscious and rational behavioral practices;
- preserving and developing the accumulated experience within the framework of the education system for improving financial literacy of children and youth, supplementing educational programs with elements of financial culture;
- the use of various communication channels on topical issues of financial literacy and financial culture in order to form and consolidate the skills of conscious financial behavior of citizens;
- conducting targeted information and educational activities in relation to certain groups of citizens;
- expanding the positive experience of citizens using financial products and services, accompanied by the expertise of the state and civil society on the quality and consumer value of financial products and services offered on the market;
- building citizens' trust in the financial market and financial institutions;
- ensuring financial security, including financial cybersecurity, by developing citizens' skills, attitudes and behavioral practices to protect against possible risks in the financial sector, effectively countering illegal activities in the financial market and fraud.;
- ensuring regular monitoring of the state of financial literacy and financial culture in the Russian Federation, including in the constituent entities of the Russian Federation;
- ensuring the openness (transparency) of the budgets of the budgetary system of the Russian Federation in order to monitor the effective use of budgetary funds in order to foster civic responsibility and strengthen citizens' trust in public authorities and local governments.

Modern financial technologies are becoming an integral part of the process of improving financial literacy among the population, opening up new horizons for education and involving citizens in personal finance management. The Russian Federation is actively implementing measures aimed at promoting financial literacy, and fintech solutions play a key role in this process. Digital platforms, mobile applications, online courses and interactive tools make financial knowledge accessible and understandable to the general public, contributing to the formation of a culture of responsible financial behavior. The interaction of technology and financial literacy

creates a synergistic effect: on the one hand, technology facilitates access to information and training, and on the other, improving the level of financial literacy stimulates the demand for innovative financial products and services.

Thus, the integration of modern technologies into the processes of financial education is becoming an important step towards the sustainable development of a society where every citizen has the necessary knowledge and skills to manage their resources in the digital economy effectively.

Thus, financial technologies not only simplify access to financial services, but also become a powerful tool for educating and raising public awareness of financial issues. Their further development and integration into educational processes will contribute to sustainable economic growth and increased welfare of citizens.

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ANALYSIS AND ASSESSMENT OF THE PROBABILITY OF BANKRUPTCY OF THE ENTERPRISE LLC “MEZ SOUTH OF RUSSIA”

Student **Perekopaiko Ekaterina Olegovna**,

Academic Advisor: Senior Lecturer **Panin Sergey Igorevich**,

Voronezh State Agrarian University named after Emperor Peter the Great,
Voronezh, Russian Federatoin

Abstract. The article describes the most common models for assessing the probability of bankruptcy. In the 21st century, there has been an increase in the number of organizations, leading to increased competition in most industries. This forces companies to be more attentive to changes in the market, and in order to remain competitive, they need to improve their efficiency. Any organization can face problems such as unstable financial situation, insolvency or bankruptcy. The main purpose of this article is to explore methods for predicting bankruptcy of small and medium – sized enterprises. The application of these methods will be demonstrated by the example of the company "MEZ South of Russia". The calculations will be based on real data from an agro-industrial complex engaged in sunflower processing and the production of vegetable oils. The relevance of the conducted research is due to the fact that its results can become the basis for developing risk management strategies and increasing the financial stability of the enterprise.

Keywords: bankruptcy of enterprises, risks, financial stability, bankruptcy assessment methods.

АНАЛИЗ И ОЦЕНКА ВЕРОЯТНОСТИ БАНКРОТСТВА ПРЕДПРИЯТИЯ ООО «МЭЗ ЮГ РУСИ»

студент **Перекопайко Екатерина Олеговна**,

науч. руководитель: ст. преподаватель **Панин Сергей Игоревич**,

Воронежский государственный аграрный университет

имени императора Петра I,

г. Воронеж, Российская Федерация

Аннотация. В статье дается характеристика наиболее распространенных моделей оценки вероятности банкротства. В 21 веке наблюдается увеличение числа организаций, что приводит к росту конкуренции в большинстве отраслей. Это заставляет компании более внимательно относиться к изменениям на рынке, и для сохранения конкурентоспособности им необходимо повышать свою эффективность. Любая организация может столкнуться с проблемами, такими как нестабильное финансовое положение, неплатежеспособность или банкротство. Основная цель данной статьи – исследовать методы прогнозирования банкротства малых и средних предприятий. Применение этих методов будет продемонстрировано на примере компании ООО «МЭЗ Юг Руси».

Расчеты будут основаны на реальных данных предприятия агропромышленного комплекса, занимающегося переработкой подсолнечника и производством растительных масел. Актуальность проведенного исследования обусловлена тем, что его результаты могут стать основой для разработки стратегий управления рисками и повышения финансовой устойчивости предприятия.

Ключевые слова: банкротство предприятий, риски, финансовая устойчивость, методы оценки банкротства.

The relevance of the research topic is determined by the fact that currently any commercial enterprise, with a focus on self-sufficiency and financial viability, must ensure the production process. The volume of gross national product, the economic development of the country and, consequently, the provision of material and social benefits to the population of the country depend on the stable financial condition of enterprises in the real sector of the economy. For the effective functioning of the enterprise itself, it is necessary to promptly make managerial decisions, monitor the likelihood of bankruptcy, apply a bankruptcy probability forecasting system, develop measures to reduce the likelihood of bankruptcy, systematically analyze the symptoms of insolvency and, if necessary, take measures to get out of the crisis zone [4]. This article examines the possibility of using the most well known Western models to assess and diagnose the likelihood of bankruptcy of a Russian agricultural enterprise, and therefore the research topic is relevant.

Bankruptcy or economic insolvency is the recognition of a business entity as unable to satisfy fully creditors' claims. Both individuals and legal entities can act as bankrupts. Bankruptcy also refers to a procedure that is applied to a debtor to assess its current financial condition. If the entity is recognized as unable to fulfill its own obligations, then the most equitable way is sought to satisfy the debtors' requests [2].

An entity is declared bankrupt if it cannot meet its obligations to creditors and employees. If the company does not pay its bills for more than 3 months, then it is possible to start bankruptcy proceedings. In Russia, the main condition for initiating bankruptcy proceedings is a debt of more than three hundred thousand rubles.

The concept of bankruptcy and the criteria by which an organization can be classified as bankrupt are prescribed in the legislation. The insolvency (bankruptcy) of organizations is regulated by the Federal Law "On Insolvency (Bankruptcy)" dated October 27, 2002 No. 127-FZ and the Civil Code of the Russian Federation.

Most enterprises in a market economy are influenced by many factors that can undermine the independence, liquidity of the company's assets, as well as economic and financial stability. One of the important principles of enterprise management is monitoring and assessing the probability of bankruptcy. Experts from Russia and Western countries use various methods to assess this probability.

Many authors in the modern literature describe methods for assessing the bankruptcy of an enterprise [3]. Among them are:

The two-factor Altman model. They take into account the current liquidity ratio and the proportion of borrowed funds in liabilities.

The five-factor Altman model. It takes into account net working capital, retained earnings, profit before taxes, the amount of authorized capital, revenue.

The Taffler model. It takes into account pre-tax profits, current assets, current liabilities, and revenue.

The Beaver model or the 5-indicator system. It takes into account the amount of borrowed funds, return on assets, the share of borrowed funds in liabilities, the current liquidity ratio, and the share of net working capital in assets.

The Fulmer model, which takes into account retained earnings, revenue, profit before taxes, net income, and long-term liabilities.

The Springate solvency model. It takes into account working capital, profit before taxes, short-term liabilities, and revenue [5].

Each of the presented models has its own advantages and disadvantages. It should be borne in mind that some of them do not take into account the specifics of the national economy. Models designed to analyze the financial insolvency of enterprises should take into account the specific characteristics of both the entire industry and an individual enterprise.

In this article, we will consider a number of methods designed to assess the risk of bankruptcy, using the example of the company MEZ Yug Rus LLC using financial reporting data for 2023.

OOO "MEZ SOUTH of RUSSIA" is a limited liability company "Oil Extraction Plant SOUTH of RUSSIA". Registered on October 12, 2000. Main activity: production of unrefined vegetable oils and their fractions. To begin with, let's evaluate bankruptcy using the Taffler method. The methodology is based on an analysis of the profitability of the company's assets, liquidity ratios and the level of debt burden. This technique has both pros and cons to the calculations. The advantages of the model include high accuracy in predicting the probability of bankruptcy of a company, due to the large number of organizations analyzed.

Among the disadvantages, it is possible to single out the limited application, since it is suitable only for joint-stock companies with actively traded shares on the stock market. There are also difficulties with interpreting the final result, and the methodology cannot be applied in Russian conditions, as it does not take into account the specifics of the Russian economy. In addition, the accuracy of calculations depends on the source information, and outdated information is also used [4].

Calculation formula: $Z = 0.53 X_1 + 0.13 X_2 + 0.18 X_3 + 0.16 X_4$, where: X_1 – profit from sales / short-term liabilities; X_2 – current assets / amount of liabilities; X_3 – short-term liabilities / total assets; X_4 – revenue from sales / total assets.

Assessment of an enterprise based on the Taffler model:

If $Z > 0.3$, the company is unlikely to become bankrupt ("green zone");

If $Z < 0.2$, the company is likely to go bankrupt ("red zone"); If $0.2 < Z < 0.3$, it is a zone of uncertainty ("gray zone").

For the calculation, we use the balance sheet based on the financial statements for 2023.

$$X_1 = 5\,078\,037\,000 / 25\,997\,750\,000 = 0,20$$

$$X_2 = 26\,966\,321\,000 / 71\,697\,435\,000 = 0,38$$

$$X_3 = 25\,997\,750\,000 / 80\,207\,308\,000 = 0,03$$

$$X_4 = 78\,246\,920\,000 / 80\,207\,308\,000 = 0,98$$

$$Z = 0,53 * 0,20 + 0,13 * 0,38 + 0,18 * 0,03 + 0,16 * 0,98 = 0,106 + 0,0494 + 0,0054 + 0,1568 = 0,32$$

The calculation results showed $Z = 0.32$, which indicates a low probability of bankruptcy of the company "MEZ South of Russia". The situation in the company remains stable.

To assess the likelihood of a company going bankrupt, consider an alternative model, such as the Fulmer Model.

The advantages of this model are its multifactorial approach, which allows you to take into account various aspects of the company's financial condition; high accuracy of forecasts; accounting for the size of the enterprise, which makes it universal for different economic conditions; as well as the possibility of using it to assess the creditworthiness of potential borrowers.

The disadvantages of the model include the complexity of calculations compared to simpler options; the need to adapt to the specifics of the Russian economy and accounting; and the lack of consideration for qualitative factors such as the company's reputation or market trends.

When using the Fulmer model in Russia, it is important to take into account the specifics of the industry and the macroeconomic situation. For example, in conditions of high volatility of the ruble exchange rate or during periods of economic sanctions, some coefficients of the model may require adjustments [1].

The calculation formula is as follows: $H = 5.528A + 0.212B + 0.073C + 1.27D - 0.12E + 2.33F + 0.575G + 1.083h + 0.899I - 6.075$, in which:

H is the probability of bankruptcy;

X_1 – Retained earnings of previous years / Balance X_2 – Sales revenue / Balance

X_3 – Profit before taxes / Equity

X_4 – Cash flow / Long-term and short-term liabilities X_5 – Long-term liabilities/

Balance sheet

X_6 – Short-term liabilities / Total assets X_7 – log (tangible assets)

X_8 – Working capital / Long-term and short-term liabilities

X_9 – log (profit before tax + interest payable/interest paid)

If, according to the results of the company's assessment according to this model, the value of H is less than 0, this indicates the risk of bankruptcy. If H is greater than 0, the probability of bankruptcy of the company is considered low.

$$X_1 = 8\,507\,925\,000 / 80\,207\,308\,000 = 0,11$$

$$X_2 = 5\,078\,037\,000 / 80\,207\,308\,000 = 0,06$$

$$X_3 = 5\,199\,563\,000 / 1\,948\,000 = 2\,669,18$$

$$X_4 = 151\,195\,390\,000 / 80\,207\,308\,000 = 1,89$$

$$X_5 = 45\,650\,000\,000 / 80\,207\,308\,000 = 0,57$$

$$X_6 = 22\,257\,201\,000 / 80\,207\,308\,000 = 0,28$$

$$X_7 = 10,90$$

$$X_8 = 26\,966\,321\,000 / 71\,697\,435\,000 = 0,38$$

$$X_9 = 9,72$$

$$5,528*0,11 + 0,212*0,06 + 0,073*2669,18 + 1,27*1,89 - 0,12*0,57 + 2,33*0,28 + 0,575*10,90 + 1,083*0,38 + 0,899*9,72 - 6,075 = 207,79$$

The calculation results showed a value of $H = 207.79$, which indicates a low risk

of bankruptcy of the company "MEZ Yug Rus" LLC. Let's also take another model for comparison.

The Springate model is a financial analytical tool designed to predict the probability of bankruptcy of companies. It was developed by Gordon L. V. Springate in 1978, based on the Altman model and the method of stepwise discriminant analysis. The main task of this model is to assess the financial stability of an organization and warn about possible financial difficulties.

Gordon Springate developed his model at Simon Fraser University using data from 40 companies, of which 30 were successful and 10 went bankrupt. In the process of working on a model of 19 financial coefficients, four main ones were identified, which became the basis of the formula. The formula of the Springate model looks like this:

$$Z = 1.03X_1 + 3.07X_2 + 0.66X_3 + 0.4X_4,$$

where:

X_1 – Working capital / Balance sheet;

X_2 – EBIT (Earnings before interest and taxes) / Balance;

X_3 – EBT (Profit before Tax) / Short-term liabilities;

X_4 – Revenue (net) from sales / Balance.

If the Z value is less than 0.862, this indicates a high probability of bankruptcy of the company.

Let's substitute the balance sheet indicators into the formula of the Springate model:

$$X_1 = 26\,966\,321\,000 / 80\,207\,308\,000 = 0,34$$

$$X_2 = 5\,078\,037\,000 / 80\,207\,308\,000 = 0,06$$

$$X_3 = 5\,199\,563\,000 / 22\,257\,201\,000 = 0,23$$

$$X_4 = 78\,246\,920\,000 / 80\,207\,308\,000 = 0,98$$

$$Z = 1,03 \cdot 0,34 + 3,07 \cdot 0,06 + 0,66 \cdot 0,23 + 0,4 \cdot 0,98 = 1,078$$

The Springate model calculation showed that the Z value is 1.078, which is significantly higher than the threshold value of 0.862. This indicates a low probability of bankruptcy of the company and indicates its stable financial position. Such results can be attractive to investors and creditors, confirming that the company is able to fulfill successfully its financial obligations. Thus, the Springate model is a useful tool for assessing the solvency and financial stability of an organization.

Practical applications of the Springate model include:

- Assessment of the insolvency risk of potential borrowers;
- Definition of credit conditions;
- Making decisions about buying or selling a business;
- Management warning about possible financial problems.

These aspects make the model a useful tool for financial analysts and managers.

Advantages of the model:

- High accuracy of forecasting for short periods (up to a year);
- Easy to calculate and interpret;
- Wide applicability in various industries.

Disadvantages of this model:

- Does not take into account macroeconomic factors and industry-specific risks;
- May be less accurate for companies with non-standard capital structures.

The Springate model is an important tool for assessing the probability of bankruptcy of companies. It helps to identify hidden risks and make informed management decisions. However, one should not rely solely on one model; it is important to apply a comprehensive approach to financial analysis, including other methods and models to achieve the best results.

The article examined various models for assessing the risk of bankruptcy of companies, among which the Taffler and Fulmer models stand out. An analysis conducted for the company MEZ Yug Rus LLC using the Taffler and Fulmer methods showed that both approaches indicate a low risk of bankruptcy. The Z value calculated according to the Taffler model was 0.32, which places the company in the "green zone", and the H value according to the Fulmer model, equal to 207.79, confirms its stable financial position. These results indicate that the company is in a fairly safe situation, but other factors such as the specifics of the industry and the economic situation in the country should be taken into account for a more accurate assessment.

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MODERN INFORMATION TECHNOLOGIES AS A MEANS OF INCREASING EFFECTIVENESS OF BUSINESS COMMUNICATION

Student **Dautova Zalifa Zagitovna**,
Student **Salmanova Lina Vasilyevna**,
Academic Advisor: PhD in Philology, Associate Professor
Kochetova Gulnara Rashitovna,
Branch of Ufa University of Science and Technology,
Kumertau, Russian Federation

Abstract. The article analyzes the main aspects of the use of information technologies in business communication processes. The features of the use of information technology tools in this area were studied. The article considers the evolutionary development of communication media and mass media over the centuries of technological progress, as well as modern information technologies that significantly increase the effectiveness of business communication.

Keywords: information technology, software, business communication, Internet, business communication.

СОВРЕМЕННЫЕ ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ КАК СРЕДСТВО ПОВЫШЕНИЯ ЭФФЕКТИВНОСТИ ДЕЛОВОЙ КОММУНИКАЦИИ

студент **Даутова Залифа Загитовна**,
студент **Салманова Лина Васильевна**,
науч. руководитель: канд филол. наук, доцент
Кочетова Гульнара Рашитовна,
Филиал ФГБОУ ВО «Уфимский университет науки и технологий»,
г. Кумертау, Российская Федерация

Аннотация. В данной статье проанализированы основные аспекты использования информационных технологий в процессах деловой коммуникации. Изучены особенности применения инструментов информационных технологий в данной области. Рассмотрены эволюционные развития средств коммуникации и массовой информации на протяжении веков технического прогресса, а также современные информационные технологии, значительно повышающие эффективность деловой коммуникации.

Ключевые слова: информационные технологии, программное обеспечение, деловая коммуникация, интернет, деловое общение.

Modern information technologies play a key role in improving the efficiency of business communication due to their many advantages.

Their profound influence affects all key elements of society, including political,

public and administrative structures. This also applies to the scientific and educational environment, cultural forms and lifestyle of people, and many other aspects. Information technology plays a critical role in business communication.

Business communication is the process of information exchange between participants in business relationships aimed at achieving specific goals and solving professional tasks. It also means a system of technologies, techniques and forms of communication that characterizes all forms of interaction within the framework of professional activity.

Informatization of business communication is understood as the process of improving business communication technologies through applied computer science developments. This progress is achieved through integration, both in theoretical and practical aspects. The key element is the introduction of modern computer technology and specialized software into work processes.

Federal Law No. 149-FZ of July 27, 2006 "On Information, Information Technologies and Information Protection" is the basic regulatory document for the use of information technology in management. The law specifies the basic concepts and terms: electronic document, information technology, documented information and access to it, provision and dissemination of information, defines the requirements for the protection of information and the rights of subjects in the field of information technology [1].

The modern era is called the time of the information explosion and revolution in the field of information. The key factors of this phenomenon are considered to be the Internet and the emergence of new technologies that provide high speed and high volume of data transmission. The evolutionary development of the means of communication and mass media over the centuries of technological progress includes many truly significant events [2].

With the development of technology, the telegraph, telephone and radio appeared, speeding up the exchange of information and reducing distances. Television has become a window into the world, and the Internet has changed the landscape of communications, providing instant access to a huge amount of data and the possibility of interactive communication.

Modern information technologies can significantly improve the efficiency of business communication and offer many tools and opportunities that make the information exchange process faster, more convenient and more efficient. Here are some key aspects of how information technology affects the improvement of business communication:

- Automation of processes that reduce costs and eliminate the human factor. For example, robotization of manufacturing: the use of industrial robots to perform repetitive physical tasks such as assembling parts or packaging goods.

- A single information base. It can be accessed from the company's divisions and from the external business environment (manufacturers, buyers, partners).

- Regulation of the applied functions of subsystems. This gives the ability to solve tasks that are common to various departments of the enterprise, for example, monitoring the condition of equipment and prompt intervention in case of malfunction detection.

– Simplification of access to information. Document management systems and cloud technologies provide the ability to store and process data on remote servers, which also greatly simplifies access to information and allows employees to easily find and share the necessary data. This reduces the time spent searching for information and increases productivity.

– Improving cross-cultural communication. Information technology makes it possible to overcome language barriers through automatic translation, mobile applications, social networks and communities, which contributes to effective interaction between international teams. The use of technology, the adaptation of communication styles and the creation of an inclusive environment contribute to effective interaction between people from different cultures.

– Security and data protection. Modern technologies provide a high level of information protection using encryption, multi-factor authentication and other cybersecurity measures. This is especially important for maintaining the confidentiality of business information and preventing data leaks [3].

Business communication for students is a basic skill necessary for a successful career in any field. Unlike informal communication with friends and colleagues, business communication requires clarity, precision, and respect for the other person.

Almost all universities have introduced the subject of "Business Communications" into their curricula, which help students prepare for the real challenges they will face in their careers. This not only improves their professional skills, but also promotes the development of self-confidence when communicating with different audiences [4].

Based on the Ufa University of Science and Technology branch in Kumertau, the subject "Technologies of effective business and scientific communications" was introduced for the first-year students in order to improve communication skills and prepare students for successful interaction in a professional environment.

This course is aimed at developing the ability to express your thoughts clearly and clearly, to increase self-confidence in public speaking and writing scientific papers.

Within the framework of the subject "Technologies of effective business and scientific communications", students study:

- fundamentals of business communication in the scientific and engineering environment;
- features of the style of technical literature;
- creation of scientific and technical text;
- communication skills in a multinational environment;
- methods of effective interaction, teamwork.

The subject "Effective Business and Scientific Communication Technologies" includes not only theoretical knowledge, but also practical knowledge such as projects, discussions and role-playing games, which allows students to master the material well. Studying this subject is very important for students of technical specialties, since after mastering the material, students can communicate more confidently and effectively in various business situations, they get the opportunity to express themselves more deeply and fully, and begin to better understand the intentions of other people, which significantly contributes to increasing competitiveness in the labor market [5].

Based on this, we can say that modern society can no longer exist without the possibilities of information and communication. Today, there is not a single sphere of human life in which the Internet, computer technology, or computers are not used.

We are spending more and more time using modern information technologies that help us in our studies, work and leisure. They make it more efficient and allow you to interact with other participants, forming a single cooperative mechanism.

Thus, modern business communication is a newly emerged method of communication, a new way of thinking and acting. Mastering these skills will help you effectively interact with friends, colleagues, partners, and loved ones in an ever-changing world. Without these technologies, modern society would face serious difficulties in functioning and development.

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DETERMINISTIC APPROACHES TO REGIONAL POLICY: CONCEPTUAL FOUNDATIONS AND DEVELOPMENT PROSPECTS

Postgraduate Student **Matyushko Elizaveta Vitalievna**,
Academic Advisor: Grand PhD in Economics, Professor
Tkachuk Peter Yurievich,
Lugansk State University named after Vladimir Dahl,
Lugansk, Russian Federation

Abstract. In the context of dynamic socio-economic processes, regional policy requires a systematic approach to the analysis of factors determining the development of territories. This article examines the deterministic approach as a method of identifying sustainable patterns of regional development. Special attention is paid to the influence of economic, social, institutional, and environmental factors on spatial development. The necessity of integrating predictive models, digital technologies and resource management to improve the efficiency of regional management is substantiated. The advantages and limitations of deterministic approaches are presented, as well as their role in shaping strategies for sustainable territorial development.

Keywords: regional policy, deterministic analysis, strategic planning, sustainable development, territorial management.

ДЕТЕРМИНИРОВАННЫЕ ПОДХОДЫ К РЕГИОНАЛЬНОЙ ПОЛИТИКЕ: КОНЦЕПТУАЛЬНЫЕ ОСНОВЫ И ПЕРСПЕКТИВЫ РАЗВИТИЯ

аспирант **Матюшко Елизавета Витальевна**,
науч. руководитель: доктор экон. наук, профессор
Ткачук Пётр Юрьевич,
Луганский государственный университет имени Владимира Даля,
г. Луганск, Российская Федерация

Аннотация. В условиях динамичных социально-экономических процессов региональная политика требует системного подхода к анализу факторов, определяющих развитие территорий. В данной статье рассматривается детерминированный подход как метод выявления устойчивых закономерностей регионального развития. Особое внимание уделяется влиянию экономических, социальных, институциональных и природно-экологических факторов на пространственное развитие. Обосновывается необходимость интеграции прогнозных моделей, цифровых технологий и управления ресурсами для повышения эффективности регионального управления. Представлены преимущества и ограничения детерминированных подходов, а также их роль в формировании стратегий устойчивого территориального развития.

Ключевые слова: региональная политика, детерминированный анализ, стратегическое планирование, устойчивое развитие, территориальное управление.

In the modern world, regional economics is developing within the framework of complex spatial and socio-economic processes that require forecasting and scientific justification. One of the key directions of economic analysis is the deterministic approach, which focuses on identifying stable patterns of regional and territorial development. This approach assumes that the factors influencing regional economic development can be measured, analyzed, and utilized for long-term planning. Deterministic theories of regional economics play a crucial role in shaping territorial management strategies. They help identify the factors determining the spatial distribution of economic activity and contribute to the development of models that promote optimal regional growth.

The relevance of our research is driven by the need to adapt classical economic models to modern conditions, characterized by digitalization, changes in global economic relations, and the increasing role of state regulation.

As part of our study, we will examine the concept of "regional policy." One of the earliest definitions of regional policy was provided by the renowned Russian economist, Professor E. B. Alaev, who specialized in the theory and conceptual framework of socio-economic geography, economic zoning, and the complex economic issues of developing countries. He defined regional policy as "a sphere of activity aimed at managing the economic, social, and political development of a country in a spatial, regional aspect," closely linked to the relationships between the state and regions, as well as interregional interactions [1, p. 24].

Turning to our previous research, we argue that the architecture of regional policy must inevitably be based on and take into account the economic potential of a region. We define economic potential as "a combination of material and intangible resources, organizational and economic mechanisms that ensure socio-economic security, sustainable development, and the competitiveness of a region within the national economy" [2, p. 84].

The aforementioned scientific principles provide a foundation for asserting that the trajectory of the conceptual framework of regional policy has undergone several key stages, ranging from the Soviet era centralized planning to a sustainable and innovative development in the modern context. In the post-Soviet period, strategic planning principles were introduced, defining the priority directions for the socio-economic development of various territories, as well as key projects [3].

Currently, the conceptual basis of regional policy is focused on creating balanced, sustainable, and technologically advanced territories capable of adapting to global challenges and internal transformations. In the future, regional policy will continue to evolve, prioritizing social responsibility, sustainable development, and the integration of innovative technologies.

Given the above, we propose considering regional policy as a holistic system of strategic and tactical decisions, shaped by a deterministic analysis of objective socio-economic, institutional, and natural-environmental factors. This approach not only

identifies the key patterns of regional development but also ensures their balanced and sustainable functioning in a dynamically changing external environment. We emphasize that regional policy should be oriented toward long-term forecasting, efficient resource management, and adaptation to contemporary challenges, making it a crucial tool for territorial development and improving the quality of life.

It is essential to add that the deterministic approach in the context of regional policy can be viewed as a method based on the assumed predictability and regularity of processes occurring at the regional level. This approach suggests that a region's development is determined by multiple objective factors that can be studied, measured, and used to create models and scenarios for its future growth.

It is important to note that determinism, in the economic sense, is a theory asserting that the economic foundation of society determines all other aspects of its existence [4]. According to this approach, economic relations – such as private or public ownership of production tools and resources – serve as the basis upon which all political, cultural, and social mechanisms of society are built. Karl Marx is widely regarded as the founder of economic determinism [5].

However, within the framework of regional policy, determinism implies that, based on the analysis of objective data – such as natural resources, infrastructure development, demographic, and social characteristics – it is possible to predict trends accurately in regional growth or decline.

It is important to emphasize that the essence of deterministic approaches lies in the systematic study of these factors and their impact on regional development. In the course of our research, we have systematized these factors, which is reflected in Table 1.

Table 1 – Factors of the Deterministic Approach Influencing Regional Development

Factors of the Deterministic Approach	Description of Influence on Regional Development
Economic	Level of industrial production, agriculture, availability and utilization of natural resources, investment attractiveness.
Social	Quality of education and healthcare, demographic situation, migration flows.
Institutional	Quality of governance, efficiency of local authorities, level of administrative and legal transparency.
Natural-Environmental	State of ecosystems, availability of natural resources, impact of environmental risks.

Next, it should be noted that a systematic study of factors allows for the development of well-founded and predictable decisions in the field of regional management.

For the effective application of deterministic approaches, it is necessary to highlight their key characteristics, which will guide the process of regional policy development:

1. Predictability and Planning – Deterministic approaches enable forecasting based on data about the current state of the region and its influencing factors, allowing

for more accurate and long-term territorial planning. For example, analyzing the level of social infrastructure and the demographic situation helps predict the region's needs in healthcare, education, and other social sectors.

2. **Analysis of Cause-and-Effect Relationships** – A core principle of this approach is an in-depth examination of the interconnections between various economic and social aspects. This makes it possible to identify key points of influence. For instance, if a region has a high unemployment rate, it is crucial to determine what specifically hinders job creation—whether it is a lack of investment, weak infrastructure, or low workforce qualifications.

3. **Statistical Justification** – Significant emphasis is placed on quantitative analysis. This helps shape regional policy based on accurate and objective data, minimizing subjectivity in decision-making.

4. **Resource Orientation** – Effective regional development is only possible with proper management of its resources, both material (natural wealth, labor resources) and intangible (technologies, knowledge, innovations). By identifying key patterns, it is possible not only to use the available potential efficiently but also to create conditions for its expansion.

5. **Resilience to External Influences** – This approach enhances the system's flexibility and stability in response to changes in the external environment.

Let us now examine the advantages and disadvantages of deterministic approaches in Table 2.

Table 2 – Advantages and Disadvantages of Deterministic Approaches

Advantages	Disadvantages
Simplicity of use. Deterministic models are based on fixed input data and assume that all variables are known and constant.	Lack of consideration for uncertainties and risks.
Ability to obtain results quickly.	Complexity in result interpretation. Misinterpretation of data can lead to incorrect conclusions.
Accurate and reliable calculations. The deterministic approach helps eliminate unpredictability and relies solely on quantitative values.	—

In practice, deterministic approaches are widely used in regional planning, strategy development, and the implementation of government programs. Based on data analysis regarding natural resources, demographic conditions, living standards, and other characteristics, programs are created to support economic growth, social stability, and sustainable development. These approaches are actively applied in the following areas:

1. **Regional Planning** – Long-term plans are developed based on an analysis of social, economic, and environmental factors, helping regions optimize resource utilization and gain competitive advantages.

2. Social and Economic Development – A key element of deterministic approaches is identifying problem regions and directing targeted efforts toward improving infrastructure, creating jobs, and enhancing quality of life.

3. Natural Resource Management – The effective use of natural resources requires a detailed analysis of their condition and a rational approach to their utilization. Deterministic approaches in this context help develop sustainable resource management strategies.

Throughout the history of economic science, various authors have analyzed deterministic approaches to regional development, aiming to identify stable patterns in economic processes. These theories have laid the foundation for spatial planning, industrial location decisions, and economic growth forecasting.

In 1909, Alfred Weber developed the theory of industrial location, explaining how enterprises choose optimal locations to minimize transportation and labor costs [6]. Later, in 1931, William Reilly proposed gravity models of spatial interaction, based on an analogy with the law of universal gravitation, which allowed for the quantitative description of migration flows and trade turnover [7].

In 1933, Walter Christaller introduced the central place theory, which explained the spatial distribution of cities and their functions, forming the basis for spatial planning [8]. In 1956, Robert Solow advanced the neoclassical theory of regional growth [9], arguing that income disparities between regions should diminish over time due to technological progress and capital investment.

However, in 1957, Gunnar Myrdal, in his theory of cumulative growth, demonstrated that economic development tends to be self-reinforcing: regions with initial advantages continue to strengthen their leadership, while lagging areas face further marginalization [10].

In Table 3, we have identified and presented the advantages and disadvantages of well-known deterministic approaches in regional economic theory.

Table 3 – Advantages and Disadvantages of Deterministic Approaches in Regional Economic Theory

Approach	Advantages	Disadvantages
Theory of Industrial Location (Alfred Weber, 1909)	Optimizes the placement of industries, reducing costs.	Does not account for modern factors such as innovation and government policy.
Gravity Models of Spatial Interaction (William Reilly, 1931)	Provides a quantitative description of migration and trade flows, helping to forecast market development.	Ignores cultural, political, and institutional factors that influence spatial interactions.
Central Place Theory (Walter Christaller, 1933)	Explains the spatial distribution of cities and their influence on surrounding areas.	Based on simplified assumptions (flat terrain, uniform population distribution).

Neoclassical Theory of Regional Growth (Robert Solow, 1956)	Justifies long-term income level convergence between regions, explaining the role of investment and technology.	Does not consider institutional barriers and fails to explain why some regions continue to lag behind.
Theory of Cumulative Growth (Gunnar Myrdal, 1957)	Accounts for the self-reinforcing effect of economic growth, explaining regional disparities.	Does not provide specific tools for addressing inequality and may lead to increased polarization between regions.

The analysis of deterministic approaches to regional economics demonstrates that, despite their significant contribution to the development of spatial planning theory, they require modernization to account for new realities. The theories proposed in the first half of the 20th century were based on relatively static models, where transportation costs, resources, and geographical location played a key role. However, in the era of globalization and digitalization, these factors have lost their absolute significance, giving way to innovation, human capital, and institutional development.

Contrary to previously established assumptions, it is important to note that Robert Solow's neoclassical growth theory, which predicted the gradual equalization of income levels across regions, has not been fully confirmed in practice. On the contrary, Gunnar Myrdal's theory of cumulative growth, which suggests that regions with initial advantages continue to strengthen their leadership, more accurately reflects contemporary economic processes. This is evidenced by the rise of innovation hubs and global agglomerations that concentrate economic activity and human capital.

One of the key challenges of modern regional development remains the issue of spatial inequality. Many regions face a lack of investment, low labor mobility, and population outflows to major cities. Under these conditions, the deterministic approach remains relevant but requires supplementation with flexible management methods, including digital technologies, adaptive strategies, and comprehensive regional development support programs.

It is also worth noting that projects related to the digitalization of public administration are already being implemented, but their large-scale application in the context of regional policy requires further improvement. The key digital solutions include:

1. Big data analysis – improving the forecasting of economic processes and the efficient allocation of resources.
2. Artificial intelligence – automating management processes and enhancing the quality of public services.
3. Blockchain – ensuring transparency in financial transactions and government contracts.
4. Digital platforms – fostering the development of e-commerce, remote education, and telemedicine.
5. Smart city concepts – improving quality of life and optimizing resource utilization.

The comprehensive implementation of digital technologies contributes to: increasing regional investment attractiveness; developing remote employment and educational programs; bridging the digital divide between urban and rural areas; and enhancing the transparency of public administration.

Thus, we conclude that modern regional policy should be based not only on the analysis of traditional factors but also on the dynamic processes occurring in the global economy. In this context, combining classical theories with innovative methods of analysis and management appears to be the most promising direction for the advancement of regional science and practice.

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WAYS TO IMPROVE THE ENERGY AND ECONOMIC EFFICIENCY OF HEATING NETWORKS

Student **Zaporoshchenko Ulyana Andreevna**,
Academic Advisor: Senior Lecturer **Semchuk Elena Vladimirovna**,
Saint Petersburg State University of Industrial Technologies and Design,
Higher School of Technology and Energy,
Saint Petersburg, Russian Federation

Abstract. The article considers current issues of increasing the energy and economic efficiency of heating networks in Russia. Modern methods of reducing heat losses are analyzed, including the introduction of highly efficient thermal insulation, a system for monitoring and diagnosing the condition of pipelines, as well as the modernization of heating points. Particular attention is paid to protecting pipelines from corrosion and the use of innovative monitoring technologies. The proposed solutions help to increase the service life of heating networks and optimize the costs of their maintenance.

Keywords: heating networks, energy saving, energy efficiency, thermal insulation, corrosion, monitoring, heat loss.

ПУТИ ПОВЫШЕНИЯ ЭНЕРГЕТИЧЕСКОЙ И ЭКОНОМИЧЕСКОЙ ЭФФЕКТИВНОСТИ ТЕПЛОВЫХ СЕТЕЙ

студент **Запорощенко Ульяна Андреевна**,
науч. руководитель: ст. преподаватель **Семчук Елена Владимировна**,
Санкт-Петербургский государственный университет
промышленных технологий и дизайна,
Высшая школа технологии и энергетики,
Санкт-Петербург, Российская Федерация

Аннотация. В статье рассматриваются актуальные вопросы повышения энергетической и экономической эффективности тепловых сетей в России. Анализируются современные методы снижения тепловых потерь, включая внедрение высокоэффективной теплоизоляции, системы контроля и диагностики состояния трубопроводов, а также модернизация тепловых пунктов. Особое внимание уделяется защите трубопроводов от коррозии и применению инновационных технологий мониторинга. Предложенные решения способствуют увеличению срока службы тепловых сетей, оптимизации расходов на их содержание.

Ключевые слова: тепловые сети, энергосбережение, энергоэффективность, теплоизоляция, коррозия, мониторинг, тепловые потери.

In modern conditions, an urgent task for Russian heating networks is to increase

their energy and economic efficiency. This area of research is due to the need to reduce heat losses and optimize the costs of operating heat supply systems. Heat supply systems are a set of technical devices, units and subsystems that ensure the preparation of the coolant, its transportation and distribution in accordance with the demand for thermal energy for individual consumers. However, many of these systems face problems such as high energy losses, insufficient efficiency and environmental problems. Figure 1 shows the main measures to extend the life of heat supply systems [1].

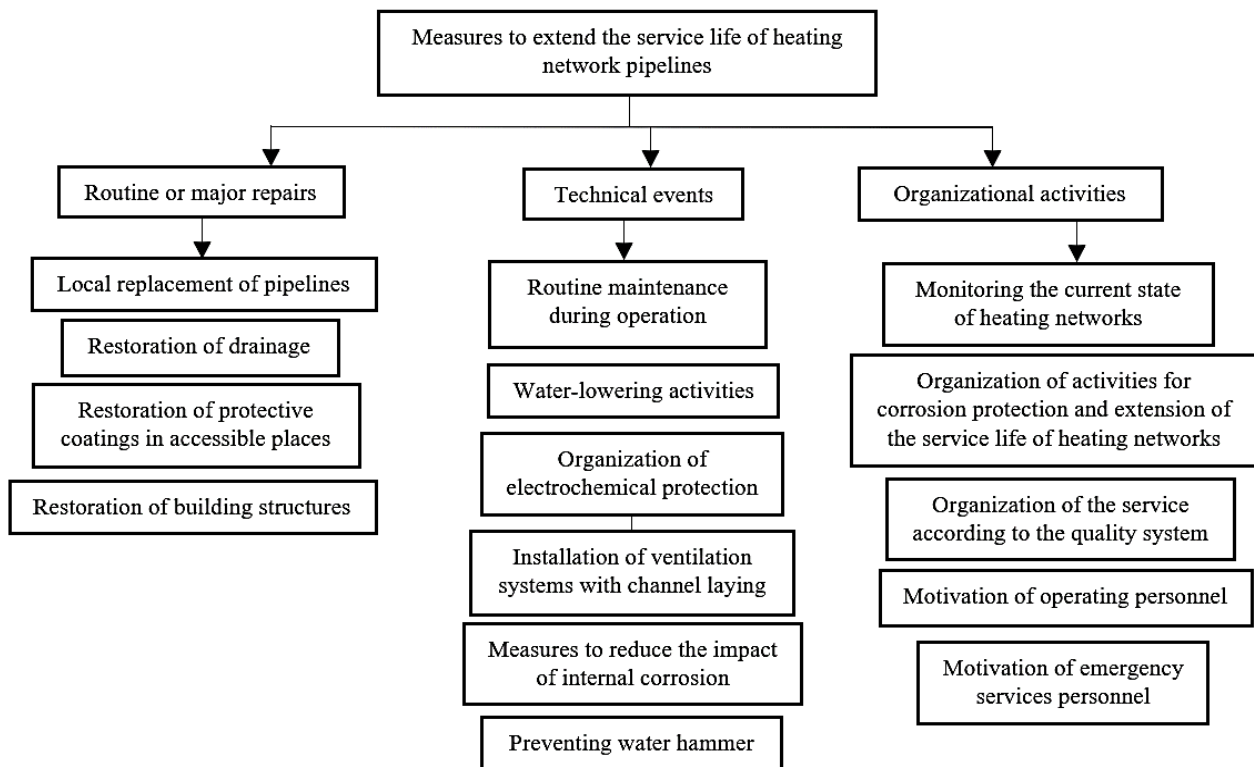


Figure 1 – Measures to extend the service life of heating network pipelines

Excessive heat loss is one of the main problems of heating systems. It can be caused by improper insulation of pipelines, leaks, poor insulation quality and other factors. Heat loss leads to inefficient use of energy and increased costs. In some heating systems, the supply temperature may be too high, which leads to increased heat energy losses and suboptimal energy use. This can be caused by improper distribution of heat energy, insufficient control and regulation of the system. In addition, many heating systems use outdated technologies and equipment, which leads to low efficiency of heat generation. As a rule, this is due to the wrong choice of heat generators, lack of regular maintenance and a decrease in productivity due to aging equipment.

One of the key aspects of increasing the efficiency of heat supply systems is the implementation of systems for monitoring and diagnosing the current state of pipelines, which requires initiative from organizations operating heat networks. Modern methods of non-destructive testing, such as ultrasonic thickness measurement, magnetic particle inspection and others, allow for continuous scanning of pipelines, but the widespread

use of these technologies is constrained by economic inexpediency under the existing tariff system [2].

Significant potential for increasing efficiency lies in the modernization of thermal insulation materials. In Russia, various types of insulation are currently used: mineral wool, polyurethane foam, foamed polymer-mineral materials, reinforced foam concrete, and others [3]. Of particular interest are pipes with factory insulation made of polyurethane foam using the "pipe in pipe" technology, where the thermal conductivity coefficient is $\lambda = 0,025 - 0,032 \text{ W}/(\text{m} \cdot \text{K})$, which is significantly lower than the performance of traditional mineral wool insulation ($\lambda = 0,070 \text{ W}/(\text{m} \cdot \text{K})$) [4]. This insulation provides high strength of the outer shell, low heat loss and an increased service life compared to traditional solutions.

An effective way to increase the reliability of heating networks is to build drainage devices for draining channels and install ventilation systems, which is especially relevant for Russian conditions with typical temperature fluctuations and high humidity. Dispatching of heating networks using modern control systems provides online monitoring of coolant parameters, recording of system operation and shutdown times, and determining heat losses in each section.

Particular attention is paid to the protection of pipelines from corrosion, which remains one of the main reasons for the reduction in the service life of heating networks in Russia. Both passive methods of protection using special coatings and active methods are used, including electric drainage, anodic and cathodic protection [5]. Anodic protection using magnesium anodes is effective for pipelines up to 5 kilometers long, while cathodic protection is implemented by connecting the protected pipeline to the negative pole of a DC generator.

The technology of using "pipe in pipe" with an operational remote control system (ORCS) is an innovative solution for Russian conditions, which is presented in Figures 2 and 3 [6].



Figure 2 – External appearance of the pipe in the "pipe in pipe" technology

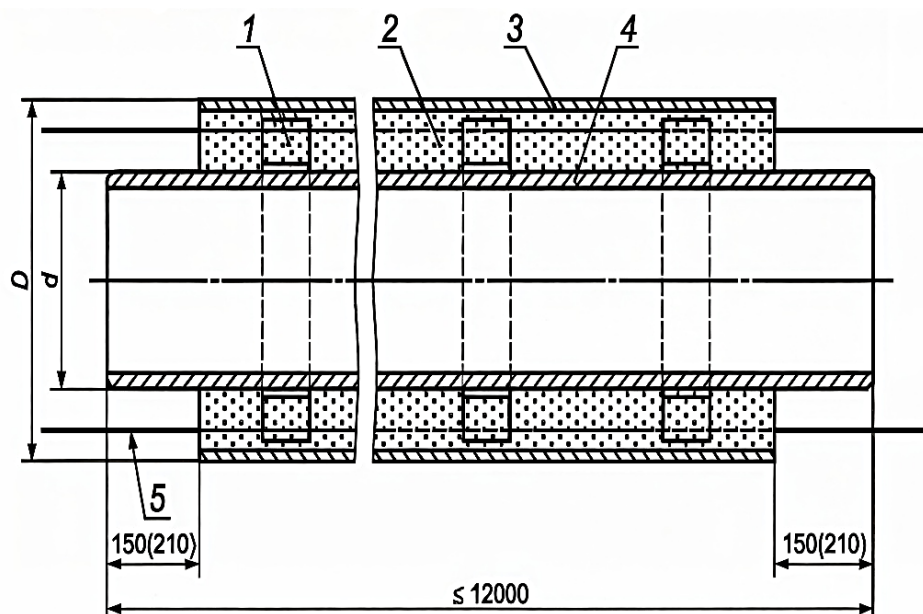


Figure 3 – Pipe device in the "pipe in pipe" technology:
 1 – centering support; 2 – polyurethane foam insulation; 3 – casing pipe;
 4 – steel pipe; 5 – SODK indicator conductors

The SODK uses signal copper conductors that allow monitoring the condition of the thermal insulation layer along the entire length of the pipeline. The pulse reflectometry method used in this system is based on probing the signal conductor line with high-frequency pulses, where determining the delay between the time of sending and receiving reflected pulses allows calculating the distance to the locations of inhomogeneities in wave resistance.

The economic efficiency of using pipes with the "pipe in pipe" technology is due to the optimal ratio between cost and reduction of heat losses during the service life. With an increase in the thickness of thermal insulation, the costs of materials and installation work increase, but at the same time heat losses decrease, which leads to savings in thermal energy. The device of thermal insulation using the "pipe in pipe" technology allows laying this type of pipes in the ground without the use of special through or non-through channels, which significantly reduces the cost of laying.

The "pipe in pipe" technology is an innovative solution for minimizing heat loss when transporting heat carriers such as hot water or steam. It consists of placing an internal working pipe inside an external protective pipe with an intermediate layer of highly efficient thermal insulation material (e. g. polyurethane foam or mineral wool). Thanks to this technology, heat loss is reduced by 30-50 % compared to traditional single-pipe systems without insulation.

For example, when transporting water at a temperature of 90 °C through a 1 km long pipeline, a conventional pipeline loses about 20-30 kW/h of thermal energy, while a pipeline using the "pipe in pipe" technology reduces these losses to 10-15 kW/h [7]. Numerically, this means that over a year of operation of such a pipeline, it is possible to save up to 200-300 Gcal of thermal energy per kilometer. With the cost of thermal energy being on average 1.5-2 rubles per Gcal, the savings are approximately 300-600

thousand rubles per year per kilometer of pipeline.

Thus, increasing the energy and economic efficiency of heating networks in Russia is possible due to the comprehensive use of modern technologies and materials. This includes the use of highly efficient factory thermal insulation, the introduction of control and diagnostic systems, the modernization of heating points, the improvement of corrosion protection systems and the introduction of modern methods of personnel motivation. All these measures help to reduce heat losses, increase the service life of pipelines and optimize operating costs, which is especially important in the context of constantly rising prices for thermal energy.

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ALGORITHMIC ADVANTAGE: HOW ARTIFICIAL INTELLIGENCE PERSONALIZATION IS CHANGING THE CUSTOMER EXPERIENCE

Student **Brueva Darya Nikolaevna**,
Student **Patsueva Anastasia Alexandrovna**,
Academic Advisor: PhD in Pedagogy, Associate Professor
Sukhareva Natalia Alexandrovna,
State University of Management,
Moscow, Russian Federation

Abstract. The article examines the transformation of personalization in business due to artificial intelligence (AI). It is emphasized that AI personalization, unlike traditional methods, dynamically adapts content and offers to customer needs using machine learning, natural language processing and predictive analytics. The advantages of AI personalization are analyzed, such as increased engagement, conversions, customer loyalty, and increased customer value. The focus is on the strategic and ethical components of successful AI implementation in personalization.

Keywords: AI, personalization, machine learning, customer experience, loyalty, conversion.

АЛГОРИТМИЧЕСКОЕ ПРЕИМУЩЕСТВО: КАК ПЕРСОНАЛИЗАЦИЯ С ПОМОЩЬЮ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА МЕНЯЕТ КЛИЕНТСКИЙ ОПЫТ

студент **Бруева Дарья Николаевна**,
студент **Пацуева Анастасия Александровна**,
науч. руководитель: канд. пед. наук, доцент
Сухарева Наталья Александровна,
Государственный университет управления,
Москва, Российская Федерация

Аннотация. В статье рассматривается трансформация персонализации в бизнесе благодаря искусственному интеллекту (AI). Подчеркивается, что AI-персонализация, в отличие от традиционных методов, динамически адаптирует контент и предложения к потребностям клиентов, используя машинное обучение, обработку естественного языка и предиктивную аналитику. Анализируются преимущества AI-персонализации, такие как повышение вовлеченности, конверсии, лояльности клиентов и увеличение их жизненной ценности. Акцент делается на стратегической и этической составляющей успешной реализации AI в персонализации.

Ключевые слова: AI, персонализация, машинное обучение, клиентский опыт, лояльность, конверсия.

AI-based personalization is becoming an integral part of modern business strategy, becoming more and more important for market success every year. According to a McKinsey study, companies that actively use personalization can increase sales by 10-30 %. However, many organizations face the challenge of implementing a personalized experience that goes beyond simple welcome emails with a customer's name. Traditional methods, such as segmentation by demographics or standard advertising campaigns, are often insufficient to create truly personalized interactions. In this article, we'll explore how artificial intelligence (AI) is transforming the customer experience, increasing engagement, conversions, and customer loyalty. We will also discuss why implementing AI requires not only a technological endeavor, but also a strategic and ethical approach. In this article, we will analyze key AI technologies, their application in practice, and examples of successful companies using AI to personalize customer experience [1].

AI-based personalization is the process of using artificial intelligence to tailor products, services, or content to customers' unique preferences, needs, and behaviors. Unlike traditional personalization, which is based on predefined rules, AI uses data to customize the customer experience dynamically and predictively. AI algorithms can learn from large amounts of data, identifying hidden patterns and predicting user actions in real time.

The main technologies that support AI-based personalization are:

- Machine learning (ML): ML algorithms learn from data to predict customer behavior. For example, they can recommend products or services based on purchase history.
- Natural Language Processing (NLP): NLP allows AI to understand text, voice, and customer requests, enabling it to respond to customer inquiries in real time.
- Predictive analytics: with the help of data analytics, AI can predict future customer needs and offer them suitable solutions in advance.
- The benefits of using AI for personalization are clear:
 - Increased customer engagement through more accurate and relevant offers.
 - Increased conversion rates due to accurate prediction of needs.
 - Improved customer loyalty by creating long-term and personalized relationships.
 - Increase customer lifecycle value through personalized offerings throughout the customer journey.

We searched for possible practical applications of AI for personalization and found many useful ones. The first one we would like to bring to the table is predictive analytics for customer segmentation. AI allows us to analyze massive amounts of data for deeper customer segmentation beyond traditional demographic categories. The use of predictive analytics and machine learning algorithms can more accurately identify groups of customers based on multiple factors including purchase history, website activity, social media interactions, and content consumption. An example is the use of RFM analysis (age, frequency, monetary value) to identify the most valuable customer segment, allowing companies to target efforts to increase customer loyalty and sales.

An example of a successful application is the use of a customer data platform (CDP) by an e-commerce company to create accurate customer profiles and segmentation based on this data.

The next thing, which is also important, is the ability to optimize content dynamically. With AI, companies can personalize content on their websites, ad campaigns and newsletters, tailoring it to individual user preferences. For example, AI algorithms can analyze the history of product visits and purchases to automatically adjust content on web pages and change recommendations in real time. In the case of email marketing, content and offers can change based on a customer's previous purchases or website behavior [2].

For example, Amazon and Netflix use AI to display recommendations based on purchase or browsing history. AI-based content optimization tools, such as A/B testing platforms, allow these elements to be fine-tuned as much as possible.

The third option we looked at is AI-powered product recommendations. This feature significantly increases conversion rates and average order value. AI uses several algorithms, including collaborative filtering, content-based filtering, and hybrid approaches, to suggest items that are most interesting to the shopper.

For example, a shopper who has recently browsed sporting goods may see additional recommendations based on what other users with similar interests are buying. This technology is actively used by major e-commerce platforms such as eBay or Amazon to increase sales and improve the customer experience. Artificial intelligence algorithms also optimize the placement of recommendations on product pages, in shopping carts and in email campaigns.

The next opportunity that will help many is the personalization of chatbots. Artificial intelligence-based chatbots play an important role in personalized customer service because they can offer personalized recommendations, answer FAQs tailored to the customer's needs, and guide them through the purchase process. For example, chatbots can suggest products based on a customer's previous inquiries or purchases, and even tailor answers to questions based on context. This greatly improves the customer experience and makes communication with the brand livelier and more effective. An example of a successful application is the use of chatbots in services such as Sephora, where they help customers choose cosmetics based on personal preferences and needs.

Last thing considered – integration with CRM systems. Chatbots can greatly enhance personalized customer interactions through integration with CRM systems (customer relationship management systems). Such systems contain important customer data such as purchase history, preferences, inquiries, company interactions, and demographic information. Through integration, chatbots can access this data in real time, allowing them to provide more accurate and personalized responses.

For example, if a customer has already made purchases from a company, a chatbot can use data from the CRM to suggest additional products that match their previous purchases. The chatbot can also remind the customer about pending orders, help with product selection, or provide personalized recommendations based on the customer's preferences. All of this helps improve the customer experience and increase the likelihood of conversion.

One prime example of using chatbots integrated with CRM is H&M, which uses this approach in its customer support. A chatbot on the website and mobile app retrieves data about a user's previous purchases and interests to offer personalized style

recommendations. For example, if a customer has purchased a certain style of clothing, the bot can suggest similar items that might interest them or remind them of new arrivals in their favorite categories. This integration with CRM can significantly increase customer satisfaction and simplify the shopping experience.

Implementing AI-based personalization is not an easy task. It requires careful planning for its implementation. Otherwise, it can lead to inefficiency, frustration, and loss of investment.

AI personalization lives and breathes data. It is from the data collected that AI algorithms learn to understand customer preferences, behaviors, and needs. Therefore, high-quality, clean, and relevant data is the cornerstone of successful personalization. Before implementing AI solutions, you need to make sure that an effective system of data collection, cleansing and storage is in place.

This includes:

- Collecting data from a variety of sources: from CRM systems and transaction data to social media activity and website behavior data.
- Ensuring data quality: identifying and correcting errors, duplicates, and incomplete information.
- Protecting data privacy: complying with regulatory requirements and ensuring that data is stored and processed securely.

We realized that you must start small and gradually scale up. Trying to implement AI personalization across an entire organization at once is a recipe for chaos. A better idea is to start with a pilot project focused on a specific area or customer segment. This will allow to test different approaches, evaluate the effectiveness of AI algorithms, and gather valuable feedback before implementing the solution on a larger scale.

Like any other business initiative, AI personalization requires a clear definition of goals. Instead of generic language such as “improve customer experience,” it is necessary to set specific, measurable, achievable, relevant, and time-bound (SMART) goals. Clearly defined goals allow you to track progress, measure effectiveness, and adjust as needed.

For example:

- Increase conversion rate by X % within Y months for segment Z using personalized product recommendations.
- Reduce customer churn by X % within Y months by offering personalized loyalty programs.

There are many AI-based tools and platforms on the market for a variety of purposes. Choosing the right technology for your specific business needs is critical. Conducting thorough research, evaluating different options, and then making sure that the chosen platform fits your technical capabilities, budget, and strategic goals is the key to success.

After analysis, we realized that it is important to consider factors such as:

- Integration with existing systems, i. e., how easily does the platform integrate with your CRM, marketing tools and other systems?
- Scalability: can the platform handle the growing amount of data and increasing number of users?

- Ease of use: how easy is the platform to use and customize?
- Support and training: do the vendor provide adequate support and training?

Implementing AI personalization is not a one-time event, but an ongoing process. It is necessary to continuously monitor the effectiveness of AI personalization initiatives and adjust as needed. Analyzing data, tracking key performance indicators (KPIs), and collecting feedback from customers are all information that, when used in the future, will help optimize algorithms, content, and strategies [3].

Successful implementation of AI personalization requires close collaboration between marketing and IT departments. Marketers understand customer needs and preferences, while IT has the technical expertise to implement and support AI solutions. Creating clear communication channels, common goals and mutual understanding will help ensure a smooth and effective implementation of AI personalization.

Also, after exploring this topic, we conclude that AI personalization is inextricably linked to ethical issues that must be carefully considered to ensure responsible and customer-respectful use of technology. Ignoring these aspects can lead to loss of trust, legal repercussions, and negative impact on a company's reputation.

- Data Privacy: It is critical to comply with strict data privacy regulations such as GDPR (General Data Protection Regulation) and CCPA (California Consumer Protection Act). This includes obtaining explicit consent for data collection and use, ensuring data is stored and processed securely, and allowing customers to access, correct or delete their data.

- Transparency: it is important to be honest and open with customers about how we use their data for personalization. Explaining what data we collect, how it is used to improve their experience and how they can control their preferences will reassure them. Transparency builds trust and makes customers feel comfortable with personalization.

- Eliminating biases: AI algorithms learn from data, and if that data contains biases, the algorithms can reproduce and even amplify them. Efforts should be made to identify and eliminate biases in data and algorithms to ensure that personalization does not discriminate or treat certain groups of people unfairly.

- How to avoid unpleasantness: personalization should be useful and relevant, not intrusive or intimidating. We have learned that we need to avoid using tactics that customers may find creepy, such as referencing overly personal information that they have not directly provided.

It is important to always remember that the ethical use of AI personalization is not just a matter of following the rules, but also a matter of building a trusting relationship with your customers. The right thing to do will be to respect their privacy, be transparent in your actions, and use personalization to create a more positive and valuable experience [4].

For now, AI-powered personalization continues to evolve rapidly, opening new opportunities for customer interactions. In the future, we will see an amplification of the following trends:

- Hyper-personalization: A shift from segmentation to personalization at the individual level. AI will enable the creation of unique experiences for each customer

based on their specific needs, preferences, and context.

- AI-powered voice assistants: Personalized experiences will become available through voice interfaces. Voice assistants will use AI to understand user intent and provide relevant information and recommendations.

- Personalization in augmented reality (AR): Augmented reality will open new horizons for personalization in retail and e-commerce. Shoppers will be able to virtually try on clothes, visualize furniture in their home, and receive personalized recommendations based on their location and preferences.

Personalization through artificial intelligence will continue to evolve, and marketers need to keep up with new trends to stay ahead of the curve and provide their customers with the most relevant and valuable experiences [5].

In conclusion, AI-powered personalization offers unprecedented opportunities to improve customer engagement, increase sales, and build long-term relationships. From optimizing content and offers to creating personalized experiences at every stage of interaction, AI allows businesses to understand and meet the needs of their customers like never before. We strongly encourage anyone interested to start exploring AI-enabled personalization strategies for business. Everyone can start small by clearly defining their goals and focusing on delivering value to their customers. It is important to remember that artificial intelligence is not just a technology, but a tool that can transform your marketing and create a more meaningful and personalized relationship with your customers. Capitalizing on this potential will help build a future where every customer feels understood and valued.

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THE ROLE OF KEY ELEMENTS OF HI-TECH STYLE IN ZAHA HADID'S CREATIVE SELF-EXPRESSION ON THE EXAMPLE OF HER ARCHITECTURAL PROJECTS IN RUSSIA

Master's Degree student **Purikova Evelina Igorevna**
Academic Advisor: PhD in Philology, Associate Professor
Nazarchuk Yulia Ivanovna,

Saint Petersburg State University of Industrial Technologies and Design,
Saint Petersburg, Russian Federation

Abstract. The article deals with the main architectural projects of Zaha Hadid in Russia. Special attention is paid to the built objects, such as Dominion Tower business center in Moscow and Capital Hill Residence. As a result of the study, the key features of high-tech style in architecture are identified and their influence on the formation of Zaha Hadid's own unique architectural style is analyzed.

Keywords: architectural projects, Zaha Hadid, high-tech style, unique style.

РОЛЬ КЛЮЧЕВЫХ ЭЛЕМЕНТОВ СТИЛЯ ХАЙ-ТЕК В ТВОРЧЕСКОМ САМОВЫРАЖЕНИИ ЗАХИ ХАДИД НА ПРИМЕРЕ ЕЕ АРХИТЕКТУРНЫХ ПРОЕКТОВ В РОССИИ

магистрант **Пурикова Эвелина Игоревна,**
науч. руководитель: канд. филол. наук, доцент **Назарчук Юлия Ивановна,**
Санкт-Петербургский государственный университет
промышленных технологий и дизайна,
Санкт-Петербург, Российская Федерация

Аннотация. В статье рассматриваются основные архитектурные проекты Захи Хадид в России. Особое внимание уделяется реализованным в Москве объектам, таким как бизнес-центр Dominion Tower и Capital Hill Residence. В результате исследования выявляются ключевые особенности стиля хай-тек в архитектуре и анализируется их влияние на формирование собственного уникального архитектурного стиля Захи Хадид.

Ключевые слова: архитектурные проекты, Заха Хадид, стиль хай-тек, уникальный стиль.

Zaha Hadid is one of the most prominent architects of our time, known for her futuristic designs that combine innovation, complexity of form and technological excellence. Her works are at the intersection of several architectural movements, including deconstructivism, parametricism, futurism, neo-futurism, and high-tech. Despite the fact that most of her projects are concentrated in Europe, Asia and America, there is also a number of remarkable buildings and architectural complexes designed by Zaha Hadid in Russia. In this article, we would like to consider the projects of Zaha

Hadid in Russia and analyze the way her work manifests the characteristic features of the high-tech style.

One of Zaha Hadid's first projects in Russia is the Dominion Tower business center in Moscow. It is a seven-story building with an unusual shape created by the dynamic interweaving of horizontal planes that alternate between each other. The consoles of the façade partially protrude beyond the facade line and partially recede deeper into the building creating a peculiar image of waves. The image of dynamic waves is a characteristic of Zaha Hadid's architectural style. Despite the visual dynamics, the facade still retains its clearly defined horizontal orientation. The horizontal orientation of the building is visually enhanced by alternating rows of ribbon windows with the rows of aluminum composite panels (Fig. 1) [1, p. 20].



Figure 1 – Facades of Dominion Tower Business Center

The use of original forming techniques, as well as the use of modern finishing materials such as metal and glass, create a sense of lightness not only in the exterior, but also in the interior. They allow to create an open space and fill it with natural light. The dynamism of the forms is also preserved inside the building. The atrium with its unusual staircases forms the famous fluidity of shapes and elements, and also “rises on all levels so that natural light enters the center of the building” [2, p. 152]. These forms do not overload the space with the details, leaving it as light as possible and aesthetically appealing. Abundant light penetration is available due to the active use of glass and metal in the construction of Dominion Tower. These materials provide the building with lightness and transparency, as well as emphasize its technological aspect. Thus, thanks to this architectural project of Zaha Hadid it is possible to trace not only the unique author's features, but also the features typical of high-tech architecture. The use of glass and metal, minimalist forms, the lack of decorative elements, high-tech and functionality – all these elements make the building consistent with the spirit of the time. The mentioned project demonstrates the way the traditional features of high-tech style can harmoniously interact with the unique vision of the architect. This approach creates a unique building, which combines functionality and aesthetics.

Capital Hill Residence is another project created and partially implemented by the Zaha Hadid architectural bureau in Russia (Fig. 2).



Figure 2 – Facades of the private residential building Capital Hill Residence

This construction is an example of private residential architecture rather than public one. The project had been developed since 2006 and was supposed to become one of the main residences of Russia, but the construction was frozen, and so far this object is still at the stage of building. The Capital Hill residence is located on a hillside on the northern side of the Barvikha Forest near Moscow. The building consists of two main parts: the first part merges with the hilly wooded landscape, and the separate part, i.e. the central tower, is “soaring” at a height of 22 meters above the ground. The shape of the complex is determined by its natural topography: the smooth lines emerge from the hilly landscape and dynamically rush upward, thus resembling a metal flower [1, p. 30]. The structure is based on a reinforced concrete frame, which allows to create a complicated and non-standard form with the abundant glazing. In Capital Hill Residence, glass plays the crucial role creating a sense of lightness and transparency. Metal elements such as frameworks and railings add an industrial touch and a futuristic feel to the building. The use of glass, concrete and metal refers to this style of architecture and shows how skillfully it is combined with the unique and distinctive vision of Zaha Hadid [3, p. 42].

Another example of office architecture, in addition to the previously discussed Dominion Tower, is the project of the Sberbank Technopark concept in Skolkovo. In 2016, the world-famous British architectural bureau Zaha Hadid won an open competition to create a concept for a technopark in Russia [5]. As a result of the design, the bureau created a seven-storey Technopark building in the Russian Silicon Valley, i.e. the Skolkovo Innovation Center in Moscow (Fig. 3).



Figure 3 – Facades of the Skolkovo Innovation Center in Moscow

The technopark complex consists of several blocks, which were united under a complex-shaped translucent dome by means of architectural and structural solutions. This dome resembles a surging wave or mountain peak. The large-scale dome glazing gives the building a sense of lightness and fluidity, which is a hallmark of Zaha Hadid's architectural style. The interior of the Technopark is also based on smooth, flowing lines. The central element is the biomorphic structures that look like trees from a futuristic fairy tale. They pierce through the building and serve as supports for a powerful vault that fills the space with natural light. The main column in the form of a tree forms a special complexity and uniqueness of the building. It is 50 meters high and weighs 260 tons. It is also important to mention the multilevel bridges of bionic shape. Their length is more than 80 meters (Fig. 4) [5].

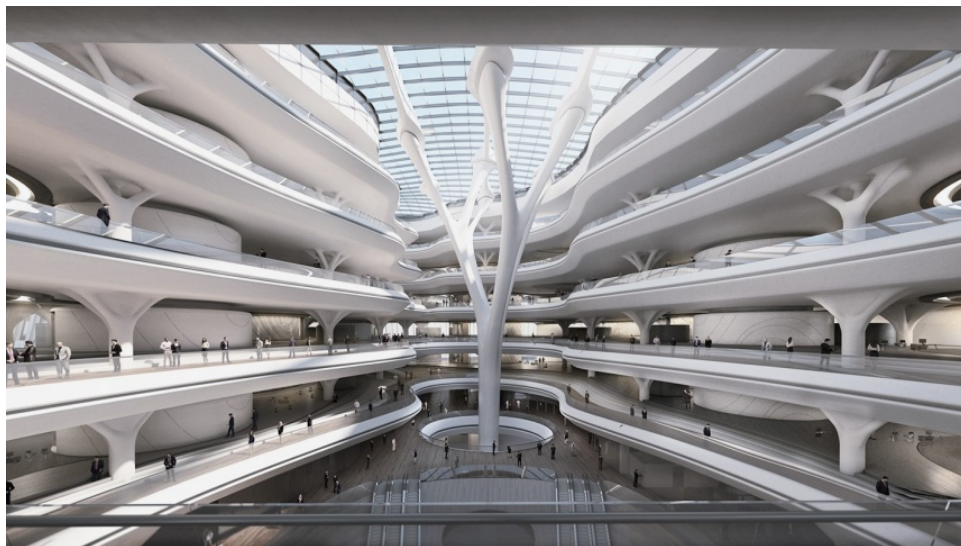


Figure 4 – Interior of the Skolkovo Center in Moscow

The futuristic roots are reflected in the innovative interior and landscape design, while the key features of high-tech can be traced in the functional organization of space, innovative solutions and the use of modern materials. The project is not just a technical structure, but a real work of art thanks to the organic nature of the bionic structure of

the bridges and the central column, as well as complex geometric shapes. Glass and metal are modern materials that create a typical high-tech atmosphere of transparency and weightlessness, but their use goes beyond the usual functionality. In this work, it is noticeable how Zaha Hadid enriches her unique style with high-tech elements, inspired by the concepts of biomorphism and deconstructivism [4].

If we continue to consider the theme of public buildings, another project which is worth mentioning is the project of the Sverdlovsk Philharmonic Hall in Yekaterinburg (Fig. 5) [5].



Figure 5 – View of the facade of the Sverdlovsk Philharmonic Society

Designed by Zaha Hadid Architects, the new project for the Sverdlovsk Philharmonic in Ekaterinburg combines modern technology, design and practicality in one structure. This building, which is to be constructed in the historic heart of the city, reflects the dynamics and rhythm of music through its wave forms. With its glass and metal facades, the Philharmonic will radiate lightness and transparency, becoming the central cultural hub of the region and giving locals and visitors a chance to immerse themselves in the world of classical music in a state-of-the-art architectural setting. Zaha Hadid's design for the Sverdlovsk Philharmonic Hall in Ekaterinburg shows her ability to integrate high-tech and bionic elements. The building is characterized by the use of modern materials such as glass and metal, giving it a modern, technologically advanced look. At the same time, the undulating shapes, both outside and inside, reflect natural imagery and correspond to the bionic design. These elements not only form a harmonious space, but also contribute to the creation of an ideal acoustic environment, emphasizing the continuity of movement that is a characteristic feature of Hadid's work [4]. This synthesis of high-tech and bionics reflects Zaha Hadid's unique approach, thanks to which her projects become not only functional objects, but also real works of art, embodying the harmony between the two.

Thus, it can be concluded that the high-tech style has a significant influence on Zaha Hadid's work. Although she does not limit herself exclusively to this style, the elements typical of high-tech architecture, such as the use of modern materials (e.g.

glass and metal), high technological efficiency, functionality, are reflected in the number of her projects. These features are particularly noticeable in commercial and public buildings where functionality and innovation plays a key role. For example, in such a project as the Dominion Tower business center in Moscow. It is important to realize that in her projects Zaha Hadid does not stop at standard high-tech approaches, but enriches it by adding elements of deconstructivism, parametricism and biomorphism. This allows her to create unique structures that go beyond the traditional high-tech and become symbols of a new era in architecture. It can be said that Zaha Hadid's high-tech work has become the basis for experimentation with form, material and function, allowing her to develop her own unique style that combines technological excellence with the artistic vision.

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APPLICATION OF INTELLIGENT RISK MANAGEMENT IN BANKING SECTOR

Student **Xiaoqi Ge**,
Lanzhou University of Finance and Economics,
Lanzhou, People's Republic of China
PhD Student **Jigeer Shawuya**,
Peter the Great Saint Petersburg Polytechnic University,
Saint Petersburg, Russian Federation

Abstract. With the development of digital transformation in banking sector, intelligent risk control systems are reshaping the risk management paradigm in banking sphere. This paper systematically examines how advanced technologies including big data, cloud computing, and artificial intelligence empower banks' risk management processes. Through the case study of selected commercial banks, which are the digital leaders in China's commercial banking sector, it reveals the practical value of intelligent risk control across six key scenarios including credit management and fraud detection. Research results demonstrates that intelligent risk management not only serves as a preventive mechanism but also functions as a strategic pivot driving banking innovation and digital transformation.

Keywords: banking sector, commercial banks, digital technology, risk management.

ПРИМЕНЕНИЕ ИНТЕЛЛЕКТУАЛЬНОГО УПРАВЛЕНИЯ РИСКАМИ В БАНКОВСКОМ СЕКТОРЕ

студент **Сяоци Гэ**,
Ланьчжоуский университет финансов и экономики,
Ланчжоу, Китайская Народная Республика
аспирант **Цзигээр Шауя**,
Санкт-Петербургский политехнический университет Петра Великого,
Санкт-Петербург, Российская Федерация

Аннотация. В условиях цифровой трансформации банковского сектора интеллектуальные системы контроля рисков меняют парадигму управления рисками в банковской сфере. В данной работе рассматривается процесс внедрения передовых технологий, таких как большие данные, облачные вычисления и искусственный интеллект в процессы управления рисками банков. На примере избранных коммерческих банков, которые являются цифровыми лидерами в китайском коммерческом банковском секторе, раскрывается практическая ценность интеллектуального управления рисками в шести ключевых сценариях, включая управление кредитами и выявление мошенничества. Результаты исследования показывают, что интеллектуальное

управление рисками не только обеспечивает превентивный механизм, но и выступает в качестве стратегического стержня, способствующего инновациям и цифровой трансформации банковского сектора.

Ключевые слова: банковский сектор, коммерческие банки, цифровые технологии, управление рисками.

Risk management is an inevitable and essential aspect of practice in any financial institution, and banks are no exception. Risk management is critical to the banking sector and its sustainable development. The importance of risk management in the commercial banking sector is increasing with the development of the financial sector and financial technology, as well as the increasing complexity of financial risks [1]. Digital technology has been facilitating the development of all industries, including the banking sector. Intelligent risk management in the banking industry is taking big data and artificial intelligence as the core technology, and based on the application of big data, combining artificial intelligence technologies including algorithms, machine learning and deep learning models to build an intelligent risk management system that breaks through the limitations and spatiality of the traditional risk management that is empirically controlled by manual means, and reduces the cost of risk control while effectively improving the efficiency of risk management [2]. By leveraging real-time data collection, model analysis, and automated decision-making, these systems enable precise identification and dynamic prevention of credit risk, fraud risk and operational risk.

The transformative potential of intelligent risk management is most vividly demonstrated in its multi-dimensional applications across banking. From credit life-cycle management to cross-industry fraud prevention, AI-driven systems are redefining risk mitigation through scenario-specific innovation. This section examines six key application scenarios. In these scenarios, intelligent risk management demonstrates its operational advantages. Application scenarios of intelligent risk management in banking operations are classified as following:

1. Credit risk management.

In pre-loan stage, intelligent risk management system will focus on credit assessment and quota pricing. Credit assessment is using machine learning models to analyze multidimensional data of users (such as credit investigation, consumption, social networking, etc.), evaluate credit risk, and predict default probability. Quota pricing is according to the user's risk level; develop differentiated loan quotas and interest rates to achieve a balance between risk and return. In the intermediate stage of loan, intelligent risk management system will focus on risk warning and quota adjustment. Risk warning is monitoring borrowers' behavioral data (spending, repayments, etc.) in real time to identify potential risks and trigger alerts for proactive measures. Quota adjustment can dynamically adjust credit limits based on borrowers' credit status changes to reduce risk exposure. In post-loan stage, intelligent risk management system will focus on collection management and non-performing asset disposal. Collection management is automating collection processes using intelligent voice systems and robots to improve efficiency. Non-performing asset disposal is leveraging big data analytics and machine learning to evaluate asset value and optimize

disposal strategies. Application direction is integrating big data and AI modeling for dynamic credit evaluation, limiting adjustments, and post-loan risk warnings.

As the first self-developed risk information platform in China's banking sector, ICBC's "Rong An e-Shield" built over 2000 risk management models and 4000 risk indicators. The following results are achieved according to the 2024 semi-annual report of the bank: (a) Non-performing loan ratio is 1.35 % (down 0.1 percentage points from the beginning of the year); (b) Provision coverage is 218.43 % (up 12.6 percentage points); (c) Credit approval time: reduced from 72 hours to 18 minutes [3].

2. Anti-fraud risk management.

Financial fraud mainly happens when banking account is theft (e.g., unauthorized transactions), identity fraud (e. g., fake loan applications) and organized fraud (e. g., cross-platform money laundering). The application of intelligent risk management focuses on real-time detection of theft, money laundering, and fake transactions through multi-dimensional fraud networks. China Merchants Bank was the first financial institution in China that introduced a mobile banking platform, and in 2016, it created the "Tian ping" system, a fintech-based intelligent risk management platform for consumers. When a user transfers money, the system captures multi-dimensional data such as transaction time, transaction amount, payee, etc. The system then uses these real-time and quasi-real-time data in its risk-control model. Subsequently, the risk control model will perform high-speed calculations based on these real-time and quasi-real-time data to determine the user's risk level in real time, and then combine the model output with different means of verifying the user's identity, so that external frauds and counterfeit transactions can be identified during the transaction process. In addition, the system can mine fraud-associated accounts through after-the-fact counter-checking, utilizing advanced graph algorithms and graph analytics. Since its launch in February 2016, the system has cumulatively protected nearly 3.2 billion customer transactions, with a response speed of less than 30 milliseconds for transactional risk decision-making, which fully achieves risk decision-making without customer perception [4]. The system combines device fingerprinting (detecting device tampering), biometrics (voice/eye tracking), since its launch in 2016, the intelligent risk control platform has been continuously iterated and optimized, the system has formed a 24*7 account monitoring and protection system covering all channels of the Bank. By the end of 2022, the above functions had helped manual outbound calls to recover a cumulative total of more than 40 million yuan in customer financial losses [5].

3. Operational Risk Prevention.

Operational risk is the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. Operational risk management includes the development of operational risk management measures, such as enhancing system security and improving operational procedures. The application focuses on monitoring internal process gaps, employee misconduct, and system failures. The Software Development Center of ICBC initiated RPA (Robotic Process Automation) research in 2019 and launched the first RPA business application scenario. The center explored the "RPA + AI" service model, covering the entire RPA technology solution for business front-end operations and middle-end business management, and

established an enterprise-level intelligent digital workforce that combines “machine intelligence” and “human intelligence” to effectively improve human performance and facilitate the digital transformation of the company [6].

4. Compliance Management.

Compliance risk identification is utilizing natural language processing technology to analyze laws, regulations, and regulatory policies, identifying compliance risk points. Compliance risk assessment is evaluating the probability and impact of compliance risks. Compliance risk management is developing compliance risk management measures, such as strengthening employee training and improving internal managements. Firstly, the application focuses on real-time risk warning. The intelligent risk management system can monitor the compliance risk status of various businesses of the bank in real time and immediately issue early warning information when the risk indicator exceeds the set threshold, so that the bank management and relevant departments can take timely measures to prevent and management the risk. Secondly, focusing on the generation of compliance reports. The system can automatically generate compliance reports, summarize and analyze the bank's compliance risk status, violation statistics and other information, provide data support and decision-making basis for the bank's compliance management, and facilitate the reporting requirements of regulators.

5. Market Risk Management.

Risk identification is the use of big data analysis technology to identify the changing trend of market risk factors (such as interest rates, exchange rates, stock prices, etc.). Risk measurement is the establishment of a risk measurement model to quantify market risk exposure and assess potential losses. Risk management is the development of risk management strategies and taking measures such as hedging and diversification to reduce market risks.

6. Customer Risk Profiling and Precision Marketing.

Customer segmentation is the classification of customers into different risk levels and groups based on customer risk profiles and behavioral data. Precision marketing is the development of differentiated marketing strategies for customers of different risk levels and groups to improve marketing efficiency and customer conversion rates. The application focuses on dynamic risk assessment and personalized product recommendations.

As analyzed above, China's commercial banks have achieved a qualitative change in risk management efficiency from the perspective of banking operations with the adoption of the intelligent risk management systems. The automated processes shorten the credit decision-making processes, reduce the operating costs, and optimize the asset allocation benefits based on the dynamic risk pricing mechanism; at the same time, the real-time risk monitoring system significantly improves the agility of the post-credit management, and effectively curbs the generation of non-performing loans. This model provides a reference path for the global banking industry – technological empowerment needs to be deeply integrated with business processes, balancing risk prevention and control with market expansion needs under the framework of data compliance and sharing, creating a sustainable model for financing services for SMEs in particular. The core of future development lies in building a risk-control decision-

making system linked to the economic cycle, enhancing risk prediction capabilities through cross-regional and cross-industry data synergies, and exploring the empowerment of banks' risk-control capabilities to the upstream and downstream of the industry chain, so as to form a more resilient business ecosystem under the dual goals of financial security and economic growth.

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IMPACT OF DIGITAL BANKING ON MICRO, SMALL AND MEDIUM-SIZED ENTERPRISE FINANCING

Student **Yixuan Wang**,

Lanzhou University of Finance and Economics,
Lanzhou, People's Republic of China

PhD Student **Jigeer Shawuya**,

Peter the Great Saint Petersburg Polytechnic University,
Saint Petersburg, Russian Federation

Abstract. As one of the important parts of economic development, micro-, small and medium-sized enterprises (MSMEs) have made great contributions to the national economy in the case of China as well as Russia. MSMEs have long faced the problem of financing difficulties globally. In the context of the digital economy, digital banking has significantly improved the efficiency and accessibility of financing for MSMEs. Data-driven credit assessment reduces information asymmetry and minimizes resource mismatch in traditional finance. The online platform breaks through geographical constraints, expands service coverage margins, and enhances financial inclusion. This work analyzes the online financial services provided by digital banks to improve the efficiency of financing for MSMEs using case study. Research result concludes that the development of digital banking has significantly improved the efficiency of MSMEs' financing.

Keywords: digital transformation, digital banking, financing, loan, micro-, small and medium-sized enterprises (MSMEs).

ВЛИЯНИЕ ЦИФРОВОГО БАНКИНГА НА ФИНАНСИРОВАНИЕ МИКРО-, МАЛЫХ И СРЕДНИХ ПРЕДПРИЯТИЙ

студент **Исюань Ван**,

Ланьчжоуский университет финансов и экономики,
Ланчжоу, Китайская Народная Республика

аспирант **Цзигээр Шауя**,

Санкт-Петербургский политехнический университет Петра Великого,
Санкт-Петербург, Российская Федерация

Аннотация. Микро-, малые и средние предприятия (ММСП) в Китае и России являются одной из важных составляющих экономического развития и вносят большой вклад в национальную экономику. Во всем мире ММСП сталкиваются с трудностями финансирования. В условиях цифровой экономики цифровой банкинг значительно повысил эффективность и доступность финансирования для ММСП. Оценка кредитоспособности на основе данных снижает информационную асимметрию и минимизирует несоответствие ресурсов в традиционном финансировании. Использование онлайн-платформы

позволяет преодолеть географические ограничения, расширить границы доступа к услугам и повысить уровень финансовой доступности. В данной работе анализируются банковские услуги, предоставляемые цифровыми банками, с целью повышения эффективности финансирования ММСП. В результате исследования получен вывод о том, что развитие цифрового банкинга значительно повысило эффективность финансирования ММСП.

Ключевые слова: цифровая трансформация, цифровой банкинг, финансирование, кредит, микро-, малые и средние предприятия (ММСП).

Micro-, small and medium-sized enterprises (MSMEs) are an extremely important part of China's economic development. According to the information released by the China Association of Small and Medium Enterprises (CASME), as of June 2024, the number of MSMEs in China has exceeded 53 million, accounting for more than 90 % of the total number of enterprises in China, contributing more than 60 % of the country's tax revenue and GDP, and accounting for 70 % of technological innovations, and becoming the core engine of the synergistic development of science and technology and the economy [1]. However, small and micro enterprises have been facing the problems of financing being difficult to approve, time-consuming and costly. Not only in China, but also in most countries around the world, MSMEs have similar problems, especially in developing countries. Therefore, it is urgent to solve the problem of financing difficulties for MSMEs.

The study “MSME Financing Gap: An Assessment of Financing Insufficiencies and Opportunities for Micro, Small and Medium Enterprises in Emerging Markets” released by the World Bank in 2017 points out that China's financing gap for micro, small and medium enterprises (MSMEs) is as high as 43.18 % [2]. In recent years, the financing problems of MSMEs have not been solved. By the end of 2021, the balance of loans to small and micro enterprises in China was 50.0 trillion yuan, and the balance of loans to inclusive small and micro enterprises with single-family credit of less than 10 million yuan was 19.1 trillion yuan [3]. The figures look pretty good, but if we calculate based on the overall data released by the official government, we can find that the proportion of China's micro and small enterprise loans to enterprise loan balances is only 40.6 %, and the size of the loan balances of single-family credit less than 10 million yuan of inclusive micro and small enterprises account for 39.4 % of the loans to micro and small enterprises. This ratio is still relatively low. Hence under the traditional financial system, the financing of micro and small enterprises faces many challenges.

1. The traditional loan approval process is complicated. Traditional offline banks require micro and small enterprises to provide a large amount of approval materials, and then go through layers of approval, which usually takes weeks or even a month to roll over. The average approval time for a traditional bank's MSME loan is up to 23.5 hours. And most MSMEs tend to have an urgent need for capital. This makes it impossible for MSMEs to get approval quickly, may even lead to bankruptcy and closure of MSMEs.

2. Low approval rate for MSME financing. The rejection rate of traditional bank loans for MSMEs has always been quite high in China, on the one hand, it is because

most of the enterprises are unable to provide qualified collaterals, such as collaterals that are too small to meet the bank's requirements. On the other hand, it is because enterprises lack complete financial statements. Because the enterprise is difficult to provide qualified and complete financial statements and collateral, it is difficult for the bank to assess the risk and credit of micro and small enterprises, so the traditional bank will think that the risk of lending to micro and small enterprises is higher, which makes the micro and small enterprises need to provide a large number of collateral, which is almost impossible to meet the requirements for the micro and small enterprises that are just starting up and do not have many resources to support them, which results in a low rate of approval of financing for the micro and small enterprises. The approval rate of financing is low. This situation is especially true for micro and small enterprises, especially those that are just starting out, where the internal financial system is not yet in place and there is not enough collateral to apply for a loan. However, these enterprises are precisely the ones that may be in the most urgent need of start-up capital, which leads to an inequality between the financing needs of MSMEs and the supply of traditional bank loans.

3. High Cost of Financing for MSMEs. 59.4 % of MSMEs reported that their borrowing costs ranged from 5 % to 10 %, with more than 40 % reporting borrowing costs of more than 10 % [4]. Because of this, MSMEs must pay more for their loans than traditional banks [4]. Because of the higher risk assessment of MSMEs, traditional banks have increased their collateral requirements for MSMEs, and the cost of loans for MSMEs is generally higher than that of traditional loans for large enterprises. Not only with this, small and microenterprise loans also need to pay the appropriate assessment fees to the bank as well as guarantees and loan matching insurance premiums. Microenterprise loans need to pay a lot of fees in the early stage, if coupled with the time cost of loan approval, the high cost of microenterprise loan financing often makes it difficult for them to support.

In short, the traditional financial model has led to the financing difficulties of micro and small enterprises, but also seriously hinder the development of micro and small enterprises. However, with the development of technology and the concept of digital banking, the emergence of online digital operating platforms has gradually eased the difficulties of micro and small enterprises.

With the introduction of the concept of digital banking, the construction of digital banks has become an operation method that Chinese banks are competing to follow. A digital bank, also known as a virtual bank or Internet bank, is a new type of financial institution that relies on financial technology to provide core banking services such as deposits, loans and remittances mainly through online channels [5]. Nowadays, digital banks optimize the loan approval process of micro and small enterprises, reduce the information asymmetry of micro and small enterprises and other problems, and fully improve the efficiency of financing for micro and small enterprises, mainly using big data, artificial intelligence, cloud computing and other technologies. The following is an analysis of the online operation of digital banks to alleviate financing problems.

1. Optimized the loan application and approval process. With the development of the digital banking concept, China's major banks and other financial institutions have launched online financing platforms. The development of online platforms allows

enterprise employees not to bring a variety of paper materials running around. Instead, they can upload their company's information through the online financing platform for quick online application, approval and fund release. According to the survey, most of the online financing platforms in China nowadays can do the whole online operation, and enterprises only need to provide a small amount of basic information to complete the approval within a few working days or even a few hours, and the funds are all accounted for. Compared with the traditional mode of financing, online platforms have greatly reduced the time cost of financing for small and micro enterprises and improved efficiency.

2. Application of big data and artificial intelligence. The online financing platform has carried out the collection of micro and small enterprises' data from multiple dimensions using big data and artificial intelligence technology. For example, digital banks can collect financial statements, bank flows and other information of micro and small enterprises through big data. This enables those small and medium-risk microenterprises to quickly pass the bank's audit, fully solving the problem of slow approval of small and microenterprises. At the same time, digital banking also supports the problem of filling in some of the credit information gaps of micro and small enterprises through POS transactions, supply chain records, e-commerce platform sales data and other non-traditional data. In this way, it solves the problem mentioned above that the traditional model of MSME financing cannot be carried out because of the lack of financial statements and other issues. Digital banks also use this data to assess the risk of enterprises, and this intelligent risk control allows some low-risk MSMEs to make loans without collateral and at low interest rates. This alleviates the problem of high financing costs for MSMEs mentioned above.

3. Improved customer service and support. Through AI-driven intelligent customer service, most online financing platforms can realize 24-hour intelligent service, and enterprises are able to open the online financing platform anytime and anywhere to ask their questions to customer service, track loan progress and other services. And some online financing platforms are able to form a very fine customer identification of small and micro enterprises and to provide customized financing solutions according to the needs and risk levels of different enterprises.

As mentioned above, the emergence of online financing platforms of digital banks has improved the efficiency of financing for micro and small enterprises from all aspects, reduced the cost of enterprise loans and saved time. Development of digital banking online operation platform has well alleviated the problem of financing difficulties of micro and small enterprises. MSMEs have improved the efficiency of financing, reduced the cost of financing, and even the quality of financing through the platform. As of the second quarter of 2024, the balance of loans used by banking financial institutions for small and micro enterprises reached 78 trillion yuan, an increase of 233 % from the end of 2018; China's mobile payment penetration rate reached 86 %, ranking first in the world [6]. By 2025, the financing confidence of micro and small enterprises has been extremely high compared to the 2010s, which is closely related to the development of digital banking online platform operation.

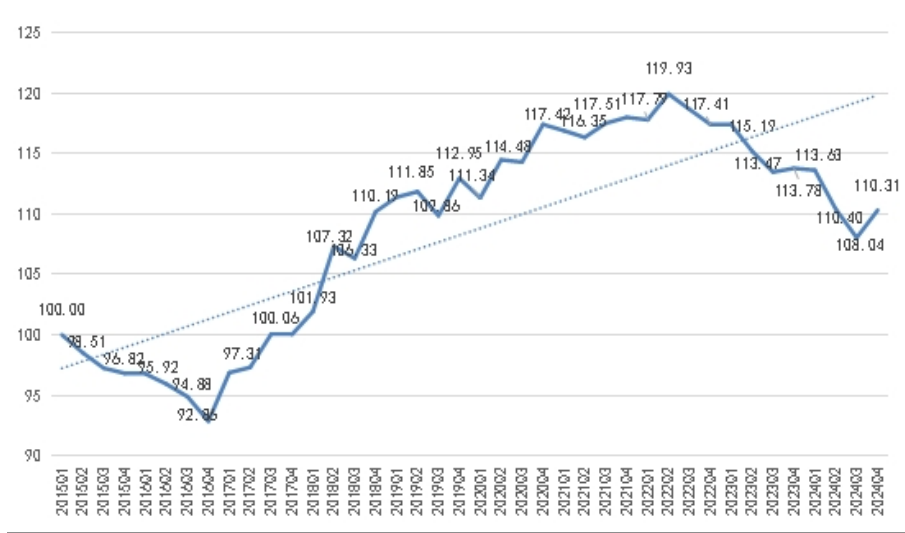


Figure 1 – Digital Finance-Small and micro service quality index operation chart
(Data source: Xinhua Finance) [7]

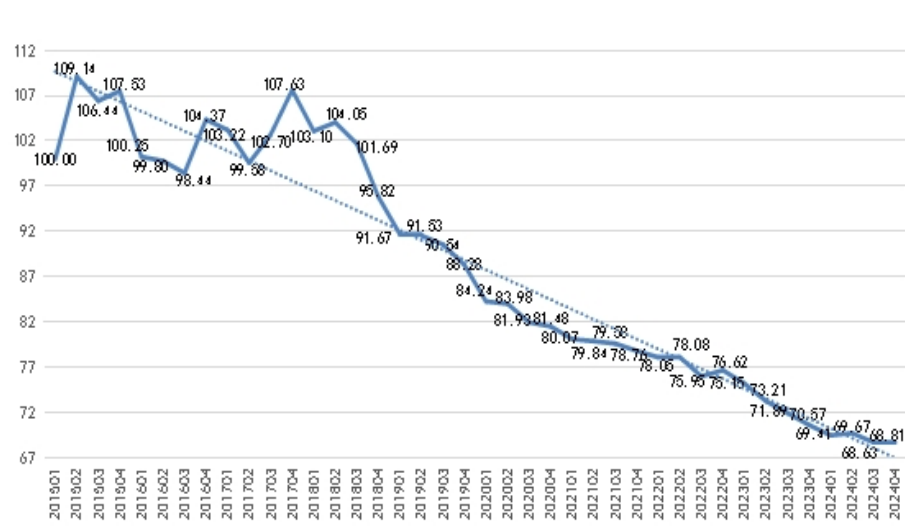


Figure 2 – Digital Finance-Small and micro financing price index operation chart
(Data source: Xinhua Finance) [7]

It can be observed from Figure 1 and Figure 2 that from the first quarter of 2015 to the fourth quarter of 2024, the service quality index of digital finance for MSMEs increased from 95.51 to 110.31 and reached a 10-year quality peak in the second quarter of 2022. The difference between the highest and lowest values over the ten-year period is 27.07. There is a very rapid growth trend from the fourth quarter of 2016 to the third quarter of 2022, and although there is a decline in quality after that, there is also some growth from the initial 2015. The quality of financing for MSMEs by digital finance is all on an upward trend. Similarly, the price index of MSME finance from the first quarter of 2015 to the fourth quarter of 2024 shows a decreasing trend, from 100 at the beginning of 2015 to 68.81 almost every year between the second quarter of 2021 and the first quarter of 2024 shows a very good decreasing trend, although there is a slight rebound in the last three quarters of 2024, but it is only a very

small growth. The difference between the highest and lowest values during this decade is 40.51, which overall shows that digital finance has sufficiently reduced the cost of financing for MSMEs. It fully demonstrates that the development of digital banking in China has alleviated the problem of financing difficulties of micro and small enterprises and promoted the development of micro and small enterprises.

In the context of the development of China's digital banking, the online financing platforms established by China's major banks as well as financial institutions have greatly improved the financing environment of micro and small enterprises to a certain extent using big data, artificial intelligence and other technologies, making their financing more convenient, low-cost and efficient. The successful experience of China's digital bank shows that the operation model of digital bank online platform can be a reference for other countries, especially for some developing countries that also face difficulties in financing MSMEs. In the future, with the continuous development of technology and the updating of the digital banking concept, digital banking is expected to provide more and more convenient financing services for micro and small enterprises, which will continue to promote the development of the global economy.

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FORECASTING PRICES OF ANDROID SMARTPHONES

Engineer **Alyokhin Yuri Valerievich**,
PhD in Pedagogy, Associate Professor, **Bazhenov Ruslan Ivanovich**,
Sholom-Aleichem Priamursky State University,
Birobidzhan, Russian Federation

Abstract. The purpose of the research is to develop a machine learning model for predicting the price of smartphones with the Android operating system. The comparison of models (Linear Regression, Random Forest, XGBoost, Decision Tree, K-Nearest Neighbors method) is based on the metrics R2, MSE. The best results were shown by the XGBoost algorithm for the prolog price, which has the highest value of R2 (0.910) and the lowest value of MSE = 0.0539.

Keywords: brand, screen size, battery capacity, year of sale.

ПРОГНОЗИРОВАНИЕ ЦЕН НА СМАРТФОНЫ С ОПЕРАЦИОННОЙ СИСТЕМОЙ ANDROID

инженер **Алехин Юрий Валерьевич**,
канд. пед. наук, доцент **Баженов Руслан Иванович**,
Приамурский государственный университет имени Шолом-Алейхема,
г. Биробиджан, Российская Федерация

Аннотация. Целью исследования является разработка модели машинного обучения для прогнозирования цены на смартфоны с операционной системой Android. Сравнение моделей (Линейная регрессия, Случайный лес, XGBoost, Дерево решений, Метод К-ближайших соседей) произведено на основании метрик R2, MSE. Наилучшие результаты показал алгоритм XGBoost для прологарифмированной цены, которая имеет самое высокое значение R2 (0.910) и самые низкое значение MSE = 0.0539.

Ключевые слова: бренд, размер экрана, емкость аккумулятора, год реализации.

1. Introduction

1.1 Relevance

In the modern world, where the Android smartphone market is rapidly evolving and characterized by a vast array of models and specifications, accurate price forecasting has become more critical than ever. The constantly changing technological landscape, intense competition among manufacturers, and the influence of macroeconomic factors contribute to a complex dynamic that necessitates reliable tools for informed decision-making for both consumers and industry stakeholders. Applying machine learning models to predict Android smartphone prices enables consumers to identify optimal deals, while manufacturers and retailers can develop

effective pricing and sales strategies. The ability to anticipate price fluctuations helps maintain competitiveness, facilitate attractive promotions, and adapt to market volatility. Furthermore, precise forecasts support the generation of personalized recommendations tailored to individual user preferences and financial capabilities.

Therefore, the development and deployment of machine learning-based price prediction models for Android smartphones represent a highly relevant and promising research direction, offering tangible benefits to all market participants.

1.2 Literature Review

The model developed by A. V. Tolmachev and O. N. Krasavina represents a machine learning tool designed for estimating the cost per square meter of real estate. It is likely that this model utilizes features such as location, area, age, amenities, and market trends to forecast the price per square meter. The underlying algorithms include machine learning techniques such as regression models or neural networks, trained on historical real estate data to identify relationships between property characteristics and their valuation. The primary goal of the model is to provide an accurate, data-driven tool for real estate assessment, which can be beneficial for buyers, sellers, and industry professionals [1]. A. M. Vasilchenko, in his works, described methods of data analysis using Python libraries, enabling efficient processing and analysis of large datasets [2]. N. E. Kosykh proposed an approach to parameter optimization for text classifiers utilizing the Google Colaboratory cloud service. This platform allows executing Python code in a web browser, leveraging virtual hardware resources, thus serving as a convenient tool for computational experiments and development [3]. T. M. Tatarnikova et. al. examined methods for studying and constructing neural networks in their publication. They emphasized that understanding the principles of neural network operation and their application to solving practical problems is achievable primarily through hands-on experience. The authors analyzed various software environments suitable for neural network training and highlighted Google Colaboratory as a modern cloud-based platform recommended for learning neural network fundamentals. This service offers pre-installed libraries such as TensorFlow, free access to GPUs, and the ability to write and run code directly in the browser, making it highly suitable for educational purposes [4]. E. A. Grigoriev and N. S. Klimov discussed exploratory data analysis methods and described tools for their implementation, including Python libraries. They provided an example involving data related to detecting human presence in indoor environments, demonstrating practical applications of these techniques [5]. Yu. S. Popkov investigated core concepts and algorithms in machine learning, including randomized methods, which are effective tools for classification and forecasting tasks under uncertainty [6]. The author notes that real estate price prediction is a complex challenge due to numerous influencing factors. Traditional methods based on expert judgment and statistical models often fail to account for all these variables, resulting in less accurate predictions [7]. S. V. Shaytura described the process of knowledge discovery in data, encompassing three stages: identifying patterns, using these patterns for predicting unknown values, and analyzing anomalies to detect and interpret deviations within the discovered patterns [8]. D. Yu. Gorodnichev summarized the fundamentals of machine learning and deep learning, providing a conceptual distinction between these terms. He

explained the process of automated model building and discussed issues encountered when integrating such systems into electronic markets and online business environments [9]. The author also examined the capabilities of software tools like Google Colaboratory and Jupyter Notebook for artificial intelligence tasks. The core functions and methodologies for utilizing these platforms were studied, highlighting their convenience for working on machine learning and data analysis projects.

1.3 Research Objective

The objective of this study is to develop a machine learning model for predicting the prices of smartphones running the Android operating system.

2. Materials and Methods

For implementation, the development environments Google Colab and various libraries and regression models were used, including DecisionTree, KNeighbors, RandomForest, LinearRegression, and XGBoost.

Data were collected from the DNS online store website.

3. Results and Discussion

The research process is outlined in the following stages:

1. Importing the main libraries.
2. Loading the data.
3. Exploratory data analysis.

Figure 1 presents the distribution plots of the categorical features.

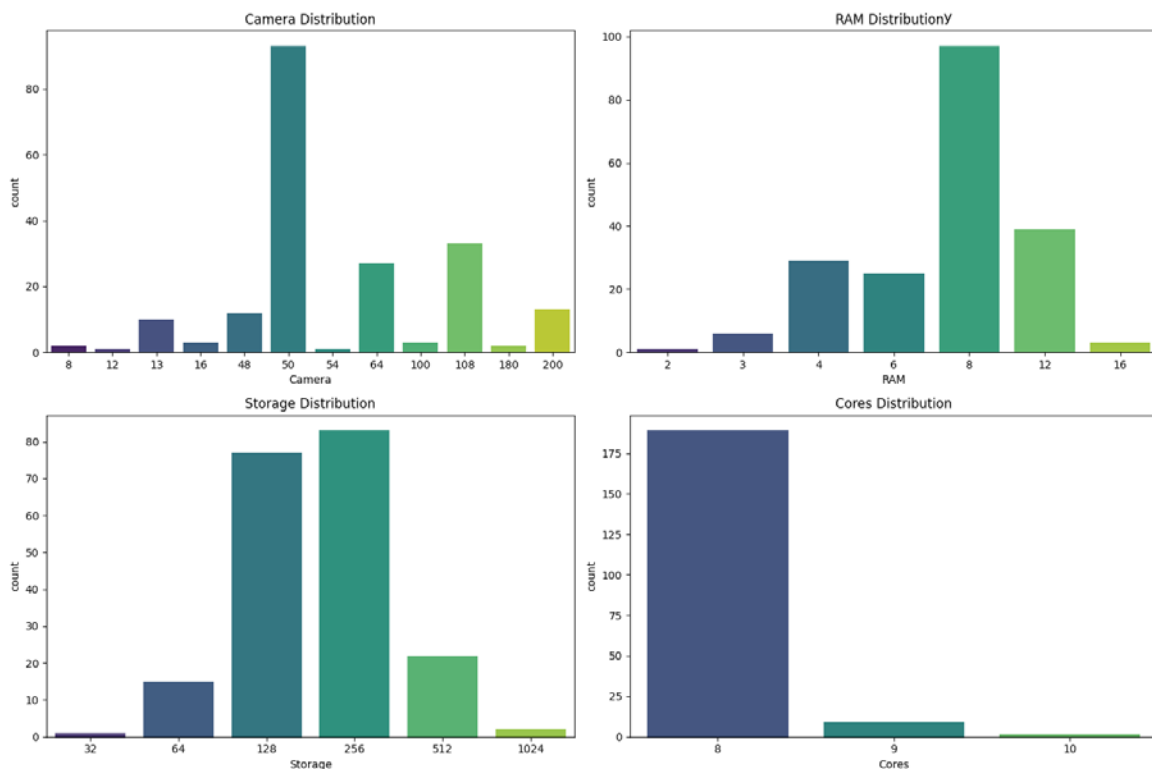


Figure 1 – Distribution plots of categorical features

Next, scatter plots illustrating the relationship between price and numerical features are presented (Figure 2).

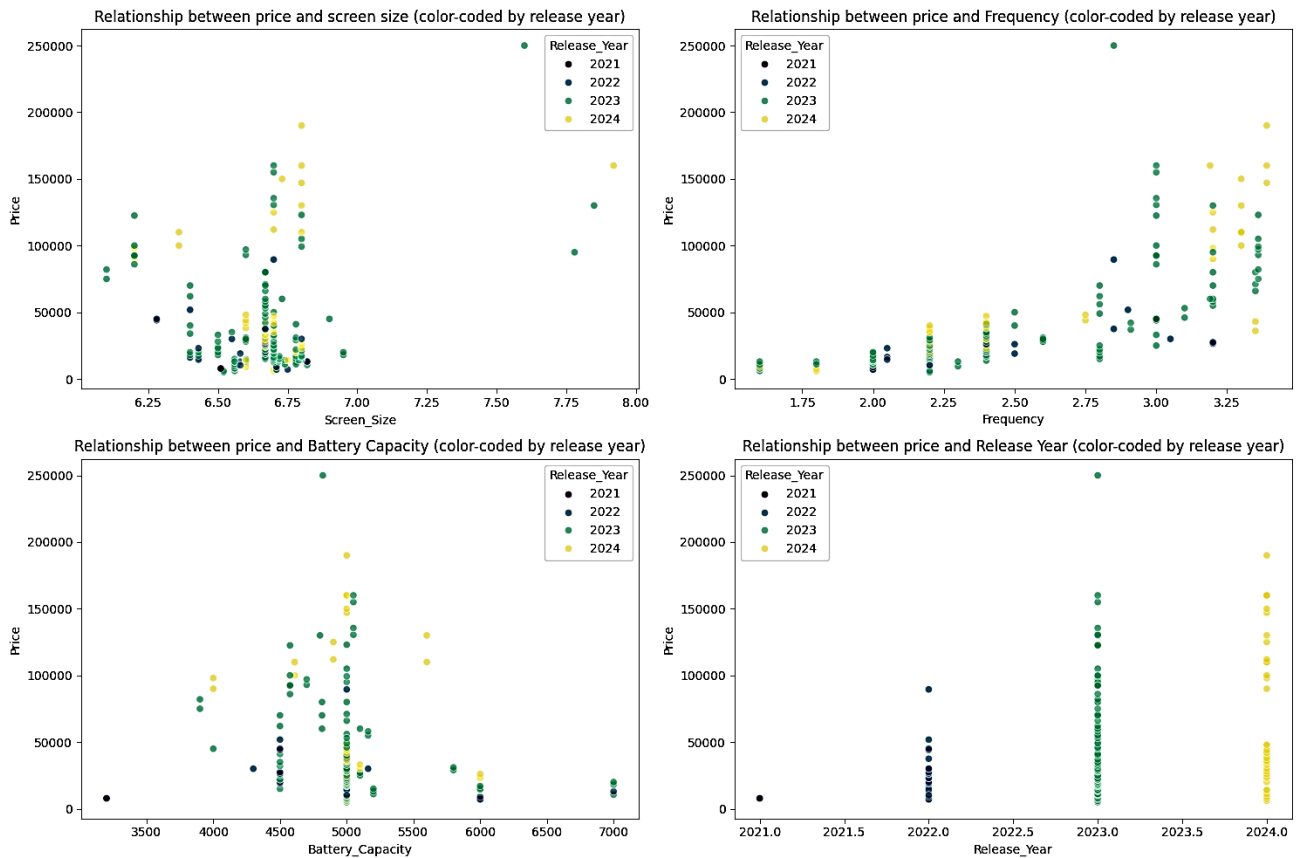


Figure 2 – Scatter diagrams

4. Data Transformation

Using LabelEncoder from the scikit-learn library, categorical columns such as “Brand,” “Camera,” “RAM,” “ROM,” “Cores,” and “NFC” were encoded into numerical values. This step is essential for utilizing these categorical features in machine learning algorithms that operate on numerical data.

5. Correlation Analysis

A correlation matrix was generated (Figure 3) to analyze the relationships between features within the dataset, enabling the identification of dependencies among various phone characteristics.

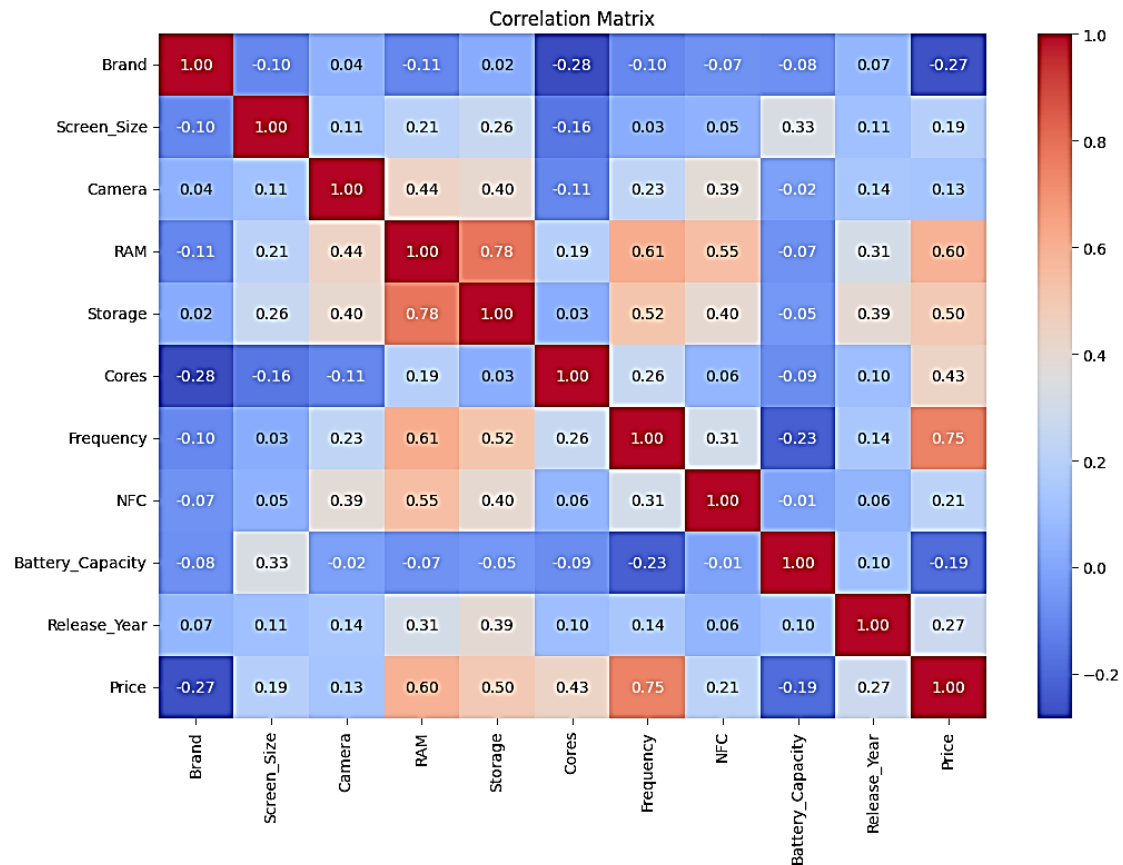


Figure 3 – Correlation matrix

Correlation analysis of smartphone characteristics indicates that the most significant factors influencing price are CPU frequency, RAM, and internal storage capacity. Conversely, parameters such as screen size or camera quality have a lesser impact. The brand may be associated with more affordable options, and it is important to consider the relationships between features – for example, between RAM and internal storage – to make an optimal choice, especially when working within a limited budget.

6. Building Machine Learning Models

To evaluate the generalization capability of the models, the data were split into training (80 %) and testing (20 %) sets, with a fixed random seed to ensure reproducibility.

Functions were defined to systematically analyze the performance of various machine learning algorithms, including model training and metric calculation (R^2 , MSE, RMSE, MAE).

To assess the effectiveness of different regression algorithms – such as linear regression, random forest, XGBoost, decision trees, and k-nearest neighbors – each model was trained and tested using predefined functions, and the results were stored in a dictionary for subsequent comparison.

7. Model Evaluation

Comparison of models trained on original and logarithmically transformed data (Table).

Table – Model Performance Comparison

Model	Target			
	Price		Log10(Price)	
	Metric			
	R2	MSE	R2	MSE
LinearRegression	0.583413	4.991095e+08	0.834373	9.932791e-02
RandomForest	0.859474	1.683625e+08	0.907700	5.535305e-02
XGBoost	0.828407	2.055847e+08	0.910056	5.394017e-02
DecisionTree	0.346445	7.830195e+08	0.855508	8.665348e-02
KNeighbors	0.805902	2.325474e+08	0.849754	9.010407e-02

Based on the comparison of the model results trained both without and with logarithmic transformation of the target variable, the following conclusions can be drawn:

1. Improvement in model quality with logarithmic transformation:

- All models trained using the logarithmic transformation of the target variable demonstrate significantly higher R2 values compared to models trained without the transformation. This indicates that the logarithmic transformation helps models better explain the variance of the target variable.
- The Mean Squared Error (MSE) values are lower for models with the transformation, suggesting an improvement in predictive accuracy.

2. Comparison of models:

- Linear Regression: The logarithmic transformation had the most significant impact on linear regression, substantially enhancing its performance. The R^2 increased from 0.583 to 0.834, and the MSE decreased markedly.
- Random Forest: The Random Forest model performed well without transformation ($R^2 = 0.859$), but its performance improved further with the logarithmic transformation ($R^2 = 0.908$).
- XGBoost: XGBoost with the logarithmic transformation achieved the best results among all models ($R^2 = 0.910$), making it the most accurate model for this task.
- Decision Tree: The logarithmic transformation significantly improved the Decision Tree's performance, increasing R^2 from 0.346 to 0.856.
- K-Nearest Neighbors: This model also showed improvement after applying the logarithmic transformation, although the enhancement was less pronounced compared to other models.

3. Best model:

The highest performance after the logarithmic transformation was exhibited by the XGBoost model (Log), which achieved the highest R^2 value of 0.910 and the lowest MSE of 0.0539. This makes it the most suitable model for this task.

4. Overall conclusion:

The logarithmic transformation of the target variable positively affected the performance of all models by reducing the influence of outliers and making the distribution of the target variable more normal. This is especially important for datasets with strong outliers or nonlinear relationships.

The best results were obtained using the XGBoost (Log) model, making it the preferred choice for forecasting in this context.

4. Conclusion

The analysis results indicated that the best performance was achieved using the XGBoost model with logarithmic transformation, which demonstrated a high R^2 value of 0.910 and low error metrics ($MSE = 0.0539$). This makes XGBoost the most accurate model for predicting Android smartphone prices.

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FRAUD IN THE FIELD OF INFORMATION SECURITY

Student **Harchevskaya Ekaterina Nikolaevna**,
Lecturer **Yurenskaya Svetlana Alekseevna**,
Space Engineering and Technology College of the Technological University named
after twice Hero of the Soviet Union,
pilot-cosmonaut A. A. Leonov,
Korolev, Russian Federation

Abstract. This article examines various types of fraud, including banking fraud, internet fraud, and fraud involving mobile communications. The author emphasizes that the development of an information protection system necessitates a comprehensive approach, which includes technological, organizational and educational measures. Key methods for preventing fraud include the implementation of multi-factor authentication, the use of cryptographic techniques, antivirus solutions, employee training on cyber threats, and the development of stringent security policies.

Keywords: fraud, information security, cyber threats, fraud prevention, information technology.

МОШЕННИЧЕСТВО В ОБЛАСТИ ИНФОРМАЦИОННОЙ БЕЗОПАСНОСТИ

студент **Харчевская Екатерина Николаевна**,
преподаватель **Юренская Светлана Алексеевна**,
Колледж космического машиностроения и технологий
Технологического университета имени дважды Героя Советского Союза,
летчика-космонавта А. А. Леонова,
г. Королев, Российская Федерация

Аннотация. Мошенничество в сфере информационной безопасности стало одной из самых серьезных проблем, характеризующих эпоху цифровизации. В статье рассматриваются разнообразные виды мошенничества, включая банковское, интернет-мошенничество и мошенничество с использованием сотовой связи. Автор акцентирует внимание на том, что работа над системой защиты информации требует комплексного подхода, который включает технологические, организационные и образовательные меры. Также описаны основные методы предотвращения мошенничества, такие как внедрение многофакторной аутентификации, применение криптографических методов, антивирусные решения, обучение сотрудников киберугрозам и разработка строгих политик безопасности. Эффективная защита информации формирует основу для безопасного будущего в сфере информационных технологий.

Ключевые слова: мошенничество, информационная безопасность, киберугрозы, предотвращение мошенничества, информационная технология.

Fraud in the field of information security has become one of the most serious and pressing threats in the era of digitalization. With the expanding use of the internet, online payments, and electronic services, fraudulent schemes are becoming increasingly sophisticated and multi-layered. Attacks on corporate structures and individual users can lead to significant financial losses, compromise confidential information, and damage reputations. Numerous studies indicate a consistent upward trend in cybersecurity incidents, suggesting that perpetrators are continuously developing new methods to bypass existing protective measures. In this context, the analysis of fraudulent schemes becomes a critical issue for forming effective protection strategies and preventing crimes in the realm of information security.

Fraud and Its Objectives. According to Article 159 of the Criminal Code of the Russian Federation, fraud is defined as “the theft of another's property or the acquisition of rights to another's property through deception or abuse of trust”. Fraud can be penalized by fines of up to 120,000 rubles or an amount equal to the convicted person's wages or other income for a period of up to one year, or by compulsory works for up to 360 hours, or corrective labor for up to one year, or restriction of freedom for up to two years, or compulsory labor for up to two years, or imprisonment for up to two years.

The primary objective of fraud is often to obtain monetary funds, for which offenders typically need to acquire the following information: details of the bank card or account; the surname, first name, and patronymic of the owner; passwords from bank account profiles; and any other information that grants access to financial resources.

History of Fraud. Fraud in the area of information security is a complex and dynamic phenomenon that has grown significantly with the advancement of information technologies and the transition of financial services into the digital space. Let us consider the stages of its development:

Table – The History of the Emergence and Development of Fraud

Key Characteristics of the Period	Description
Early Years (1970s-1980s)	Initial Hacks: With the advent of computers, some hackers used their skills to test system security. This was not always considered fraud, as many hacks aimed to identify vulnerabilities. First Viruses: Fraudulent programs like Creeper (1971) began to emerge, though they were not seen as a real threat at the time.
Development of Computer Networks (1980s-1990s)	Phone Fraud: Some fraudsters used telephone lines to hack systems. They installed programs that could make phone calls, leaving users with large bills for telephone services.

	Viruses and Worms: The spread of viruses such as the Morris worm (1988) was a significant event in the history of internet security, demonstrating how malicious programs could cause serious disruptions.
Commercialization of the Internet (1990s)	Email: With the emergence of email, fraudsters began to use phishing—a deception method in which victims received counterfeit messages to disclose their personal information. Emergence of the First Viral Scheme: In 1996, the first known email fraud utilizing phishing techniques to steal users' passwords was recorded.
Era of Globalization and Increased Cyber Attacks (2000s)	Online Banking Systems: The popularity of online banking led to a new level of fraud, including cases where users became victims of personal data theft. Credit Card Fraud: There was an increase in cases of credit card data breaches and the creation of counterfeit cards.
Attacks on Corporate Structures (2010s)	Targeted Attack Schemes: Schemes such as Business Email Compromise (BEC) emerged, using social engineering to steal funds from corporate accounts. Cyber Attacks on Large Companies: Attacks, such as those on Target and Sony, highlighted vulnerabilities in data protection. These attacks often utilized social engineering and hacks to gain access to confidential information.
Modern Threats and Trends (2020s)	Ransomware: There has been an increase in attacks where perpetrators encrypt data within organizations and demand ransom for access, such as the attack on Colonial Pipeline. Fraud Involving Cryptocurrency: As the popularity of cryptocurrencies grew, the number of frauds related to Initial Coin Offerings (ICOs) and schemes involving cryptocurrencies fraud also increased.

There are 5 main types of fraud (Figure). Let's examine them in more detail.

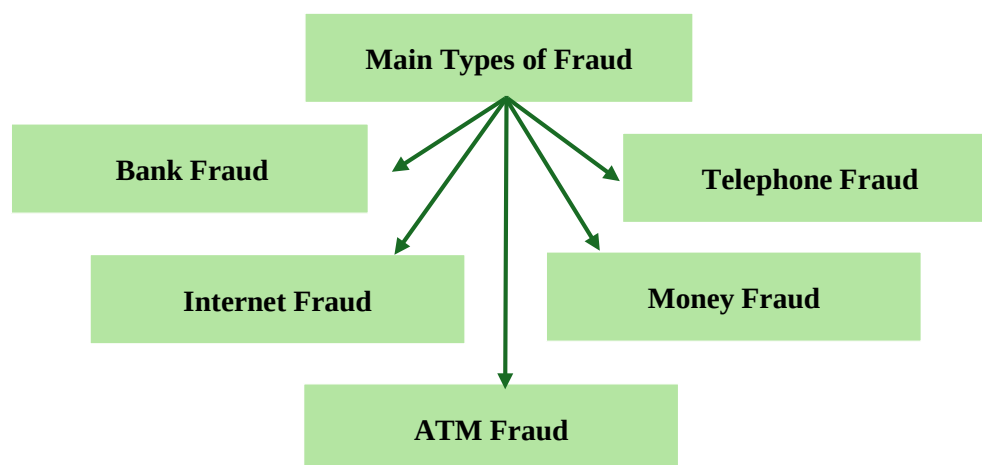


Figure – The main types of fraud

Fraud in the Banking Sector can be categorized into three main types:

1. ***Fraud in Credit Operations:*** This includes crediting amounts intended for debt repayment to other accounts, issuing loans to non-existent borrowers, and approving loans without the knowledge of the clients.
2. ***Fraud in Cash Management:*** This involves unauthorized withdrawal of amounts from accounts, substitution of genuine banknotes with counterfeit ones, and the theft of banknotes from counted bundles.
3. ***Fraud with Deposits:*** This includes the seizing of deposited funds, undervaluation of amounts in documents, and the withdrawal of funds without the client's knowledge.

Most banking frauds are perpetrated in branches and divisions of banks, where there is less oversight, rather than in large head offices. In such environments, there are fewer employees who are involved in a greater number of business processes, which creates broader opportunities for illicit activities [1, p. 269].

A notable example of fraud is the incident involving Target in 2013, when perpetrators gained access to data from over 40 million credit and debit cards of customers. The main issue was a vulnerability in the security system that allowed hackers to install malicious software, collecting data from skimmers placed on terminals in stores. Investigations revealed that the vulnerability arose from insufficient protection of the network associated with third parties, underscoring the importance of monitoring all aspects of business processes. As a result of the incident, Target suffered billions of dollars in losses, including costs for upgrading security systems, compensation payments, and reputational damage.

Internet Fraud. As the market for electronic payments and online shopping has grown, new modern forms of fraud using information technologies have also emerged [2, p. 52], [3, p. 96]. The most common types of internet fraud include:

Phishing: This is the theft of personal data (such as passwords and usernames) with the aim of stealing funds from bank cards. Phishing primarily utilizes email campaigns containing links to fake websites [4, p. 83].

Email Scams: Known as “Nigerian letters”, these scams contain elaborate stories about inheritances from fictional relatives, requesting the victim to transfer money to pay for legal services or commissions.

Internet Wallet Schemes: This type of fraud occurs when a buyer transfers a deposit to a seller's internet wallet but ultimately receives neither the goods nor the money back.

In May 2015, according to the information agency CNews, the first known court case in Russia against a group of phishers who stole money from internet users concluded. The perpetrators lured users to counterfeit web pages of banks and payment systems, obtaining their confidential information. As a result of their fraudulent actions, more than 170 clients of VTB24 bank across 46 regions of Russia were affected, with total financial losses amounting to 13 million rubles. The initiators of the fraud, twin brothers Yevgeny and Dmitry Popelyshy, were sentenced to six years of conditional imprisonment each and fined 450,000 rubles.

Mobile (or Telephone) Fraud. Fraud utilizing mobile communication can be conditionally divided into two groups. The first group pertains to the direct withdrawal of money from the account of the number holder without their knowledge. Such schemes can be carried out by both mobile operators and fraudsters unrelated to their companies. The second group includes cases in which the subscriber voluntarily transfers money to a specified account, hands it over directly, or leaves it in a location designated by the fraudsters. In these instances, mobile communication serves merely as a tool for staging. For example, a call may be staged from a close relative in distress, urgently needing money [5, p. 345]. The fraudster poses as a relative (or acquaintance) and, in a worried tone, informs the victim over the phone that they have been detained by law enforcement for committing a crime (such as a traffic accident, possession of weapons or drugs, or causing serious bodily harm). Then, a supposed police officer joins the conversation, confidently stating that they have “helped” people like this before. However, unlike before when money was delivered directly to them, the money now needs to be taken to a specific location, handed to a particular person, or transferred to an account (mobile phone number).

Money Fraud is an extensive and all-encompassing category. Fraud involving monetary assets constitutes one of the broadest and most comprehensive categories, as nearly all types of fraudulent activity, in one way or another, imply the illegal appropriation of someone else's funds. Nevertheless, several methods of fraud are identifiable that are indirectly or directly related to cash banknotes. These methods are commonly employed by perpetrators in retail stores, currency exchange points, and similar establishments.

One of the simplest and most widespread techniques involves *replacing genuine banknotes* within a stack with counterfeit or altered bills (often, genuine banknotes are placed on the top and bottom, with counterfeit or regular paper in the middle). Another prevalent method is “*shortchanging*”, where several banknotes are discreetly withdrawn from a pre-counted cash bundle.

ATM Fraud. Fraud can also be conducted through the use of ATMs: perpetrators may install sensors that read personal data or implement skimming devices to capture card information. For example, scammers may deceive cashiers in small shops lacking

surveillance cameras. A customer, during a transaction, may produce a large denomination bill, engage in conversation with the cashier, and then withdraw it, claiming that they will provide a smaller bill instead. If the scam is successful, the perpetrator effectively steals goods without payment.

A common scheme involving ATMs involves the following procedure: a fraudster initiates a transaction, such as a mobile phone top-up, enters the phone number and transfer amount, selects a bank card as the payment method, but does not complete the transaction and walks away from the terminal. Typically, both the terminal and the ATM provide a 90-second window to complete the operation. If another customer inserts their card and enters the PIN within this period, the funds for the previous transaction can be fraudulently withdrawn [6, p. 70].

Methods for Preventing Fraud in the Sphere of Information Security. To effectively combat fraud in the realm of information security, a comprehensive approach is essential, encompassing technological, organizational, and educational measures [7, p. 308], including:

1. *Technological Solutions:* Implementing multi-factor authentication (MFA) significantly reduces the risk of unauthorized access to critical resources. The application of cryptographic data encryption methods ensures protection against data interception and misuse. Anti-malware solutions (antivirus programs) and intrusion detection and prevention systems (IDS/IPS) enable effective identification and response to anomalous activity within network infrastructures.

2. *Employee Training:* Enhancing employees' knowledge regarding cyber threats and social engineering techniques plays a crucial role in preventing successful attacks. Regular cybersecurity training programs develop competencies that enable staff to recognize and counteract phishing attacks and other fraudulent schemes in a timely manner [8, p. 124].

3. *Security Policies:* Developing and implementing strict information security policies – covering password management standards and access control protocols – contribute to the substantial reduction of potential risks [9, p. 72]. These policies must be adaptable to the continuously evolving threat landscape and aligned with industry best practices.

In conclusion, effective countermeasures against fraud within the domain of information security demand a holistic approach and coordinated efforts among various agencies and organizations. The deployment of advanced technologies, personnel training, and the formulation of rigorous security policies collectively mitigate the risks associated with fraudulent schemes and foster a resilient informational environment. Moreover, it is essential to continuously adapt security strategies to maintain a high level of protection in the field of information technology.

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**SOFTWARE IMPLEMENTATION OF THE ALGORITHM
FOR IDENTIFICATION OF THE STATE OWNERSHIP OF AIRCRAFT
BY CIRCULAR SCANNING OF THEIR IDENTIFICATION MARKS**

Cadet Popov Ivan Andreevich,

Academic Advisor: PhD in Technical, Associate Professor

Konovaltsev Eduard Valerievich,

Krasnodar Higher Military Aviation School of Pilots named after

Hero of the Soviet Union A. K. Serov,

Krasnodar, Russian Federation

Abstract. The article presents a program that implements the determination of an aircraft's affiliation with the air forces of a specific state. To perform the identification task, a method of circular scanning of the image of the aircraft identification mark located on the aircraft (on the fuselage, wing or vertical stabilizer of the aircraft) is proposed. The principle and means of obtaining the image of the identification mark are not considered in this work; only the main stages of the scanning method with the image of the aircraft mark itself are described.

Keywords: nationality, aircraft, circular image scanning method.

**ПРОГРАММНАЯ РЕАЛИЗАЦИЯ АЛГОРИТМА ИДЕНТИФИКАЦИИ
ГОСУДАРСТВЕННОЙ ПРИНАДЛЕЖНОСТИ ЛЕТАТЕЛЬНЫХ
АППАРАТОВ СПОСОБОМ КРУГОВОГО СКАНИРОВАНИЯ
ИХ ОПОЗНАВАТЕЛЬНЫХ ЗНАКОВ**

курсант **Попов Иван Андреевич,**

науч. руководитель: канд. техн. наук, доцент

Коновальцев Эдуард Валерьевич,

Краснодарское высшее военное авиационное училище летчиков

имени Героя Советского Союза А. К. Серова,

г. Краснодар, Российская Федерация

Аннотация. В статье представлена программа, реализующая определение принадлежности самолета к военно-воздушным силам конкретного государства. Для выполнения задачи идентификации предложен способ кругового сканирования изображения опознавательного знака самолета, расположенного на самолете (на фюзеляже, крыле или киле самолета). Принцип и средства получения изображения опознавательного знака в данной работе не рассматривается, изложены только основные этапы работы способа сканирования с самим изображением знака самолета.

Ключевые слова: государственная принадлежность, самолет, способ

кругового сканирования изображения.

Any theoretical study of any methods, techniques, principles or approaches in programming is accompanied by an interest in their applied implementation. At the same time, programming, or more precisely, the development of applied programs, is interconnected with many areas of science, education, everyday activities and production.

For example, a group of authors under the supervision of a scientific supervisor developed such programs as:

- when studying issues of psychology – “Training program for employees of the Russian Ministry of Internal Affairs in situations” [1];

- when studying issues of the effectiveness of using weapons – “Software package for calculating the effectiveness of defeating typical ground targets with controlled air-to-surface class aircraft weapons equipped with optical-electronic homing heads” [2];

- when studying the theory of random numbers – “Generator of ten pairs of tables with dimensions 10x50 random non-repeating numbers in the range from 000 to 999” [3];

- when studying the issues of interaction of probability theory and mathematical statistics with testing – “Calculation of the risks of the “supplier” and “customer” to determine the required number of tests” [4];

- when studying the basics of reliability theory – “Calculation of the probability of failure-free operation of a radio-electronic complex with verification of reliability according to the Ukp criterion” [5];

- when studying the fundamentals of designing data transmission equipment – “Program for preparing initial data for developing a functional diagram of a code converter for a digital device of data transmission equipment” [6];

- when studying radar – “Program for modeling the processes of comparing trajectory data of a long-range radar station” [7].

A review of the application programs of a small team confirms the widespread introduction of programming techniques into all spheres of human activity. The desire to automate monotonous processes, similar actions in order to eliminate errors arising from the human factor, or to introduce automation into the process of checking the completion of tasks in the field of education is a task that is relevant to this day.

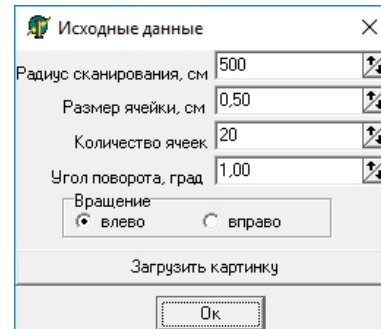
In continuation of the development of programming skills, the article proposes a method of circular scanning of an image based on the decomposition of the colors of the image into components red (R-), green (G-), blue (B-), which can be used to determine the affiliation of an aircraft to the Air Force (AF) of a particular state. The image that is processed is the aircraft identification mark located on the fuselage, wing or tail of the aircraft.

Air Force identification marks are symbols applied to aircraft belonging to the Air Force to indicate their nationality. Identification marks are generally round (rondel) and repeat the motifs of national flags [8]. More than 200 countries have aviation in their armed forces, so the diversity of these symbols suggests that automating their identification will greatly simplify the task of determining the nationality of an aircraft.

In this paper we will consider only a part of the signs (Figure 1a), and we will focus on the study of the possibility of using the circular image scanning method implemented in the application program [9] to perform the identification task.



a)



б)

Figure 1 – Initial data:
a) identification marks; b) scan data

The program operation is divided into a number of stages:

- input of initial data (Figure 1b);
- circular scanning of the image (calculation of the standard deviation (SD) of the values of the averaged RGB color components in the elements of the scanning line);
- comparison by subtracting the obtained SD values and those searched in the database;
- output of the comparison result.

The essence of the method of circular scanning of an image consists of the following sequence of actions:

- calculation of the parameters of the scanning line, based on the size of the image, the scanning radius and the size of the element of the square area of the scanning line (Figure 2);
- averaging the color values in the square of the scanning line (Figure 3). The color of each pixel is not considered, but the color over the entire area of the scanning line element. According to the authors, this approach will speed up the processing of color images of the observed objects and it is advisable to use it for primary identification;

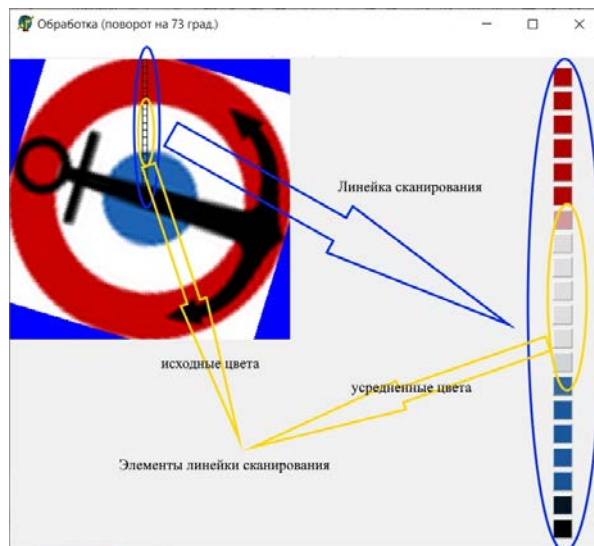


Figure 2 – The image under study

```
//читаем цвет в одном квадрате
for X_Col:=(W_pictur div 2-StrToInt(FloatToStr(round(r*mash-0.11)))) to
(W_pictur div 2+StrToInt(FloatToStr(round(r*mash-0.11)))) do
begin
for Y_col:=(H_pictur div 2-StrToInt(FloatToStr(round(aa*2*r*mash-0.11)))) to
(H_pictur div 2+StrToInt(FloatToStr(round((aa-1)*2*r*mash-0.11)))) do
begin
Clr:=PB_Picture.Canvas.Pixels[X_Col,Y_col]; //берем цвет пикселя
Color := ColorToRGB(Clr); //преобразуем цвет в RGB
r_col := Lo(Color); //красный
g_col := Lo(Color shr 8); //зеленый
b_col := Lo((Color shr 8) shr 8); //синий
R_mass[nn]:= r_col;G_mass[nn]:= g_col; B_mass[nn]:= b_col;
nn:=nn+1;
end;
end;
for ii:=0 to V_mass-1 do //сумма по каждому цвету R G B
begin
R_sred:=R_sred+R_mass[ii];G_sred:=G_sred+G_mass[ii];B_sred:=B_sred+B_mass[ii];
end;
//среднее значение по каждому цвету
R_sred_Sum :=Round(R_sred/V_mass);G_sred_Sum:=Round(G_sred/V_mass);
B_sred_Sum:=Round(B_sred/V_mass);
//преобразуем среднее значение в Byte для одного диода
R_sred_byte:=R_sred_Sum;G_sred_byte:=G_sred_Sum;B_sred_byte:=B_sred_Sum;
//заносим значение в массив цвета линейки светодиодов
R_Line[aa-1]:= R_sred_byte;G_Line[aa-1]:= G_sred_byte;
B_Line[aa-1]:= B_sred_byte;
```

Figure 3 – A fragment of the program code for averaging color values in a cell

- decomposition of the average color into RGB components and recording of these values in a temporary array (the array row for each RGB color contains twenty values from 0 to 255);
- rotation of the image by one degree (the image rotation procedure is shown in Figure 4);

```

procedure RotateBitmap_ads(SourceBitmap: TBitmap;
out DestBitmap: TBitmap; Center: TPoint; Angle: Double);
begin
  DestBitmap.Width := SourceBitmap.Width;
  DestBitmap.Height := SourceBitmap.Height;
  DestBitmap.PixelFormat := pf24bit;
  Radians := -(Angle) * PI / 180;
  sinRadians := Sin(Radians);
  cosRadians := Cos(Radians);
  for inX := DestBitmap.Height-1 downto 0 do
  begin
    RotatedRow := DestBitmap.Scanline[inX];
    inXPrime := 2*(inX - Center.y) + 1;
    for inY := DestBitmap.Width-1 downto 0 do
    begin
      inYPrime := 2*(inY - Center.x) + 1;
      inYPrimeRotated := Round(inYPrime * CosRadians - inXPrime * sinRadians);
      inXPrimeRotated := Round(inYPrime * sinRadians + inXPrime * cosRadians);
      inYOriginal := (inYPrimeRotated - 1) div 2 + Center.x;
      inXOriginal := (inXPrimeRotated - 1) div 2 + Center.y;
      if (inYOriginal >= 0) and (inYOriginal <= SourceBitmap.Width-1) and
        (inXOriginal >= 0) and (inXOriginal <= SourceBitmap.Height-1) then
      begin
        OriginalRow := SourceBitmap.Scanline[inXOriginal];
        RotatedRow[inY] := OriginalRow[inYOriginal]
      end
      else
      begin
        RotatedRow[inY].rgbtBlue := 255;
        RotatedRow[inY].rgbtGreen := 0;
        RotatedRow[inY].rgbtRed := 0
      end;
    end;
  end;
end;
end;

```

Figure 4 – Code fragment of the image rotation procedure

- calculation of the standard deviation values of each RGB component during a full rotation of the image and recording in temporary arrays R_σ , G_σ , B_σ (the array for each color consists of a row with twenty standard deviation values).

Let us consider the stages in more detail.

The input initial parameters allow us to determine automatically the dimensions of the scanning line (Figure 1b). In this example, a line consisting of twenty squares is proposed, in each of which the color is decomposed into average numerical values of the RGB color components.

During the circular scanning process, the ruler rotates 360 degrees (Figure 2). This forms an array of average color values, consisting of three hundred sixty rows and twenty columns, for one color image.

To determine the “uniqueness” of each picture, it is proposed to calculate the standard deviation of the average values using the formula:

$$RGB_\sigma[i] = \sqrt{R_\sigma^2[i] + G_\sigma^2[i] + B_\sigma^2[i]},$$

where $RGB_\sigma[i]$ – SD of RGB colors in the i -th element of the ruler when rotating,
 $R_\sigma[i]$, $G_\sigma[i]$, $B_\sigma[i]$ – SD of the corresponding color R-, G-, B- in the i -th

element of the ruler when rotating,

i – number of elements in the scanning line (from 1 to 20).

A fragment of the code for the SD calculation program is shown in Figure 5.

```
//расчитываем СКО в каждом элементе линейки (от 0 до 19 ячеек)
for dd:=0 to N_svet-1 do
begin
for ss := 0 to N_Otschet-1 do
begin
Sigma_raschet_R[ss+1]:= R_All[ss,dd];
Sigma_raschet_G[ss+1]:= G_All[ss,dd];
Sigma_raschet_B[ss+1]:= B_All[ss,dd];
end;
R_sigma[dd+1]:=StdDev(Sigma_raschet_R);
G_sigma[dd+1]:=StdDev(Sigma_raschet_G);
B_sigma[dd+1]:=StdDev(Sigma_raschet_B);
RGB_sigma[dd+1]:=sqrt(power(R_sigma[dd+1],2)+power(G_sigma[dd+1],2)+power(B_sigma[dd+1],2));
end;
```

Figure 5 – Fragment of the code for calculating the SD

As a result, the primary array of 360 x 20 is transformed into a string of twenty SD values. This approach allows to form a database of identification marks (Figure 6), which is an array of lines with the name of the country and SD values, and also to reduce the volume of information processed at the comparison stage and to speed up the time of identification of the aircraft identification mark.

Бельгия	0	0	0	0	0.165548711064347	14.1248048824797	8.68858915783791	0.614869146121651	0	0	0	0.913120938509333	10.1073941542462	2.
Болгария	0	0	0	0	0.479654136200761	4.27493866482938	15.7030462756002	0.590200328998854	0	0	0	0.925903074101585	14.8523817997434	1.447
Великобритания	0	0	0	0	1.12603334707772	14.1158236147637	8.15833950992906	0.688399252915358	0	0	0	0.547114769806248	18.6878310099153	4.3
Венгрия	37.1336071746511	91.1165912542557	90.486472738662	121.882417740442	108.228518897251	115.82338096761	116.974944576262	114.628849118						
Германия	0	0	0	0	2.77673966983899	59.7513089253411	125.153736379722	153.82110187966	169.420072540337	175.300590166492	164.11064268003			
Греция	0	0	0	0	1.26166178801911	16.6369819210222	9.09890758048214	0.781156718355542	0	0	0	0.484828635007699	19.9633723331453	4.0
Дания	0	0	0	0	0.56249075785935	4.00459153062373	16.6801456637053	1.06318125427844	0.41062000663429	0	0	0	0.426998	
Испания	0	0	0.0527046276694741	2.09004767604619	10.9418806609576	0.640473120928585	0.337382555192822	0	0	0	0.312127214976028	5.3130		
Италия	0	0	0	0	0.898483884108722	14.6764240671333	8.1390271863841	0.660861446944959	0	0	0	0.342661944625668	16.5095950455184	3.5
Латвия	0	0	0	0	0.479347539638362	1.40900352433914	19.5446688582832	2.16335007926586	0.379263649886248	0.514829603142982	14.23879			
Литва	0.792709936634925	50.6910270446479	149.338515151673	114.890492853802	118.92266619064	135.624364411092	120.566303799548	107.7529862						
Нидерланды	0	0	0.543944748864619	1.69405308254705	83.0057185927347	136.781919211162	137.435640321493	137.928899599703	138.310908425016	138.				
Норвегия	0	1.37155917078341	78.3803516607472	141.11532291862	129.053458311413	139.412472194136	138.592200622372	122.771103475751	143.59667					
Польша	36.5261385529033	109.925904745878	120.20638698501	124.763619269737	127.005782858907	128.436047567508	129.435900225169	130.12084290						
Португалия	0	16.9988686881202	102.808106050844	124.022289326427	111.243070162768	116.956448013658	119.342411556932	117.656856259302	114.8501					

Figure 6 – Fragment of the database of the values of the SD of the RGB components

It should be noted that formula is a mathematical apparatus for both processing the input image and forming the database. This condition is mandatory for the functioning of the proposed software solution.

Next, at the comparison stage, by subtracting the obtained values of the SD of the input image of the identification mark, processed according to formula, and the values searched in the database, the aircraft's affiliation is determined (the minimum

difference identifies the country to which the aircraft belongs).

In our case, the sign of the French Air Force naval aviation was chosen (Figure 2), and it was also identified (Figure 7).

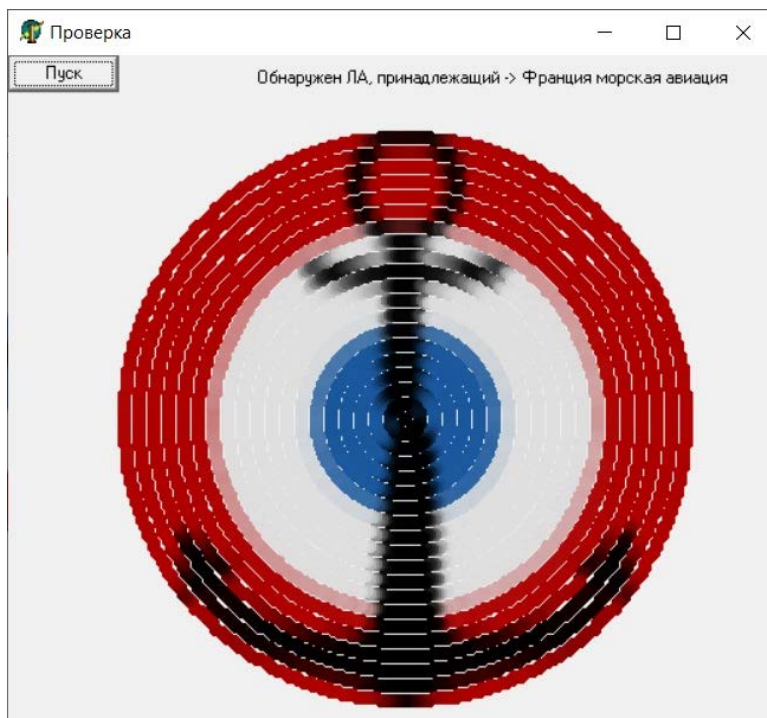


Figure 7 – Reconstructed circular scan image

In conclusion, I would like to note that work on the applied application of the circular image scanning method continues, and the program code [9] is open. As part of further research into the application of circular image scanning, the team of authors is investigating the possibility of recognizing an aircraft by its contour, and the application of the method in practical classes on the subject “Unmanned Aerial Vehicles” to recognize them by silhouette.

It is expected that the results of these studies will be used in the educational process in such disciplines as [10, 11, 12], as well as integration into educational environments, for example, presented in [13]. In addition, the possibility of using the method in models of optical-electronic tracking and guidance systems, for example, presented in [14], as well as its integration into models of control panels for these systems [15, 16], is being investigated. The results of these studies, according to the authors, will be aimed at the interaction of the military-industrial complex and military education [17].

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FEATURES OF ELECTRODE MATERIALS OF LITHIUM-ION BATTERIES

Master's Degree Student **Larionov Denis Nikolaevich**,
Academic Advisor: PhD in Chemistry, Associate Professor
Davletbaev Ruslan Sagitovich,
Kazan State Power Engineering University,
Kazan, Russian Federation

Abstract. The paper discusses the features of electronic materials of lithium-ion batteries. The main cathode and anode materials promising for use in modern batteries are analyzed, with an emphasis on their cyclic stability and energy efficiency. Based on the comparative analysis, the best cathode and anode materials are identified, and ways to modify them to improve the characteristics of batteries, such as capacity, service life and safety, are proposed.

Keywords: cathode materials, nanomaterials, anode materials, energy intensity, cyclic stability, nanothreads.

ОСОБЕННОСТИ ЭЛЕКТРОДНЫХ МАТЕРИАЛОВ ЛИТИЙ-ИОННЫХ АККУМУЛЯТОРОВ

магистрант **Ларионов Денис Николаевич**,
науч. руководитель: доктор хим. наук, доцент
Давлетбаев Руслан Сагитович,
Казанский государственный энергетический университет,
г. Казань, Российская Федерация

Аннотация. В работе рассматриваются особенности электронных материалов литий-ионных аккумуляторов. Анализируются основные катодные и анодные материалы, перспективные для применения в современных батареях, с акцентом на их циклическую стабильность и энергоэффективность. На основе сравнительного анализа выделены лучшие катодный и анодный материалы, а также предложены пути их модификации для повышения характеристик аккумуляторов, таких как емкость, срок службы и безопасность.

Ключевые слова: катодные материалы, наноматериалы, материалы анода, энергоемкость, циклическая стабильность, нанонити.

Cathode materials

Currently, the most common and sought-after material for cathodes is lithium cobaltate, known as LiCoO_2 . This material has high velocities of electrons and lithium ions. High ion conductivity is achieved due to the layered structure of LiCoO_2 and numerous bulk channels. The LiCoO_2 cathode has a high operating potential (3.6 - 4V) as well as a theoretical specific capacitance. However, the cobalt dioxide that must be

formed during the charging process is unstable, so cobalt and lithium-based cathode materials are typically used for only half of their theoretical capacity (140 mAhg⁻¹). In addition, during fast charging with high potential difference, the formation of non-equilibrium phases on the surface of the cathode material particles is possible, which leads to spontaneous combustion and makes such a battery less safe. The phase transition with a change in electrochemical potential occurring at a capacity of 130-140 mAhg⁻¹ in Li_xCoO₂ is a signal of the end of the process. It is important to note that cobalt is an expensive material and its utilisation causes certain environmental problems [1].

In addition to lithium cobaltate (LiCoO₂), there are a number of other materials used as cathodes in Li-ion batteries. These materials have different characteristics and applications, making them suitable for different types of devices and requirements.

Manganese oxide (LiMnO₂) is one of the alternative cathode materials. It has lower cost than lithium cobaltate and higher thermal stability, which increases its safety. However, LiMnO₂ has a lower specific capacity (about 120-150 mAh/g) compared to LiCoO₂. To improve the performance of this material, research is underway to partially substitute manganese with other elements such as nickel or cobalt [2].

Manganese-based spinel structures such as LiMn₂O₄ are also of interest as cathode materials. They are characterised by high charge/discharge rate, low cost and relatively high specific capacity (120-140 mAh/g). However, LiMn₂O₄ is prone to self-destruction under prolonged cycling, which limits its use [3].

Another interesting group of cathode materials are iron-based compounds. One example is lithium iron phosphate (LiFePO₄), which has high thermal stability, safety and low cost. LiFePO₄ has a specific capacitance of about 170 mAh/g and a discharge voltage of about 3.4 V, but a lower voltage compared to LiCoO₂ [4].

Nickel oxides such as LiNiO₂ are also considered as potential cathode materials. They have a higher specific capacity (about 200 mAh/g) compared to LiCoO₂, but are less stable during the charge/discharge process.

Significant progress has been made in the use of vanadium oxide cathodes, which makes them very attractive. The use of vanadium oxides has made it possible to achieve maximum values of specific capacitance. Extremely interestingly, high capacitance values have been achieved here for charging and discharging at high rates by using nanomaterials including nanocomposites (Figure 1).

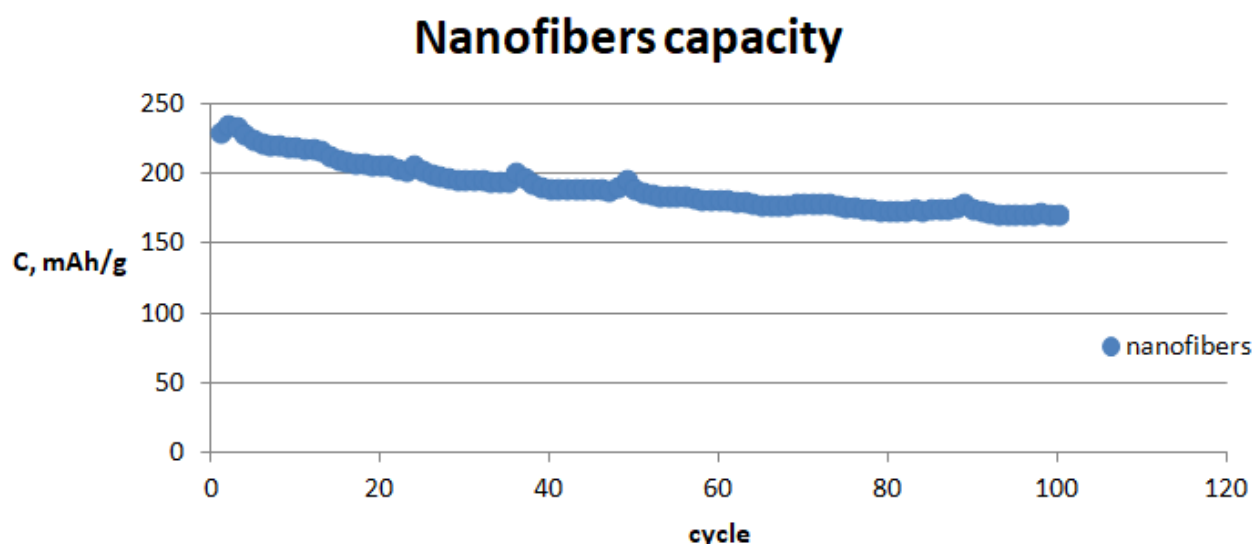


Figure 1 – Dependence of the specific capacitance of the cathode based on V_2O_5 nanofilaments in LIA with lithium plate as anode on the charge-discharge cycle number

At the same time the rate of lithium intercalation and deintercalation is increased throughout the entire volume of the material due to the acceleration of transfer across grain boundaries and a significant reduction in the diffusion layer inside the particles, while also providing good stability of the cathode material in the process of cyclic use [5].

Dynamic development of lithium-ion batteries can be expected in the coming years due to the use of nanomaterials. This will solve the problems of increasing specific capacity, reliability and stability during cyclic charge-discharge, as well as providing high charging and discharging speeds. As a result, LIAs will continue to play a leading role in the power supply of portable electronic devices, as well as being actively used in other areas.

Anode materials

Graphite, an allotropic modification of carbon with a hexagonal layered structure, is widely used as an anode material in lithium-ion batteries (LIBs) due to its high electrical conductivity, relatively low cost, and sufficient cyclic stability. However, its characteristics have its limitations, which are actively investigated [6, 7].

The theoretical energy capacity of graphite based on LiC_6 formation is 372 mAh/g. However, in practice, the achievable energy capacity is much lower and depends on several factors including particle size, morphology, crystal structure and electrode manufacturing technology. In commercial LIBs, the energy capacity of graphite anodes is typically in the range of 300 to 360 mAh/g in the first cycle, with a gradual decrease in capacity in subsequent cycles due to the formation of the SEI layer.

The loss of capacity in cycles is mainly due to the formation and growth of the SEI layer on the surface of graphite particles. This layer, consisting of reaction products of the electrolyte with lithium, is an electrical insulator and increases the resistance of the electrode, reducing the availability of active centres for lithium intercalation. The rate of degradation depends on the type of electrolyte, temperature

and charge/discharge current. In high quality commercial anodes, capacity degradation over 1000 cycles is typically less than 10 % [8].

Silicon has also attracted considerable attention as a promising anode material for lithium-ion batteries (LIBs) due to its high theoretical energy content. However, its practical application is limited by a number of significant drawbacks [9].

The theoretical energy capacity of silicon is ~ 4200 mAh/g, which is significantly higher than the energy capacity of graphite (~ 372 mAh/g) traditionally used in commercial LIBs [10]. This high energy capacity is due to the large amount of lithium that can be incorporated into the silicon crystal lattice during the intercalation process. However, in practice, the achievable energy intensity is much lower than the theoretical one and depends on the silicon morphology, particle size as well as the electrode fabrication technique. Experimental values of energy capacity vary from several hundreds to ~ 1000 mAh/g depending on the type of silicon used and test conditions.

The main problem limiting the use of silicon in LIBs is its low cyclic stability. During lithiation, silicon undergoes a significant (up to ~ 300 %) volume change, which leads to cracking of the active material, delamination from the current collector and, as a consequence, to rapid deterioration of battery capacity and power [11]. As a result, there is a constant decrease in capacity cycle after cycle, characterised by a capacity decay factor that can reach several per cent per cycle.

Metal oxides SnO_2 , Fe_3O_4 , TiO_2 can serve as an alternative to the above discussed materials as anode materials.

Tin dioxide has a high theoretical energy capacity (1494 mAhg $^{-1}$), much higher than that of graphite. However, the practical energy capacity of SnO_2 is significantly lower (400 - 600 mAhg $^{-1}$ in initial cycles, rapidly decreasing to 200 - 300 mAhg $^{-1}$) due to the formation of an unstable SEI layer and significant volumetric expansion (~ 300 %) during lithiation/delithiation. The cyclic stability of SnO_2 is low due to particle fragmentation leading to loss of electronic contact. Nanostructured materials and composites with carbon additives are proposed to improve the characteristics of SnO_2 [12].

Iron oxide (Fe_3O_4) shows higher practical energy capacity (600 - 800 mAhg $^{-1}$ in initial cycles) than SnO_2 , but with slower lithium intercalation/deintercalation kinetics and a gradual decrease in capacity in subsequent cycles. The cyclic stability of Fe_3O_4 is higher than that of SnO_2 , but still insufficient for long-term operation. Unlike SnO_2 , the main problems of Fe_3O_4 are slow kinetics and limited utilisation of the active material, which can be improved by nanostructuring and carbon-added composites [13].

Lithium, due to its extremely low electronegativity and high theoretical capacity (3860 mAh/g), is the most attractive anode material for lithium-ion batteries (LIBs). Its use provides high energy density, which is critical for portable electronics, electric vehicles and energy storage systems. However, in practice, pure lithium as an anode material faces a number of serious challenges that limit its use in commercial LIAs. The main obstacles are the low Coulombic efficiency during the first charge-discharge cycles, the formation of dendrites (lithium needle-like growths) that can puncture the separator and cause short circuits, and the significant volume effect leading to cracking and electrode failure.

Various strategies have been attempted to improve the cyclic stability of the lithium anode. These include lithium surface modification, the use of artificial solid electrolytes, and the development of composite anodes where lithium is in the form of nanoparticles or thin films embedded in a conductive matrix. These approaches aim to reduce the surface area of lithium interacting with the electrolyte, thereby reducing the likelihood of dendrite formation, as well as stabilising the anode structure and mitigating bulk changes. The development of new, more efficient electrolytes, such as those using additives or new solvents, also plays a key role in improving the cyclic stability of the lithium anode.

Results and discussions

In conclusion, the analysis of various cathode and anode materials for lithium-ion batteries has shown that the most promising cathode materials are vanadium oxide nanofibres (V_2O_5 , VO_2 , etc.). Their use provides high energy efficiency reaching 250 W-h/kg with cyclic stability of at least 500 cycles with preservation of 80 % of initial capacity at discharge current of 1C. This exceeds the performance of traditional cathode materials such as $LiCoO_2$ (200 W-h/kg, 300 cycles, 70 % of residual capacity at 1C), confirming the relevance of further research in this direction.

However, despite the high specific capacity of the lithium anode (3860 mAh/g), its tendency to form dendrites, which reduces the cyclic stability and safety of the battery, limits the possibilities of further improving the battery performance. To overcome this problem, it is proposed to replace the lithium anode with nanostructured silicon. Studies show that nanoscale silicon with controlled porosity can provide specific capacity up to 2000 mAh/g, significantly reduce volumetric changes during cycling and hence reduce the probability of dendrite formation.

Further research should focus on optimising the nanostructure of vanadium oxides, including adjusting particle size, morphology and composition, to achieve higher values of energy capacity and cyclic stability. In parallel, comprehensive studies of nanostructured silicon and other promising anode materials should be conducted, with a focus on minimising dendrite formation and improving the efficiency of the binder and electrolyte to maximise the performance and safety of next-generation lithium-ion batteries.

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METHODS AND TOOLS FOR DEPLOYING WEB APPLICATIONS ON DOMESTIC OPERATING SYSTEMS

Student **Nesterov Kirill Alekseevich**,
Academic Advisor: Senior Lecturer **Ermakov Alexander Valentinovich**,
National Research University "MPEI",
Moscow, Russian Federation

Abstract. The article examines methods and tools for deploying web applications on domestic operating systems such as "Astra Linux," "Red OS," and others. The paper describes containerization tools, orchestration, and standard deployment methods. The advantages and disadvantages of different approaches, as well as their adaptation to import substitution requirements, are analyzed.

Keywords: deployment, web applications, domestic OS, containerization, orchestration, DevOps.

МЕТОДЫ И ИНСТРУМЕНТЫ РАЗВЕРТЫВАНИЯ ВЕБ-ПРИЛОЖЕНИЙ НА ОТЕЧЕСТВЕННЫХ ОПЕРАЦИОННЫХ СИСТЕМАХ

студент **Нестеров Кирилл Алексеевич**,
науч. руководитель: ст. преподаватель **Ермаков Александр Валентинович**,
Национальный исследовательский университет «МЭИ»,
Москва, Российская Федерация

Аннотация. В статье рассматриваются методы и инструменты развертывания веб-приложений на отечественных операционных системах, таких как «Астра Линукс», «Ред ОС» и др. Описываются средства контейнеризации, оркестрации и стандартные инструменты для развертывания приложений. Анализируются преимущества и недостатки различных подходов, а также их адаптация к требованиям импортозамещения.

Ключевые слова: развертывание, веб-приложения, отечественные ОС, контейнеризация, оркестрация, DevOps.

Modern web application development requires effective deployment methods that ensure stability, fault tolerance, and security. With the increasing emphasis on import substitution, more attention is being paid to the use of domestic operating systems. Developing and administering web applications in such an environment requires adaptation of existing methods and tools. This article explores the key approaches to deploying web applications in the environment of domestic operating systems.

Overview of Domestic Operating Systems. Domestic operating systems are developed with a focus on information security requirements and Russian regulatory standards. Among the most widely used solutions are:

- Astra Linux – A certified system actively used in government institutions and the corporate sector.
- Red OS – A system compatible with Russian software, supporting containerization and enterprise solutions.
- Alt Linux – A distribution with extensive capabilities for both server and user tasks.
- Rosa Linux – Another Russian solution that meets modern security standards and offers a stable environment for application deployment.

Each of these systems requires a specialized approach to application deployment, considering their architecture, container support, and available automation tools. As these operating systems evolve, they provide increasingly robust security mechanisms, ensuring compliance with national cybersecurity policies [1].

Containerization in Domestic Operating Systems. Containerization has become the standard for deploying web applications, enabling the creation of isolated and manageable environments. In domestic OS environments, the following tools are used:

- Docker – Supported in several distributions, though with certain limitations related to security policies and software compatibility.
- Podman – A daemonless alternative to Docker that supports OCI-compliant containers, offering better security and flexibility.
- LXC/LXD – System-level containerization ensuring high performance and lower overhead compared to traditional virtual machines.
- Kubernetes – A powerful container orchestration system adapted for domestic OS environments, allowing scalable application management.

Given the increasing importance of cybersecurity, domestic OS distributions focus on integrating security-hardened versions of these containerization tools, ensuring compliance with national data protection regulations [2].

Deployment Tools and Best Practices. Deploying web applications effectively requires a comprehensive approach that includes automation, monitoring, and configuration management. Key tools and best practices include:

- CI/CD Platforms: GitLab CI, Jenkins, and domestic solutions such as "Sputnik CI" provide automated deployment pipelines that streamline the release process.
- Configuration Management: Ansible and SaltStack are widely used to automate infrastructure provisioning, ensuring consistent deployment configurations across various environments.
- Monitoring and Logging: Tools like Zabbix, Prometheus, and Grafana enable real-time monitoring, log analysis, and alerting, ensuring application stability.
- Virtualization Solutions: KVM and OpenVZ are utilized in data centers running domestic OS environments, enabling efficient resource utilization and system management.

The adoption of these tools ensures reduced deployment times, minimized risks, and improved system resilience. Additionally, container security scanning and compliance verification tools are being integrated into domestic OS ecosystems to enhance deployment security [3].

Future Perspectives and Challenges. The transition to domestic operating systems presents challenges related to software compatibility, integration of international cloud technologies, and the need for skilled personnel. However, continued development in this field is fostering technological independence and enhancing national cybersecurity measures. The advancement of domestic containerization platforms, orchestration tools, and automation frameworks will further optimize web application deployment processes.

Security Considerations in Deployment. When deploying web applications on domestic operating systems, security is a critical factor. Several security measures must be considered to ensure the integrity and confidentiality of applications:

- Access Control and User Management: Implementing role-based access control (RBAC) and multi-factor authentication (MFA) ensures that only authorized personnel can access deployment environments.
- Application Sandboxing: Using container isolation techniques, such as SELinux and AppArmor, enhances security by restricting access to system resources.
- Automated Security Scanning: Integrating tools for vulnerability scanning, such as OpenSCAP or domestic security solutions, helps identify and mitigate potential threats.
- Network Security: Employing VPNs, firewalls, and intrusion detection systems (IDS) protects web applications from unauthorized access and cyber threats [4].

Challenges in Deploying Web Applications on Domestic OS. While domestic operating systems offer security and compliance advantages, there are several challenges developers and administrators must address:

Software Compatibility: Some international development tools and libraries may not have native support in domestic OS environments, requiring alternative solutions or workarounds.

- Limited Cloud Integration: Many cloud services are optimized for Western OS distributions, necessitating the development of domestic cloud infrastructures that support enterprise-level deployment.
- Technical Expertise: A shortage of experienced specialists familiar with domestic OS deployment practices can slow down adoption and implementation.
- Regulatory Compliance: Ensuring adherence to Russian security and data protection laws (e.g., FSTEC, FSB certification) adds complexity to the deployment process.

Case Studies and Real-World Implementations. Including case studies of organizations that have successfully deployed web applications on domestic OS can enhance the article's credibility and provide practical insights.

- Government Institutions: Ministries and public sector agencies adopting Astra Linux for secure web-based services.
- Financial Sector: Banks and financial institutions migrating to domestic OS for improved data security and regulatory compliance.
- Educational Institutions: Universities and research centers using domestic OS to develop and host web applications in controlled environments.

Future Trends in Web Application Deployment on Domestic OS. The deployment of web applications on domestic operating systems continues to evolve,

driven by the need for technological independence and enhanced security. One promising direction is the development of native container orchestration systems tailored to the architecture and security standards of Russian OS environments. These solutions may offer tighter integration with system components, reducing overhead and improving performance [5].

Another key trend is the growing role of artificial intelligence in deployment automation. Machine learning algorithms are increasingly being integrated into CI/CD pipelines, enabling real-time optimization of resource allocation, anomaly detection, and automatic scaling of applications under fluctuating workloads. This approach not only enhances reliability but also reduces the need for manual intervention, accelerating the deployment cycle.

Additionally, hybrid cloud infrastructures are gaining traction. Companies are seeking solutions that combine the benefits of on-premises data centers with the flexibility of cloud platforms. Domestic OS vendors are actively developing cloud environments that ensure data sovereignty while maintaining compatibility with widely used international standards, allowing businesses to deploy web applications without sacrificing performance or compliance.

The ongoing modernization of deployment tools, combined with advances in automation and hybrid infrastructure, is paving the way for more resilient, secure, and adaptable web application ecosystems on domestic operating systems.

Challenges and Solutions in Domestic OS Deployment. Despite the growing potential of domestic operating systems, deploying web applications in such environments presents several unique challenges. One of the key difficulties is ensuring compatibility with modern development frameworks and libraries, many of which are primarily designed for Western operating systems. To address this, developers are increasingly turning to containerization and virtualization technologies that abstract the underlying OS, allowing applications to run consistently across different environments.

Another challenge lies in the limited availability of cloud infrastructure optimized for domestic OS ecosystems. To mitigate this, organizations are beginning to invest in private cloud solutions and hybrid environments, balancing local data control with the scalability of cloud technologies. Moreover, domestic cloud platforms are evolving to support seamless integration with enterprise solutions, offering native APIs, infrastructure-as-code capabilities, and compliance with data protection standards.

A critical aspect of successful deployment on domestic OS is ensuring high performance and reliability under load. Load balancing and traffic distribution tools, such as HAProxy and NGINX, are increasingly being adapted to work in these environments. Combined with advanced monitoring solutions like Zabbix and Prometheus, these tools enable proactive performance tuning and fault detection, minimizing downtime and ensuring a smooth user experience.

Finally, the human factor remains a significant obstacle. The demand for specialists proficient in domestic OS deployment practices exceeds the current supply. This gap is gradually closing through educational initiatives, professional development programs, and the promotion of open-source communities focusing on domestic

operating systems. Companies are also investing in internal training to upskill existing DevOps teams, ensuring a smoother transition to localized infrastructures.

The ability to tackle these challenges head-on will define the success of web applications in domestic OS environments. As the ecosystem matures, it is expected that more tailored tools, improved infrastructure, and a growing talent pool will ease the deployment process, making it more accessible to a wider range of businesses and institutions.

Conclusion. The use of domestic operating systems necessitates the adaptation of deployment methods for web applications. Containerization, CI/CD automation, and monitoring play crucial roles in ensuring flexibility and stability. The continued evolution of domestic deployment tools will contribute to increased technological sovereignty, providing organizations with secure, efficient, and scalable solutions for web application deployment in controlled environments.

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THE ROLE OF TECHNOLOGICAL MAPS IN MODERN CONSTRUCTION

Student **Sigacheva Marina Alexandrovna**,
Student **Sigacheva Karina Alexandrovna**,
Academic Advisor: PhD in Economics, Associate Professor
Pakhomova Julia Alexandrovna,
Financial University under the Government of the Russian Federation,
Moscow, Russian Federation

Abstract. In article discusses the relevance of technological design in the construction industry. The article analyzes the role and necessity of technological maps in modern construction, considering them as a tool to improve the efficiency and quality of production. The study addresses the problems of their negligent use by organizations. The main types of this document are given, and its general structure is described. It is shown how the correct use of the technological map contributes to effective planning, organization and control of work, including the creation of schedules, optimization of logistics, standardization of processes.

Keywords: technological map, construction, technology, organization, optimization, resources, costs, quality.

РОЛЬ ТЕХНОЛОГИЧЕСКИХ КАРТ В СОВРЕМЕННОМ СТРОИТЕЛЬСТВЕ

студент **Сигачева Марина Александровна**,
студент **Сигачева Карина Александровна**,
науч. руководитель: канд. экон. наук, доцент
Пахомова Юлия Александровна,
Финансовый университет при Правительстве Российской Федерации,
Москва, Российская Федерация

Аннотация. В статье рассматривается актуальность технологического проектирования в строительной отрасли. Анализируется роль и необходимость технологических карт в современном строительстве, воспринимая их как инструмент повышения эффективности и качества производства. Исследование затрагивает проблемы пренебрежительного использования их со стороны организаций. Приведены основные виды данного документа, описана его общая структура. Показано, как правильное использование технологической карты способствует эффективному планированию, организации и контролю работ, включая создание календарных графиков, оптимизацию логистики, стандартизацию процессов.

Ключевые слова: технологическая карта, строительство, технология, организация, оптимизация, ресурсы, затраты, качество.

Currently, the construction industry is one of the most labor-intensive and complex fields of activity. It includes many different technological operations, each of which is interconnected with the previous one. For the correct and accurate organization of the process, it is necessary to combine all the building chains into a single structure with a clear understanding of the sequence and technology. There is a high degree of competition between participants in the construction industry market like nowhere else. At the same time, the intensification of technological processes is increasing, the requirements for the quality of products are increasing, and there is a tendency towards high staff turnover.

Technological processes are embedded at all stages of the project implementation, whether it is the construction of the structure itself or a preliminary analysis of the economic efficiency of the facility or the preparation of its working documentation. Since construction is a multicomponent process, its organization should take into account the expediency of deepening technological specialization during construction and installation operations. Based on the optimal combination of industrial and construction production, it is necessary to apply mixed organizational management models [1, p. 98]. Thus, it becomes obvious that technological design plays a key role in the construction industry.

Currently, most organizations neglect the use of technological maps during the implementation of their projects. This is because qualified specialists who have the right to do so should carry out the development of this document. They are not present at the headquarters of every organization. Drawing up a technological map is time-consuming and one of their most expensive activities, and, of course, managers try to avoid additional sources of costs. [2, p. 31]. But by avoiding their use, they put their project at risk.

"Technological map is an organizational and technological document developed for the implementation of a technological process and defining the composition of operations and means of mechanization, quality requirements, labor intensity, resources and safety measures" [3, p. 5].

This regulatory document is being developed for any technological process, the result of which is a completed high-quality construction facility.

The initial data for creating a technological map are the construction plan, the working documentation of the facility, information on the availability of construction machinery, equipment and tools, the schedule of work, as well as the potential for using advanced methods and technologies.

There are three main types of technological maps in the modern construction industry:

1. Standard technological map. It is not tied to a specific construction project and is created for specific types of work used at various facilities, regardless of their purpose.

2. A standard technological map adapted to a specific construction site, but not taking into account the specific conditions of its construction. Such maps are usually used for large-scale construction of buildings of the same type.

3. An individual technological map, designed taking into account the unique characteristics of the facility, taking into account all the features of the construction process, including its location. This type of map is used for unique architectural projects.

Let's consider the structure of the technological map, consisting of several sections, and give a brief description of each of them.

1. Scope of application – here it is noted for which specific construction process the document was drawn up, the type of object and the method of carrying out the ongoing construction activities (construction of a new building, reconstruction of an existing one or carrying out repair work) are determined. The specifics and conditions of the work are also specified here.

2. Organization and technology of work performance – according to the composition of the work performed, it can be divided into several stages. The first stage is "preparatory work".

It is devoted to preparatory activities, during which a complete list of regulatory documentation necessary for the implementation of the planned work is provided. Along with this, a nomenclature of necessary equipment for materials and technicians is being compiled, and a plan for organizing construction work is being developed. It should indicate the participants in the storage of building materials, machinery and equipment, as well as the location of sanitary units. The plan is drawn up taking into account the reference to the object under construction, as well as indicating the dangerous areas.

The subsection "basic work" contains a description of the methods of work, the division of complex technological processes into simpler stages and their detailed description.

"The description should contain information on the size and professional level of the team; recommendations on the organization of work areas, including drawings for the placement of personnel, materials and mechanized equipment; a list of actions necessary to ensure the stability of structures and building elements; a list of technological stages, procedures and methods of their implementation; methodology for coordinating processes and operations over time and space, with an emphasis on the safety of execution; Slings schemes and methods of delivering materials to workplaces, etc." [4, p. 8].

The subsection "final work" includes a list of actions to be performed after the completion of the main work. These include: putting the territory in order, recultivating green areas, dismantling temporary structures and elements that ensured the functioning of the construction site (for example, warning signs, fire safety equipment, protective fences of the work area).

3. Requirements for the quality of work – this section plays a key role in shaping the cost of construction and its profitability. With the help of monitoring, the compliance of the technological processes with regulatory documents is monitored. During the inspection, a methodology for examining key parameters is established to identify those responsible for the correctness of operations, and limits for acceptable

errors are also set. These measures are aimed at improving the quality of work performed and preventing unsuitable construction sites from being used.

4. The need for material and technical resources – the section presents the final specification of the required material and technical equipment. The choice of machines and mechanisms should be based on a thorough analysis and comparison of various options for the mechanization of construction processes. At the same time, the selected equipment must ensure that the deadlines are met and that the regulatory requirements for the quality of the work performed are met. The calculation of the need for materials and products required for the implementation of technological processes and operations in specified volumes is carried out on the basis of working documentation and current building standards for the consumption of materials.

5. Occupational safety and health – this section reflects the complex of measures taken to ensure the safe conduct of the work performed. Safety regulations at the workplace are given, a list of necessary protective equipment for employees is listed, and a diagram of dangerous areas with warning signs and protective devices is shown. The methods of lighting the work area are also described.

6. Technical and economic indicators – this section outlines the key characteristics of the projected facility. These include the duration of the work, the calculation of the cost of materials and equipment, the schedule of work with an indication of the sequence of their execution, and the cost estimate based on the estimated documentation.

Having considered in detail the structure of the technological map, we can conclude that this organizational and technological document allows not only to correctly establish the methods and sequence of production of work, but also to improve the quality of their implementation through a detailed description of each technological stage.

An example is the use of the "Technical and economic indicators" section during the preparation of a calendar schedule for the completion of work. A detailed description of the stages of work, a clear visualization of their sequence and relationship, as well as a careful selection of the necessary specialists and an accurate calculation of the resources involved allows you to accurately establish the continuity of construction production. This approach also makes it possible to optimize coordination of actions and minimize the risks of delays in materials, which ultimately has a positive effect on the effectiveness of the entire project [5]. Effective management of supplies of materials and equipment will optimize logistics, reduce costs and minimize the risk of delays due to lack of resources. Timely receipt of the necessary components guarantees the continuity of the workflow and avoids downtime associated with waiting for deliveries. In addition, technological maps contribute to the standardization of work processes, which is especially important when working with different teams and specialists. Ultimately, a properly organized production process and uniformity of approaches ensure the stability of production quality, increase its efficiency and competitiveness.

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DETECTING AI GENERATED IMAGES: FINE-TUNING VISUAL TRANSFORMER ON SYNTHETIC DATA

Student **Smirnov Alexander Alexandrovich**,
Academic Advisor: Associate Professor **Raskatova Marina Victorovna**,
National Research University "MPEI,"
Moscow, Russian Federation

Abstract. The article examines an approach to identifying AI-generated images by fine-tuning swin transformer model using PyTorch framework. The paper describes the model architecture and its advantages over traditional CNN models. The paper also provides description of the dataset used for fine-tuning, that combines both human-made and ai-generated images.

Keywords: AI, computer vision, pytorch, visual transformer, torchvision.

ОПРЕДЕЛЕНИЕ ИСКУССТВЕННО СОЗДАННЫХ ИЗОБРАЖЕНИЙ: ДООБУЧЕНИЕ ВИЗУАЛЬНОГО ТРАНСФОРМЕРА НА СИНТЕТИЧЕСКИХ ДАННЫХ

студент **Смирнов Александр Александрович**,
науч. руководитель: доцент **Раскатова Марина Викторовна**,
Национальный исследовательский университет «МЭИ»,
Москва, Российская Федерация

Аннотация. В статье рассматривается подход к идентификации AI-генерированных изображений путем дообучения визуального трансформера Swin Transformer с использованием фреймворка PyTorch. Описаны принципы работы swin, его архитектурные особенности и преимущества по сравнению с традиционными CNN. Представлен обзор набора данных, состоящего из комбинации реальных и синтетических изображений, подготовленного для дообучения модели.

Ключевые слова: искусственный интеллект, компьютерное зрение, визуальные трансформеры.

With the development of generative AI models such as Dall-E, Stable Diffusion and MidJourney, it has become possible to create images that are virtually indistinguishable from real photographs. These technologies are widely used in art, design, marketing and entertainment, but at the same time, the problem of their identification and detection arises. The abundance of synthetic images without clear markers of origin (watermarks) can lead to the spread of misinformation and copyright infringement [1].

Swin Transformer and its advantages over CNNs. For a long time, computer vision tasks such as object detection, classification and segmentation were primarily

solved using convolutional neural networks (CNNs). However, despite their success, CNNs are computationally expensive and have limitations in capturing global dependencies. These challenges prompted researchers to explore alternative architectures, one of which has been the adoption of visual transformers, which were first introduced in 2021 [2]. A visual transformer is a deep learning architecture that applies the transformer mechanism – originally designed for natural language processing – to computer vision tasks. Unlike traditional convolutional neural networks (CNNs), which process images using local receptive fields, visual transformers divide an image into small patches and treat them as a sequence of tokens. Each patch is embedded into a feature vector and passed through a self-attention mechanism, allowing the model to capture global dependencies across the entire image.

The Swin Transformer is a type of visual transformer. The key distinction of its architecture lies in the construction of a hierarchical feature map, which enables linear computational complexity relative to the input image size. To achieve this, the image is divided into patches, which are progressively merged in deeper layers of the model. Self-attention is computed only within local windows (Figure 1b, highlighted in yellow), which ensures linear computational complexity [3]. This approach is radically different from traditional visual transformers, where the image is divided into fixed-size patches, and self-attention is computed globally.

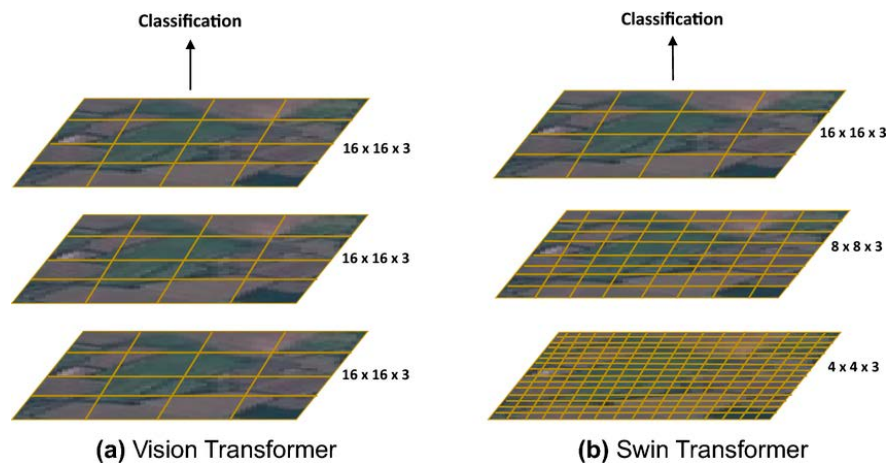


Figure 1 – a) Visual Transformer scheme; b) Swin Transformer scheme

Dataset for finetuning: structure and characteristics. A specialized dataset was collected for fine-tuning the model. The base version of the model was pre-trained on the widely used ImageNet-1K dataset, which contains 1.28 million images divided into 1,000 classes. However, standard datasets do not provide a clear distinction between human-created images and those generated by neural networks, making them unsuitable for the given task [4].

To address this, a new dataset was created, consisting of 80,000 images, evenly split into two classes:

- 40,000 human-created images (real photographs, graphics, drawings);

- 40,000 AI-generated images produced by modern generative models such as Stable Diffusion, MidJourney, Dall-E, and others.

To ensure diversity and improve the model's generalization ability, the dataset includes images from various categories, such as people (portraits, group photos), food, nature, and animals (Figure 2).

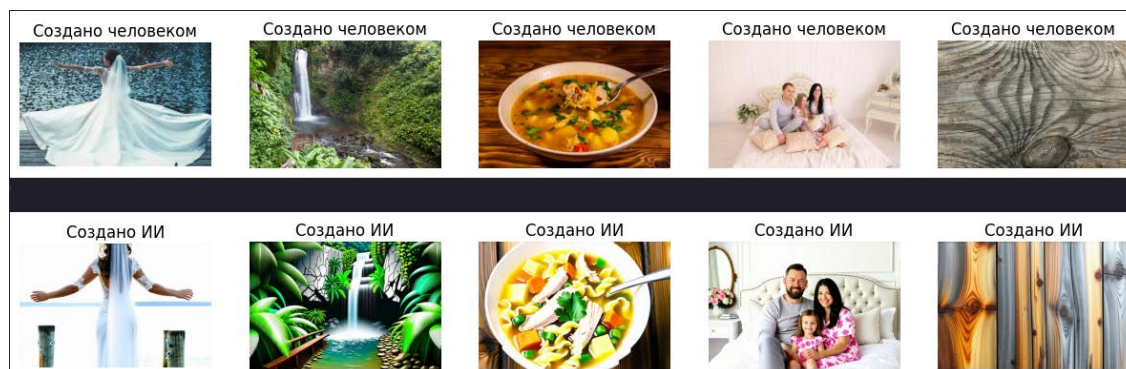


Figure 2 – Examples of images in dataset

Before training, an Exploratory Data Analysis (EDA) was conducted to identify statistical differences between the two classes. The analysis revealed that the RGB channel distribution (shown in Figure 3) for AI-generated images exhibits a flat characteristic, with distinct peaks in the 250–256 range. In contrast, human-created images have a more evenly distributed color profile. This indicates that, on average, synthetic images tend to appear more saturated, high-contrast, and sharper compared to real photographs [5]. This characteristic can be leveraged during model training to improve classification accuracy.

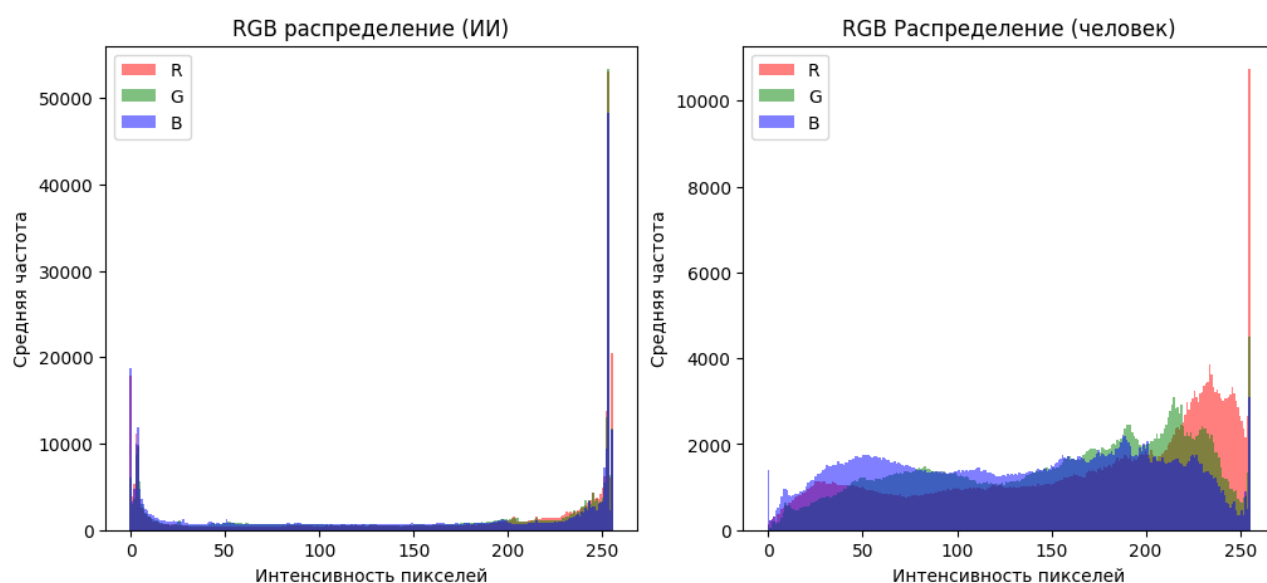


Figure 3 – Color distribution comparison

Finetuning results. After constructing the dataset and preprocessing the images, the model was fine-tuned to classify AI-generated images. The training process lasted

20 epochs, allowing the model to achieve stable convergence and minimize validation loss. F1-score was selected as primary evaluation metric, helping capture the balance between precision and recall. The results of 20-epoch training cycle are:

- The F1-score on the validation set reached 0.92, indicating high accuracy on the dataset used for hyperparameter tuning;
- However, when tested on previously unseen data, the F1-score dropped to 0.78, suggesting limited generalization ability.

Despite the high validation performance, the discrepancy between validation and test F1-scores indicates a potential issue of overfitting. This means that the model may have learned patterns too specific to the training data, reducing its ability to generalize effectively to new, unseen images.

Conclusion. The experiment achieved high accuracy on the validation set ($F1 = 0.92$) and reasonably good results on test data ($F1 = 0.78$). However, the model exhibits a drop in performance on previously unseen images, highlighting the need for additional techniques to improve generalization. One possible approach to enhancing model performance is data augmentation. Applying various image transformations, such as lighting adjustment, addition of noise and compression, color channel shifts, etc. These techniques can help reduce the impact of artifacts characteristic of specific generative models and improve the classifier's robustness.

If the ultimate goal is detecting deepfake content, it is crucial to consider that modern AI generative models are rapidly evolving and adapting to existing detection methods. To maintain classification efficiency, the model should be trained on datasets containing realism-enhancing techniques, such as Low-Rank Adaptation (LoRA). This will improve its ability to detect AI-generated images specifically designed to evade detection algorithms.

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NUCLEAR ENERGY IN PEOPLE'S REPUBLIC OF CHINA AND FRANCE

Student **Nikulina Elizaveta Maksimovna**,
Academic Advisor: Senior Lecturer **Buskin Ruslan Vladimirovich**,
Kazan State Power Engineering University,
Kazan, Russian Federation

Abstract. The paper examines the history of the development of nuclear energy in the People's Republic of China and France, from the beginning of the industry to the present day. The key stages of formation, technological breakthroughs that influenced the formation of national nuclear programs, and problems of the nuclear industry are highlighted and analyzed.

Keywords: nuclear power, energy, electric power, China, People's Republic of China, France, pressurized water reactor PWR.

АТОМНАЯ ЭНЕРГЕТИКА КИТАЙСКОЙ НАРОДНОЙ РЕСПУБЛИКИ И ФРАНЦИИ

студент **Никулина Елизавета Максимовна**,
науч. руководитель: ст. преподаватель
Бускин Руслан Владимирович,
Казанский государственный энергетический университет,
г. Казань, Российская Федерация

Аннотация. В работе рассматривается история развития атомной энергетики в Китайской Народной Республике и Франции, начиная с зарождения отрасли и до наших дней. Выделяются и анализируются ключевые этапы становления, технологические прорывы, повлиявшие на формирование национальных ядерных программ, проблемы атомной отрасли.

Ключевые слова: атомная энергетика, энергия, электроэнергия, Китай, Китайская Народная Республика, Франция, водо-водяной ядерный реактор.

The 21st century is a time of active development of science and technology: humanity needs more and more energy to perform many tasks. In this regard, interest in nuclear energy has increased dramatically. This happened against the background of efforts to reduce greenhouse gas emissions and the search for stable, reliable energy sources. This is how nuclear energy has become the most important sub-sector of global energy. The cost of electricity generated by nuclear power plants today suggests serious competition with other types of power plants. Many countries, especially the United States, France, China, and Russia, are concerned about green energy generation. They actively sponsor and develop nuclear energy, striving for waste-free production. In this paper, I will look at the history of the formation of China and France in the nuclear energy industry.

Let us start with the People's Republic of China (PRC). Any densely populated country needs a stable energy base that ensures economic development and a high standard of living. It has been established that at the current level of energy consumption, traditional fuel sources such as oil and natural gas can last for only a few decades. In this regard, there has been a steady trend in the field of energy supply: moving away from fossil fuels and switching to alternative energy sources, for example, nuclear energy. However, the country, which was poor in uranium deposits, depended on imports of nuclear technology and equipment. To date, China has gone through several stages of the evolutionary development of the industry, has consistently implemented the development of foreign technologies and is at the stage of technological synthesis in a number of areas; development and development, as a rule, are carried out on their own with the involvement, if necessary, of an external expert community. China has more than fifty years of experience in the field of nuclear energy: the first nuclear power plant was opened on February 8, 1970, and the first nuclear reactor with a capacity of 288 MW, the Pressurized Water Reactor, was launched on December 15, 1991. – PWR at the Qinshan NPP, a generation 3+ reactor was launched in 2021, which was formed by combining its own projects: ACPR-1000 (Advanced Chinese Pressurized Water Reactor-1000) and ACP-1000 (Pressurized Water Reactor, which is a descendant of the first Chinese nuclear reactors of its own design, created using French technological solutions) [1].

Today, most nuclear power plants are located on the coast, based on the use of seawater for direct cooling. Despite this, the nuclear energy capacity allows us to say that China is developing at the fastest pace among all the countries of the 21st century in order to overtake France in the next few years and become the owner of the second largest nuclear fleet in the world. The country sets ambitious goals for itself – to achieve a breakthrough in a number of key technologies by 2026, which will become the basis for further innovative industries: it is planned to create new enterprises where nuclear technologies will serve the development of medicine, the food industry, and agricultural breeding.

Let us move smoothly on to the history of French nuclear energy.

The development of nuclear energy in France began in 1945 with the creation of the Atomic Energy Commission (CEA), which was headed by Frederic Joliot-Curie, a renowned physicist and son-in-law of Marie Sklodowska-Curie. Three years later, he supervised the launch of the country's first nuclear reactor [2]. In 1946, the *Électricité de France* electric power company was established, which became the largest energy company in the world. The events on the Suez Canal in 1956 confirmed the dependence of the French economy on fuel imports, which cannot be eliminated due to the limitations of conventional energy sources. It was decided to develop the nuclear industry actively.

In 1956, the first nuclear reactor with a capacity of 2 MW was commissioned; by the 1973's, nuclear power already provided about 8 % of electricity production in France. At the end of 1997, a pressurized water reactor unit (PWR) with a capacity of 1450 MW was commissioned. The first 8 reactors were of the gas-cooled type, however, to date they have been disabled [3].

To improve the safety of nuclear energy and the control of spent nuclear fuel, a

law was passed in 2005 establishing a research policy for the development of innovative energy technologies and defining the role of renewable energy sources in electricity generation, heat supply and transport. In 2008, the Conseil Politique Nucléaire – CPN was created, which highlights the importance of nuclear technology for France in terms of economic strength, in particular energy supply [4].

At the moment, all 58 PWRs operating in the country belong to the second generation and have a high degree of standardization.

A characteristic feature of the development of reactor engineering in France is the abandonment of uranium isotope separation in favor of producing plutonium at the Marcoul production center. The uranium needed for nuclear energy is supplied from abroad: 35-40 % is supplied from Nigeria, the rest from Canada, Kazakhstan and Australia [5].

After a brief review of the history of the development of China and France in the nuclear power industry, you can proceed to their comparison.

China has caught up with France in terms of the number of operating nuclear power units: 58 versus 58 in France, however, China's operating capacity of 58.1 GW is in third place after France with its 64.0 GW.

China is currently the largest producer of electricity in the world (more than 30 % worldwide), its output is more than sixteen times higher than that of France (around 2 %). The production of nuclear energy is equal to 395.4 TWh.

Despite this, the percentage of China's energy production is still much lower than the corresponding global average: the demand for electricity in a densely populated country is high.

Let us smoothly move on to the weak points of the nuclear power industry in China and France.

The weak point of Chinese nuclear energy is the small share of electricity generated per share of the population. In addition, the country depends on coal-fired power plants. Hydropower, and consequently PWR, are limited by many factors, including natural ones.

The weak point of France's nuclear power industry is the lack of uranium deposits on its territory, and therefore all uranium is imported from abroad. There it is mined at Orano (Areva) controlled enterprises.

Personnel is another problem for the entire French nuclear power industry: 2,600 companies, including small and medium-sized businesses, account for only 220,000 jobs. In this regard, there is a loss of labor skills and a lack of quality control at all stages of design and construction with the participation of suppliers [6].

In order to solve the problems facing China and France, the countries will resume their partnership in the field of nuclear energy starting in 2023. EDF has signed an agreement with China General Nuclear Power Group to extend the Global Partnership Agreement of 2007, which includes the development of the concept, construction and operation of nuclear power plants. EDF has also signed a €1 billion contract with China Energy Investment Corporation for the construction of an offshore wind turbine park in China.

In the 51-point final declaration signed by Macron and Chinese President Xi Jinping, paragraph 23 speaks of a common desire to transition to a low-carbon energy

system [7].

Summing up the review of the nuclear power industry in China and France, one can see the presence of both common features and significant differences in approaches to the development of this industry. Both countries consider nuclear energy as an important element of ensuring energy security and reducing dependence on fossil fuels. However, while France, with many years of experience and a well-developed infrastructure, relies on the modernization of existing capacities and the development of new generation reactors, China is actively increasing the construction of nuclear power plants, introducing both its own and foreign technologies. The scale is also different: China is rapidly becoming the world leader in the number of reactors under construction, while France is focusing on maintaining and improving the efficiency of its existing fleet. Cooperation between the countries, despite the competition, also takes place, especially in the field of construction and maintenance of nuclear power plants.

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ENERGY-EFFICIENT SOLUTIONS IN ARCHITECTURE

Student **Sigacheva Karina Alexandrovna**,
Student **Sigacheva Marina Alexandrovna**,
Academic Advisor: PhD in Economic, Associate Professor
Pakhomova Julia Alexandrovna,
Financial University under the Government of the Russian Federation,
Moscow, Russian Federation

Abstract. The task of ensuring sustainable development covers many areas of human and business life. This is not only a concern for the social well-being of the staff and the consumer. Sustainable development goes beyond corporate social responsibility. This is both a concern for the environment and the task of economical consumption of natural resources. Architects support this trend by offering solutions not only in interesting visualization, but also including engineering practices to ensure energy conservation with natural spatial solutions.

Keywords: energy saving, thermal protection of buildings, multi-storey construction, energy-efficient buildings, building ecology.

ЭНЕРГОЭФФЕКТИВНЫЕ РЕШЕНИЯ В АРХИТЕКТУРЕ

студент **Сигачева Карина Александровна**,
студент **Сигачева Марина Александровна**,
науч. руководитель: канд. экон. наук, доцент
Пахомова Юлия Александровна,
Финансовый университет при Правительстве Российской Федерации,
Москва, Российская Федерация

Аннотация. Задача обеспечения устойчивого развития охватывает многие сферы жизнедеятельности человека и бизнеса. Это не только забота о социальном благополучии персонала и потребителей. Устойчивое развитие выходит за рамки корпоративной социальной ответственности. Это одновременно забота об экологии и задача экономного потребления природных ресурсов. Архитекторы поддерживают эту тенденцию, предлагая решения не только в виде интересной визуализации, но и включая инженерные практики для обеспечения энергосбережения с помощью естественных пространственных решений.

Ключевые слова: энергосбережение, тепловая защита зданий, многоэтажное строительство, энергоэффективные здания, строительная экология.

The issue of energy conservation in the construction industry is becoming increasingly significant. The growth in construction output is of particular concern, and

the expansion of construction activities is creating new challenges for future research. With the growth of the construction sector, the need to create a comfortable and high-quality living environment has become a key priority. Consequently, it is imperative to ensure the maintenance of ecologically favourable conditions for residential habitation. However, any building or structure, being an introduced object, faces an increased risk of damage from natural disasters and climate change. This vulnerability is due to the fact that the structure is not part of the natural ecosystem and has no inbuilt mechanisms to protect itself from its forces. Therefore, during design and construction, it is necessary to consider the potential threats and apply appropriate measures to ensure the durability and safety of the facility [1, p. 136].

«Relationship between the urban environment and the natural environment is characterised by a complex interplay of interactions, which manifest in a dynamic equilibrium of processes that are both destructive and constructive. The relationship between the urban environment and the natural environment is characterised by a complex interplay of reciprocal processes that influence the quality and sustainability of both environments. It is important to recognise the influence of these processes on the quality of life and the sustainability of the urban environment, as well as the natural environment» [1, p. 137].

The construction sector consumes a significant share of non-renewable natural resources such as water and energy. It accounts for about half of the total utilisation of these resources. The annual energy consumption of construction accounts for about 40 per cent of the world's total, emphasising its significant impact on global energy resources.

Global climate change and the increasing cost of energy resources make humanity feel the consequences of irresponsible use of natural wealth. One of the ways to solve the issue of excessive energy consumption is the construction of modern energy-efficient buildings. A building is considered energy efficient if its design takes into account architectural and technical solutions aimed at reducing energy consumption compared to typical projects. The main concept of designing such buildings is to use modern technologies based on non-traditional renewable energy sources.

In order to implement successfully energy saving strategies in the building sector, a clear sequence must be followed. The first task is to assess accurately the current heat losses of the building. Such an analysis will allow rational prioritisation of ways to minimise these losses. Next, technologies and materials that provide reliable protection against such energy losses in the long term should be favoured. Thoughtful and timely choices at this stage will help to minimise environmental impact in the context of increasing energy demand. Next, a list of the equipment required and its cost to implement the selected technologies must be compiled. This is followed by an assessment of the annual savings achieved by implementing the proposed measures, both in kind and in monetary terms. Finally, the total economic effect from the implementation of the recommendations should be calculated, which will serve as a kind of verification and confirmation of the effectiveness of the actions taken compared to the initial data.

Competent application of the above-mentioned measures will significantly reduce energy losses and improve the environment [2, p. 605]. Thus, to date, the following main directions of groups of measures for energy saving of construction objects can be identified [5]:

1. Reduction of fuel and energy consumption is achieved through a set of measures to reduce the need for fuel and energy resources by 12-15 % of the current consumption level;
2. Widespread introduction of exclusively energy-saving technologies and equipment into production ensures energy savings of up to 12 % of total consumption;
3. A promising direction is to re-evaluate and improve the existing economic model using modern innovative developments. This method is expected to reduce the use of energy resources by 25-30 %.

Today, there is a wide range of engineering and design solutions aimed at reducing energy costs. The key to saving energy is to improve the thermal protection properties of building materials, improve architectural and planning solutions, upgrade engineering systems and use alternative energy sources.

For example, improving the thermal behaviour of a building is achieved by designing the optimal shape, selecting the location, sizing windows and controlling air circulation. In addition, buildings with high energy efficiency have a favourable environmental impact. By integrating into the environment, they do not pollute or degrade it, they save resources and prevent ecological and energy imbalances.

The modern understanding of the term 'energy efficient building' has broadened considerably. Energy efficiency now refers to the use of heat and other forms of energy and resources. Globally, there is a steady trend towards an increasing number of buildings meeting high energy efficiency standards, and the requirements for such buildings are constantly increasing. It is not enough to minimise heat loss. Energy efficiency is seen as an integrated approach that takes into account all stages of a building's life cycle – from design to operation and utilisation. This includes the use of renewable energy sources, the use of modern materials and technologies, and the optimisation of engineering systems. The growing interest in energy efficient buildings is driven not only by environmental considerations, but also by economic benefits, as they can significantly reduce the costs of energy and utilities

The introduction of energy efficiency emerged after the global energy crisis of the 1970s. However, the development of the first such project started as early as 1972 in Manchester (Figure 1). This was a seven-storey office building, including a technical floor. The project was complemented by a two-level car park. The building was designed in accordance with General Services Administration requirements to test and identify the most efficient energy saving technologies. The implementation of the project proved to be very successful.



Figure 1 – The first energy efficient building in Manchester (USA)

The energy consumption of the building was reduced through the efficient use of solar radiation, double-layer envelope structures and computer control of the engineering equipment [3, p. 93]. Reduction of energy consumption related to ventilation is achieved by reducing the volume of air supplied. This is possible due to several factors: rational room layout, improved airflow distribution, and the use of air recirculation instead of fresh air from outside. For additional energy savings, the building utilises an artificial lighting control system. This system automatically adjusts the brightness of the artificial light sources according to the level of natural light coming in from outside, thereby reducing energy consumption.

Currently, the energy policy of states all over the world is oriented towards the development of energy-efficient buildings. The main principle of modern building design is to recognise the direct influence of the environment on the quality of urban development. The concept of 21st century architecture suggests that nature is not just a passive backdrop to our lives: through our activities, it is possible to create a new natural environment that offers favourable conditions for urban planning and building adaptation. The integration of renewable energy at the building design stage significantly transforms all components of the design process. This applies both to the choice of location and the overall building concept, as well as to the functional purpose of spaces and their spatial organisation. This approach enables the creation of more environmentally friendly and sustainable buildings, reducing their negative impact on the environment [4].

Foreign experience of architectural design with the use of advanced technologies demonstrates, in particular, the multi-storey building Pearl Tower, Guangzhou (China), designed by architect Gordon Gill and architectural bureaus Skidmore, Owings & Merrill (Figure 2).



Figure 2 – Pearl River Tower ‘Pearl River Tower’ in Guangzhou (China)

The unique appearance of the building is due to the original approach to the integration of wind turbines. The technical floors, pierced by through horizontal channels, are located at levels corresponding to the first and second third of the building's height. Vertical wind turbine generators are installed in these ducts, providing increased efficiency.

The building is designed in the shape of a vertical wave with smooth curves in front of each entrance to the technical channel, which directs the air flow to the turbines, increasing the speed of rotation of the blades and, consequently, energy generation. The facade is clad with panels, of which solar panels are a part. This structure converts sunlight into electricity, and the excess energy is stored in batteries. The double-glazed windows installed on the south side have a ventilation system between the panes, which helps to reduce indoor temperatures. Automated blinds change the position of the lamellae, tracking the movement of the sun, and fully open on cloudy days, ensuring maximum use of daylight. ‘The floors have a system that circulates chilled liquid for the air conditioning of the building, the water comes from roof-mounted rainwater collectors, which are heated by solar thermal collectors, then sent to its further purification and recycling to be used for domestic purposes’ [1, p. 139]

The Abu Dhabi Investment Council's Al Bahar building, designed by Aedas Architects, is also noteworthy (Figure 3). These twin towers are characterised by a south-facing sloping roof, which is equipped with photovoltaic panels to generate electricity.



Figure 3 – Abu Dhabi Investment Council ‘Al Bahar’ building in Abu Dhabi, UAE

The facade structure, with the exception of the north side, consists of two thousand umbrella elements designed in such a way that their opening is computer-controlled according to the position of the sun. The intensity of opening varies from full opening in the morning to maximum closing at midday, thus significantly reducing the heating of the interior spaces. This renewable energy system provides natural ventilation and reduces solar heat penetration by 50 %.

The study of international experience in the field of energy efficient technologies for buildings will make it possible to optimally and effectively introduce them into high-rise construction in the Russian Federation, adapt them to Russian climatic conditions and develop unique domestic solutions.

Based on the above, it is very likely that modernisation of building structures, materials, products and equipment will continue within the framework of the existing advanced technological trends. These trends will be aimed at meeting the needs in energy saving, environmental safety, technological efficiency, economic benefits, reduction of labour costs in construction, as well as at adapting to the conditions of reconstruction and modernisation of residential and industrial buildings. Improving the energy efficiency of buildings encompasses a set of regulatory, organisational, technical, administrative and other measures aimed at improving the efficiency of fuel and energy resources use, taking into account environmental aspects.

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EXPLORING REMOTE DATA STORAGE SOLUTIONS FOR RUSSIAN USERS AND ENTERPRISES

Student **Bormotov Aleksandr Dmitrievich**,

Academic Advisor: Senior Lecturer **Marsheva Nataliia Vladimirovna**,
The Bonch-Bruевич Saint Petersburg State University of Telecommunications,
Saint Petersburg, Russian Federation

Abstract. This paper explores the possibilities of cloud storage services for both individual users and corporate business in Russia. It analyzes the features of the most popular cloud resources, identifies advantages and disadvantages of existing solutions, and provides recommendations for their application.

Keywords: cloud technology, data storage, remote storage, cloud services.

ПОТЕНЦИАЛ УДАЛЕННЫХ СИСТЕМ ХРАНЕНИЯ ДЛЯ ЧАСТНЫХ ЛИЦ И КОМПАНИЙ РОССИИ

студент **Бормотов Александр Дмитриевич**,

науч. руководитель: ст. преподаватель **Маршева Наталия Владимировна**,
Санкт-Петербургский государственный университет телекоммуникаций
им. проф. М. А. Бонч-Бруевича,
Санкт-Петербург, Российская Федерация

Аннотация. Данная работа исследует возможности облачных сервисов хранения данных как для отдельных пользователей, так и для корпоративного бизнеса в России. Проанализированы особенности наиболее популярных облачных ресурсов, выявлены преимущества и недостатки существующих решений, сформулированы рекомендации по использованию.

Ключевые слова: облачные системы, хранение данных, удаленное хранение, облачные технологии.

In the modern world, cloud services have become an integral part of everyday life for both ordinary users and business organizations. The popularity of cloud storage systems is based on their ability to offer scalable, reliable, and accessible data storage solutions across the internet [1].

These systems are built upon several key components and technologies that work together [2] and form a strong framework, enabling individuals and organizations to take advantage of cloud storage and leading to a more interconnected and efficient digital environment. For effective data management, a well-structured data architecture is essential, with each layer playing its specific role. The Data Storage Layer is the foundational component that connects various storage elements responsible for actual data storage. It includes a variety of storage devices and technologies aimed at efficient data storage and retrieval, ensuring that large volumes of data can be stored and

accessed quickly to meet user and application needs. The Data Management Layer offers vital technologies for services like data organization, storage virtualization, and migration. It enables efficient data handling, ensuring that information remains organized and easily accessible. The Data Service Layer supports storage applications like backup, replication, and data duplication. It ensures data integrity and availability, giving users confidence that their information is secure and retrievable during failures or breaches. Finally, the User Access Layer enables user interaction with the cloud storage system through intuitive interfaces for data access and management. It ensures that users can access their data securely and easily, making cloud storage both powerful and user-friendly.

There are some limitations that should be taken into consideration while choosing a system for remote data storage. Results of literature analysis [2, 3, 4, 5, 6] are presented in Table 1.

Table 1 – Limitations for cloud storage system implementation

Limitations	Description
Security and privacy concerns	Storing data in the cloud introduces security risks, including potential data breaches and unauthorized access. Ensuring data integrity and correctness can be challenging, necessitating robust security measures.
Cost implications	While cloud storage can be cost-effective, expenses can escalate, particularly for large-scale data storage and high-frequency access. Additionally, there may be hidden costs associated with data transfer and retrieval.
Dependence on internet connectivity	Accessing cloud storage requires a reliable internet connection, which can pose challenges in areas with poor connectivity.
Performance variability	The performance of cloud storage can fluctuate depending on the service provider and the specific service plan, potentially impacting data access speeds and reliability.
Compliance and legal issues	Organizations need to make certain that their use of cloud storage complies with relevant data protection regulations and legal requirements, which can be complex and vary by country.

Among the cloud storage services designed for individual users, several key players have been identified:

- Google Drive offers users 15 GB of storage free of charge and seamless integration with a variety of other Google services [7]. While the reliability of Google's servers is well-established, it is essential for users to be aware that their data may be accessed by the company or foreign government agencies without their consent. Although Google encrypts data during transmission and storage, they retain the keys to decrypt it, enabling them to analyze the data for advertising and marketing purposes. Despite assurances of privacy, users should exercise caution regarding the files they upload and download.

- Yandex Disk, a leading cloud service in Russia, offers 10 GB of free of charge storage along with robust tools for collaboration and immediate access to documents [7, 8]. However, it is important to note that this service does not employ end-to-end encryption, which compromises the level of data protection available to users.

- Dropbox is renowned for its user-friendly interface and simplicity; nonetheless, its free storage capacity is limited to only 2 GB [9]. The service has faced significant criticism due to data breaches and inadequate measures to protect user confidentiality. Additionally, Dropbox has used scientists' data without their consent for research, underscoring the importance of understanding the service's terms of use.

- Nextcloud distinguishes itself as an open-source platform that supports end-to-end encryption, thereby providing a superior level of security for user data [10]. The cost of cloud storage on this platform varies based on the server selected by the user for data storage.

Some companies misuse the term “end-to-end encryption”. While it refers to data being encrypted on the user's device before being sent to the server, it is not always clear who controls the encryption keys. If a third party holds these keys, it can create privacy risks. Users should be careful and understand who has access to their data.

Risk analysis of remote systems indicates that the use of cloud storage, particularly those reliant on foreign companies, is associated with several potential threats to users. Among the primary risks is the transfer of data to third parties, such as government agencies or advertisers, which jeopardizes confidentiality. Additionally, there is a risk that access to data may be restricted or blocked during periods of political instability due to reliance on foreign infrastructure. Furthermore, if the servers of a company providing remote data storage services are compromised, user data may be exposed to malicious actors. While using services that support end-to-end encryption can mitigate some risks, it does not guarantee complete security. Traditionally, local storage systems are considered more secure due to their reduced exposure to external influences.

Based on the comparison criterion of value for money, Yandex Disk and Nextcloud stand out among services intended for personal use. Yandex Disk is noted for its ease of use, while Nextcloud offers a higher level of security. It is important to emphasize that two-way encryption is a crucial factor in ensuring reliable protection of stored data.

There are various remote storage systems available in the enterprise solutions market, each with its own unique features. One of the most popular services is Amazon S3 [11], which offers high performance and scalability; however, its use comes with a dependence on foreign infrastructure. Microsoft OneDrive is integrated into the Windows ecosystem, providing opportunities for collaboration. Yet, similar to Amazon S3, it does not offer complete protection of data from third-party access.

Among Russian alternatives, Mail.ru Cloud and Yandex Cloud stand out. Mail.ru Cloud features competitive pricing and an intuitive interface, but users should be aware of the possible risks of data leakage. In contrast, Yandex Cloud provides a high level of security and reliability. The company is actively working to enhance its services, offering a variety of tariff plans for businesses. However, it is essential to recognize that these Russian services were initially designed for the consumer market (B2C). As

a result, they may exhibit certain limitations and characteristics, such as integration difficulties and reliance on a specific ecosystem. Thus, the services provided by these domestic options may not be suitable for all organizations.

Today, citizens and businesses have access to reliable solutions for deploying local servers. For instance, Nextcloud offers functionality for interacting with local servers; however, it falls short in terms of innovation and performance compared to MinIO. MinIO is a high-performance object storage system that is compatible with the S3 protocol, enabling users to create custom cloud storage that combines high reliability, security, and efficiency [12].

Choosing between cloud and on-premises storage requires a careful analysis of an organization's needs and resources. By implementing an on-premises storage system, organizations gain greater control over their data, have more options for additional solutions to enhance security, and can create a system that is self-contained and independent of external Internet connectivity. This autonomy is particularly beneficial for organizations aiming to create closed systems that have limited access to the network. However, the decision to develop a custom storage system comes with certain limitations. The primary ones include the need for ongoing maintenance and the high initial costs associated with server equipment, especially if the system to be created has demanding requirements for storage capacity and performance. These factors should be carefully considered, as not all organizations, particularly small businesses, can transition to a local solution quickly.

To identify the best solutions for both individuals and Russian businesses, the most advanced remote storage systems currently available were analyzed [7, 8, 10, 11, 12]. Table 2 provides a comparative overview of various storage systems based on several criteria, including pricing, service difficulty level, reliance on foreign infrastructure, encryption algorithms, and service suitability for companies.

Table 2 – Comparison of different storage systems

system name	pricing	service difficulty level	dependance on foreign infrastructure	encryption algorithm	Enterprise-focused services level
Yandex Drive	from 199 rub/month	low	-	AES256	average
Google Drive	from 199 rub/month	low	+	AES256	average
Amazon S3	from \$0.023 / GB	medium	+	AES256	high
MinIO	free	high	-	AES256	high
Nextcloud	free	high	-	AES256	average

Yandex Disk and Google Drive both have a cost starting at 199 rub/month, making them affordable options for users seeking cloud storage. Amazon S3 operates on a pay-as-you-go model starting at \$0.023 per GB, which can be economical for businesses with variable storage needs but may become costly with large data volumes. MinIO and Nextcloud offer their services for free, which is attractive for users or small businesses looking to minimize expenses. However, the lack of cost may imply limited support or features.

Yandex Disk and Google Drive are considered user-friendly options, rated as having low difficulty. This makes them suitable for individuals or small teams without extensive technical expertise. In contrast, Amazon S3 is rated with medium difficulty, indicating that it is more complex and may require some technical knowledge. This makes it better suited for businesses with IT resources. On the other hand, MinIO and Nextcloud are rated as having high difficulty, suggesting that they demand significant technical expertise to set up and manage, which could pose a barrier for less experienced users.

Google Drive and Amazon S3 rely on foreign infrastructure, which can raise concerns about data sovereignty and compliance with country regulations. In contrast, Yandex Disk, MinIO, and Nextcloud do not depend on foreign infrastructure, potentially providing better compliance for users who are concerned about the location of their data storage and processing.

All systems use the AES256 encryption algorithm, which is a strong and widely accepted standard for data protection. This uniformity suggests that users can expect a similar level of security across these platforms.

While user-oriented services can be useful, they may not always meet the specific requirements of businesses. Amazon S3 is rated as having high suitability for companies, reflecting its scalability, robust features, and flexibility tailored to meet enterprise needs. MinIO also receives a high suitability rating, likely due to its open-source nature and adaptability for various enterprise applications. In contrast, Yandex Disk, Google Drive, and Nextcloud are rated as average, suggesting they may be appropriate for smaller businesses or specific use cases but may lack some of the advanced features required by larger enterprises.

The comparison highlights that while all systems provide AES256 encryption, their suitability varies significantly based on cost, service difficulty, and infrastructure dependencies. It should be noted that MinIO, as a more recent development, offers enhanced functionality with improved support for various tools that can significantly improve the reliability and security of data storage. Based on the analysis, it can be concluded that companies looking for robust, scalable solutions may prefer Amazon S3 or MinIO, while individual users or small businesses might find Yandex Disk or Google Drive more accessible, while Nextcloud is identified as the most reliable solution. What is more, Yandex Disk and Nextcloud are user-friendly and operate independently of foreign infrastructure. In the corporate sector, in addition to domestic solutions, deploying servers using MinIO is also a viable alternative for secure data storage. Understanding these differences is crucial for users and business organizations to make informed decisions based on their specific needs and capabilities.

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AUTONOMOUS FLIGHT AND WAYPOINT NAVIGATION OF UAV VIA REINFORCEMENT LEARNING

Student **Smirnov Alexander Alexandrovich**,
Academic Advisor: Associate Professor **Raskatova Marina Victorovna**,
National Research University “MPEI”,
Moscow, Russian Federation

Abstract. This paper explores the use of deep reinforcement learning to train an autonomous fixed-wing UAV to perform takeoff and waypoint navigation in a simulated environment. The UAV agent is trained using the Proximal Policy Optimization (PPO) algorithm from the Stable-Baselines3 library. The simulation environment is built using Godot 4, allowing for real-time physics, modular environment control, and visualization.

Keywords: AI, reinforcement learning, stable-baselines3, UAV, python.

АВТОНОМНЫЙ ВЗЛЕТ И НАВИГАЦИЯ БПЛА С ПОМОЩЬЮ ОБУЧЕНИЯ С ПОДКРЕПЛЕНИЕМ

студент **Смирнов Александр Александрович**,
науч. руководитель: доцент **Раскатова Марина Викторовна**,
Национальный исследовательский университет «МЭИ»,
Москва, Российская Федерация

Аннотация. В статье рассматривается использование глубокого обучения с подкреплением для обучения взлету и навигации по заданным точкам автономного БПЛА с фиксированным крылом в моделируемой среде. Агент обучается с помощью алгоритма Proximal Policy Optimization (PPO) из библиотеки Stable-Baselines3. Моделирование среды выполнено в Godot 4, что позволяет использовать физику в реальном времени, модульный контроль среды и визуализацию.

Ключевые слова: искусственный интеллект, обучение с подкреплением, stable-baselines3, БПЛА, python.

The popularity of unmanned aerial vehicles (UAVs) has surged in recent years, driven by their effectiveness in both civilian applications, such as mapping, agriculture, and delivery, and military operations. With this widespread use comes an increased risk of signal interference, particularly the jamming of video feeds and control channels, which can render traditional remote-based piloting methods unreliable [1]. Autopilot systems like ArduPilot, while powerful, often rely on rigid rule-based control and require uninterrupted sensor or communication links to function properly. In contrast, reinforcement learning (RL) offers a data-driven approach that enables UAVs to learn adaptive control policies directly from environmental feedback. By training

agents to act autonomously based on onboard sensory data, RL can produce controllers that are more resistant to signal loss, noise, or novel flight conditions. This paper presents an RL-based method for training a fixed-wing UAV to autonomously take off and navigate between waypoints in a custom Godot 4 simulation environment.

Proximal Policy Optimization (PPO) in Stable-Baselines3. Proximal Policy Optimization (PPO) is a state-of-the-art policy gradient algorithm widely used in reinforcement learning due to its simplicity, reliability, and strong performance across a range of tasks. It strikes a balance between the stability of Trust Region Policy Optimization (TRPO) and the ease of implementation of vanilla policy gradients [2, 4]. Stable-Baselines3 implements PPO as an on-policy algorithm, where the agent collects fresh samples from the environment at each training iteration and uses them to update its policy. The core idea of PPO is to prevent large, potentially destabilizing updates to the policy by using a clipped surrogate objective. This surrogate objective is:

$$L^{CLIP}(\theta) = \hat{E}_t[\min(r_t(\theta)\hat{A}_t, \text{clip}(r_t, 1 - \epsilon, 1 + \epsilon)\hat{A}_t)],$$

where: $r_t(\theta)$ – probability ratio between the new and old policy;

$\hat{A}_t$ – estimated average at timestep t ;

ϵ – hyperparameter.

In practice, PPO collects batches of trajectories by interacting with the environment for a fixed number of steps. For each step, it stores observations, actions, rewards, estimated values, and log probabilities. Once enough data is gathered, PPO performs several epochs of optimization using mini-batches, updating both the policy and the value function. The policy network is updated using the clipped objective, while the value function is trained to minimize the mean squared error between predicted and actual returns. An entropy bonus is also included to encourage exploration during early stages of training.

Godot 4 and the "Godot RL Agents" Plugin. Godot 4 is an open-source, feature-rich game engine that has recently seen significant improvements, making it a compelling choice for building interactive simulations and experimental environments. Compared to larger, more complex engines like Unity or Unreal Engine, Godot's minimal setup and cross-platform support make it easier and faster to prototype custom environments, especially for academic or research-focused projects where agility and transparency are critical.

One of the key enablers of using Godot 4 for RL is the "Godot RL Agents" plugin, an open-source tool that bridges the gap between the Godot engine and external machine learning frameworks such as Python's Stable-Baselines3. The plugin sets up a socket-based communication protocol that allows Godot to act as an environment while Python handles the agent training. Observations, actions, and rewards are exchanged over this connection in real time, enabling tight integration without embedding Python directly into the engine [3].

The environment (Figure 1) created in Godot consists of a 300 by 300 meter virtual plane featuring a designated runway for takeoff and landing. Five spatially distributed waypoints are placed at varying altitudes throughout the environment, each visualized as a black torus with a glowing green interior to guide the agent's navigation. The physics simulation incorporates key aerodynamic factors such as lift coefficient,

drag force, and relative direction of airflow to provide a realistic flight model. This enables reinforcement learning agents to experience more authentic flight dynamics during training. For visual and demonstrational purposes, a simplified 3D model resembling the Russian fixed-wing UAV "Orion" is used as the controllable aircraft, giving the simulation a real-world reference and enhancing the interpretability of agent behavior.

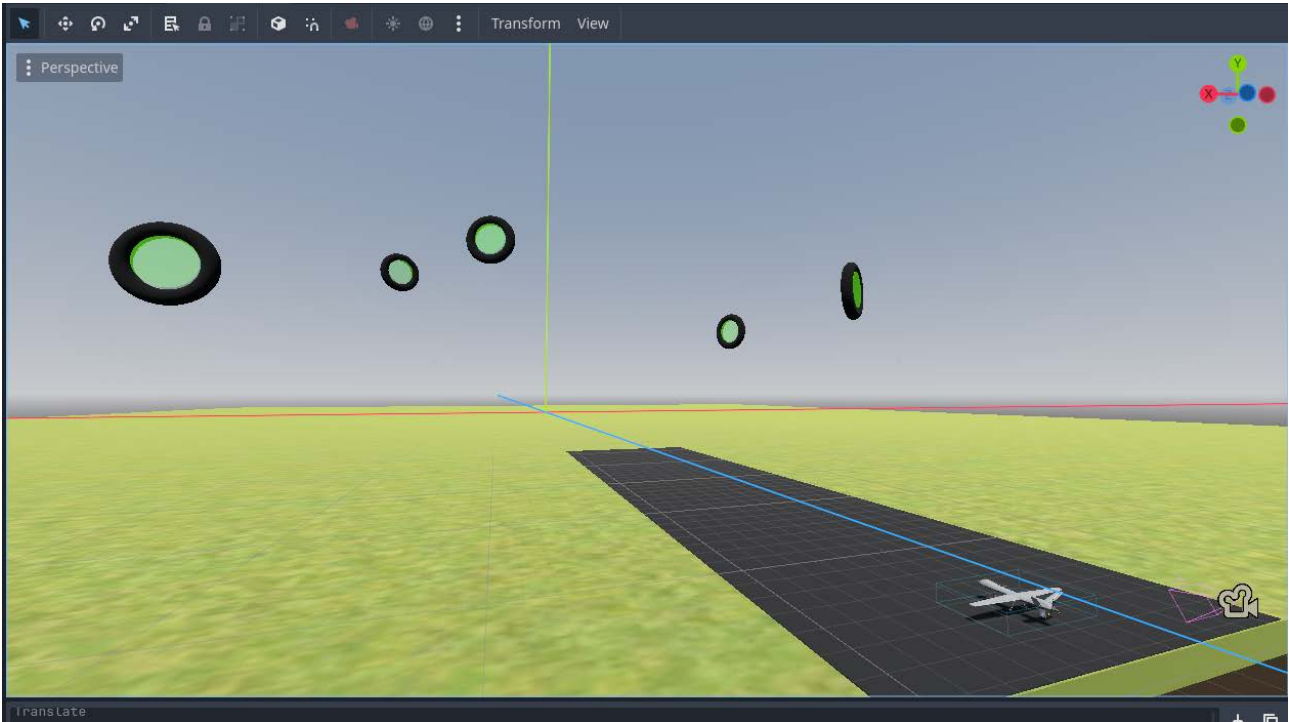


Figure 1 – Simulated environment in godot editor

Training Setup: Observations and Reward Design. To effectively train the reinforcement learning agent to autonomously take off and navigate between aerial waypoints, a carefully structured observation and reward system was implemented. The observation space provides the agent with essential information about its current flight status and navigation targets. Specifically, the agent observes:

- 3D vector pointing to the current waypoint;
- Euclidean distance to that waypoint;
- Current altitude;
- 3D vector to the next waypoint in sequence;
- Euclidean distance to next waypoint.

These observations are normalized and updated every frame, ensuring that the agent maintains an accurate sense of its orientation and objectives.

The reward function is crafted to encourage optimal and realistic flight behavior while penalizing critical errors. Positive rewards are granted for key accomplishments such as:

- Successfully taking off within the bounds of the runway collision shape;
- Maintaining wings-level (stable roll);

- Staying on an optimal trajectory toward the current waypoint (measured by the alignment between the vector to the goal and a calculated ideal trajectory);
- Passing a waypoint within its bounding volume;
- Completing the full course of all waypoints. These incentives reinforce both short-term control precision and long-term goal completion.

To promote safe and efficient flight, negative rewards (penalties) are applied in various failure scenarios. These include crashing into the ground or other surfaces (triggering a game over), flying out of the defined environment bounds, exceeding a critical angle of attack (AOA) which could simulate stall conditions, and depleting fuel reserves before finishing the course. This reward and punishment structure creates a balanced training signal that pushes the agent to learn efficient, stable, and safe navigation strategies while discouraging erratic or reckless behavior [5].

Training results. To accelerate the reinforcement learning process, parallelization was employed by running 8 simultaneous instances of the simulation environment (Figure 2). This allowed the PPO algorithm to collect diverse experiences and converge faster toward optimal behavior. Over the course of training, the agent was exposed to a variety of takeoff and navigation scenarios, gradually refining its policy through reward-guided exploration.

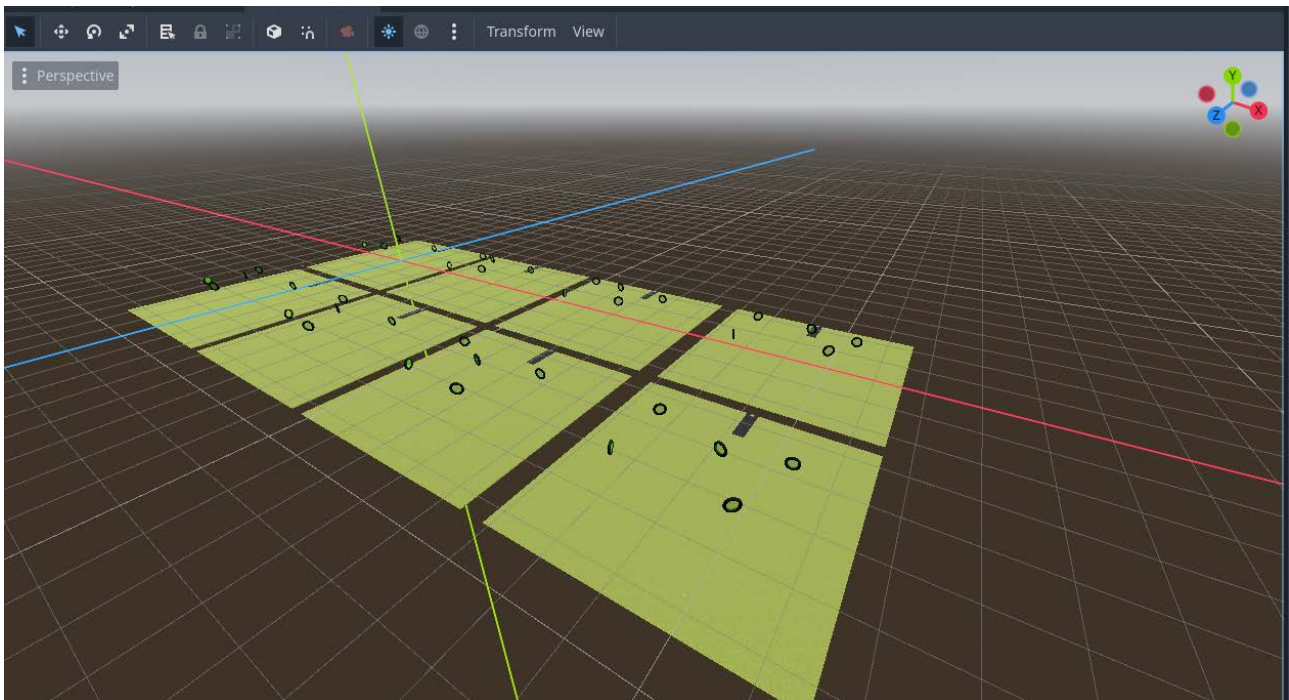


Figure 2 – 8 environments in the same scene

After approximately 150,000 timesteps, the UAV demonstrated the ability to reliably take off, maintain stable flight, and pass through all five waypoints without crashing or exiting the bounds of the environment. The agent successfully learned to balance flight control with navigation objectives, showing smooth transitions between waypoints and consistent wing-level flight. These results highlight the effectiveness of the training setup and the potential of reinforcement learning for autonomous UAV control in simulated environments.

Conclusion. This paper demonstrated the feasibility of using reinforcement learning, specifically the PPO algorithm from Stable-Baselines3, in combination with the Godot 4 engine to train an autonomous fixed-wing UAV to take off and navigate a predefined course. The current environment and training setup were intentionally simplified to focus solely on basic flight dynamics and waypoint navigation. While the UAV successfully learned to complete the course without crashing, this setup represents only a foundational step toward more sophisticated real-world applications. To approach real operational performance, future work must involve significantly more complex and purposeful environments. This includes dynamic weather conditions, moving targets, fuel efficiency optimization, and more realistic aerodynamic modeling. An important next step would be integrating computer vision systems into the simulation, enabling the UAV to perform navigation and target recognition based on visual input rather than predefined waypoints. This would bring the system closer to the autonomy required in practical UAV missions.

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APPLICATION OF MODERN INFORMATION TECHNOLOGIES IN THE IMPLEMENTATION OF 3D MODELS IN AUGMENTED REALITY

Student **Taratunina Alexandra Valerievna**,
Academic Advisor: Lecturer, Postgraduate student
Novikova Polina Alexandrovna,
Russian State University named after A. N. Kosygin
(Technology. Design. Art),
Moscow, Russian Federation

Abstract. This article discusses the application of modern information technologies for the implementation of 3D models in augmented reality (AR). Key aspects of integrating 3D content on the Architeque platform allow users to interact with virtual objects in real time. The advantages of AR in educational institutions and the opportunities for visualization and design are analyzed. The study emphasizes the importance of design and branding in creating a unique visual identity for educational institutions. As a result of the work, 3D models based on the university's logo were developed and tested, demonstrating the practical application of technologies in the educational environment.

Keywords: augmented reality, 3D models, information technology, visualization, Architeque, design, branding, Blender, integration, interactive interaction.

ПРИМЕНЕНИЕ СОВРЕМЕННЫХ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ ПРИ ВНЕДРЕНИИ 3D-МОДЕЛЕЙ В ДОПОЛНЕННУЮ РЕАЛЬНОСТЬ

студент **Таратунина Александра Валерьевна**,
науч. руководитель: преподаватель, аспирант
Новикова Полина Александровна,
Российский государственный университет имени А. Н. Косыгина
(Технологии. Дизайн. Искусство),
Москва, Российская Федерация

Аннотация. В статье рассматривается применение современных информационных технологий для внедрения 3D-моделей в дополненную реальность (AR). Ключевые аспекты интеграции 3D-контента на платформе Architeque позволяют пользователям взаимодействовать с виртуальными объектами в реальном времени. Анализируются преимущества AR в образовательных учреждениях и возможности для визуализации и проектирования. Исследование подчеркивает важность дизайна и брендинга в создании уникального визуального образа учебного заведения. В результате разработаны и протестированы 3D-модели на основе логотипа

университета, что демонстрирует практическое применение технологий в образовательной среде.

Ключевые слова: дополненная реальность, 3D-модели, информационные технологии, визуализация, Architeque, дизайн, брендинг, Blender, интеграция, интерактивное взаимодействие.

In the modern world, information technology plays a key role in the development of visualization methods and interactive engagement. One of the most promising and rapidly evolving fields is augmented reality, which allows the real and virtual world to integrate, providing users with new opportunities to interact with their environment. The implementation of 3D models in augmented reality opens up vast prospects for visualization, education, and design.

Augmented reality (AR) is a technology that overlays digital information onto the real world. This technology operates on the basis of markers, geolocation tags, or arbitrary planes [1]. The distinctive feature of augmented reality lies in the software-based visual integration of two initially independent spaces: the world of real objects and the virtual world recreated on a computer. A new virtual environment is formed by overlaying programmed virtual objects onto the video signal from a camera, becoming interactive through the use of special markers. Any specific physical object, image, QR code, or logo can be a marker. With the help of AR, users can interact with virtual objects that are integrated into their physical surroundings, creating new opportunities for business, education, and leisure [1].

There are numerous platforms offering tools for integrating three-dimensional objects into augmented reality. The choice of a specific solution depends on the tasks at hand, functional requirements, and available resources. This study examines the application of the Architeque platform, which facilitates the simple integration of 3D content [2]. This program allows to display AR on mobile device screens when the camera is pointed at horizontal surfaces, thanks to an additional application on the phone. Architeque is a free tool for presenting 3D objects and provides capabilities for uploading models, creating electronic catalogs with a 3D configurator, web pages, and demonstrating content through links or QR codes on mobile devices. It is most convenient to take advantage of the benefits of augmented reality through mobile applications, as most people already own smartphones with powerful cameras and sensors, making AR technologies accessible to almost everyone [1].

Before starting work on 3D models, it is necessary to prepare their design. The development of design solutions has been significantly transformed by digital technologies, providing designers with unique tools and opportunities [3]. Design plays an important role in shaping a brand and its recognition; using a logo as inspiration for creating original corporate identity solutions is becoming increasingly relevant. Universities actively compete in the educational services market, striving to attract the attention of potential students and partners. An important tool in this process is the logo, which significantly influences the image and reputation of the educational institution [4]. Elements in the form of the logo of the Russian State University named after A. N. Kosygin can become the key aspect in forming a unified visual image of the educational institution. To achieve this, testing is conducted using augmented

reality programs to implement the project and integrate digital models into the real life of the university.

Special software and tools are used to create and visualize the models. Blender3D is a program used for three-dimensional modeling and rendering, which makes it ideal for creating 3D models [4]. Design programs allow creators to see how the finished products will look, enabling adjustments to be made at early stages of the design process [5].

As a result of the work in Blender, three digital models were created based on the university logo: a library bookshelf shaped like the letter of the logo; a transparent glass vase styled after the RGU logo; and a bench integrating the form of the logo (Figure 1).



Figure 1 – 3D models created in Blender:
a – Bench; b – Vase; c – Library bookshelf

After completing the modeling, each model is exported in OBJ format, creating a separate file with geometric data that can be used in other programs. The models are then integrated into the augmented reality environment using the Architeque platform.

The process of working in Architeque begins with registering on the platform and logging into the profile. To access the platform, the user is to open the Architeque website and go through the authorization procedure. In the menu, the user selects the "3D Scenes" option, which serves as the starting point for further actions.

Creating a new scene is done on the "My Scenes" page, where the user clicks the "Create New 3D Scene" button. The next step is to upload the model: the user needs to select the "Upload OBJ file from Blender" option and upload the corresponding file. After the model is uploaded, a workspace opens where the user has the opportunity to adjust various parameters, such as scene properties, annotations, hierarchy, materials and textures, as well as animation.

One of the key points is the ability to move the model into the desired position using axes and to assign colors to each object, which helps to maintain the visual identity created in Blender. After completing the adjustments, users can view the model from all angles to ensure correct placement and aesthetic appeal.

At the stage of publishing the scene, the user needs to go to the "Public Information" tab, enter the scene name, and check the box "Available via QR code or link." Clicking the "Share" button provides access to the scene in the mobile app, making the interaction with 3D models even more convenient.

To access the scene in the mobile app, the user needs to install the Architeque app on their phone, log into their account, and scan the generated QR code with their mobile device or select the desired scene from the app's library. After that, the user can open the scene in augmented reality (AR) mode and place the model in real space using the phone's camera. The integrated models are shown in the Figure 2.



Figure 2 – AR Display in the Architeque App:
a – Bench; b – Library Bookshelf; c – Vase

The proposed algorithm provides a convenient and effective integration of 3D models created in Blender into augmented reality using the Architeque platform and mobile application. The process includes creating a new 3D scene, uploading the model, and adjusting various parameters, allowing users to successfully transfer three-dimensional objects into the real world.

The created models demonstrate the wide opportunities to use the logo within the university space through user-friendly augmented reality applications. These models can be successfully implemented in the university environment, enriching real life.

Modern information technologies allow designers' ideas to come to life, simplifying work and reducing the time spent on creating a creative project [6]. The use of AR technologies opens up new opportunities for creative potential [1].

It is important to modernize and refine design solutions in accordance with the theme of the event, the calendar plan, and to introduce and develop new elements that take into account trends and social demands for renewal in society while preserving cultural roots. The further development of this direction can contribute to the formation of a unique visual identity for the university, enhancing its recognition and attracting the attention of potential students and partners.

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ECOLOGICALLY SAFE SORBENTS FOR WATER PURIFICATION FROM PETROLEUM PRODUCTS

Student **Akinina Polina Olegovna**,
Student **Tsyrendashieva Anastasia Tumerovna**,
Academic Advisor: PhD in Technical Sciences, Associate Professor
Yanchukovich Svetlana Georgievna,
Saint Petersburg State University of Industrial Technologies and Design,
Higher School of Technology and Energy,
Saint Petersburg, Russian Federation

Abstract. The problem of pollution of reservoirs with petroleum products is becoming more urgent in the light of global climate change and the increasing number of technogenic disasters. At the end of 2024, the Black Sea faced a serious environmental problem - a major oil spill occurred in the Kerch Strait. As a result, thousands of tons of fuel got into the water, which led to pollution of the water area and the coast. The main impact fell on the eastern coast of Crimea, in particular on the Kerch Strait, Feodosia and nearby areas. In this regard, the development of effective and environmentally friendly sorbents for water purification is becoming an extremely urgent task.

Keywords: sorbents, water purification from petroleum products, thermally expanded graphite, rice husk, hogweed, waste paper.

ЭКОЛОГИЧЕСКИ БЕЗОПАСНЫЕ СОРБЕНТЫ ДЛЯ ОЧИСТКИ ВОД ОТ НЕФТЕПРОДУКТОВ

студент **Акинина Полина Олеговна**,
студент **Цырендашиева Анастасия Тумэровна**,
науч. руководитель: канд. техн. наук, доцент
Янчукович Светлана Георгиевна,
Санкт-петербургский государственный университет
промышленных технологий и дизайна,
Высшая школа технологии и энергетики,
Санкт-Петербург, Российская Федерация

Аннотация. Проблема загрязнения водоемов нефтепродуктами становится все более актуальной в свете глобальных изменений климата и увеличения числа техногенных катастроф. В конце 2024 года Черное море столкнулось с серьезной экологической проблемой – в Керченском проливе произошло крупное разлитие нефти. В результате в воду попали тысячи тонн топлива, что привело к загрязнению акватории и побережья. Основной удар пришелся на восточное побережье Крыма, в частности на Керченский пролив, Феодосию и близлежащие районы. В связи с этим разработка эффективных и экологически безопасных сорбентов для очистки воды становится крайне актуальной задачей.

Ключевые слова: сорбенты, очистка вод от нефтепродуктов, терморасширенный графит, рисовая шелуха, борщевик, макулатура.

Currently, cleaning of water bodies from oil products is one of the most important tasks of our time. Pollution of water resources with oil and its derivatives leads to serious environmental consequences, including the death of aquatic flora and fauna, deterioration of drinking water quality and negative impact on human health. Among the various treatment methods, the sorption method stands out for its efficiency, relative simplicity and cost-effectiveness. Of particular interest are sorbents of natural origin and materials derived from renewable raw materials, which are biodegradable and do not create secondary pollution of the environment [1, 2].

Traditional sorbents and their disadvantages

Previously, various conventional sorbents such as:

- Sand – often used due to its availability, but its effectiveness in removing oil products is limited.
- Activated carbon – has good adsorption properties, but its production is associated with high-energy costs and negative environmental impact.
- Synthetic polymers – such as polyethylene and polypropylene have also been used to create sorbents. However, they are not biodegradable and can add to the pollution problem [2].

The disadvantages of traditional sorbents are high cost, low efficiency under high pollution conditions, and negative environmental impact during their production and disposal.

New ecologically safe sorbents

In recent years, the attention of scientists has been attracted by new environmentally safe sorbents such as:

- Thermally expanded graphite

Thermally expanded graphite (TEG), also known as penographite, is a macroporous material derived from natural crystalline graphite. Its structure consists of layers of carbon atoms, which after special treatment acquire a porous and volumetric shape. This material has unique properties that make it particularly effective for water purification from oil products [3].



Figure 1 – Thermally expanded graphite

Due to the high porosity and hydrophobicity of the surface, TRG is able to absorb selectively organic molecules such as oil and its derivatives without absorbing water. One gram of thermally expanded graphite can absorb up to 50 grams of oil, making it one of the most effective sorbents for oil spill response [3].

It is obtained by thermal treatment of intercalated graphite (graphite with molecules or ions of other substances embedded in the interlayer space). Rapid heating to temperatures of 800-1000 °C results in a sharp increase in the volume of the material by 200-300 times with the formation of worm-like particles with a highly developed surface.

Thermally expanded graphite (TEG) is widely used in practice today due to its unique structural characteristics: chemical inertness, heat resistance, mouldability and good sealing ability. Such properties as high porosity, low bulk density and developed specific surface area are responsible for its high sorption properties [4].

High efficiency of TRG is due to the presence in its structure of micropores (diameter less than 2 nm), mesopores (2-50 nm) and macropores (more than 50 nm), provides a multilevel system of retention of oil products. The hydrophobicity of the TRG surface due to the π -electronic system of graphene layers favours selective absorption of non-polar oil hydrocarbons by repulsion of water molecules.

One of the important advantages of TEG is its reusability [4]. The main method of material regeneration is mechanical squeezing, which allows efficient and cost-effective extraction of up to 95 % of collected oil and petroleum products. To remove the remaining hydrocarbons after squeezing, the sorbent is thermally treated.

Firstly, the polluted area is fenced off, sorbents are dumped, they absorb oil and then special skimmers mechanically collect them. After mechanical collection, the thermally expanded graphite that has absorbed the oil is subjected to a squeezing process to remove excess liquid. The resulting material can be reused as a sorbent or recycled according to established recycling standards. After 5-7 regeneration cycles the sorption, capacity of TRG is reduced by 15-20 % due to partial destruction of the porous structure and residual contamination [5].

- Borschevik

Borschevik is a genus of plants in the umbrella family with 152 species distributed in the temperate zone of the Eastern Hemisphere. Some species are cultivated as ornamental plants, others as fodder for livestock, and others as food for humans. Some species (belonging to the family Pubescentia Manden) contain photosensitizing substances (furanocoumarins) that cause phytophotodermatitis, cancerous tumors and congenital pathologies in humans and animals.

In Russia and CIS countries, there are about 40 species of borschevik, mainly in the subalpine mountain belt. There is an acute problem with the spread of Sosnovsky's Borschevik, which causes severe allergic bullous dermatitis, so-called 'burns' (up to lethal cases) in the northern, north-western and central regions of our country [6].

Gubkin University of Oil and Gas presented a method of obtaining a sorbent from borschevik, which can be used to eliminate emergency spills of oil and petroleum products on land and in water areas, as well as for the treatment of industrial water.

The time of active absorption of contaminants by the sorbent is up to 1.5 hours. The results of the research allow us to conclude that the sorbent with a high degree of buoyancy has a large sorption capacity. Compared to known organic analogues, the sorption capacity of the sorbent from Sosnovsky's borschevik is on average 50% higher. In addition, the development will help to reduce the spread of borschevik in Russia [7].



Figure 2 – Sosnovsky's Borschevik

- Rice husk

Rice husk is a multi-tonnage agricultural by-product that is highly porous and has the ability to adsorb oils. This sorbent does not sink, absorbing the oil, which is mechanically collected and sent for incineration.



Figure 3 – Rice husk

Low cost and availability make rice husk a promising raw material for sorbents, especially for localised treatment projects in rice-growing regions. It contains about 20 % mineral components, mainly silica, and 80 % organic matter including cellulose, hemicellulose and lignin.

The porous structure of the husk, including cavities and capillaries of various sizes, ensures retention of petroleum products. Untreated rice husk has both hydrophilic and hydrophobic sites, which limits its selectivity.

After 2-3 regeneration cycles, the spent rice husk is disposed of by incineration or composting.

The buoyancy of rice husk is medium (retained on the water surface for 24-48 hours), which allows it to be used for spill response on calm water surfaces, but limits its use in wave or current conditions [8].

- Modified pulp and waste paper

Waste paper, or recycled paper, can also be used to create effective sorbents. It has good adsorption properties and can be easily recycled after use. For example, the Balticfloc Company in Latvia recycles waste paper, producing environmentally friendly materials such as cellulose mulch and sorbents for water purification from oil products. In addition, studies show that recycling paper waste into hydrophobic sorbents can be an effective method for collecting oil spills [9].



Figure 4 – Waste paper

Cellulose and its derivatives are widely used as a basis for the development of sorbents for petroleum products. By chemical modification, such as acetylation (replacement of hydroxyl groups with acetyl groups) or silanisation (treatment with organosilanes), the hydrophilic surface of cellulose can be transformed into a hydrophobic one. This significantly increases its sorption capacity towards petroleum

products [10].

The porous structure of cellulose materials provides capillary retention of liquid petroleum products.

Sorption efficiency depends on the degree of modification, the type of modifying agent and the form of cellulose material (fibres, granules, aerogel). The highest efficiency of modified cellulose is demonstrated at sorption of medium fractions of petroleum products (diesel fuel, lubricating oils).

After 3-4, regeneration cycles the sorption capacity decreases by 20-30 %, which is connected with partial washing out of modifying agents and changes in the structure of the material.

The buoyancy of modified cellulose is high (it remains on the water surface up to 72 hours and more), which makes it promising for use in open water bodies [10].

Comparative characterization of environmentally safe sorbents is presented in Table.

Table – Comparative characterization of environmentally safe sorbents

<i>Title</i>	<i>Sorption mechanism</i>	<i>Sorption capacity</i>	<i>Regeneration</i>
Thermally expanded graphite	Physical adsorption on the surface and capillary condensation in pores.	1 g/g of TEG can absorb up to 50 g of oil	Thermal regeneration (heating up to 300-400 °C) to remove up to 95 % of sorbed petroleum products. Extraction with organic solvents (hexane, toluene). Mechanical squeezing (up to 70-80 % extraction).
Borschevik		Of Sosnovsky's borschevik, the average is 50 per cent more	
Rice husk	Based mainly on physical adsorption and capillary phenomena.	Untreated rice husk 3-5 g/g at oil concentrations of 1-5 g/litre. After carbonisation or chemical modification -8-12 g/g	Regeneration is limited and can be carried out mainly by squeezing (for light fractions of oil products) or solvent extraction. However, after 2-3 regeneration cycles the sorption capacity decreases by 40-50 %
Modified pulp and waste paper	Based on hydrophobic interactions between non-polar parts of the modified surface and oil hydrocarbons.	15-25 g/g at oil product concentrations from 0.5 g/litre	Washing with organic solvents (acetone, hexane). Mechanical squeezing (for some forms of material). Mild heat treatment (up to 120-150 °C).

Thus, the development of environmentally friendly sorbents for water treatment from oil products represents an important step towards solving the problem of water pollution. The use of such materials as rice husk, modified cellulose, waste paper, thermally expanded graphite and bursal wood opens new horizons in the field of ecology and sustainable development for water treatment from oil products.

Analysis of the properties of the considered sorbents shows that each of them has certain advantages and disadvantages. Thermally expanded graphite demonstrates the highest sorption capacity and the possibility of multiple regeneration, which makes it optimal for elimination of large spills of oil products, especially in cases where it is important to ensure the maximum degree of purification. However, its application is limited by its high cost and complexity of production.

Natural sorbents such as rice sorbents are characterized by affordability, environmental friendliness and biodegradability. They are suitable for localized applications, especially in regions where these materials are available waste or natural resources. Despite their lower sorption capacity, their use can be economically justified for small spills or as an additional clean-up step.

Modified cellulose occupies an intermediate position, combining a relatively high sorption capacity with biodegradability. This material holds promise for applications where a balance between efficiency, environmental friendliness and cost is required.

It is important to continue research in this area to create effective solutions that will help preserve our water resources for future generations.

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USING RECYCLED CONSTRUCTION MATERIALS TO REDUCE THE ENVIRONMENTAL LOAD

Student **Tagrifullina Alsu Ilyasovna**,
Academic Advisor: PhD in Philology, Associate Professor
Shpar Tatyana Vladimirovna,
Bashkir State Agrarian University,
Ufa, Russian Federation

Abstract. The article considers the types of recycled raw materials (concrete, glass, plastic, etc.), their processing technologies (crushing, sorting, etc.), as well as the advantages (cost reduction, waste reduction, resource conservation). Barriers to widespread use and ways to overcome them are discussed. A conclusion is made about the need to improve the regulatory framework and develop infrastructure for the introduction of secondary materials in construction.

Keywords: secondary building materials, waste recycling, construction waste, secondary raw materials.

ИСПОЛЬЗОВАНИЕ СТРОИТЕЛЬНЫХ МАТЕРИАЛОВ ИЗ ВТОРИЧНОГО СЫРЬЯ ДЛЯ СНИЖЕНИЯ ЭКОЛОГИЧЕСКОЙ НАГРУЗКИ НА ОКРУЖАЮЩУЮ СРЕДУ

студент **Тагрифуллина Алсу Ильясовна**,
науч. руководитель: канд. филол. наук, доцент
Шпар Татьяна Владимировна,
Башкирский государственный аграрный университет,
г. Уфа, Российская Федерация

Аннотация. В статье представлены виды переработанного сырья (бетон, стекло, пластик и др.), технологии их переработки (дробление, сортировка и т. д.), а также преимущества (снижение затрат, уменьшение отходов, сохранение ресурсов). Рассмотрены барьеры для широкого использования и пути их преодоления. Сделан вывод о необходимости совершенствования нормативной базы и развития инфраструктуры для внедрения вторичных материалов в строительство.

Ключевые слова: вторичные строительные материалы, переработка отходов, строительные отходы, вторичное сырье.

The modern construction industry has a significant impact on the environment, consuming huge amounts of natural resources and producing significant amounts of waste. In the context of growing urbanization and increasing construction volumes, finding sustainable solutions that can reduce the environmental burden is becoming an

urgent task. One of the most promising areas is the use of building materials made from recycled materials.

Recycling construction waste allows not only to reduce the volume of garbage, but also to reduce the consumption of primary natural resources, such as sand, crushed stone, clay and wood. As a result, this leads to a decrease in waste disposal costs, a decrease in environmental pollution and an increase in the economic efficiency of construction. This paper discusses the main types of secondary building materials, their processing technologies and the advantages of their use in construction.

The main types of secondary building materials:

1. Recycled concrete. Concrete is one of the most widely used building materials. Its processing involves crushing old concrete structures and using the resulting material as a filler for new concrete. This reduces the need for natural crushed stone and reduces the volume of construction waste.

2. Recycled glass. Glass waste can be used as a filler for concrete, glass block production, thermal insulation materials and even in road construction. The use of recycled glass reduces the load on landfills and reduces the need for natural sand mining [1].

3. Recycled plastic. Plastic waste is used in the production of composite building materials, synthetic wood, insulation and even road surfaces. This helps to reduce the volume of plastic waste and reduce wood consumption.

4. Recycled metal waste. Metals such as steel and aluminum can be recycled many times without losing their properties. The use of secondary metals in construction reduces energy costs for their production and reduces carbon dioxide emissions.

5. Broken bricks. Used as a filler, additive in construction solutions and for road backfill.

6. Wood waste. Used for the production of chipboard and fibreboard, and as fuel for boilers.

7. Rubber crumb from car tyres. Used as an additive to asphalt concrete, for the production of paving slabs and sports ground surfaces.

8. Ash and slag waste from thermal power plants: Used as an additive to cement and concrete, and for the production of building blocks and bricks (Figure 1).

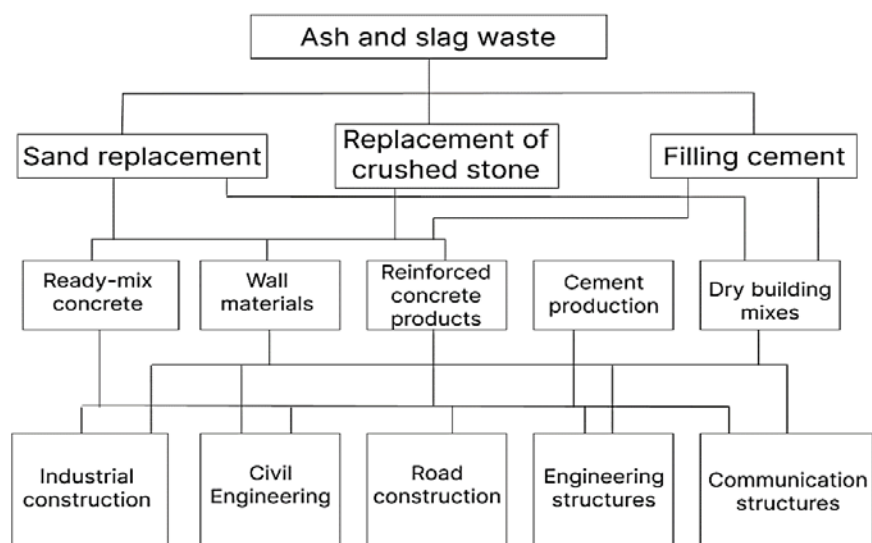


Figure 1 – Use of ASW in the production of building materials

For example, to obtain screenings, concrete scrap, and recycling crushed stone, which can subsequently be used in construction, finishing and household work, the following types of waste are processed:

1) Remains of reinforced concrete structures include various elements, such as slabs, beams, floors, load-bearing walls, wall panels, columns, as well as dismantled elements of industrial structures.

2) Fragments of brick buildings are formed during the dismantling of chimneys, fortifications, boiler houses and thermal furnaces. Various types of brick are processed: sand-lime, ceramic, refractory, as well as double and triple-fired brick, known as "iron" brick. Ceramic brick crushed stone, which has high hygroscopicity and moisture resistance, is formed from the resulting material.

3) Removed road surfaces are asphalt pavement, dismantled fragments of worn-out road sections.

4) Production waste includes defective reinforced concrete products, material residues generated during the cleaning of equipment associated with working with concrete.

5) Old construction materials, such as roofing felt, glass and other waste, can also be recycled and reused.

Various technological processes are used to convert secondary raw materials into materials suitable for construction, the choice of which depends on the type of waste and the required characteristics of the final product:

1) Crushing and sorting – this method is used to process solid waste, such as concrete and brick scrap, as well as glass waste. The process begins with crushing large pieces into smaller fractions. Then sorting occurs, allowing you to separate different types of materials (for example, concrete from reinforcement) and remove contaminants. The resulting material, after cleaning, can be used as filler for concrete, road bases, or for other construction purposes [2].

2) Pressing – this technology is used to process wood and plastic waste. Under high pressure and temperature, waste is formed into various products, such as chipboard or polymer sand tiles (Figure 2). Pressing allows for the creation of strong and durable materials, while effectively utilizing waste.



Figure 2 – Pressing of chipboards

3) Thermal treatment – this method is used to process ash and slag waste from thermal power plants, as well as in the cement production process. Ash and slag waste is heated, resulting in chemical reactions that change its structure and properties. The resulting material can be used as an additive to cement or for the production of building bricks.

4) Chemical treatment – this technology is used to process plastic and rubber waste. With the help of chemical reactions, the waste is decomposed into simpler components, which can then be used to produce new materials, such as polymer additives for concrete or rubber crumb for road surfaces and sports grounds. Chemical processing allows not only to utilize waste, but also to obtain valuable products with improved properties.

The use of secondary raw materials in construction brings tangible economic benefits, allowing to reduce costs both for the demolition of obsolete buildings and structures, and for subsequent construction work and landscaping. One of the advantages is flexibility in processing, because crushing concrete scrap allows you to obtain materials of various sizes, adjusting the degree of crushing to achieve the required density required when creating new concrete structures. In addition, secondary crushed stone can be combined with sand and special additives, creating building solutions with specified performance characteristics [3]. It is important to note that recycled materials can be used in almost the same areas as the original raw materials, which contributes to the transition to environmentally friendly and economical waste-free production. The use of secondary raw materials is especially relevant in regions where there are no quarries for the extraction of natural stone, because in this case, secondary raw materials become a convenient and profitable alternative, significantly reducing transportation costs. At the same time, concrete waste retains the strength properties of the original material, which allows you to create reliable and durable structures from recycled reinforced concrete. Currently, despite the obvious advantages for the environment and economy, the widespread use of materials made from secondary raw materials in construction encounters a number of difficulties. First of all, there is a lack of clear state rules and standards that would define the requirements for the quality and use of these materials. This creates uncertainty among construction companies and manufacturers, slows down the implementation of new technologies and makes it difficult to obtain permits. Secondly, many consumers are prejudiced against recycled materials, doubting their reliability and safety. The lack of information and examples of successful use only exacerbates this problem. Thirdly, the construction waste recycling industry is underdeveloped: there are not enough waste collection and recycling companies, and logistics often leave much to be desired. This leads to an increase in the cost of recycled materials and makes them difficult to access. Finally, the waste collection and recycling processes themselves require significant financial investments, which also makes recycled materials less competitive compared to traditional materials. However, despite these difficulties, recycled building materials have enormous potential [4]. To implement it, it is necessary to improve the legislative framework by developing clear quality standards. It is also important to raise consumer awareness by talking about the benefits of recycled materials and demonstrating successful examples of their use. It is necessary to develop infrastructure by creating

more waste recycling facilities and improving logistics. And, of course, government support is important, for example, in the form of benefits and subsidies for recycling companies. These measures will help overcome existing obstacles and make the construction industry more environmentally friendly, sustainable and cost-effective. The use of secondary building materials helps reduce the burden on the environment, reduce the volume of construction waste and reduce the consumption of natural resources. Despite existing difficulties, such as a lack of standards and consumer bias, the development of recycling technologies and government support can make this process more efficient. The introduction of secondary materials into the construction industry is an important step towards environmentally friendly and cost-effective waste-free production.

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PROSPECTS FOR THE DEVELOPMENT OF THE RUSSIAN LAND RECLAMATION COMPLEX

Postgraduate Student **Stepanova Elvira Nikolaevna**,
Student **Demenkova Ekaterina Sergeevna**,
Student **Demenkova Anastasia Sergeevna**,
Academic Advisor: PhD in Philology, Associate Professor
Petina Svetlana Sergeevna,
Novocherkassk Reclamation Engineering Institute
named after A. K. Kortunov, FSBEI HE Donskoy SAU,
Novocherkassk, Russian Federation

Abstract. The article examines the development of the land reclamation industry in Russia, analyzes the main problems and prospects. Special attention is paid to modern technologies and innovative solutions that enhance the efficiency of land reclamation and adaptation to climate change.

Keywords: land reclamation, water resources, agriculture, technology, innovation, reclamation industry, irrigation regime.

ПЕРСПЕКТИВЫ РАЗВИТИЯ МЕЛИОРАТИВНОГО КОМПЛЕКСА РОССИИ

аспирант **Степанова Эльвира Николаевна**,
студент **Деменкова Екатерина Сергеевна**,
студент **Деменкова Анастасия Сергеевна**,
науч. руководитель: канд. филол. наук, доцент
Петина Светлана Сергеевна,
Новочеркасский инженерно-мелиоративный институт
им. А. К. Кортунова ФГБОУ ВО Донской ГАУ,
г. Новочеркасск, Российская Федерация

Аннотация. В статье рассматривается развитие мелиоративной отрасли в России, анализируются основные проблемы и перспективы. Особое внимание уделяется современным технологиям и инновационным решениям, способствующим повышению эффективности мелиорации и адаптации к климатическим изменениям.

Ключевые слова: мелиорация, водные ресурсы, сельское хозяйство, технологии, инновации, мелиоративная отрасль, режим орошения.

In modern conditions of agricultural development, the problem of efficient use of land resources is of particular importance. The land reclamation industry, being one

of the key tools for increasing soil fertility and crop yields, plays a crucial role in ensuring the country's food security. The development of the land reclamation industry directly affects the efficiency of agricultural production and its ability to adapt to changing climatic conditions [1].

The relevance of the study is due to several factors. First, there is the need to increase the efficiency of using reclaimed land in the face of a growing shortage of fertile soils. Secondly, the need to modernize the existing land reclamation infrastructure and introduce modern technologies. Thirdly, the importance of solving environmental problems related to reclamation farming. The implementation of the state program for the development of agriculture and the need to achieve targets for the export of agricultural products give special relevance to the topic.

The purpose of this article is a comprehensive analysis of the current state of the land reclamation industry in Russia and an assessment of its further development.

The problem of the development of the land reclamation industry has received significant coverage in the scientific literature. Fundamental research in the field of land reclamation was carried out by such scientists as V. N. Myakshin, A. N. Kostyakov, I. P. Aidarov. Modern aspects of the development of the land reclamation industry were considered in the works of A. I. Golovanov, V. P. Shabanov, N. V. Alexandrov.

Agricultural production both in the Russian Federation and in the Rostov region is conducted in difficult climatic conditions. Precipitation deficiency is observed in over 80 % of the land area used in agricultural production, over 10 % of arable land is in the zone of excessive moisture. Land reclamation, which has no alternative, is a cardinal solution to reduce significantly the negative impact of adverse climatic factors.

Land reclamation plays an important role in ensuring food security, as it helps to increase crop production and increase yields. Land reclamation includes various methods such as irrigation, drainage, erosion control and soil fertilization, which can improve the quality and quantity of products.

The land reclamation industry ensures a stable supply of food to the population, especially in arid and semi-arid regions, where it is the only way to obtain high yields. Land reclamation makes it possible to expand acreage, increase agricultural productivity and reduce dependence on weather conditions [2].

Reclaimed land plays a key role in ensuring stable agricultural production worldwide and in Russia. Proper operation, the use of high-tech and high-tech methods of crop cultivation contribute to the sustainable development of the agro-industrial complex [2, 3].

The adoption of relevant laws and regulations aimed at the control and protection of water resources, as well as stimulating investments in land reclamation and water supply, contributes to the stable development and improvement of the quality of water supply. Increased investments, including in irrigation, drainage and drainage systems, will accelerate the development of this industry and increase the production of competitive products by 70 %.

Equipping reclaimed territories with sprinkler equipment contributes to the

expansion of areas for vegetable crops, potatoes and corn for grain by up to 50%. The introduction of domestic scientific developments in the Stavropol and Krasnodar territories, Dagestan, Astrakhan, Volgograd and Rostov regions will provide markets with environmentally friendly products [4].

Reclaimed land occupies less than 8 % of the total area of arable land in the country, but it is on them that half of all potatoes and vegetables are grown, as well as the full amount of rice is produced. At the same time, statistics show that Russians consume vegetables in an amount significantly below the norm recommended by the Ministry of Health – the actual figure is 35 % lower than the recommended 104 kg per year per person [2].

A differentiated approach to irrigation is of great importance for successful farming, as it allows you to take into account the needs of plants and soil characteristics. This helps to save water and increase yields. It is important to use water resources efficiently and take into account the environmental consequences when planning irrigation [5].

To solve the existing problems of the industry, it is necessary to introduce modern irrigation technologies and modernize fixed assets. This will not only reduce equipment wear, but also increase the efficiency of land reclamation. At the same time, it is important to develop comprehensive measures to manage climate risks and rational use of water resources, which will ensure the sustainable development of the industry in the long term.

An integrated approach ensures the stable development of agriculture in the long term.

Figure 1 shows a graph for the countries with the largest areas equipped for irrigation [6].

In some regions of the world where irrigation is of great importance for agriculture, high levels of water stress exacerbate the problem. According to the United Nations Food and Agriculture Organization (FAO), 171 million hectares of irrigated arable land (62 % of the total area) have high or very high levels of water stress [5]. In Russia, only a small number of agricultural universities offer training in specialties related to irrigation and drainage of agricultural land. However, the Novocherkassk Engineering and Reclamation Institute named after A. K. Kortunov provides excellent conditions for training highly qualified specialists and conducting scientific research, which is confirmed by the number and quality of publications [7].

Despite the high quality of education, graduates face difficulties in finding a job in their specialty, as the number of jobs in cities is limited or non-existent, and work in rural areas does not attract them due to unfavorable conditions and underdeveloped infrastructure [3].

The history of land reclamation goes back thousands of years. The first irrigation canals were built in ancient Egypt, along the banks of the Nile. In Russia, the issues of land improvements were dealt with closely after the severe drought of 1891, when the Department of Land Improvements was established under the Ministry of Agriculture and State Property. At the beginning of the 20th century, in 1907, in Novocherkassk,

for example, among the four faculties of the Don Polytechnic Institute, Russia's first melioration engineering faculty was opened [8].

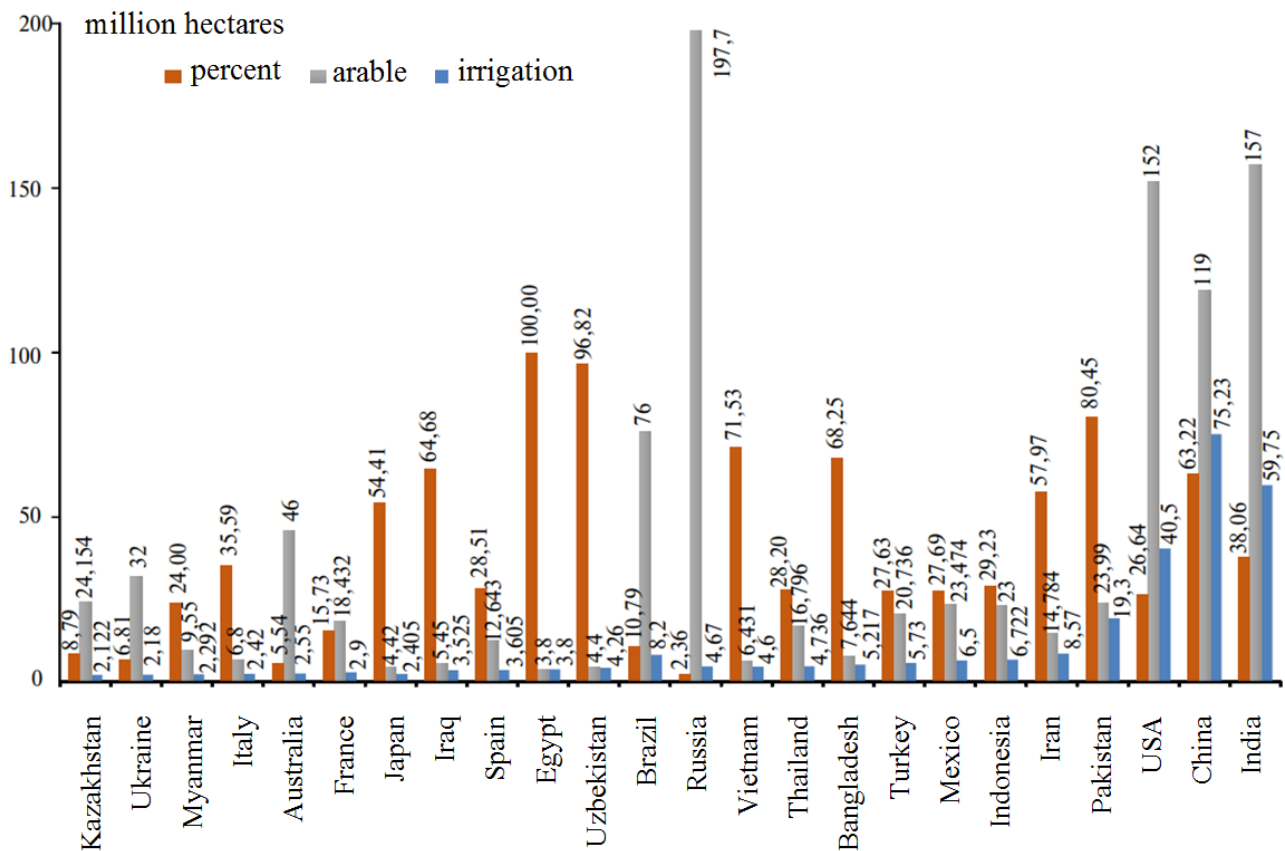


Figure – Countries with the largest amount of reclaimed (irrigated) land

The land reclamation industry is starting to revive, and, most importantly, business is coming into it. However, making a profit is of paramount importance for entrepreneurs. At the same time, land reclamation is not an area where everything happens quickly.

Modern technologies and innovative solutions contribute to improving the efficiency of land reclamation and adaptation to climate change. These include the use of artificial intelligence, machine learning, the Internet of Things, as well as the development of new materials and data processing methods. These technologies make it possible to optimize water resources management, predict and prevent droughts and floods, and increase crop yields.

Currently, the field of land reclamation is actively developing the direction of creation and registration of intellectual property. One of the important aspects of this work is the development of specialized software products and databases that help optimize the management processes of land reclamation systems.

After creating a unique software or database containing information about reclamation facilities, developers need to go through the state registration procedure. To do this, applications are submitted to Rospatent, where the materials are examined

for compliance with legal requirements.

Based on the results of a successful examination, a certificate of state registration of a database or computer program is issued. These documents confirm the exclusive rights to the development and enable its legal use [9].

The certificates are important for protecting the intellectual rights of developers, the possibility of commercializing developments, increasing the competitiveness of domestic solutions and developing the digitalization of the industry. The certificates obtained make it possible to implement developments at land reclamation facilities and disseminate application experience throughout the country. This contributes to improving the management efficiency of land reclamation systems and the development of the scientific and technical potential of the industry as a whole.

The scientists of our institute are engaged in developments in this field. So, in 2024, several certificates of state registration of databases and computer programs were registered [10, 11].

Long-term studies on the cultivation of vegetable crops with various irrigation methods have shown that their yield was primarily closely related to the improvement of the soil's water regime. Its efficiency increased with the application of mineral fertilizers when using drip irrigation, and with the improvement of the location of the irrigation network when using subsurface irrigation [12].

The efficiency of irrigation water use in the processes of crop cultivation, distribution and consumption is based on the measurement of interregional virtual water flows [13].

Given the ecological need of rivers for water, this will have a comprehensive impact on agricultural water use and groundwater in irrigation areas, especially in regions with overexploitation of groundwater [14].

Thus, it can be concluded that for successful farming it is necessary to take into account a differentiated approach to irrigation, rational use of water resources and develop comprehensive measures to manage climate risks.

The introduction of modern irrigation technologies, the modernization of fixed assets and the development of comprehensive water management measures will ensure the stable development of agriculture in the long term.

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STUDY OF FEATURES OF REALIZATION OF MODERN THERMAL PROTECTION OF OIL-FILLED TRANSFORMER

Master's Degree Student **Rakhmatullin Samat Sultanovich**,
Master's Degree student **Abdullin Musa Maratovich**,
Academic Advisor: PhD of Engineering, Associate Professor
Gataullin Airat Mukhamedovich,
Kazan State Power Engineering University,
Kazan, Russian Federation

Abstract. The paper presents the main aspects of realization of protections of transformer oil-filled electrical equipment tripping at overheating of the designated type of electrical installations. Particular attention is paid to the importance of using microprocessor-based relay protection devices in the electric power industry with the possibility of integrating SCADA systems into them in order to obtain and process instantaneous values of the temperature of the most heated point to minimize the negative consequences of power device operation in conditions of its overheating.

Keywords: electric power industry, power supply, power transformer, insulation heating, thermal protection, SCADA.

ИССЛЕДОВАНИЕ ОСОБЕННОСТЕЙ РЕАЛИЗАЦИИ СОВРЕМЕННОЙ ТЕПЛОВОЙ ЗАЩИТЫ МАСЛОНАПОЛНЕННОГО ТРАНСФОРМАТОРА

магистрант **Рахматуллин Самат Султанович**,
магистрант **Абдуллин Муса Маратович**,
науч. руководитель: канд. техн. наук, доцент **Гатауллин Айрат Мухамедович**,
Казанский государственный энергетический университет,
г. Казань, Российская Федерация

Аннотация. В работе представлены основные аспекты реализации защит трансформаторного маслонаполненного электрооборудования, срабатывающие при перегреве обозначенного типа электроустановок. Особое внимание уделяется важности использования в электроэнергетике микропроцессорных устройств релейной защиты с возможностью интеграции в них систем SCADA. Это необходимо для получения и обработки мгновенных значений температуры наиболее нагретой точки, чтобы минимизировать негативные последствия эксплуатации силового устройства в условиях его перегрева.

Ключевые слова: электроэнергетика, электроснабжение, силовой трансформатор, нагрев изоляции, тепловая защита, SCADA.

It is well known that in normal operation a transformer experiences no-load losses and load losses, which mainly manifest themselves in the form of thermal energy

dissipation. This energy is determined by the design of the transformer itself, its capacity and the installation conditions. The amount of heat dissipated into the environment is directly proportional to the temperature difference between the transformer and the room temperature. If the room temperature is known, the temperature of the transformer itself is mainly determined by the load losses.

Indeed, the increase of the load entails an increase in losses, which accelerates the destruction of the insulation and increases the probability of dielectric failure. In this connection, the importance of the use of so-called thermal protection for transformers is actualized. The correct operation of thermal protections for this type of electrical equipment is currently an urgent task [1, p. 107].

The purpose of the paper is to present key aspects and modern principles of implementation of thermal protection of power oil-filled transformers, designed to eliminate and minimize the negative effects of heating of electrical installations.

It is well known that the heating graph of a power oil-filled transformer is an exponential dependence expressed in the form of a heating curve, which is drawn after determining the excess of the body temperature over the cooling medium ($\Delta\theta$), which is shown in figure 1. Knowing the character of heating, it is possible to calculate the period during which the temperature exceedance in the considered electrical equipment will be established. The value of this period is necessary for determining the time before disconnection from the protection of the electrical installation.

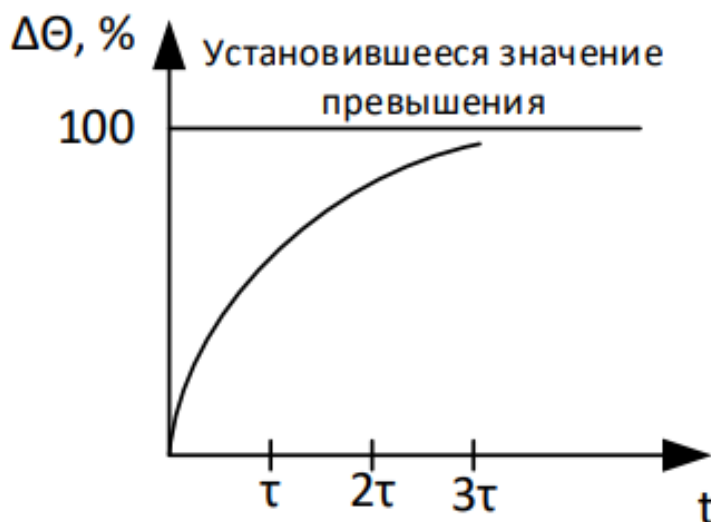


Figure 1 – Power transformer heating graph

Studies show that the temperature increase is not only due to load and overcurrents, which are detected by protective devices, but also due to the influence of external factors (inefficiency of the cooling system, problems with forced ventilation and increased room temperature), which affect the heat dissipation through transformer specific losses [2, p. 182]. Therefore, electronic devices are usually used for temperature monitoring. They are needed to activate alarms or trigger transformer protection. Temperature sensors such as PT100 temperature sensors and PTC thermistors are available for many oil-filled electrical installations [3, p. 146]. The PT100 transmits a signal corresponding to the monitored temperature and the PTC

transmits an ON/OFF signal depending on whether the measured temperature is less or more than the sensor threshold. The sensors are located in the hottest part of the winding. Both PT100 and PTC signals must be processed by the temperature control unit. The temperature rise protection system must be configured based on the determination of the highest room temperature, taking into account the maximum temperature rise defined by the standards and the highest heating point where the sensors are installed [4, p. 349].

High-voltage oil transformers of 1000 kVA and above are necessarily equipped with an electrically contacted thermometer to provide thermal protection, which is usually triggered by a signal. As a rule, the thermometer is placed in the upper part of the transformer tank where the oil temperature reaches its maximum. The specified maximum oil temperature for regular loads of transformer equipment is 95 °C. This type of protection is the simplest and does not require the calculation of setpoints and coordination with other protective devices [5, p. 21].

Multifunctional microprocessor-based relay protection devices (MRPD) are actively used in the power sector today. One MRPD module is capable of performing many protection functions and types of measurements. Complex algorithms that analyze various parameters of the protected object can be integrated into the MRPD software [6, p. 183].

The algorithm as such underlies the operation of all existing transformer thermal protection systems, including MRPD. However, it is not able to determine the type of transformer overheating (natural or abnormal) and the parameters of abnormal heating of the electrical installation. To solve this problem, attempts are being made to extend the MRPD software by adding algorithms based on mathematical models of oil transformer thermal processes [5, p. 22]. These models should take into account the ambient temperature, the transformer load current, the number of cooling devices used, the equipment passport data, and provide sufficient accuracy for a fully serviceable electrical power device. An example of a thermal model of a power transformer with an indication of its components is shown in figure 2.

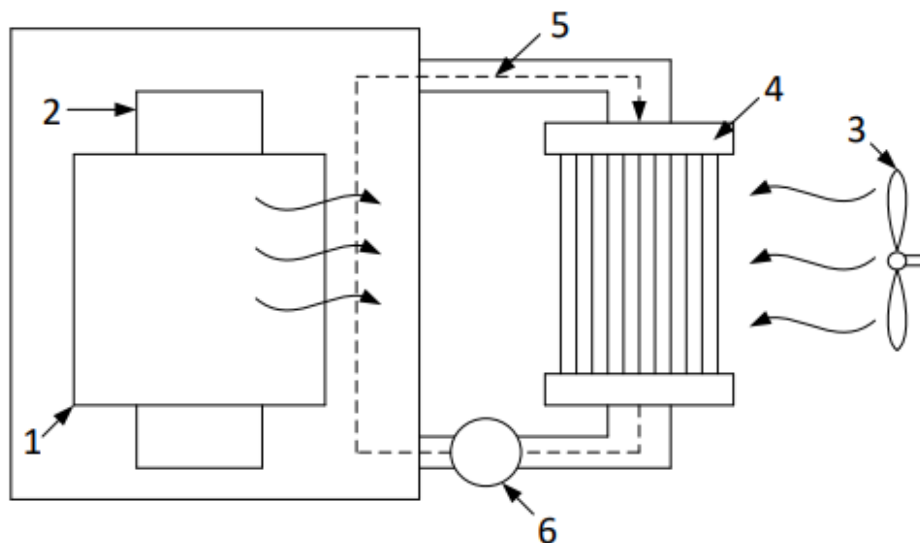


Figure 2 – Thermal model of power transformer electrical equipment:
1 – transformer winding; 2 – stator core; 3 – cooling system fan; 4 – cooling system radiator; 5 – transformer oil flow; 6 – cooling system pump

If the risk of temperature rise is low, the possibility of a transformer accident due to abnormal heating is extremely low, so in this situation the protection should be triggered by a visual signal (switching on a warning light or displaying a message on the screen of a personal computer), and the operating personnel should record the date and time when the abnormal heating is detected. An extremely high threat level indicates an increased risk of an accident on the transformer. In this situation, the operation of the protection should begin with the action to unload and then move to the action to shut down the transformer [7, p. 25].

In the conditions of rapid development and introduction of specialized systems called SCADA (Supervisory Control and Data Acquisition), which is a hardware-software complex for automation and control of technological processes, it is important to make attempts to integrate thermal protection of power transformers into them [8, p. 1522]. To transport information from the thermal protection of the transformer electrical installation to the server on the SCADA-system, it is necessary to consider the correctness of its collection and the quality of subsequent processing. For this purpose, researchers recommend the use of modern controllers, in particular, PLC, capable of processing not only the data on the instantaneous value of the relative wear of the insulation of the electrical installation and the remaining life of the latter, but also the instantaneous value of the temperature of the most heated point of the transformer [9, p. 2327].

Thus, thermal protection is a critical element of ensuring reliable and safe operation of oil-filled power transformers. Improvement of thermal protection systems remains one of the priority areas of transformer engineering development, directly affecting the efficiency of power supply and the quality of electrical equipment operation. When designing thermal protection systems, including adaptive protection and protection triggered by integral temperature, special attention should be paid to the improvement of MRPD software, as well as to the development and improvement of methods of their integration into SCADA-systems.

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INNOVATIVE SOLUTION FOR THE COLLECTION AND PROCESSING OF ORGANIC WASTE

Student **Naroda Ekaterina Sergeevna**,
Student **Mironyuk Anastasiya Sergeevna**,
Academic Advisor: PhD of Engineering, Associate Professor
Yanchukovich Svetlana Georgievna,
Saint Petersburg State University of Industrial Technologies and Design,
Higher School of Technology and Energy,
Saint Petersburg, Russian Federation

Abstract. The article is devoted to the research of the method for collection and recycling of organic waste. The advantages and disadvantages of this solution are determined. The basic principles and technological features of this method, providing controlled and accelerated process of decomposition of organic materials, are analyzed.

Keywords: recycling, organic waste, solid municipal waste (SMW), tunnel composting, compost.

ИННОВАЦИОННОЕ РЕШЕНИЕ ПО СБОРУ И ПЕРЕРАБОТКЕ ОРГАНИЧЕСКИХ ОТХОДОВ

студент **Народа Екатерина Сергеевна**,
студент **Миронюк Анастасия Сергеевна**,
науч. руководитель: канд. техн. наук, доцент
Янчукович Светлана Георгиевна,
Санкт-Петербургский государственный университет
промышленных технологий и дизайна,
Высшая школа технологии и энергетики,
Санкт-Петербург, Российская Федерация

Аннотация. Статья посвящена исследованию метода по сбору и переработке органических отходов. Определены достоинства и недостатки данного решения. Анализируются основные принципы и технологические особенности данного метода, обеспечивающие контролируемый и ускоренный процесс разложения органических материалов.

Ключевые слова: переработка, органические отходы, твердые коммунальные отходы (ТКО), туннельное компостирование, компост.

As a result of a population growth in cities and the emergence of megacities, the situation with the neutralization of solid waste, not only industrial, but also domestic and municipal became hazardous. Mountains of waste and problems with its processing or utilization have become one of the factors threatening the ecology of countries, cities, seas and oceans.

Utilization of solid municipal waste (SMW) includes various methods and technologies such as: recycling, incineration, composting, landfilling.

Recycling includes: collection, sorting and processing of waste to produce secondary raw materials that can be used in the production of new goods.

Incineration is carried out to reduce the volume of waste and generate energy.

Composting is the biological process of decomposing organic waste (e.g. food residues, garden waste) using microorganisms.

Landfilling is a method of waste disposal by placing it in landfills.

The most widespread in the world practice are landfilling and incineration of TCO. The most widespread method of utilization to date is still burial in landfills.

Table – Options for eliminating TCO in countries of the world in 2015 and 2024, %

	2015				2024			
Country	Recycl- ing	Incinera- tion	Compost- ing	Landfill- ing	Recycl- ing	Incinera- tion	Compost- ing	Landfill- ing
Germany	50	20	10	30	55	25	15	< 5
Switzerland	55	45	5	< 1	55	35	10	< 1
Sweden	50	47	3	< 1	50	40	10	< 1
South Korea	30	60	5	5	35	55	10	< 1
Japan	20	70	5	5	25	60	10	5
France	40	30	10	20	55	30	10	5
UK	45	10	20	25	55	30	10	< 10
USA	35	12	8	45	35	15	15	35
Israel	20	10	10	60	35	20	20	25
Mexico	10	5	5	80	15	5	15	65
Russia	5	< 1	< 1	95	15	5	5	75

A comparison of waste management practices in different countries around the world shows that approaches to TPO management can vary considerably depending on the level of development, cultural characteristics and environmental policies [1].

The possibility of reuse of waste or waste products is one of the main environmental and economic problems.

Table shows that from 2015 the amount of buried waste has significantly decreased in many of the presented countries, and, accordingly, the percentage of recycling has increased. This indicates the continuous development of countries in the field of waste utilization, but, unfortunately, in Russia, on the example of St. Petersburg

and the Leningrad region, despite the creation of a new structure NEO (Nevsky Environmental Operator) positive changes have not occurred. There are no new developments and solutions in the issues of waste utilization and environmental protection. The area of waste disposal for 2024 amounted to over 85 % based on the materials of the international conference held in March 2025 in St. Petersburg.

Along with high recycling rates, such countries as Japan, South Korea, Sweden, Switzerland widely use incineration of solid waste, which causes atmospheric pollution, which includes (along with CO₂) products of incomplete combustion of organic substances [1]. But paying attention to the air quality index in these countries, we can conclude that incineration of waste with the use of high-quality equipment.

Composting of organic waste allows to get rid of waste of biological origin with simultaneous production of environmentally friendly fertilizer – compost. Organic fraction of municipal MSW, as well as paper, cardboard and garden waste, leaf fall, lawn grass clippings, waste from processing, pulp and paper and pharmaceutical industries can be used as compostable materials.

The tunnel method of composting was implemented for the first time in Russia in the closed building of “EcoVector” at the waste processing complex of KPO “Neva” in December 2021. The capacity of the complex is 150 thousand tons per year, energy consumption of 1.25 MW, area 12631 sq.m. [2].



Figure 1 – KPO “Neva”

“EcoVector” was established in June 2020 to implement projects in the field of waste utilization and recycling, based on the principle of an integrated approach in terms of design, supply, installation and commissioning of technological sites.

The company's activities allow increasing the share of neutralized or utilized waste by implementing innovative composting technologies, such as tunnel composting.

Tunnel composting is the most promising solution in waste treatment [2]. A complex system consists of a number of components:

- tunnel ventilation;
- general exchange ventilation;
- irrigation and filtrate collection;
- air purification (washing box and biofilter);
- automation of the composting process;
- screening area for the production of techno-soil.

Tunnel composting is carried out by pouring MSW into tunnels, which are reinforced concrete climate chambers with aeration, humidification, and exhaust and supply ventilation systems. The exhaust air is fed centrally to one of two biofilters with a washing box for cleaning. The tunnels are controlled by an aeration system that prevents the formation of anaerobic zones, minimizing the possibility of odorous substances and improving compost quality. Organics enter the composting plant from the waste sorting facility via a closed gallery with a conveyor. This reduces the amount of transport, prevents the dispersal of fine waste and prevents odor. The composting process takes at least 21 days. As a result, weight loss is from 30 to 50 %, moisture loss is from 30 to 50 %, and the hazard class is downgraded from 4 to 5.

Tunnel composting is quite effective, this method allows to quickly process large volumes of organic waste due to the controlled conditions of the process, and the closed system allows to minimize the impact on the environment (sanitary protection zone not more than 1000 m) [3].

After the composting process, the material is sent to screening, where it is separated into a technical soil and ballast fraction (in a ratio of approximately 40/60). By varying the size of the fractions, it is possible to change the characteristics of the resulting material depending on how it will be used [4].

The considered composting methods are realized by similar engineering solutions. Let us dwell on the main innovative components of the system, which in their totality allow to achieve the required result, namely to obtain a quality product from the organic fraction of MSW [5].

- **Aeration system.** Concrete aeration pipes are located under each bunker. At 10 cm intervals, nozzles are installed in the pipes to ensure constant aeration along the entire length of the bunker. Specially designed aeration fans connected to a network of concrete ducts inject air into the bunker or suck air out of it, depending on the current demand. In addition, the system helps to accelerate the warm-up of new bunches by redirecting warm air from neighboring bunches.

- **Ventilation system.** During production, the maximum air exchange rate in the building must be guaranteed. To this end, several exhaust fans are installed according to the size of the room, also controlled by a common automation system. Energy savings are realized by optimizing the operating modes of the ventilation system. For example, the fans are switched on at full capacity during the tedding process, when the maximum amount of gases is emitted, and then automatically return to normal operation. The ventilation system in tunnel composting plays a key role in ensuring efficient decomposition of organic waste. Adaptation to the specifics of composting is a key aspect that distinguishes this ventilation system from conventional

methods: the ventilation system in tunnel composting is tailored to the specifics of organic material decomposition, such as oxygen demand, temperature and humidity control. This allows optimized conditions for aerobic microorganisms.

- **Air purification system.** The air from the composting bales is hot (~ 60-70 °C) and saturated with moisture (~ 95-100 %). Therefore, it cannot be fed directly into the biofilter (max. 42 °C) and mixing with cold air for cooling is required. The incoming air streams are humidified in the washing box before entering the biofilter to ensure moisture-rich air and prevent the biofilter from drying out. The wash box is a concrete structure filled with hollow fillers and a water spray system. The biofilter is filled with wood chips in which a colony of special bacteria is planted. The bacteria feed on the organic molecules present in the exhaust air. The temperature of the biofilter inlet air and the temperature of the biofilter material are continuously monitored by an automatic system. The air purification system in the tunnel composting method has several unique features such as specific filtration and effective odor elimination.

- **Irrigation system.** Irrigation is required to ensure optimal conditions for the composting process. The moisture content of the incoming feedstock can vary and there is also moisture loss during the composting process itself. The proper moisture level is maintained by the irrigation system through irrigation lines installed under the roof of the composting hall. In this way, the irrigation system has precise moisture control and uniform moisture distribution. Modern systems can be automated using humidity and temperature sensors.

- **Temperature monitoring system.** The temperatures of all bunches are measured by sensors. The measurement is carried out over the entire height of the bale by three different level sensors. The current temperature values are transmitted via radio signal to a receiver which is connected to the control system. The temperature values inside each bunk are also used to control the aeration and irrigation systems, thus ensuring process optimization.

- **Automation system of technological processes.** The system provides for the use of wireless sensors that constantly measure temperature and pressure in each bunk and transmit the data to the automation system, and then using frequency converters, the system controls the process - regulates the work of aeration fans by time and volume of air supplied to the bunches, as well as provides additional humidification of bunches if necessary.

- **The automatic fan control system is a modular unit with electrical panels.** The control room is air-conditioned and automatic ventilation is installed in the engine room. In this way, employee involvement and presence in the composting room is minimized and the system is monitored from a tablet.

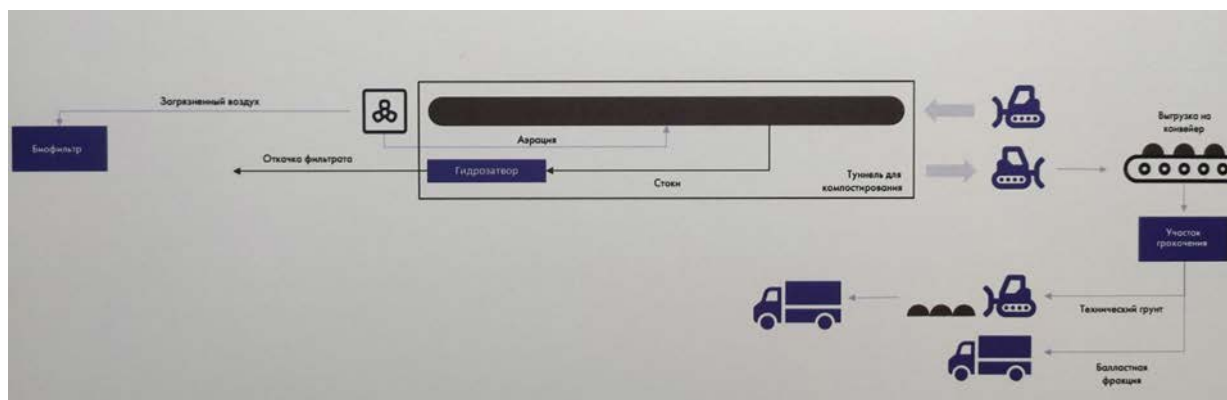


Figure 2 – General technological scheme

Conclusion

The study of an innovative solution for the collection and processing of organic waste – tunnel composting – has shown its high efficiency and prospects in the Russian Federation. This method allows to significantly reduce the volume of organic waste disposal, preventing the negative environmental impact associated with the emission of greenhouse gases and pollution of soil and groundwater [6]. Tunnel composting provides a controlled and accelerated process of decomposition of organic materials, allowing to obtain high-quality compost suitable for use in agriculture and landscaping. Moreover, this technology is characterized by a high degree of automation and flexibility in adapting to different types of organic waste.

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EVOLUTION OF INFORMATION SECURITY IN SPACE: THREATS, PROTECTIVE MEASURES AND KEY STRATEGIES

Student **Ivanova Katerina Aleksandrovna**,
Lecturer **Yurenskaya Svetlana Alekseevna**,
Space Engineering and Technology College of the Technological University
named after twice Hero of the Soviet Union,
pilot-cosmonaut A. A. Leonov,
Korolev, Russian Federation

Abstract. This article analyzes key aspects of information protection, including national security, the safeguarding of commercial interests, scientific research, and cybersecurity threats. The author describes essential data protection measures such as encryption, access control, incident detection systems, regular software updates and physical security of assets. These measures enable reliable protection of critical information and systems against a variety of threats. An integrated approach to information security is fundamental to achieving a sustainable and secure future in the space industry.

Keywords: information security, cyber threats, data protection, space industry, space technologies.

ЭВОЛЮЦИЯ ОБЕСПЕЧЕНИЯ ИНФОРМАЦИОННОЙ БЕЗОПАСНОСТИ В КОСМОСЕ: УГРОЗЫ, МЕРЫ И КЛЮЧЕВЫЕ СТРАТЕГИИ ЗАЩИТЫ ИНФОРМАЦИИ

студент **Иванова Катерина Александровна**,
преподаватель **Юренская Светлана Алексеевна**,
Колледж космического машиностроения и технологий
Технологического университета имени дважды Героя Советского Союза,
летчика-космонавта А. А. Леонова,
г. Королев, Российская Федерация

Аннотация. В статье анализируются ключевые аспекты защиты информации, включая национальную безопасность, защиту коммерческих интересов, научные исследования и киберугрозы. Автор описывает основные меры защиты данных, такие как шифрование, контроль доступа, системы обнаружения инцидентов, регулярное обновление программного обеспечения и физическая защита объектов. Комплексная реализация этих мер позволяет обеспечить надежную защиту критически важной информации и систем от различных угроз. В статье подчеркивается, что интегрированный подход к информационной безопасности является основой для достижения устойчивого и безопасного будущего в космической отрасли.

Ключевые слова: информационная безопасность, киберугрозы, защита данных, космическая отрасль.

The Importance of Information Security in the Space Sector. With the advancement of technology and the increasing number of space missions, the protection of information has become a critically important task. Information security, both in space and on Earth, encompasses the safeguarding of data against unauthorized access, data leaks, and cyberattacks. The protection of information is particularly significant for the space industry, as data collected from spacecraft is utilized for both scientific research and military purposes. Ensuring information security in space involves a comprehensive set of measures aimed at protecting critical data, communication systems, and control mechanisms [1, p. 7]. It includes all aspects, from onboard software of satellites and spacecraft to ground control centers, ensuring the reliable and secure operation of all components within the space system.

Key areas of focus in ensuring information security include:

1. **National Security:** Given that space technologies can be employed for both civilian and military purposes, the leakage of confidential information may pose a threat to national security and the strategic interests of the state.
2. **Commercial Interests:** There are companies that develop satellites and space technologies for commercial use. For such companies, it is vital to protect data to prevent intellectual property theft and ensure competitiveness.
3. **Scientific Research:** Data obtained from spacecraft is of immense importance for scientific research and discoveries; thus, leaks or distortions of such data may lead to incorrect conclusions and negatively impact the development of science.
4. **Cyber Threats:** With the increasing number of space missions, the risk of cyberattacks on satellites and ground stations rises. A successful attack could result in the loss of control over spacecraft and damage to critical infrastructure.
5. **Trust and Reputation:** Data protection contributes to building trust among government institutions, private companies, and research centers. Data leaks can adversely affect reputation and lead to financial losses at various levels.

The History of Information Security in Space. The exploration of space began long ago in 1957 with the launch of the first spacecraft – the artificial Earth satellite. The first documented breach of information security, as confirmed by official sources, occurred in 1998 when hackers infiltrated the control system of the German-American satellite ROSAT X-Ray [2, p. 51]. By gaining access to the computer controlling the satellite, the intruders directed ROSAT X-Ray's solar panels directly at the Sun, resulting in the rapid depletion of the solar battery and rendering the satellite inoperable. The mission was terminated, and the satellite “returned” to Earth in 2011. Another notable incident in the history of space exploration occurred in 1999 when hackers seized control of the British military satellite Skynet and held it ransom in an attempt to extract payment from the government [2, p. 52].

Currently, a significant amount of data is transmitted between spacecraft and terrestrial control centers. This data transfer occurs via line-of-sight radio-relay links or at extremely high frequencies. To safeguard this data, modern space agencies and companies are actively developing cutting-edge technologies and methods for information protection, including cryptography, authentication systems, and multilayered data security [3, p. 41]. Thus, in today's world, information security has become an integral part of space activities, and its importance continues to grow year by year.

In the space industry, **three types of security threats** faced by organizations and companies are identified:

- Cyberattacks on satellites and ground stations – These involve negative impacts on space infrastructure through computer methods [4, p. 302]. For instance, in 2022, hackers attacked the American satellite company Viasat. The malware known as “AcidRain” erased all information on Viasat's modems and routers, causing them to continuously reboot or shut down, effectively rendering them inoperable.

- Confidential information leakage occurs for three main reasons: vulnerabilities in satellite systems, the lack of government standards in this area of security, and the use of cheap and widely available components. An example of this is the case of the theft in March 2011 of a NASA (National Aeronautics and Space Administration) laptop that contained control codes for the International Space Station (ISS).

- Physical interference with the operation of equipment refers to unauthorized actions affecting objects, which can lead to a complete distortion of their functioning. An example is the deployment of the ELSA-d space debris removal system, which utilizes a multi-magnetic capture technology [5, p. 23]. By default, the system is secured to the spacecraft with a mechanical locking mechanism, but during operation, it detaches and uses magnetic capture to seize drifting objects.

Table presents the measures and means of information protection that have been implemented in the space sector.

Table – Measures and means of information protection in space

Protection measures	Application in space	Security features (including software)
Data encryption	The “Avtomatika” concern of the State Corporation “Rostec” has developed a hardware and software complex for protecting data transmitted from Earth to the “Meridian” spacecraft. This complex ensures secure information transmission via the radio channel “Earth-space” and prevents	“IVK Crypto” is a hardware and software complex designed for the organization of virtual private networks and the automatic encryption/decryption of information that does not contain classified state secrets, transmitted within such networks.

	unauthorized interception of control over the spacecraft.	
Access control	To protect the spacecraft from unauthorized access by external space objects, a protective shield is utilized. It is designed in the form of a capsule filled with compressed gas, encased in a hermetic shell made of an elastic polymer material with a metallic coating.	The shell of the protective shield reflects radiation in the optical range of the spectrum perpendicular to the direction of the approaching external object.
Incident detection and response	Monitoring systems track the condition of equipment and network traffic to detect suspicious activity and respond to potential attacks.	A solid-state accelerator is aimed at potentially hazardous objects. When fired, a special projectile strikes and adheres to the hazardous object, transferring its momentum, altering its trajectory, and thereby minimizing the likelihood of a collision with the spacecraft.
Updates and patches	Regular software updates and the application of patches help protect systems from known vulnerabilities.	Data backup systems help prevent failures that could lead to the loss of accumulated information.
Physical security	Ground stations and control centers are provided with physical security measures to prevent unauthorized access.	Onboard documentation outlines all potential actions in various situations, ensuring safety in space.

To achieve a high degree of effectiveness with the proposed protective measures and means, space companies implement them in conjunction, thereby ensuring reliable information security in space and protecting critical data and systems from various threats [6, p. 193]. Professionals in this field should pay particular attention to:

- 1) the protection of critical infrastructure (as space systems provide communication, navigation, and monitoring essential for national security);
- 2) data management protection (satellites collect vast amounts of data that must be safeguarded against unauthorized access and loss);
- 3) the prevention of emerging threats (cyberattacks are becoming increasingly sophisticated, requiring space security systems to adapt to new challenges).

International cooperation in the field of space security facilitates the consolidation of efforts, enhances awareness of emerging threats, and the development of standardized approaches to combat cyberattacks in space. This is particularly crucial given the increasing number of satellites and the widespread deployment of space technologies across various sectors. In 2021, NATO (North Atlantic Treaty

Organization) launched the Space Situational Awareness (SSA) program, which encompasses data sharing on potential threats, monitoring of the space environment, and countermeasures against cyberattacks targeting satellites and ground-based stations. Similarly, the European Space Agency (ESA), representing the European Union, implements projects aimed at information exchange and collaborative efforts to safeguard space systems. One such initiative is the “Secure Communications in Space” project, which involves establishing protected communication channels for satellites utilizing cryptographic solutions and automated defense mechanisms.

Moreover, key organizations such as NASA (USA), Roscosmos (Russia), CNES (Centre National d'Études Spatiales, France), JAXA (Japan Aerospace Exploration Agency, Japan), and others participate actively in international collaborations in space security. They exchange information regarding cyber threats and vulnerabilities, thereby enhancing the overall security posture of their respective infrastructures. This multilateral engagement includes threat monitoring, knowledge sharing, and the development of regulatory frameworks, which contribute to the creation of more resilient and secure space systems. Thus, international cooperation diminishes risks, strengthens security in space, and supports the development of advanced information protection systems.

In conclusion, it is important to note that information security in the space industry is a crucial component of any successful mission, as the increasing number of satellites and space technologies also elevates security threats. Protecting space data safeguards the national interests of states and the commercial interests of private companies in this domain. Given the growing reliance on space technologies to address various challenges, ensuring information security becomes a prerequisite for preventing crises and conflicts. Effective information protection in space forms the foundation for a sustainable and secure future, as well as for maintaining stability and safety in the world.

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SECURITY OF SPACE SYSTEMS: HOW TO PROTECT DATA AND INFRASTRUCTURE FROM CYBERATTACKS?

Student **Kostina Alena Aleksandrovna**,
Lecturer **Yurenskaya Svetlana Alekseevna**,
Space Engineering and Technology College of the
Technological University named after twice Hero of the Soviet Union,
pilot-cosmonaut A. A. Leonov,
Korolev, Russian Federation

Abstract. This article dedicated to the assurance of cybersecurity and information protection in the space industry. It examines the threats and scenarios of cyberattacks targeting satellites, methods for their prevention and enhancing the resilience of space systems. Particular emphasis is placed on modern protection technologies and the necessity of establishing international standards in the field of space systems security. Statistical data and examples demonstrate that strengthening cybersecurity measures is of critical importance for maintaining the reliability and security of modern space infrastructure.

Keywords: space security, cybersecurity, information security, space systems, space industry.

БЕЗОПАСНОСТЬ КОСМИЧЕСКИХ СИСТЕМ: КАК ЗАЩИТИТЬ ДАННЫЕ И ИНФРАСТРУКТУРУ ОТ КИБЕРАТАК?

студент **Костина Алёна Александровна**,
преподаватель **Юренская Светлана Алексеевна**,
Колледж космического машиностроения и технологий
Технологического университета имени дважды Героя Советского Союза,
летчика-космонавта А. А. Леонова,
г. Королев, Российская Федерация

Аннотация. В статье рассматриваются вопросы, связанные с обеспечением кибербезопасности и защиты информации в космической отрасли, анализируются основные угрозы и сценарии кибератак на спутники, а также методы их предотвращения и повышения устойчивости космических систем. Особое внимание уделяется современным технологиям защиты, перспективам развития и необходимости установления международных стандартов в области безопасности космических систем. Статистические данные и примеры показывают, что усиление мер кибербезопасности имеет критическое значение

для поддержания надежности и безопасности современной космической инфраструктуры.

Ключевые слова: безопасность космоса, кибербезопасность, информационная безопасность, космические системы, космическая промышленность.

The informatization of society has led to an increased role of space-derived information in everyday human life. Through space technology, governments ensure essential societal needs such as satellite communication and broadcast relay services. Information obtained from remote sensing satellites of Earth satisfies demands for real-time monitoring of territories and continuous analysis of environmental conditions. For instance, space-based information enables the detection of large-scale fire outbreaks, assessment of river, waterbody, and soil conditions, monitoring ice coverage, and controlling snowmelt, river flooding, and reservoir levels during spring floods. It also facilitates the evaluation of ecological damage caused by natural disasters and human activities, among other applications.

The continuous operation of the international COSPAS-SARSAT satellite system (a global search and rescue satellite network) allows for the reception of distress signals from emergency beacons worldwide, identification of distressed objects, determination of accident sites, and alerting rescue services [1, p. 170]. Moreover, the capabilities of global navigation systems, such as GPS (Global Positioning System) and GLONASS (Global Navigation Satellite System), have expanded to provide highly accurate positioning and velocity data. Consequently, information is regarded as a strategic national resource – one of the main assets of a country – and the high-tech space industry significantly contributes to the development of information processes within the state. This, in turn, influences the potential development of key sectors of society and strengthens the country's defense capabilities.

Since the earliest spaceflights, scientists and researchers have been concerned about information security. Initially, onboard spacecraft employed automated computing systems, and later, more sophisticated computer systems; the risks associated with their secure operation primarily related to the durability and reliability of semiconductor components. The threat level of such impacts was considered minimal. However, the increasing number of satellites and the growing complexity of technical equipment in space missions have led to an increase in transmitted data and the need for measures to ensure its security. According to the Department of the United Nations Office for Outer Space Affairs (UNOOSA), the number of space assets grew nearly fivefold from 957 in 2011 to 4,852 satellites in 2022, and exceeded 6,000 in 2023 (Figure 1). As satellites become more widespread and accessible, security risks are becoming more prominent and likely to manifest.

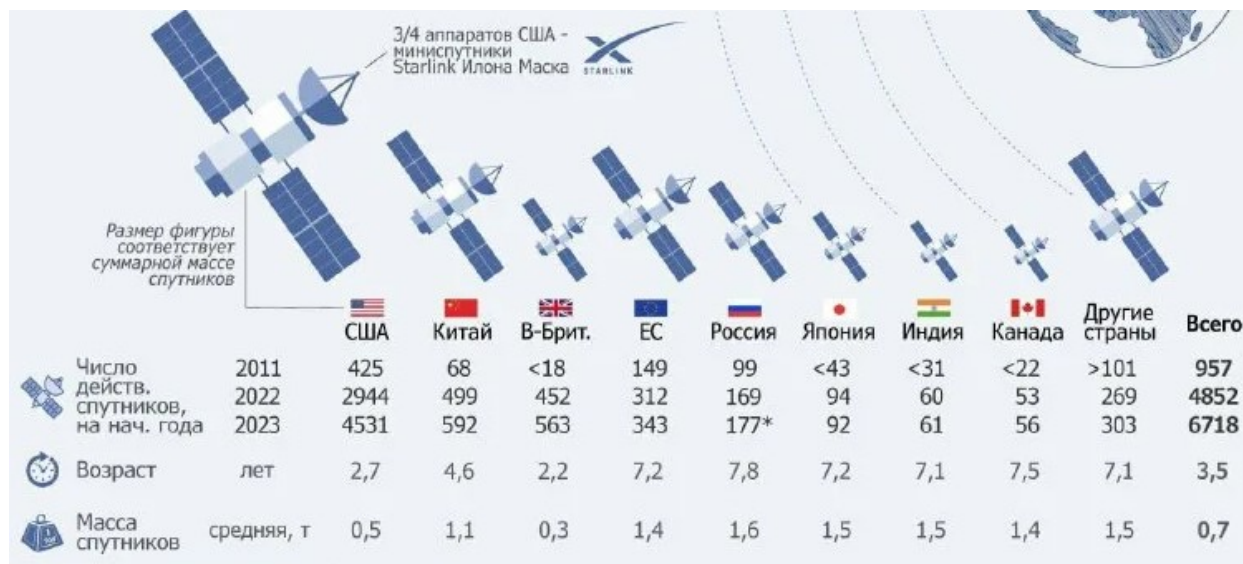


Figure 1 – Trends in the Increase of Satellites in Orbit from 2011 to 2023

The most well-known cyberattacks on space objects include the hacking of the control system of the German-American X-Ray satellite ROSAT in 1998, the hijacking and control of the navigation systems of the British military satellite Skynet in 1999, several malfunctions of the Landsat-7 satellite, operated by the United States National Aeronautics and Space Administration (NASA), in October 2007 and July 2008, and the interception of the internet connection of the Terra AM-1 satellite with the ground satellite station in Svalbard, Norway (Figure 2).

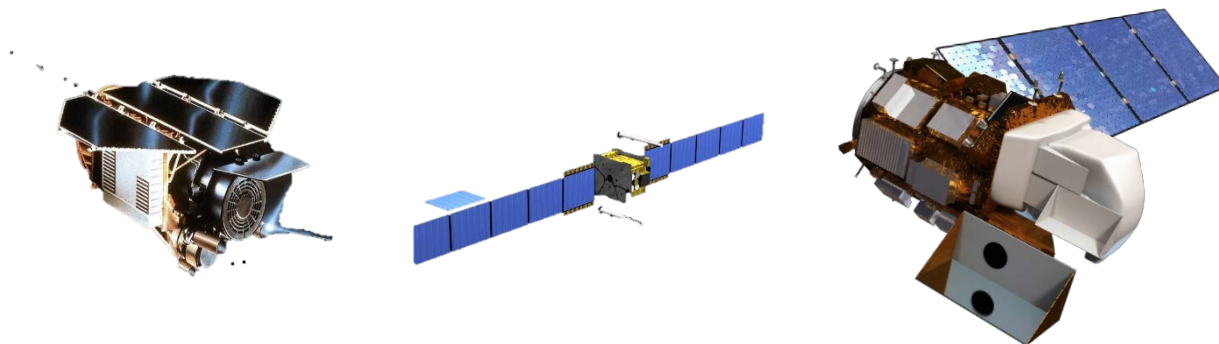


Figure 2 – Satellites ROSAT X-Ray, Skynet, and Landsat-7 (from left to right)

On one hand, all these incidents demonstrate the importance of protecting satellite communication systems for organizations. On the other hand, cybercriminals continue to improve their methods, and even companies for which satellite communications are critical to business continuity are not always able to defend against cyberattacks. For example, in 2022, the satellite operator Viasat was subjected to a large-scale cyberattack: approximately 45,000 out of 100,000 subscribers across 13 countries in Eastern Europe and Africa lost connectivity [2]. The incident not only impacted internet users but also caused malfunctions in about 6,000 wind turbines in Germany, which were controlled via satellites.

Thus, **information security** is the practice of preventing unauthorized access, use, disclosure, distortion, modification, research, recording, or destruction of

information [3]. This universal concept applies regardless of the form that data may take (electronic or physical, for example). The main goal of information security is a balanced protection of confidentiality, integrity, and availability of data, considering the feasibility of implementation and without compromising organizational performance. This is primarily achieved through a multi-stage risk management process, which allows the identification of key assets and intangible resources, sources of threats, vulnerabilities, potential impacts, and risk management opportunities. This process is accompanied by an assessment of the effectiveness of the risk management plan.

When discussing security measures in the space industry, it is necessary to differentiate between two concepts: “**information security**” and “**cybersecurity**” (Table). The first term encompasses a broader scope of issues, while cybersecurity specifically focuses on protecting information operating in the digital realm.

Table – Differences Between Cybersecurity and Information Security

Information Security	Cybersecurity
Definition	
Protection of information in any format –both digital and physical. Includes physical security, data management, security policies, and organizational measures.	A subset of information security, but exclusively focused on protecting digital data and networked systems.
Main Objectives	
- Protection of information confidentiality - Ensuring data integrity - Guaranteeing information availability for authorized users	- Protection against cyberattacks and malicious software - Ensuring the security of network infrastructure - Protecting cloud services and data - Safeguarding personal and corporate data from leaks and unauthorized access
In the Space Industry	
- Protecting critical equipment from external influences such as radiation and electromagnetic interference, which can negatively impact the functioning of space systems. - Preventing unauthorized access to space systems and networks. This involves developing and implementing reliable access control systems to minimize risks of	- Securing communication satellites, navigation satellites, and space vehicles from various threats, including cyberattacks and impacts on operational systems. A comprehensive approach is employed, including cryptographic data protection methods that ensure confidentiality and integrity of information.

confidentiality breaches and maintain system resilience against potential threats.	- Key components of cybersecurity include malware protection systems, as well as authentication and authorization procedures aimed at verifying users' rights to access systems and data.

Cybersecurity of Satellites. To understand orbital security, it is not enough to simply identify potential threats; it is also necessary to systematize various scenarios of their practical implementation. Currently, researchers distinguish three possible vectors of cyberattacks on satellites (Figure 3).

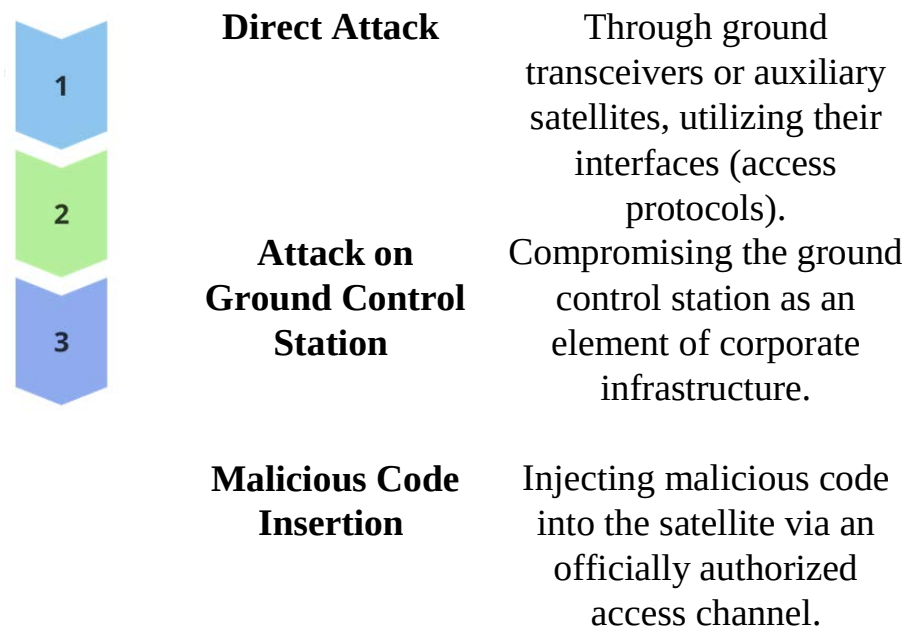


Figure 3 – Three Vectors of Cyberattacks on Satellites.

Additionally, there is a possibility of compromising untrusted code within the satellite's software. Like any computing system, satellites have an update function that is accessible even for outdated spacecraft. For example, in October 2023, NASA (National Aeronautics and Space Administration, headquartered in the United States) announced the successful firmware update of the Voyager 1 spacecraft, launched back in 1977. This example demonstrates that during the updating process, access to the main control commands can potentially be obtained. Consequently, given that space vehicles are not entirely autonomous, the risk of their compromise remains, even for systems launched many years ago.

Methods for Ensuring Cybersecurity in Space. There are five main methods applied in the space sector: cryptographic data protection, intrusion detection and prevention systems (IDS/ IPS), secure access control systems, regular audits and penetration testing and incident monitoring and response.

Cryptographic Data Protection. The use of modern encryption algorithms (such as AES or RSA) to secure data transmitted between space vehicles and ground stations.

This allows encrypting information sent from spacecraft to prevent interception or manipulation. For example, in 2019, the Indian communication satellite GSAT-6A was targeted by a cyberattack that caused operational disruptions. The use of encryption and information security systems became critical in restoring control over the satellite [4, p. 174].

Intrusion Detection and Prevention Systems (IDS/IPS). These systems help identify and prevent suspicious network activity, thereby minimizing the risk of cyberattacks.

Secure Access Control Systems. Implementation of multi-factor authentication and strict authorization procedures to control access to critical systems. This prevents unauthorized access to sensitive information and protects against malicious software. In 2009, hackers managed to interfere with data transmitted via the Inmarsat satellite network. This highlighted the need for more reliable access control and encryption systems.

Regular Audits and Penetration Testing. Conducting vulnerability assessments and regular security checks to identify and eliminate system weaknesses. Regular security audits of space systems help identify vulnerabilities in information security, which in turn minimizes the risks posed by external threats to space missions and ensures the confidentiality of sensitive data.

Incident Monitoring and Response. Having an active incident response team capable of continuously monitoring threats and responding swiftly. For example, in 2018, hackers gained access to NASA and the Jet Propulsion Laboratory (JPL) systems, potentially threatening missions including the Mars Rover. This incident prompted organizations to strengthen cybersecurity measures, including personnel training.

The prospects for the development of cybersecurity in space include several key directions. First, the development and implementation of quantum cryptography technologies will create virtually unbreakable data protection in space communications, providing a high level of security against interception. Second, the use of artificial intelligence and machine learning for threat analysis, automation of security management, and prediction of possible cyberattacks will significantly enhance cybersecurity levels. Third, establishing international standards and protocols for cybersecurity in the space industry will promote unification and improve security on a global scale. Finally, increasing cooperation with private companies in the space sector could lead to the development of new technologies and methods of data protection based on innovation and advanced solutions. Cybersecurity in space remains a relevant issue that requires both technological innovation and in-depth analysis of existing threats, and discussions of new data protection methods will become an important part of future space missions.

In conclusion, it should be noted that space systems constitute the fundamental elements upon which the key infrastructure of states is built. While researchers, policymakers, and engineers are increasingly focusing on the cybersecurity of critical infrastructure, space resources supporting these systems remain insufficiently engaged

under current conditions. It is evident that cybersecurity issues will grow in importance as technology advances. Organizations managing space systems should not rely solely on active measures taken by regulatory authorities, as there are specific steps that can be undertaken to protect their systems without political directives. Therefore, responsible officials are obliged to integrate space technologies into the strategic process of evaluating technologies that require cybersecurity to ensure the sustainable digital “vector” of nations. Furthermore, efforts must currently be directed toward eliminating the legal vacuum in the field of cybersecurity for space systems.

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DEVELOPMENT OF THE AIRFIELD AREA OF THE KURUMOCH INTERNATIONAL AIRPORT TAKING INTO ACCOUNT THE NOISE EFFECT

Student **Zheleznov Yaroslav Alexandrovich**,
Student **Krupnik Nadezhda Olegovna**,
Academic Advisor: PhD of Chemistry, Associate Professor
Varfolomeeva Vera Vasilyevna,
Samara National Research University named after S. P. Korolev,
Samara, Russian Federation

Abstract. The article considers a section of the airfield territory of the Kurumoch International Airport near the village of Malaya Tsarevshchina. The most common types are identified commercial aircraft used for regular air traffic at Kurumoch Airport. It shows territories that are affected by noise when approaching runway 15/33 with a heading of 328°. In accordance with the federal aviation regulations, the time characteristics of take-off and landing operations for five types of aircraft and the maximum intensity of their movement, taking into account noise exposure, are calculated.

Keywords: aviation noise, Kurumoch airport, airfield area, air transport, traffic intensity.

РАЗВИТИЕ ПРИАЭРОДРОМНОЙ ТЕРРИТОРИИ МЕЖДУНАРОДНОГО АЭРОПОРТА «КУРУМОЧ» С УЧЕТОМ ШУМОВОГО ВОЗДЕЙСТВИЯ

студент **Железнов Ярослав Александрович**,
студент **Крупник Надежда Олеговна**,
науч. руководитель: канд. хим. наук, доцент
Варфоломеева Вера Васильевна,
Самарский национальный исследовательский
университет им. академика С. П. Королёва,
г. Самара, Российская Федерация

Аннотация. В статье рассмотрен участок приаэродромной территории международного аэропорта «Курумоч» в районе села Малая Царевщина. Выявлены наиболее распространенные типы коммерческих воздушных судов, использующиеся для регулярного воздушного сообщения в аэропорту «Курумоч». Показаны территории, подверженные шумовому воздействию при заходе на посадку на полосу 15/33 с курсом 328°. Рассчитаны, в соответствии с Федеральными авиационными правилами, временные характеристики взлетно-посадочных операций для самолетов пяти типов и предельная интенсивность их движения с учетом шумового воздействия.

Ключевые слова: авиационный шум, аэропорт «Курумоч», приаэродромная территория, воздушный транспорт, интенсивность движения.

The operation of an airport as an enterprise is aimed primarily at obtaining profit, achieved through the development of related aviation and non-aviation services. The quantity and quality of services offered in the current reality, in economically developed countries, is equal in importance to the quantity of goods produced [1].

The Transport Strategy of the Russian Federation until 2030 with a forecast for the period until 2035 pays special attention to the development directions of air passenger transportation as one of the most important principles of development of transport services. Modernization of airport infrastructure, expansion of volumes and directions of passenger and cargo transportation, improvement of service quality and marketing programs provided to airlines and passengers contribute to the development of competitiveness of air transport services. Nevertheless, the development of many airports in our country is limited by environmental regulations and state standards, especially with regard to aerodrome territories and air terminals.

In this paper, the object of the study was the airfield area of the Kurumoch International Airport, due to the stable annual increase in passenger traffic at the airport, as well as the airport's status as a “hub”.

In the Russian Federation, in addition to the airports of the Moscow Aviation Hub, 20 major airports are usually considered “hub” airports (designated by Government Resolution No. 1242 of 25.12.2013), 11 of which are administratively located outside urban districts (Figure 1) [2].



Figure 1 – Administrative location of the largest Russian airports

It is worth noting that administrative non-inclusion of an airport in an urban district does not always mean remoteness from populated areas. Often, civil and social infrastructure facilities for employees of aviation enterprises are located near airports, or the airfields themselves are built near small settlements, which subsequently give them their name (for example, Khrabrovo Airport, Kaliningrad Region).

Administratively, Kurumoch airport belongs to the Krasnoglinsky district of the

urban district of Samara, near the village of Bereza, with a real distance from the city of 35 kilometers. In the area of 10 km from the airport there are 7 settlements (Beryoza, Kolodinka, Molgachi, Svetloe Pole, Mirny, Malaya Tsarevshchina and Kurumoch). As of 2025, one runway with an approach course of 15/33 with asphalt concrete pavement is in operation, the dimensions of which belong to class B [3].

The airport is capable of handling aircraft with a maximum takeoff weight of up to 390 t. The average number of takeoffs and landings per week exceeds 400 units. The most common types of aircraft are B-737, A-320 and SSJ-100, as well as their modifications. The remaining types of aircraft make up an insignificant share of the intensity of regular commercial aviation traffic (Figure 2).

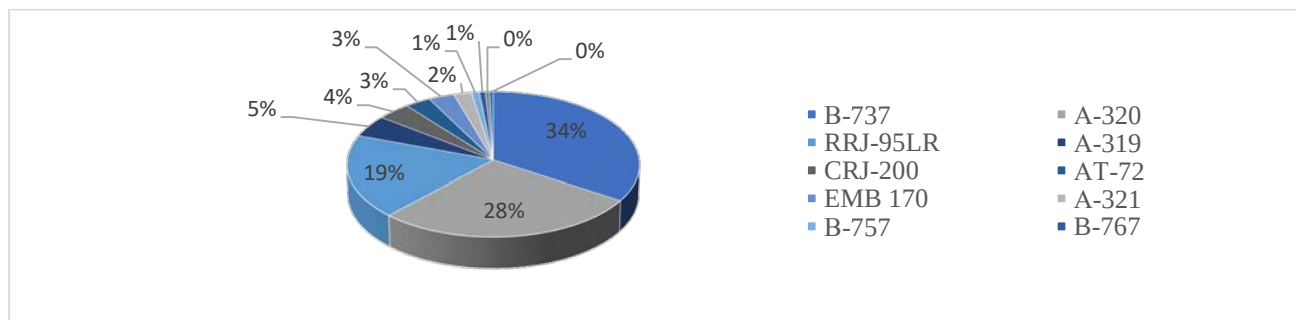


Figure 2 – Distribution of departing and arriving flights to Kurumoch International Airport by aircraft types from April 7 to April 14, 2025

The current capacity of the airport terminal is 1,500 people per hour, the maximum number of takeoffs and landings per hour for aircraft with a maximum takeoff weight of over 70 tons is 12 takeoffs and landings per hour. In the period from April 7 to April 14, 2025, the peak intensity of aircraft traffic was observed on April 7 from 17:00 to 18:00 – 8 takeoffs and landings. It is worth noting that the limitation on the increase in traffic intensity is imposed by both the technological features of the airfield and the capacity of the elements of the airport complex, as well as regulatory noise restrictions in accordance with GOST 22283-2014.

The seventh subzone is allocated for restrictions related to aircraft noise in the airfield area, which limits the construction of residential buildings, the placement of sanitary, educational and leisure institutions, etc. [4, 5]. The main source of noise in the seventh subzone are aircraft taking off and landing. Secondary sources of noise are engineering equipment of buildings and structures, airfield equipment and motor vehicles moving along internal driveways and access roads.

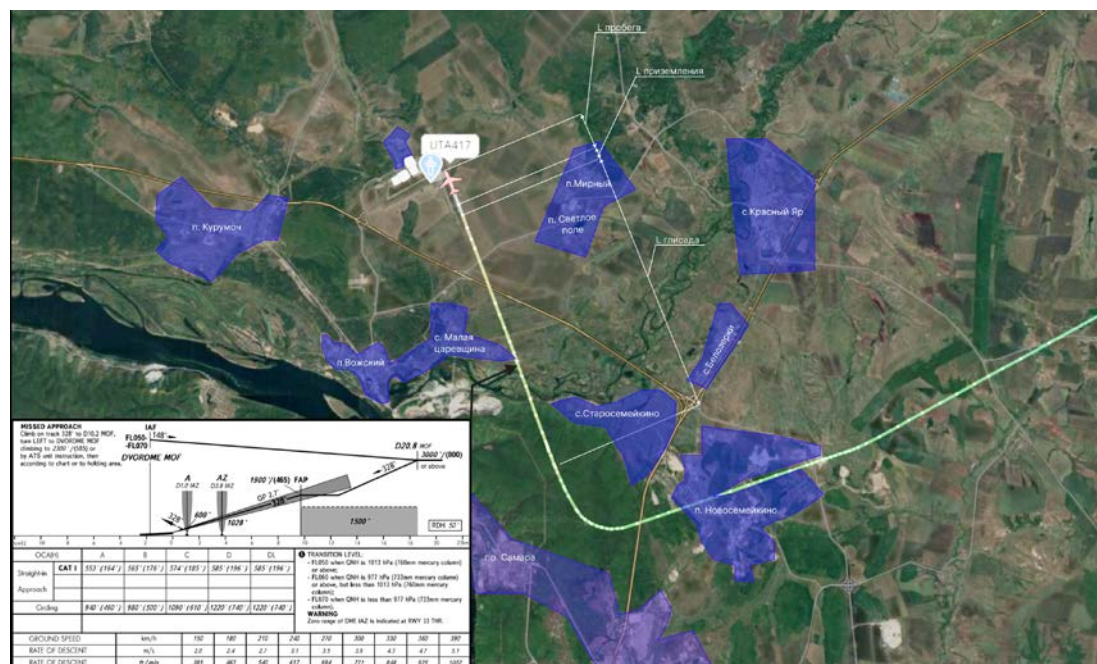
In accordance with the plans of the Strategy for the Socio-Economic Development of the Samara Region, by 2030 it is planned to expand the area of the Kurumoch airport terminal from 42 to 60 thousand square meters, which will entail an increase in the technical capacity of the airport. Thus, with the trend of increasing traffic volumes and developing an existing aviation enterprise, in order to determine potential aircraft routes, it is necessary to know the maximum permissible flight intensities of aircraft in relation to aircraft noise indicators.

When calculating the maximum permissible intensity of aircraft traffic, we will

designate the following initial data:

1. Takeoff or landing approach trajectory.
2. Aircraft types under consideration.
3. Time characteristics of aircraft noise impact (takeoff and landing time).
4. Critical points of noise impact on nearby areas.

To determine the critical points, the landing approach pattern on runway 15/33 with a heading of 328° was selected (Figure 3).



for expanding the airport terminal area. For the general case under normal conditions, the calculations will be given for the peak intensity hour (daytime). For a design altitude of 500 meters, the noise level from a single impact will obey the law of geometric attenuation. Table 3 shows the noise impact levels on the territory during the landing approach of a single aircraft.

Table 1 – Time characteristics of aircraft takeoff and landing operations

Aircraft time characteristics		A-319	A-320	B-737	RRJ-95LR	CRJ-200
Runway occupancy time at takeoff						
Taxiing time (s)		25	25	25	25	18
Time spent at the executive start (s)		48,5	48,5	48,5	48,5	42,5
Run-up time (s)		31,721	32,668	38,143	40,035	90,945
Time to climb (s)		12,721	14,057	15,658	17,856	5,953
Total takeoff time (s)		117,942	120,225	127,301	131,391	157,256
Runway occupancy time during landing on glide path						
Glide path descent time (s)		20,839	22,249	30,504	31,603	40,090
Planning time (s)		26,984	28,872	24,762	26,178	22,823
Travel time (s)	Taxiway	27,770	26,143	36,005	43,548	42,460
	High-speed taxiway	25,286	24,078	33,069	40,256	38,674
Taxiing time (s)	Taxiway	5,049	5,049	5,049	5,049	5,049
	High-speed taxiway	3,047	3,047	3,047	3,047	3,047
Total landing time on glide path (s)	Taxiway	80,642	82,583	96,319	106,378	110,422
	High-speed taxiway	75,156	78,246	91,382	101,084	104,634

Table 2 – Permissible noise levels of the aircraft under consideration

Aircraft type	A-319	A-320	B-737	RRJ-95LR	CRJ-200
Maximum takeoff weight of aircraft, kg	73500	77000	53000	49500	24000
Noise during takeoff from the side of the runway axis (450 m), dB	94,7	94,9	93,5	93,2	92
Noise during climb, dB	87,4	87,7	85	85	85
Approach noise, dB	100,5	100,6	99,4	99,2	96

Table 3 – Estimated noise level over the village of Malaya Tsarevshchina

Aircraft type	A-319	A-320	B-737	RRJ-95LR	CRJ-200
Noise during climb, dB	33,4	33,7	31,0	31,0	31,0
Approach noise, dB	46,5	46,6	45,4	45,2	42,0

Since flying aircraft, as a source of noise, have the character of a single impact on the terrain, to calculate the impact of several units of aviation equipment, it is necessary to use the equivalent level method, according to the recommendations of GOST 31296.1-2005 “Noise, description, measurement and assessment of noise on the terrain”. Table 4 shows the total levels of impact of aviation noise in the territory under consideration for three types of aircraft.

Table 4 – Equivalent noise level indicators for the aircraft types under consideration

Aircraft traffic intensity	A-320			B-737				CRJ-200			
	1	5	10	1	5	10	14	1	5	10	19
Equivalent noise level, dB	13,4	36,2	40,4	12,4	35,5	39,7	40,5	9,4	33,4	37,2	40,1

Currently, taking into account the schedule and current intensity of aircraft traffic, the equivalent noise level during the daytime complies with regulatory requirements and is equal to 37.2 dB. With maximum readings of 40 dB for residential buildings during the daytime, the maximum permissible intensity of aircraft per hour will be equal to 9 aircraft for A-320, 13 for B-737 and 18 for CRJ-200.

The indicator of the maximum intensity of aircraft traffic in the area of the village of Malaya Tsarevshchina as a whole partially reflects the maximum capacity of the airport due to the existence of several landing approach schemes. However, this indicator defines the traffic section as critical. Thus, the introduction of new models of aircraft with the lowest degree of noise impact will increase the capacity of the section, and, consequently, improve the economic performance of the enterprise.

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AUTOMATION AND ROBOTIZATION OF GROUND HANDLING AT THE AIRPORT

Student **Igumenova Polina Vyacheslavovna**,
Student **Ponomarenko Darya Andreevna**,
Academic Advisor: PhD in Chemistry, Associate Professor
Varfolomeeva Vera Vasilievna,
Samara National Research University named after S. P. Korolev,
Samara, Russian Federation

Abstract. The article addresses key challenges in improving ground handling efficiency at Kurumoch International Airport amid growing passenger traffic and cargo volumes. It demonstrates that traditional service methods are no longer sufficiently effective, necessitating the implementation of automated and robotic systems. An analysis of cargo turnover, passenger flow, and the airport's infrastructure is presented, justifying the need to upgrade from Class III to Class II under the current classification system.

Keywords: airport, ground handling, automation, robotics, cargo turnover, passenger traffic.

АВТОМАТИЗАЦИЯ И РОБОТИЗАЦИЯ НАЗЕМНОГО ОБСЛУЖИВАНИЯ В АЭРОПОРТУ

студент **Игуменова Полина Вячеславовна**,
студент **Пономаренко Дарья Андреевна**,
науч. руководитель: канд. хим. наук, доцент
Варфоломеева Вера Васильевна,
Самарский национальный исследовательский
университет им. академика С. П. Королёва,
г. Самара, Российская Федерация

Аннотация. В статье рассмотрены актуальные вопросы повышения эффективности наземного обслуживания в международном аэропорту «Курумоч» на фоне роста пассажиропотока и грузооборота. Показано, что традиционные методы обслуживания становятся недостаточно эффективными, что обуславливает необходимость внедрения автоматизированных и роботизированных систем. Проведен анализ грузооборота, пассажиропотока, а также инфраструктуры аэропорта, обосновывающий необходимость перехода от III ко II классу по действующей классификации.

Ключевые слова: аэропорт, наземное обслуживание, автоматизация, роботизация, грузооборот, пассажиропоток.

The term “ground handling” in aviation covers a wide range of services required

to prepare an aircraft for departure, move it on the ground, and complete the flight. These services include both client services and technical operations on the platform [1, p. 23].

Modern operating conditions of international airports are characterized by significant workload. The largest Russian airports – Sheremetyevo, Domodedovo, Pulkovo, Koltsovo, Kurumoch – are experiencing the greatest load, which receive and send hundreds of flights daily, serving tens of thousands of passengers [2].

The statistics of cargo turnover at international airports are shown in Figure 1. Traditional ground handling methods are no longer able to cope with the increasing passenger traffic, baggage handling, cargo and mail. Among the most problematic processes are:

- 1) Baggage handling;
- 2) Loading and unloading operations;
- 3) Logistics of ground operations.

This is why automation and the introduction of robots are becoming an inevitable solution to improve the efficiency of ground handling. This approach helps to significantly reduce the time spent on preparing aircraft for flights, minimize the impact of the human factor and ensure stable operation of airports even under high loads.

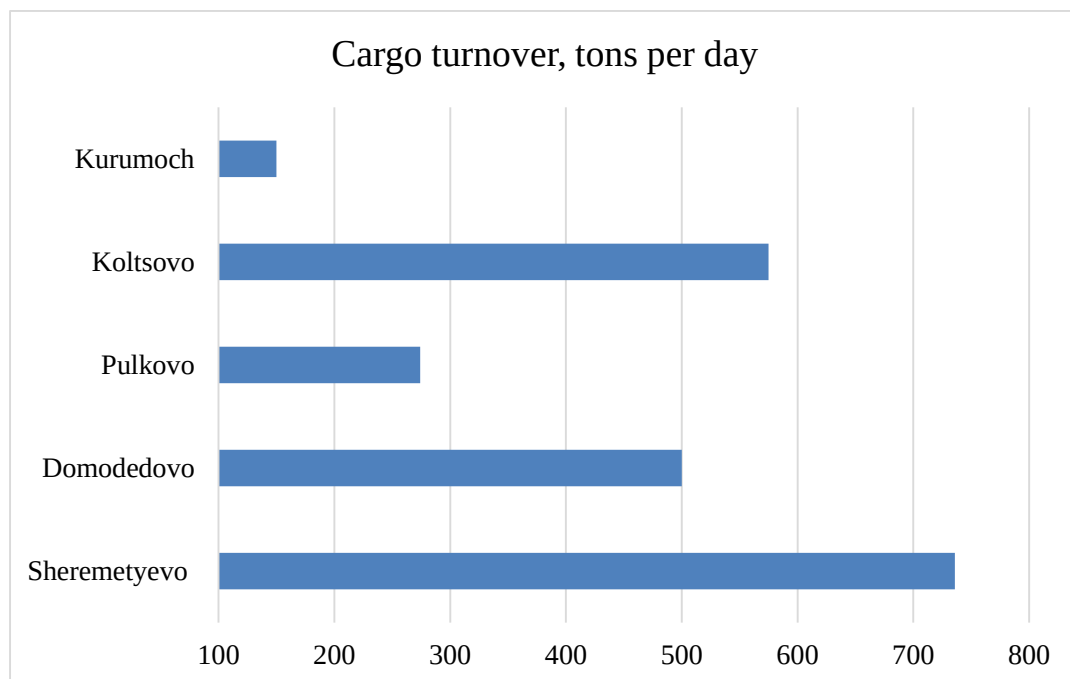


Figure 1 – International airport cargo turnover statistics

Analyzing the data presented in Figure 1, it can be seen that S.P. Korolev Kurumoch International Airport (hereinafter referred to as AP Kurumoch), located in Samara, is not one of the leaders in terms of daily cargo transportation among Russian airports. The average daily cargo turnover of the airport is about 150 tons. The airport's cargo terminal specializes in servicing domestic and international air traffic. Its total area reaches approximately 5,000 square meters, which corresponds to Class III according to the current classification based on the volume of air traffic [3].

The transition of Kurumoch International Airport from Class III to Class II in terms of passenger traffic is possible due to the introduction of innovative technologies: automation and robotization of the main production processes. This will increase the terminal's capacity and allow the airport to meet international service standards. For a successful transition to the second class, it is necessary to modernize the airport's infrastructure, including improving runway coverage and expanding the areas of the corresponding terminals. These measures will allow the airport to accommodate heavier types of aircraft such as the Airbus A310 and Boeing 757. At the same time, it is possible to implement automated logistics systems and optimize production processes in all areas of service (Figure 2). Such a transition of the airport from Class III to class II will open up additional development prospects: the number of scheduled flights per day will increase, the list of aircraft types accepted will expand, and revenues from providing various types of ground services will increase.



Figure 2 – Kurumoch Airport (top view)

The expected effect of the introduction of automation and robotics in the ground handling system of Kurumoch airport:

- 1) Increase overall labor productivity and improve safety indicators;
- 2) Reducing the risks associated with the influence of the human factor on production processes.

The prospect of upgrading the airport to Class II will provide an opportunity to significantly increase the volume of services provided and attract additional funding for further technological upgrades. An important aspect is also the retention of highly qualified personnel, which will be made possible by optimizing jobs and increasing the attractiveness of the profession.

According to the official website of the airport, Kurumoch served about 3.57 million passengers in 2024 (Figure 3) [3]. To move to Class II, according to the Russian classification of airfields, the airport must reach an annual passenger traffic of 7 to 10 million people [2].

Figure 3 clearly shows that the efficiency of the service increases with increasing passenger traffic to a certain point. If the number of passengers exceeds this threshold, the efficiency of operation decreases sharply, especially after the drop in traffic due to

the COVID-19 pandemic in 2020. Therefore, further expansion of the airport is impossible without automation and robotization.

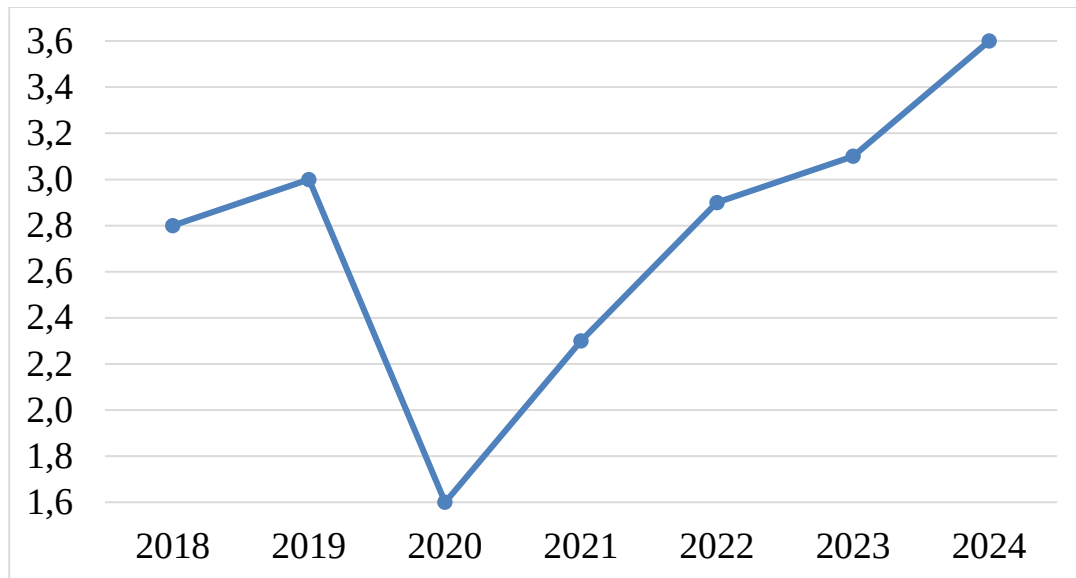


Figure 3 – Kurumoch Airport passenger traffic growth (2018-2024), million people

According to IATA, the transition to advanced Ground Support Equipment (GSE) can potentially reduce the cost of repairing damage on the ground by 42 % and create a safer environment. In order to provide ground maintenance work, Kurumoch AP has the following equipment:

- 1) Automated cargo accounting system;
- 2) Electric and diesel loaders;
- 3) Automated pallet/container loaders [3].

It is important for Kurumoch International Airport to integrate robotic solutions in every passenger service area, baggage handling, cargo and mail in a timely manner. The growing passenger traffic and the need to improve service efficiency place serious demands on the airport's infrastructure. Teswell Samara company is one of the leading domestic manufacturers of robotic equipment. For more than 18 years, the company has been actively developing the field of automation and robotization of production, including for aviation activities. Part of the Volgaenergoprom Group of companies, it has experience in implementing complex projects in the field of robotics. The company's location in the Samara region creates a unique advantage for Kurumoch airport: the proximity of the manufacturer reduces logistics costs, reduces the delivery time of spare parts and facilitates maintenance. Among the company's technical innovations, a robotic palletizing cell with two independent work areas stands out (Figure 4).



Figure 4 – Robotic palletizing cell with two work areas

It should be noted that the robot can be programmed with various baggage handling algorithms, adapting to specific tasks. The study of the robot for implementation in aviation activities has shown a number of advantages:

1. The robot is able to quickly adjust to perform a number of special tasks, depending on the program algorithm;
2. Does not require regular maintenance;
3. Ensures a high level of employee safety when interacting in a production environment;
4. Requires no specialized knowledge for operation or configuration;
5. Ensures uninterrupted operation, reducing baggage handling time and its distribution to the required conveyor belt for further delivery on board the aircraft [4].

Thanks to the built-in artificial intelligence and machine vision system, the robot is able to recognize the dimensions of cargo and increase the efficiency of the entire ground handling chain. In addition, it has the ability to program for a different logistics chain from unloading baggage from an airplane to sending it for pickup or transportation to a temporary storage area. Thus, the robot becomes a universal solution for both standard and non-standard cargo sizes.

The considered characteristics confirm the high efficiency of using the robot to optimize the time spent on packing cargo and transporting it to a conveyor belt for further transportation by air. The robot's productivity reaches up to 10 baggage handling units per minute, and the maximum weight of the handled cargo is up to 18 kilograms. With the help of built-in sensors, the robot automatically recognizes the size of objects on the conveyor, sequentially picks them up, and then puts them on an adjacent pallet.

When studying the prospects of automation and robotization at the airport, attention should be paid to innovative foreign developments. An example is the device of the Japanese company Cyberdyne, a wearable exoskeleton designed to ease the physical exertion of warehouse and transportation workers. Cyberdyne's hybrid auxiliary limb is designed specifically for logistics-related tasks.

Cyberdyne, weighing only three kilograms, is worn by an employee around the waist and takes part in the process of lifting heavy objects. The principle of operation

of the suit is to read the bioelectric signals of the employee's brain and activate the weight support mechanism. This is especially important in conditions of constant handling of baggage and cargo during the work shift [5].

Another promising solution for airport cargo operations is the use of the evoBOT mobile robot. It is designed to perform maintenance and cargo transportation tasks directly at the airport. Structurally, it is an autonomous mobile platform equipped with a pair of wheels for efficient movement, maneuvering and maintaining balance. Of particular interest are mechanical “hands”-grips capable of adapting to the shape and size of various objects, ensuring reliable fixation and cargo transfer. The robot's developers have identified a number of important functions for it, including handling particularly dangerous goods, delivering parcels over long distances, and providing support during loading and unloading operations. The load capacity of this robot reaches 100 kg, and the maximum travel speed is 60 km/h [5]. The high mobility of the robot allows you to quickly deliver cargo from the aircraft to the cargo terminal and back. This helps to process more flights in the same time period, thereby reducing aircraft downtime and increasing cargo turnover. Thus, the introduction of this technology will serve as an important factor in improving the efficiency of the Kurumoch agricultural complex and provide prerequisites for its transition to Class II.

In conclusion, it should be noted that the successful operation of various airport services directly depends on the speed and accuracy of cargo handling operations. The development of robotic technologies has a positive impact on the airport's logistics sector, contributing to the efficiency of all processes. To assess the effectiveness of the introduction of robotic technology, we will conduct a comparative analysis of the basic indicators of ground handling before and after their application (Table) [6].

Table – Analysis of the effectiveness of the introduction of robotic technology

Indicator	Manual labor	Automation
Baggage handling speed	6-8 minutes per unit	2-3 minutes per unit
Cargo turnover (tons/day)	150 tons	180 tons (up to +30 % increase)
Number of service personnel	20-25 people per shift	12-15 people (decrease to - 40 %)
Risk of injury and staff overload	High (manual lifting, shifts of 10-12 hours)	Minimal (exoskeletons, assistants)
Overall efficiency of the service area	100 % (base value)	130-150 % (growth due to speed and continuity)

Thus, the transition of the international Airport from the usual methods of ground handling to modern automated and robotic systems is an obligatory step towards increasing efficiency, competitiveness and approaching the requirements of international standards. The use of automated and robotic systems makes it possible to optimize production processes, reduce operating costs, increase passenger traffic and cargo turnover, creating the necessary conditions for the transfer of the airport from the third category to the second. Consequently, automation and robotization are the most important strategic directions for the development of Kurumoch airport.

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INTEGRATION OF ARTIFICIAL INTELLIGENCE IN ELECTRONIC CIRCUIT DESIGN FOR ENHANCED PERFORMANCE

Student **Slobodenyuk Dmitriy Ruslanovich**,

Student **Fazylov Roman Viktorovich**,

Lecturer **Yurenskaya Svetlana Alekseevna**,

Space Engineering and Technology College of the Technological University
named after twice Hero of the Soviet Union,
pilot-cosmonaut A. A. Leonov,
Korolev, Russian Federation

Abstract. The article describes the role and development of integrated circuits (ICs) and their interconnection with artificial intelligence (AI). Advances in IC technology have accelerated the development of modern computing systems and turned AI into a more powerful tool. Special emphasis is placed on the use of AI for diagnosing faults in microchips and designing new chips, as well as the advantages of employing specialized AI chips such as TPUs. The author discusses the synergy between ICs and AI, which drives innovation and opens new horizons in the field of technology.

Keywords: integrated circuits, artificial intelligence, fault diagnosis, circuit design optimization, microchips.

ИНТЕГРАЦИЯ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ПРОЕКТИРОВАНИЕ ЭЛЕКТРОННЫХ СХЕМ ДЛЯ ПОВЫШЕНИЯ ИХ ПРОИЗВОДИТЕЛЬНОСТИ

студент **Слободенюк Дмитрий Русланович**,

студент **Фазылов Роман Викторович**,

преподаватель **Юренская Светлана Алексеевна**,

Колледж космического машиностроения и технологий
Технологического университета имени дважды Героя Советского Союза,
летчика-космонавта А. А. Леонова,
г. Королев, Российская Федерация

Аннотация. В статье описывается роль и развитие интегральных схем (ИС) и их взаимосвязь с искусственным интеллектом (ИИ). Прогресс в области ИС позволил ускорить развитие современных вычислительных технологий и сделать ИИ более мощным инструментом. Особое внимание уделяется применению ИИ для диагностики неисправностей в микросхемах и проектирования новых чипов, а также преимуществ использования специализированных ИИ-чипов, таких как TPUs. Автор обращает внимание на синергию между ИС и ИИ, которая стимулирует инновации и открывает новые горизонты в области технологий.

Ключевые слова: интегральная микросхема, искусственный интеллект, диагностика неисправностей, оптимизация проектирования схем.

Integrated circuits (ICs) are miniature electronic devices or components that play a crucial role in modern technologies. They consist of semiconductor devices and passive components fabricated on the surface of semiconductor wafers. IC technology serves as the backbone of various industries, including computing, medicine, and industrial applications, and forms the foundation of digital technologies. In recent years, the rapid development of artificial intelligence (AI) has become deeply intertwined with IC technology, making their integration a key direction in the advancement of information technologies [1, p. 7].

The synergy between ICs and AI is profound. Continuous improvements in ICs drive the rapid growth of computing technologies, which are essential for AI development. AI's reliance on advanced computational capabilities means its progress is closely linked to the evolution of ICs. Moreover, AI algorithms, which require extensive data processing for tasks such as recursion, iteration, and convolution, depend on reliable hardware built on ICs. This has led many companies to develop specialized chips tailored for executing AI algorithms, optimizing performance, and enabling complex AI functionalities.

Conversely, AI technologies are increasingly applied in the design, analysis, and fault detection of ICs [2, p. 456]. By overcoming the limitations of human operations, AI assists developers and manufacturers in creating more precise and efficient circuits and production processes. This mutual advancement of AI and ICs highlights the importance of their integration, fostering progress in both fields and contributing to the broader landscape of technological innovation.

Development of Integrated Circuits. The concept of ICs emerged from the need to compact electronic components and wiring into a small carrier, reducing the overall size and volume of circuits. In 1946, the first electronic computer in the U.S. occupied 150 square meters and weighed 30 tons. Its circuitry included 17,468 vacuum tubes, 7,200 resistors, 10,000 capacitors, and 500,000 wires, consuming 150 kW of power. Its enormous size and immobility were its most obvious drawbacks [3, p. 17].

To address these issues, Bell Laboratories invented the first transistor in 1947, which provided the core functions of vacuum tubes while overcoming their disadvantages, such as bulkiness, high energy consumption, and fragility. The advent of transistors quickly led to the concept of semiconductor-based ICs. By 1960, Fairchild Semiconductor introduced the first practical monolithic IC, marking a milestone in the field. Since then, circuit integration has advanced rapidly: early circuits with fewer than 100 components have evolved into modern Very Large Scale Integrated Circuits (VLSI), where tens of thousands to millions of transistors can be integrated onto a silicon wafer just a few millimeters in size, with line widths of less than 1 μm .

The development of ICs has transformed computers from room-sized machines into portable devices. The global IC market has also grown rapidly, reaching \$361.226 billion in 2020, an 8.3 % increase from 2019, reflecting the swift progress of the information age (Figure 1) [3, p. 18].

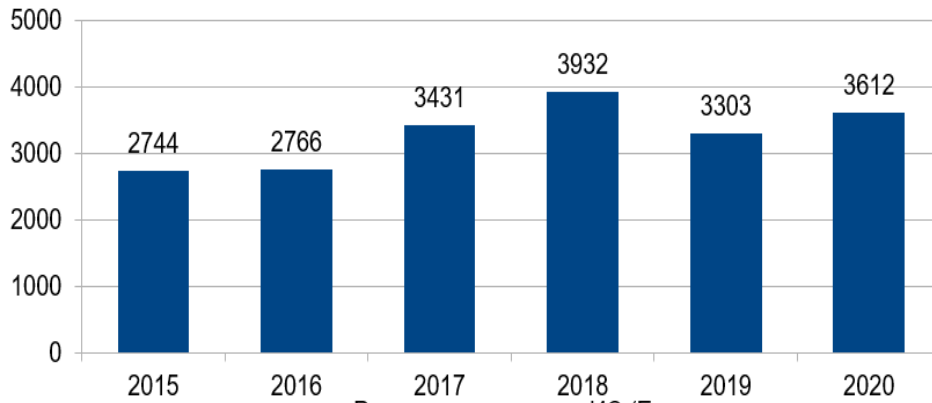


Figure 1 – Global IC Market Growth Chart (hundreds of millions of US dollars)

Development of Artificial Intelligence. The term “artificial intelligence” was coined by the Dartmouth Society in 1956 to describe a field focused on using computers to simulate human cognitive processes and intelligent behaviors, such as learning, reasoning, and thinking [4, p. 20]. ICs serve as the hardware foundation for AI, enabling high integration and performance. The rapid evolution of ICs has significantly increased computational power and application possibilities, making AI technology feasible and practical. Without ICs, AI would remain theoretical and unrealized.

This interdependence makes ICs a primary driver of AI development. In turn, AI not only enhances human cognitive capabilities but also pushes the boundaries of IC design and applications to previously unimaginable levels. Furthermore, AI technology influences the trajectory of IC development. For example, deep learning requires processing vast amounts of data, leading to challenges like the “memory wall” problem, where memory and bandwidth limitations hinder progress. The high computational demands of deep learning also necessitate continuous improvements in hardware performance.

Application of AI Technology in Integrated Circuits. AI Chips: Traditional central processing units (CPUs) consist of a controller and an arithmetic logic unit (ALU), where data is processed by a separate ALU module while other modules ensure orderly instruction execution. This structure works well for traditional software computations but struggles with deep learning, which requires extensive data operations rather than numerous software instructions [5, p. 1439].

As power consumption constraints limit the ability to continually increase CPU frequency and memory, the CPU system becomes an insurmountable bottleneck in performance. AI chips emerged as a solution, offering significant improvements in performance, latency, and energy efficiency. The core of AI chips lies in the use of a Multiplier and Accumulation (MAC) accelerator array, which speeds up critical convolution operations in convolutional neural networks (CNNs). This design is tailored for large-scale computational tasks typical of AI applications, while non-computational tasks remain the responsibility of the CPU.

For example, Google's Tensor Processing Unit (TPU) handles tasks 15–30 times faster than traditional CPUs and GPUs, with energy efficiency improved by 30–80 times. As shown in Table, compared to powerful GPUs, low-power TPUs offer better rack-level density, highlighting their efficiency in AI-related tasks.

Table – Haswell v3, K80 and TPU comparison table

Model	Die										Benchmarked Servers				
	mm ²	nm	MHz	TDP	Measured		TOPS/s		GB/s	On-Chip Memory	Dies	DRAM Size	TDP	Measured	
					Idle	Busy	8b	FP						Idle	Busy
Haswell E5-2699 v3	662	22	2300	145W	41W	145W	2.6	1.3	51	51 MiB	2	256 GiB	504W	159W	455W
NVIDIA K80 (2 dies/card)	561	28	560	150W	25W	98W	--	2.8	160	8 MiB	8	256 GiB (host) + 12 GiB x 8	1838W	357W	991W
TPU	NA*	28	700	75W	28W	40W	92	--	34	28 MiB	4	256 GiB (host) + 8 GiB x 4	861W	290W	384W

Fault Diagnosis. During the design, testing, and operation of ICs, faults are inevitable. Fault networks in chips are often ambiguous, meaning observed symptoms may not correspond to the actual problem, complicating fault analysis. AI integration enhances the accuracy, efficiency, and scientific rigor of fault diagnosis.

For instance, artificial neural networks (ANNs), which emphasize self-organization and self-learning, are particularly effective in diagnosing complex fault scenarios that defy explicit formulaic representation. They address issues related to nonlinearity, tolerance, and feedback loops, which traditional models struggle with. ANNs consist of three types of processing units: input units, output units, and hidden units. Input units receive external data and signals, output units manage processed results, and hidden units, located between input and output units, are not directly observable from outside the network. These neural processing units can represent various entities—such as letters, concepts, or abstract patterns—and the weights of connections between neurons indicate the strength of internal network links and information processing.

For example, in a three-phase rectifier circuit (Figure 2), when a fault occurs, a neural network-based fault diagnosis method can sample the output voltage waveform. This data is fed into the neural network, which, through training, correlates the input information with fault element encoding, enabling precise fault identification in the circuit. Using neural networks for fault detection allows more efficient management and optimization of IC design, testing, and operation.

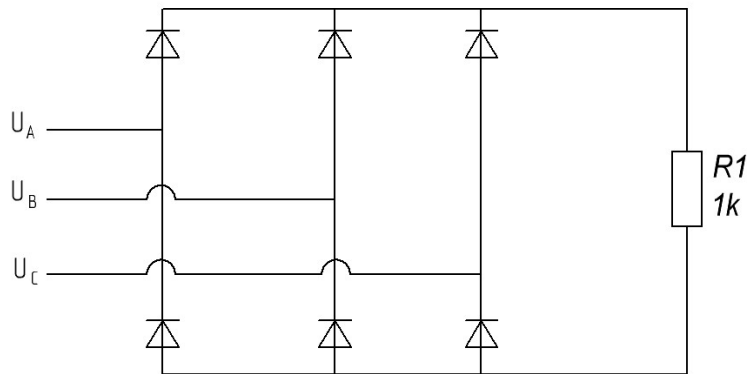


Figure 2 – Three-phase rectifier circuit diagram.

Circuit Design Optimization. Traditional circuit design relies on iterative simulation methods based on prior experience to achieve optimal target parameters. Such conventional optimization often involves numerous parameters and iterations, resulting in significant time costs for each optimization cycle. With machine learning, designers can select design parameters before optimization and obtain corresponding target parameters through circuit simulation. As shown in Figure 2, machine learning optimizes the circuit design optimization process. A machine learning model is created based on sampling results, predicting the relationship between design parameters and target outcomes. This approach requires only a few samples to build a model, which then generates each optimization. The prediction speed of machine learning models far exceeds that of traditional simulations, effectively solving the time-cost problem and accelerating circuit optimization.

Conclusion. Integrated circuits (ICs) have played a pivotal role in shaping modern technologies, serving as the foundation for progress in various industries, including computing, medicine, and industrial applications. As IC technology advances, it is instrumental in the rapid development of artificial intelligence (AI), which, in turn, drives further improvements in IC design and functionality.

The symbiotic relationship between AI and ICs underscores their mutual dependence: ICs provide the necessary hardware infrastructure for AI's complex data processing needs, while AI enhances the design, analysis, and optimization of ICs. This integration has led to the development of specialized AI chips, improved fault diagnosis methods, and more efficient circuit design processes. Together, these innovations expand the boundaries of what is possible in both fields, ensuring a future of faster, more efficient, and intelligent technologies. The ongoing collaboration between AI and IC technologies will undoubtedly foster further breakthroughs, reinforcing their significance in the broader landscape of technological innovation.

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INNOVATION METHODS OF PRESERVATION AND EXHIBITION OF PALAEOLITHIC MONUMENTS

Student **Alekseeva Elizaveta Timurovna**,
Student **Skamay Maria Olegovna**,
Academic Advisor: PhD in Philology, Associate Professor
Osintseva Tatiana Nikolaevna,
Saint Petersburg State University of Industrial Technologies and Design,
Saint Petersburg, Russian Federation

Abstract. The study is devoted to the application of artificial intelligence (AI), virtual reality (VR) for the research, preservation of art of the Late Palaeolithic. The examples of Atxurra Cave, Las Monedas Cave, Capova Cave, White Sea petroglyphs shows the possibilities of digital technologies in documentation, analysis and promotion of monuments. Comparative effectiveness of methods is conducted, the most perspective approaches in work on Palaeolithic monuments are highlighted. The need to combine traditional and innovative methods of protection is emphasized.

Keywords: VR, AI, three-dimensional (3D) modeling, Palaeolithic monuments, petroglyphs, digital technologies, efficiency.

ИННОВАЦИОННЫЕ МЕТОДЫ СОХРАНЕНИЯ И ЭКСПОЗИЦИИ ПАЛЕОЛИТИЧЕСКИХ МОНУМЕНТОВ

студент **Алексеева Елизавета Тимуровна**,
студент **Скамай Мария Олеговна**,
науч. руководитель: канд. филол. наук, доцент
Осинцева Татьяна Николаевна,
Санкт-Петербургский государственный университет
промышленных технологий и дизайна,
Санкт-Петербург, Российская Федерация

Аннотация. Исследование посвящено применению искусственного интеллекта (ИИ), виртуальной реальности (VR) для изучения, сохранения искусства позднего палеолита. Примеры пещеры Атксурра, пещеры Лас-Монедас, Каповой пещеры, петроглифов Белого моря показывают возможности цифровых технологий в документировании, анализе и популяризации памятников. Проводится сравнительная эффективность методов, выделяются наиболее перспективные подходы в работе над палеолитическими памятниками. Подчеркивается необходимость сочетания традиционных и инновационных методов охраны.

Ключевые слова: VR, ИИ, 3D-моделирование, палеолитические памятники, петроглифы, цифровые технологии, эффективность.

Introduction. Modern society, consumed by the digital world and everyday concerns, often ignores the value of Palaeolithic monuments. Many sites are not properly studied and are also being destroyed due to climate change, anthropogenic impacts and lack of funding. But it is the innovative technologies, which improve every year, can help in the study and preservation of cultural heritage. We want to show that digital methods can open new worlds of Palaeolithic works and leave them in history.

The purpose of the study: to draw attention to the preservation of the heritage of late Palaeolithic monuments.

Tasks:

1. Show how modern technologies (VR, AI, 3D-modelling) help in the study, preservation and popularization of ancient monuments.
2. Analyze which innovative methods are used in the exploration and preservation of prehistoric objects, such as the Atxurra Cave, the Las Monedas Cave, the Kapova Cave and the White Sea petroglyphs.
3. Justify the need to protect petroglyphs and other artifacts, many of which have not yet been studied.

1. Modern methods of studying and preserving monuments

1.1. Virtual reality in the study of art

Automated scanning, 3D modeling, and virtual reality applications have revolutionized the creation of precise digital copies of historical artifacts and places. These technologies enable conservationists to capture intricate detail with unprecedented precision, facilitating better access for researchers, educators, and the general public. Virtual reality (VR) technologies are being actively implemented in many professions, including the visual arts. Today's creative opportunities for people are almost limitless: new technologies make it possible to create works from any materials. One of the applied and constantly developing directions has become the technology of VR-drawing, which is the creation of paintings using traditional artistic means in digital format. This type of creativity belongs to digital art and includes graphics, animation, video, interactive installations and other forms of self-expression. VR technologies also provide artists with the opportunity not only to immerse themselves in virtual reality, but also to use a wide range of modern tools to realize their ideas. It is important to study the applications that today allow you to create masterpieces of fine art using VR-drawing. In virtual reality, the key role is played by tools for creating paintings, their simplicity and intuitiveness of use, as well as the ability to save and share the results of work.

As for the topic of our article VR is transforming the way we study and interpret ancient art by creating immersive environments that simulate the conditions under which prehistoric artists worked. This technology enables researchers to recreate the atmospheric effects of firelight, shadows, and textures, providing a new perspective on how early humans experienced and produced art. As highlighted in the article “Illuminating palaeolithic art using virtual reality: A new method for integrating dynamic firelight into interpretations of art production and use”, VR allows the incorporation of sensory factors such as tactility, darkness, and acoustics, enhancing

the realism and depth of reconstructions. Fire can also feature prominently within cosmological systems [1, p. 2].

A new digital method in VR modelling is an essential tool for art investigating using dynamic lighting conditions when it is not feasible to use fire, torch, or lamp light within art-bearing caves or museum collections [1, p. 2]. First of all, the integration of virtual reality into the field of cultural heritage opens new opportunities for studying, interpreting, and popularizing ancient objects. This method is especially useful for working with Palaeolithic artifacts and images because it allows us to recreate conditions that are difficult to achieve with traditional approaches. Research using VR is based on combining 3D modeling, photogrammetry, and the simulation of dynamic effects. This helps to recreate the atmosphere of ancient rituals and the perception of Upper Palaeolithic art.

Using VR makes it possible to investigate:

- The social and cultural context, including modeling joint rituals and storytelling with the help of dynamic lighting.
- Safe examination of fragile objects without risking damage, which is especially important for unique Paleolithic artifacts.

Thus, VR has become a powerful tool for archaeologists and researchers, allowing not only the recreation of lost details from the past but also creating interactive educational platforms for a wide audience. This offers the exciting potential to show how cave art and some portable art may have been seen from the perspective of those people who made and used it [1, p. 8]. This method helps preserve cultural heritage, making it more accessible and livelier, while also revealing new aspects of human interaction with art and nature in ancient times.

1.2. Artificial intelligence as an innovative tool for analyzing, restoring, and protecting works of art

Artificial intelligence (AI) is becoming increasingly important in the field of art, offering new approaches for analyzing, restoring, and preserving cultural objects. Using automatic image recognition, 3D modeling, and virtual reality technologies, AI can create accurate digital copies of artworks. This significantly improves access and helps protect valuable items from damage. By digitizing cultural heritage, AI ensures that these precious assets are preserved in digital form, protecting them from possible physical damage or loss [2, p. 96].

One of the main areas where AI is used in art studies is detecting damages and planning restoration work. Algorithms for image recognition and pattern detection help experts find cracks, abrasions, and other damages on paintings, sculptures, and archaeological objects. This ensures more precise and effective restoration, preserving fine details and original artistic features. Additionally, AI contributes to virtual restoration and the reconstruction of missing or damaged parts of artworks. Using machine learning, researchers can model the original look of objects, fix damages, and restore missing parts of images. This not only helps preserve cultural values but also deepens our understanding of their historical and artistic significance.

AI is also used for continuous monitoring of artworks and monuments in real-time. Sensor systems and data analytics help detect potential threats such as temperature changes, humidity, or pollution, allowing quick responses to prevent damage. As a result, these systems ensure the long-term preservation of cultural objects. The digital models and monitoring systems also support educational and research projects. For example, virtual reconstructions allow researchers and students to interact with artworks, broadening access to cultural heritage and deepening understanding of its historical and artistic importance.

How does this process work? First, artworks are digitized using technologies like laser scanning and photogrammetry. This creates detailed digital models that capture textures and structures. Then, the data are processed with AI algorithms, which analyze the 3D models and images to detect damages and cracks. This automated detection speeds up diagnosis significantly. Next, AI helps model the original appearance of the object, removing damages through virtual restoration. Algorithms can reconstruct missing or damaged parts, creating virtual reconstructions that help preserve the artistic value. AI also helps plan restoration activities by predicting effective methods and minimizing risks, making the process safer and more efficient.

In summary, AI-based analysis plays an important role in determining damage and developing targeted restoration plans. Pattern detection and image recognition algorithms help experts understand the extent of degradation of artifacts and structures, thereby facilitating evidence-based decisions about conservation methods the most suitable one [2, p. 96]. Through AI-supported analysis, the preservation process becomes more efficient and informed, contributing to the long-term sustainability of cultural heritage preservation.

2. Comparative effectiveness of methods of research, preservation and exhibition of prehistoric art

The article “Illuminating Palaeolithic art using virtual reality: a new method for integrating dynamic firelight into interpretations of art production and use” discusses in detail how VR enables a deeper understanding of the role of fire in creating and perceiving Palaeolithic images. This kind of research appreciates an array of factors pertinent to how the art may have been understood or experienced by people during the Paleolithic, including placement, lighting, accessibility, sound, and tactility [1, p. 1]. The method involves creating accurate 3D models of cave walls and paintings using laser scanning and photogrammetry. These models are then integrated into virtual environments where effects such as flickering of fire and dynamic lighting are simulated. This allows us to recreate the conditions in which ancient artists worked and to study how light, shadows, and textures interacted – aspects that are hard to show with static images or traditional technologies.

For the Las Monedas simulation, photogrammetric models of the majority of the cave walls were imported into a virtual environment constructed in Unity (a free and accessible game-development software), with 28 of the 30 figurative depictions analysed within the VR simulations (Figure 1) [1, p. 4].

It is important to note that VR allows us to conduct virtual experiments by running scenes with different lighting scenarios and recording their visual effects for further analysis. This is one of the main advantages of the method – the ability to observe changes in image perception depending on the position and behavior of the light source. While interpreting the results requires caution, these models greatly expand our knowledge of the sensory aspects of ancient art. In the future, more precise and complex models may incorporate new data about fire properties and lighting conditions, opening new horizons for analysis and the promotion of Palaeolithic art.



Figure 1 – Digital tracing (top) and VR simulation (bottom)

Example such as cave paintings in Las Monedas Cave shows that VR helps expand our knowledge of ancient practices by recreating conditions as close as possible to the real ones. Although this article concentrates on fire's psychological and sensory effects in art perception, the technology offers significant potential for public engagement, providing unique insights into how cave art may have been perceived by its Palaeolithic creators.

A similar study was conducted in the Atxurra Cave, also known as the “Ledge of the Horses”, northern Spain. Scientists conducted an experiment with the simulation of cave space, considering the angle, lighting and other features.

The workflow involves the identification and collection of archaeological and geological data in situ, followed by an interdisciplinary study of these data. Subsequently, specific experimental programs are developed, 3D documentation of the underground environment is conducted, and finally, all this information is integrated into a graphics engine to create the Support Vector Regression (SVR) experience [3, p. 5]. The results obtained in this study demonstrate the technical feasibility of creating

an SVR experience for archaeological study and for disseminating the results derived from the analysis of the contexts of Palaeolithic rock art creation [3, p. 9]. Thus, the user can move around the cave and also hear the sounds of a torch or bonfires and use various objects that were worn in Atxurra Cave (Figure 2). This virtual historical environment demonstrates in the present sensory and interactive data that people can use and interpret for new research in archaeology, as well as to preserve information about Palaeolithic cave. It also helps spread the word about Paleolithic art and allows people to immerse themselves in the ancient world.



Figure 2 – View of the real-time experience in SVR with using interactive torch lighting

Otherwise it is the case with the archaeological heritage of Kapova Cave in Bashkortostan. Over many years of research, mistakes were made, as a result the ramp builders dug a trench that exposed and destroyed about one third of the cultural deposits of the Upper Palaeolithic era [4, p. 305]. In addition, the cave taped the impact of tourists, as many paleolithic drawings were painted graffiti, and a metal ladder laid for the route damaged the surface.

But today modern researchers use the following methods to study cave paintings: recording all surfaces of halls with drawings (using modern photo and video equipment), panoramic photography (covering space in 360°), mosaic photography (multiple photographs that are combined into a single image), photogrammetry (a method that allows obtaining partially overlapping 3D models of wall sections, the area of which exceeds the possibility of shooting in one frame) [5]. Many methods were used thanks to the experience of foreign colleagues, however, as a result it was possible to find images not previously recorded. Continuous photo shoot helped to record the traces of artists in Capua cave.

It should be noted that in large part thanks to the educational work of the reserve, the attitude of the visitors to the cave has changed [4, p. 305].

Reading the Vestnik of the Commission of the Russian Federation for UNESCO, it became clear that the White sea petroglyphs of the Palaeolithic period have not been fully studied. Predominantly traditional methods are used. For a long time, the White sea petroglyphs were not protected, the images were poorly rendered due to the washing of petroglyphs by Vyg river and tourist walks through ancient drawings.

In 2016, Karelian artist Svetlana Georgievskaya developed, tested and successfully used black Chinese rice paper to make relief prints of petroglyphs. Chinese rice paper in black colour has been successfully used ever since. As a result, high quality copies are obtained which allow to trace not only the outlines of the image, but also the nature of its inner filling and embossing depth because, unlike mica paper, rice paper retains the relief of the print. In some cases, it is also possible to discern the sequence of the process of stamping the image on the rock [6, p. 65]. The creative collective did the work on the complex documentation of the petroglyphs of the White Sea (topographical survey, photofixation, copying, description, study of lichen influence), created a database management system, and also carried out some practical conservation measure [6, p. 69].

However, there were not enough studies using innovative technologies. The only mention of the use of photogrammetry based on digital photographs of petroglyph fragments and of the fixation with the digital microscope Leica DVM 5000 was made by Fedorova D. N. As a result of her work, the dating of the petroglyphs and the tool used to create them was questioned [7, p. 105].

Conclusions. Digital technologies, such as AI, VR, 3D modelling, are widely used, especially in Europe, and are the most promising methods for preserving and understanding prehistoric monuments. Together, these methods complement each other: VR makes ancient art more accessible and engaging whereas AI ensures the accurate analysis, restoration, and safeguarding of cultural artifacts for future generations. The visualization of the simulation allows you to experiment with different scenarios and lighting conditions, which can be very useful for the exhibition and analysis of the artistic experience of the Palaeolithic. In addition to its role in disseminating modern archaeological knowledge, SVR provides inclusive digital access to heritage sites that are unavailable due to conservation or physical limitations. In this way, the cave paintings remain safe and the viewers can explore them online.

However, we have found that many paleolithic objects are at the stage of being studied and protected. They need special attention because, in addition to traditional methods, in their research very rarely use innovations. We believe that the example of successful work on the caves of Atxurra and Las Monedas will be followed by other specialists, and state bodies will be more actively involved in the introduction of technology and training of professionals to best preserve the monuments of history.

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DEVELOPMENT OF PROPULSION UNITS FOR ARCTIC NON-NUCLEAR ICEBREAKERS

Postgraduate Student **Afanasieva Serafima Yuryevna**,
Academic Advisor: PhD in Philology, Associate Professor
Manukyan Asmik Manukovna,
Saint Petersburg State Marine Technical University,
Saint Petersburg, Russian Federation

Abstract. This paper provides an overview of development of propulsion units on arctic non-nuclear icebreakers. The role of the arctic shipping and icebreakers is discussed.

The history of propulsion units development is analyzed, bringing as examples the key projects of the 20th century. The role of azimuth thrusters in the development of icebreakers' propulsion is underlined.

The main tendencies of propulsion unit utilization on modern Russian icebreakers are indicated. The perspective view overlooks the main goals and challenges of the Russian propulsor production industry.

Keywords: propulsion unit, icebreaker, mechanical azimuth thruster, electric azimuth thruster, Northern Sea Route.

РАЗВИТИЕ ПРОПУЛЬСИВНЫХ КОМПЛЕКСОВ АРКТИЧЕСКИХ НЕАТОМНЫХ ЛЕДОКОЛОВ

аспирант **Афанасьева Серафима Юрьевна**,
науч. руководитель: канд. филол. наук, доцент
Манукян Асмик Мануковна,
Санкт-Петербургский государственный морской технический университет,
Санкт-Петербург, Российская Федерация

Аннотация. В работе рассматривается развитие пропульсивных комплексов на арктических неатомных ледоколах. Обсуждается роль арктического судоходства и ледоколов.

Анализируется история развития пропульсивных комплексов на примере ключевых проектов 20 века. Подчеркивается роль винторулевых колонок в развитии движительно-рулевых комплексов ледоколов.

Приведены общие тенденции использования пропульсивных комплексов на современных российских ледоколах. Обзор перспективы обозначает основные цели и вызовы российской отрасли по производству движителей.

Ключевые слова: движительно-рулевой комплекс, ледокол, механическая винторулевая колонка, электрическая винторулевая колонка, Северный морской путь.

Introduction

The role of arctic shipping

The Arctic zone plays special roles in various spheres of life. Ecology wise, the Arctic is one of the regions especially vulnerable to human activity, such as contamination, invasive species expansion, and warming issues. Economy and industry wise, this region is rich with hydrocarbon fields and deposits of commercial minerals. Finally, transportation wise, the Arctic seas provide a route along the Russian northern coast between the West and the East, called the Northern Sea Route (NSR).

Therefore, it is natural that the Arctic zone attracts growing interest of countries all over the globe. The main challenges in research and transportation in the Arctic are ice-covered waters requiring the use of ice-strengthened vessels, as well as lack of bases and ports.

Russia is particularly interested in developing its sector of the Arctic. The most important sphere of development is nowadays the transportation of hydrocarbons (oil, liquid natural gas, liquid petroleum gas) by sea. In 2024 the amount of cargoes transported via the NSR came to a total of 37.9 million tons [1], out of which 56 % were hydrocarbons [2]. According to the NSR Development Plan up to the year 2035 [3], hydrocarbons are expected to constitute more than 70 % of cargo volume before 2030 (Table 1).

The sanctions against Russia that emerged in 2022 have had an impact on all spheres of economy including transportation, provoking a significant underrun of the planned volumes. Nevertheless, the cargo volume carried via the NSR has been continuously growing.

Table 1 – NSR cargo volume

Cargo volume, million t	2023	2024	2025	2026	2027	2028	2029	2030	2035
Prediction (optimistic) [3]	46,8	90,0	110,2	124,4	139,8	164,6	192,5	216,5	238,1
Actual volume [1]	36,2	39,7	-	-	-	-	-	-	-

The transit cargo volumes stay around 4 million tons yearly, thus forming a minor but significant part of the overall volume [2].

The idea of converting the NSR into an international sea passage from Europe to Asia, creating this way an alternative to the “traditional” routes (through the Suez Channel and around Africa) has been popular in the 2010s. The key advantage is the route length which is 2 to 2.5 times less than the ones commonly used today. To this day though, these ideas have not been successfully brought to life due to various challenges.

Northern Sea Route: the challenges

The challenge most emphasized has always been the lack of powerful icebreakers needed for providing the line balancing of cargo shipping in heavy ice areas. This problem is in progress of being solved by the construction of nuclear

icebreakers Project 22220 “Arktika” and Project 10510 “Rossiya”, as well as the plan for four powerful non-nuclear icebreakers [4].

Apart from the powerful convoy-leading icebreakers, the auxiliary (non-cargo) fleet needed for the development and support of the NSR includes tug vessels, port icebreakers, auxiliary icebreakers, standby and supply vessels, salvage and rescue vessels etc.

Still, icebreaking vessels are not enough for creating competition between the NSR and the “traditional” routes. Although the route length is shorter, the ice infestation does not allow the vessels to move at economy speeds, making the schedule less predictable. Icebreaker services can be required even for high-ice-class vessels, which causes additional costs and time management issues. Moreover, ice-class cargo vessels have smaller inner volumes and poorer open water performance than equivalent non-ice-class vessels.

The development of the NSR as an international shipping route requires not only icebreaking facilities but also extensive development of northern ports, repair bases, salvage and rescue centres. This complex infrastructural system needs to be unified by informational systems and databases, forecasts and monitoring facilities. This immense project is now at the very beginning of its creation.

Types of icebreakers

Nuclear icebreakers being one of the most distinguishable symbols of Russia’s merchant service fleet naturally overshadow the less powerful port and auxiliary icebreakers. These vessels are however a vast area for interest and research. Apart from being open for development of various hull and equipment features, they have been a field for innovations concerning propulsion, i. e. the systems providing movement and steering.

In fact, modern shipping can differentiate two different types of icebreakers with two models of operation. The main purpose of a powerful convoy-leading icebreaker, either nuclear or not, is to create an ice channel for vessels cruising behind her, or – in especially heavy ice conditions – to tow a vessel behind herself. Thus, the main goal of propulsion units on these vessels is to provide as much drive and thrust as possible.

Less powerful icebreakers have turned into multi-functional ships that, apart from “classic” icebreaker functions, are capable of performing tug operations, salvage and rescue operations, fire-fighting etc. Apart from icebreaking capability, they strive for maneuverability, steering response and high stern-first performance characteristics necessary for operation in narrow passages and limited areas.

Goals and Objectives

One of the most important roles of making this possible is played by their propulsion units. Therefore, the goal of this paper is to analyze the tendencies of development of propulsion units on Arctic icebreakers in appliance to auxiliary non-nuclear vessels. The following objectives are chosen:

- gather the information concerning propulsion units installed on icebreakers since the beginning of the 20th century to nowadays. From the moment icebreakers begin to diversify into two types (see before) non-nuclear auxiliary icebreakers are of interest;

- analyze the general tendencies found in the development of propulsion units of icebreakers;
- consider the possible differences in the propulsion units of Russian and other flags' icebreakers;
- provide ideas on further development of propulsion units on icebreakers.

Development of propulsion unit schemes: 20th century

Ermak

The first ever Arctic-class icebreaker *Ermak* was built in 1899 in Newcastle, England. Its purpose was to escort vessels in the areas with seasonal ice cover, such as the Baltic Sea during the winter months, and operate in the Russian Arctic by breaking ice in the large river estuaries and support polar research expeditions.

The vessel was primarily equipped with four shaft lines: one at the bow and three at the stern (Figure 1).

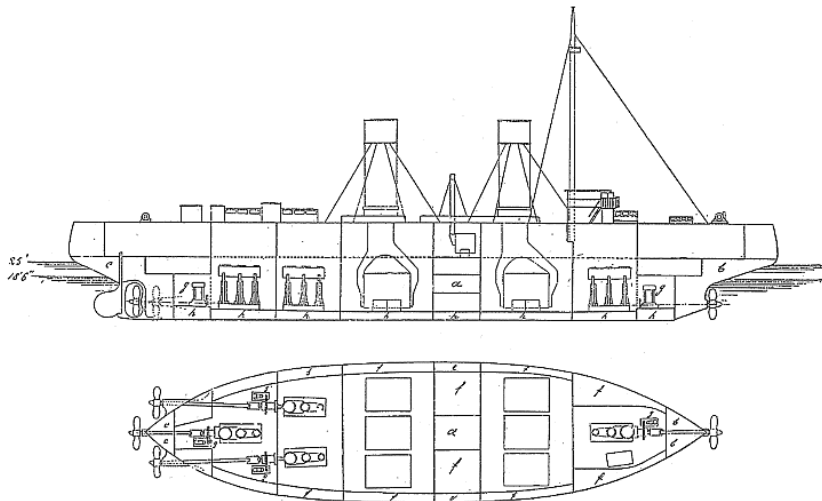


Figure 1 – Icebreaker *Ermak* General Arrangement Scheme [5]

However, the icebreaker was damaged by ice in its very first voyage to the Arctic, and had to be reconstructed. The repairs included elimination of the bow shaft line and propeller due to the lack of their strength. From then on, the propulsion scheme consisting of three shafts at the stern became classic for heavy icebreakers.

The vessel began operating successfully in the Baltic Sea, and the second voyage to the Arctic seas was undertaken in 1901 [5].

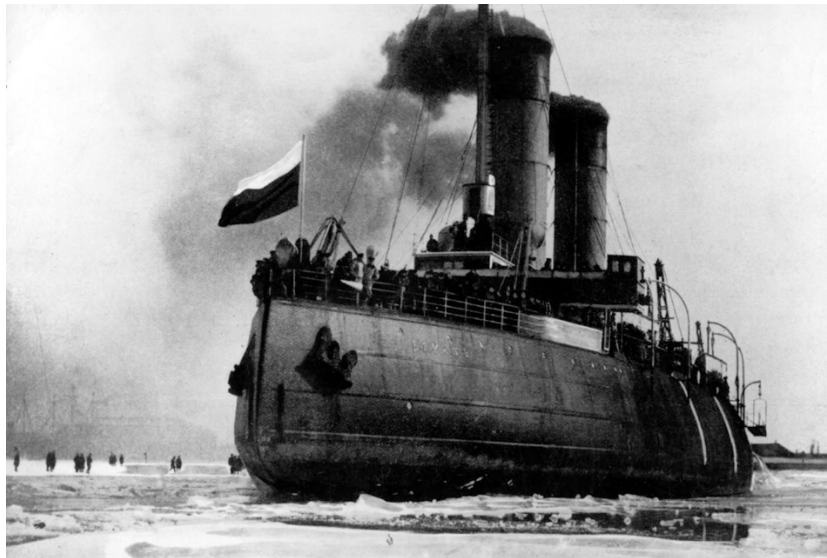


Figure 2 – Icebreaker *Ermak* [6]

Ermak was in high demand for the next decades. It was decommissioned only in 1963, deep into the Soviet era.

Tarmo (1907)

Although the first experience of utilizing the bow shaft line and propeller was unsuccessful, the idea remained relevant. The Finnish icebreaker *Tarmo* built in 1907 was equipped with a bow propeller (Figure 3).

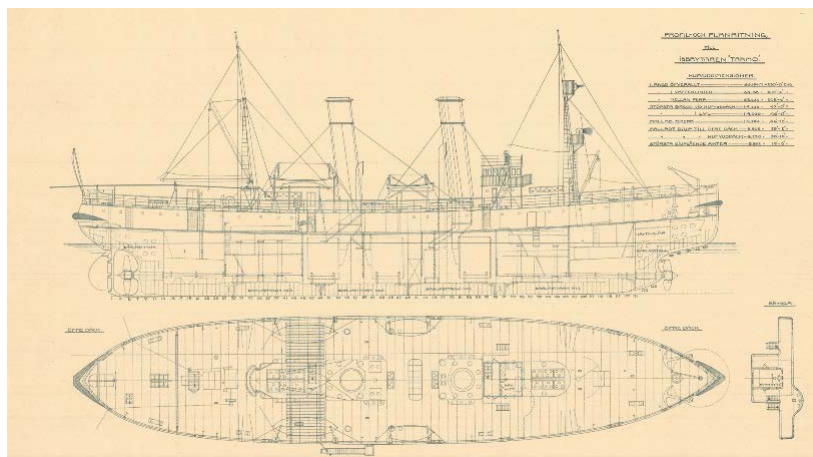


Figure 3 – Icebreaker *Tarmo* (1907) General Arrangement Scheme [private source]

A similar propulsion scheme was utilized for the so-called Baltic Icebreakers built for Russia in 1914-1917. These vessels (*Tsar Mikhail Fedorovich*, *Kozma Minin* and others) were equipped with two stern and one bow shaft lines.

Iosif Stalin Type

Strength issues prevented heavy Arctic icebreakers from being equipped with a bow propeller. The four *Iosif Stalin* Type icebreakers commissioned from 1938 to 1941

had again the classic icebreaker propulsion scheme – three shaft lines at the stern (Figure 4).

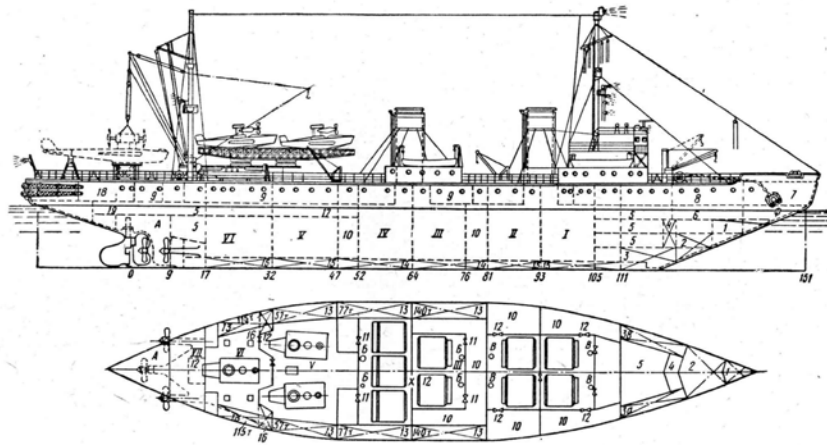


Figure 4 – *Iosif Stalin* Type General Arrangement Scheme [private collection]

Mid-century US icebreakers

In the 1940s, the United States built seven diesel-electric *Wind*-class icebreakers (Figure 5) and one icebreaker *Mackinaw* which operated in the Great Lakes. Both projects featured a bow propeller. The *Wind*-class vessels were successfully used in the polar waters [7].



Figure 5 – *Wind*-class icebreaker [8]

The first purpose-built US-flagged polar icebreaker was *USS Glacier* commissioned in 1955 (Figure 6). Its propulsion system consisted of two propellers at the stern.



Figure 6 – *USS Glacier* [9]

Lenin

Simultaneously, the USSR launched an ambitious plan of developing the NSR starting with the construction of the world's most powerful icebreaker. This way, the nuclear icebreaker *Lenin* (Figure 7) was created, with ca. 32 000 kW of installed power. This was the first surface ship equipped with a nuclear reactor, which allowed *Lenin* to boast an almost unlimited endurance.



Figure 7 – Icebreaker *Lenin*

The propulsion scheme used was the by that time classical for Arctic icebreakers three shaftlines at the stern. All nuclear icebreakers built after *Lenin* including the newest Project 22220, feature the same propulsion scheme.

It is only Project 10510 *Rossiya* being currently under construction, that will have four shaft lines. This vessel with 120 MW of power on the shaftlines will be the biggest and the most powerful icebreaker ever built [10].

The 1960s

In the USSR the 1960s were the period of construction of Project 97 light icebreakers meant to operate as auxiliary and port vessels. Having a displacement of just under 3000 t, they were equipped with two propellers at the stern and one at the bow. The design turned out to be very successful, and various modifications (military, patrol, research) were introduced. Seven vessels of the modified projects are still in operation (Figure 8).



Figure 8 – Project 97A *Ivan Kruzenshtern*

During the same period, in 1963, the icebreaker *Tarmo* was built in Finland. This vessel operates till nowadays under the Estonian flag in the Baltic sea. Just as Project 97, this vessel also features a bow propeller, as shown in Figure 9.

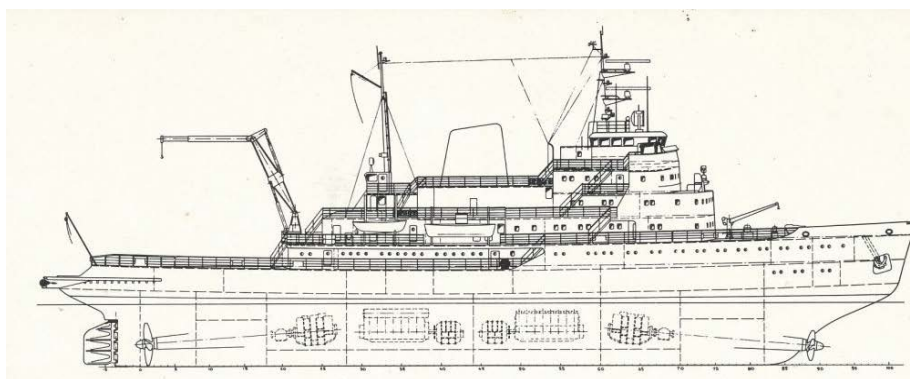


Figure 9 – Icebreaker *Tarmo* (1963) general arrangement scheme [private source]

The 1980s

The 1980s in icebreakers design and operation were notable with experiments. Hull wise, for example, the Thyssen-Waas bow was introduced (Figure 10).



Figure 10 – Icebreaker Kapitan Sorokin with a Thyssen-Waas bow

Thus, remarkable is the Swedish icebreaker *Oden*, (Figure 11) which, apart from a Thyssen-Waas bow, is also equipped with diesel (not diesel-electric) propulsion, and two stern propellers with nozzles. This choice was made to increase the propeller thrust of the vessel.

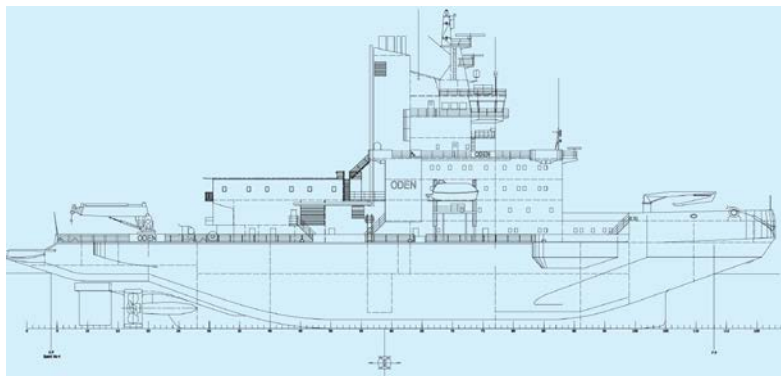


Figure 11 – Icebreaker Oden general arrangement scheme [private source]

Conclusions: 20th century

The 20th century demonstrated rapid development of icebreakers as a special class of vessels all over the world.

Propulsion scheme wise, general tendencies show that Arctic convoy-leading icebreakers quickly came to the now “traditional” scheme with three propellers at the stern. Auxiliary icebreakers and vessels designed for operations in lighter ice conditions tended to be equipped with a bow propeller as an addition to two or three stern propellers.

The main advantage of the bow propeller is the possibility of milling ice in heavy conditions. This decreases the ice loads on the hull as well as provides additional

icebreaking capability. However, for heavy ice conditions of the Arctic this solution demonstrates strength issues, which is why it is typically not used for convoy-leading icebreakers.

The revolution in propulsion

Since the 1990s a revolution in propulsion occurred. This was marked by the popularity of azimuth thrusters.

An azimuth thruster (Figure 12) is a propulsor and an active means of ship's steering. The propeller is installed on a pod situated under the hull of the vessel, which can rotate around the vertical axis. This way the direction of propellers' thrust is controlled and the vessel is steered.



Figure 12 – Mechanical azimuth thrusters

Azimuth thrusters can be divided into two main types. Their main difference is the location of the drive: mechanical thrusters are diesel, diesel-electrically, or hydraulically driven, while the motor is located inside of the vessel's hull. The torque is transmitted via a system of shafts and gears (Figure 13).

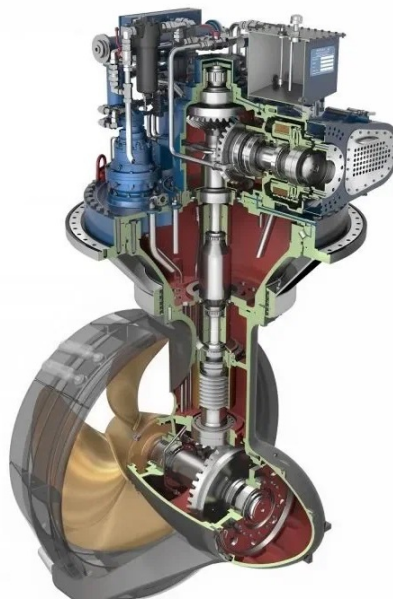


Figure 13 – 3D model of a mechanical azimuth thruster [11]

Electric azimuth thrusters contain the electric motor inside of the pod, while the motor is directly connected to the propeller (Figure 14). The main advantages of this system are higher efficiency, absence of a complicated mechanical power transmission, unlimited reverse operation, better thrust sensibility etc.



Figure 14 – 3D model of an electric azimuth thruster [12]

Azimuth thrusters provide excellent maneuverability and control which are crucial for auxiliary vessels including icebreakers.

Electric azimuth thrusters are especially useful for icebreaking vessels due to their overtorque ability. This means these thrusters can surpass their nominal torque rate by 30-80 % which allows them to mill ice. The use of azimuth thrusters revolutionized ice shipping and icebreaking.

Modern propulsion units

As it has been stated above, nuclear icebreakers have stayed with the “traditional” propulsion scheme consisting of three stern shaft lines.

Auxiliary icebreakers adopted the advantages offered by azimuth thrusters. The variety of propulsion schemes utilized on Russian icebreakers is illustrated by Table 2 and Table 3.

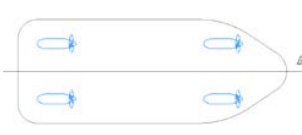
Table 2 – Propulsion schemes on Russian icebreakers equipped with mechanical azimuth thrusters

Project No.	Year built	Type of vessel	Propulsion scheme	Vessel photo
21900	2008 - 2009	Multi-functional icebreaker		

21900M	2015 - 2016	Multi-functional icebreaker		
P-70202	2015	Multi-functional rescue oblique icebreaker		
21180M	2022	Multi-functional Navy icebreaker		

Table 3 – Propulsion schemes on Russian icebreakers equipped with electrical azimuth thrusters

Project No.	Year built	Type of vessel	Propulsion scheme	Vessel photo
P-702021 Aker ARC 121	2012 - 2013, 2017 - 2018	Icebreaking supply vessel		
22600	2020	Multi-functional icebreaker		

Aker ARC 130A	2017 - 2018	Multi- functional icebreaking supply and stand-by vessel		
Aker ARC 124, 30044	2019	Port icebreaker		

The first Russian icebreakers equipped with azimuth thrusters were Project 21900. At that time, the country was slowly overpassing the 1990s – early 2000s crisis, and the choice for mechanical azimuth thrusters was made due to more trust to this technological solutions. The latter Project 21900M was designed as development of Project 21900, and the general solution for propulsion stayed intact.

The advantages of installation of electric azimuth thrusters were fully understood in the 2010s, and up to nowadays and into the future, this type of propulsor is prioritized over all others.

A less obvious advantage of azimuth thrusters is their compatibility with shaft line propellers. An example of this scheme is Project 22600 – the 25 MW diesel-electric icebreaker for the Baltic Sea and the Arctic. The utilized scheme allowed to install two 7.5 MW electric azimuth thrusters in combination with a 10 MW shaftline propeller. This resulted in lower costs and smaller vessel draft, while the maneuverability stayed as high as it would have been with just two azimuth thrusters.

Projects Aker ARC130A and Aker ARC124 (30044) demonstrate the strive for bow propellers that have been less reliable during the 20th century. The use of azimuth thrusters have finally provided a secure solution for these ideas. However, it has to be noted that both projects are not designed to act as leaders in heavy ice conditions, or cruise long distances in open water [7].

Perspective

Modern Russia owns more than a half of the world's icebreakers. Beginning with the 2010s the focus has been on both convoy-leading Arctic icebreakers and auxiliary icebreaking fleet. Since then, over 50 % of diesel-electric icebreakers built for Russia have been equipped with electric azimuth thrusters installed in accordance with the schemes indicated above. Over 60 % of the rest are equipped with mechanical azimuth thrusters.

The increasing interest for the Arctic from other countries triggered a number of icebreaker building programs. However, according to statistics, western countries primarily count upon mechanical azimuth thrusters for their new vessels.

At the moment, Russia does not produce electric azimuth thrusters, as before 2022, every vessel was equipped by thrusters produced abroad. One of the key challenges of the modern shipbuilding industry is to develop our own industry of this technically advanced machinery production sphere.

This problem is underway of being solved. For example, АО “KONAR” is in progress of designing a 2 MW electric azimuth thruster expected to be installed on the Project 22740 shallow water icebreaker. However, apart from that, Russia needs various types of electric azimuth thrusters, all necessary for the development of the NSR as an international transportation corridor.

Although the scope of challenges to be met stays immense, the shipbuilding industry together with the whole of the technical sector is working towards the big goal.

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**USING A PROGRAM FOR RECOGNITION OF ARMORED VEHICLES
BY THEIR FRONTAL PROJECTION IN THE TRAINING
OF OBSERVATION POINT OPERATORS**

Cadet **Danilyan Egor Stanislavovich**,
Academic Advisor: Senior Lecturer **Guzeev Alexey Evgenievich**,
Krasnodar Higher Military Aviation School
named after Hero of the Soviet Union K. Serova,
Krasnodar, Russian Federation

Abstract. The article presents the rationale for the need to use a program for recognizing armored vehicles by their silhouettes using a circular image scanning method when training observation point operators. The experience of conducting various types of training both without and with the use of the above-mentioned program is analyzed, and recommendations for conducting various types of training using the program are offered. The use of this program has a positive impact on the educational process of observation station operators, which contributes to the successful operation of modern visual surveillance systems.

Keywords: problem solving template; lecture; practical training; comprehension.

**ИСПОЛЬЗОВАНИЕ ПРОГРАММЫ РАСПОЗНАВАНИЯ
БРОНЕТАНКОВОЙ ТЕХНИКИ ПО ИХ ЛОБОВОЙ ПРОЕКЦИИ
ПРИ ПОДГОТОВКЕ ОПЕРАТОРОВ НАБЛЮДАТЕЛЬНЫХ ПУНКТОВ**

курсант **Данильян Егор Станиславович**,
науч. руководитель: ст. преподаватель **Гузеев Алексей Евгеньевич**,
Краснодарское высшее военное авиационное училище летчиков
имени Героя Советского Союза А. К. Серова,
г. Краснодар, Российская Федерация

Аннотация. В статье представлено обоснование необходимости использования программы распознавания бронетанковой техники по их лобовой проекции способом кругового сканирования изображения при подготовке операторов пунктов наблюдения. Проанализирован опыт проведения различных видов занятий как без использования, так и с использованием вышеупомянутой программы, а также предложены рекомендации по проведению различных видов занятий с использованием программы. Отмечается положительный вклад использования указанной программы в образовательный процесс операторов пункта наблюдения, что способствует успешной работе современных систем визуального наблюдения.

Ключевые слова: шаблон решения задачи, лекция, практические занятия, осмысливание.

The training of a future visual observation post operator at a certain stage requires students to comprehend and correctly understand the processes that underlie the functioning of the systems and complexes being studied [1]. This allows for reliable and timely identification of an object to select the further, most preferable scenario. In general, this concept is typical for training in any technical higher educational institution [2], however, in the process of training a visual observation post operator, more and more attention is paid to the issues of timely detection, recognition and identification of armored vehicles (BTT). At the same time, it is advisable to begin studying the basics of these actions by considering examples based on simpler scenarios. Then, the performance of more complex tasks is considered, such as reconnaissance using optical-electronic and radar systems, as well as, if necessary, further confrontation with enemy BTT.

Analysis of the experience of modern military conflicts has shown that the timely detection, recognition and identification of armored vehicles is currently a very urgent task. In the educational process when preparing a visual observation point operator, this task is considered especially carefully, since the further development of the battle depends on the speed of decision-making. Taking into account these factors, an urgent scientific and practical task is to improve the process [3] of training a visual observation point operator to use the studied systems and complexes to solve the problems of detection, recognition and identification of armored vehicles. To solve this issue, the authors propose using a program for recognizing an aircraft by its silhouette using a circular image scanning method [4].

Let us recall that the work of the program [4] is divided into a number of stages:

- input of initial data;
- circular scanning of the image (calculation of the standard deviation (SD) of the values of the averaged RGB color components in the elements of the scanning line);
- comparison by subtracting the obtained SD values and those searched in the database;
- output of the comparison result.

The essence of the circular image scanning method is the following sequence of actions:

- calculation of the parameters of the scanning line based on the image size, scanning radius and the size of the square area element of the scanning line;
- averaging the color values in the square of the scanning line. The color of each pixel is not considered, but the color over the entire area of the scanning line element. According to the authors, this approach will speed up the processing of color images of the observed objects and it is advisable to use it for primary identification;
- decomposition of the average color into RGB components and recording of these values in a temporary array (the array line for each RGB color contains twenty values from 0 to 255);
- rotation of the image by one degree;
- calculation of the standard deviation values of each RGB component during full rotation of the image and recording in temporary arrays (the array for each color consists of a line with twenty standard deviation values).

The input parameters allow you to automatically determine the dimensions of

the scanning line. In this example, a line consisting of twenty squares is proposed, in each of which the color is decomposed into average numerical values of the RGB color components.

During the circular scanning process, the ruler rotates 360 degrees. This forms an array of average color values, consisting of three hundred sixty rows and twenty columns, for one color image.

To determine the “uniqueness” of each image, it is proposed to calculate the standard deviation of the average values using the formula given in [4]. As a result, the primary array of 360x20 is transformed into a row of twenty standard deviation values. This approach allows the formation of a BTT database, which is an array of lines with the BTT name and standard deviation values, as well as to reduce the volume of information processed at the comparison stage and speed up the BTT recognition time.

Next, at the comparison stage, by subtracting the obtained values of the standard deviation of the input image of the BTT and the values searched in the database, a specific vehicle is recognized.

It should be noted that the article makes a number of assumptions:

- the images were obtained at a right angle to the armored vehicle;
- the distance to the armored vehicle is the same for all (as can be seen from the geometric dimensions of the armored vehicle in the image);
- the course position is constant for all armored vehicles;
- the frontal projection of the armored vehicle (color image) was used in the processing;
- the database was formed based on the above conditions.

Classically, in classes with operators of visual observation points, situations are modeled, considered and analyzed in which, for example, when performing a task of patrolling space, it is necessary not only to detect, recognize, but also to determine the type of armored vehicle. Experience in conducting such classes shows that errors regularly occurred in the process of identification, caused both by the inattention of students to the parameters characterizing the given armored vehicle, and by a weak mastery of the material being studied. In addition, the main disadvantage of this approach is that the leader of the lesson must either examine one instance of the BTT in parallel with the study group, or have several templates with the results of detection and recognition for different initial data. In the first case, as has been repeatedly noted by teachers, the overall level of involvement of students in the educational process decreases, which negatively affects the understanding and comprehension of the processes taking place. In the second case, the experience of conducting training shows that the process of detection and identification for a group of 25-30 operators takes up to 2.5 hours. This time interval is quite difficult to correlate with the duration of the training itself (2 academic hours). That is why it was decided to use the program to work with each operator separately with the setting of an individual task of identifying various BTT during one training.

Before using the program [4], it is advisable for students and the teacher to discuss the input and output parameters, study the structure (Figure) and the rules for using the program in a group lesson.

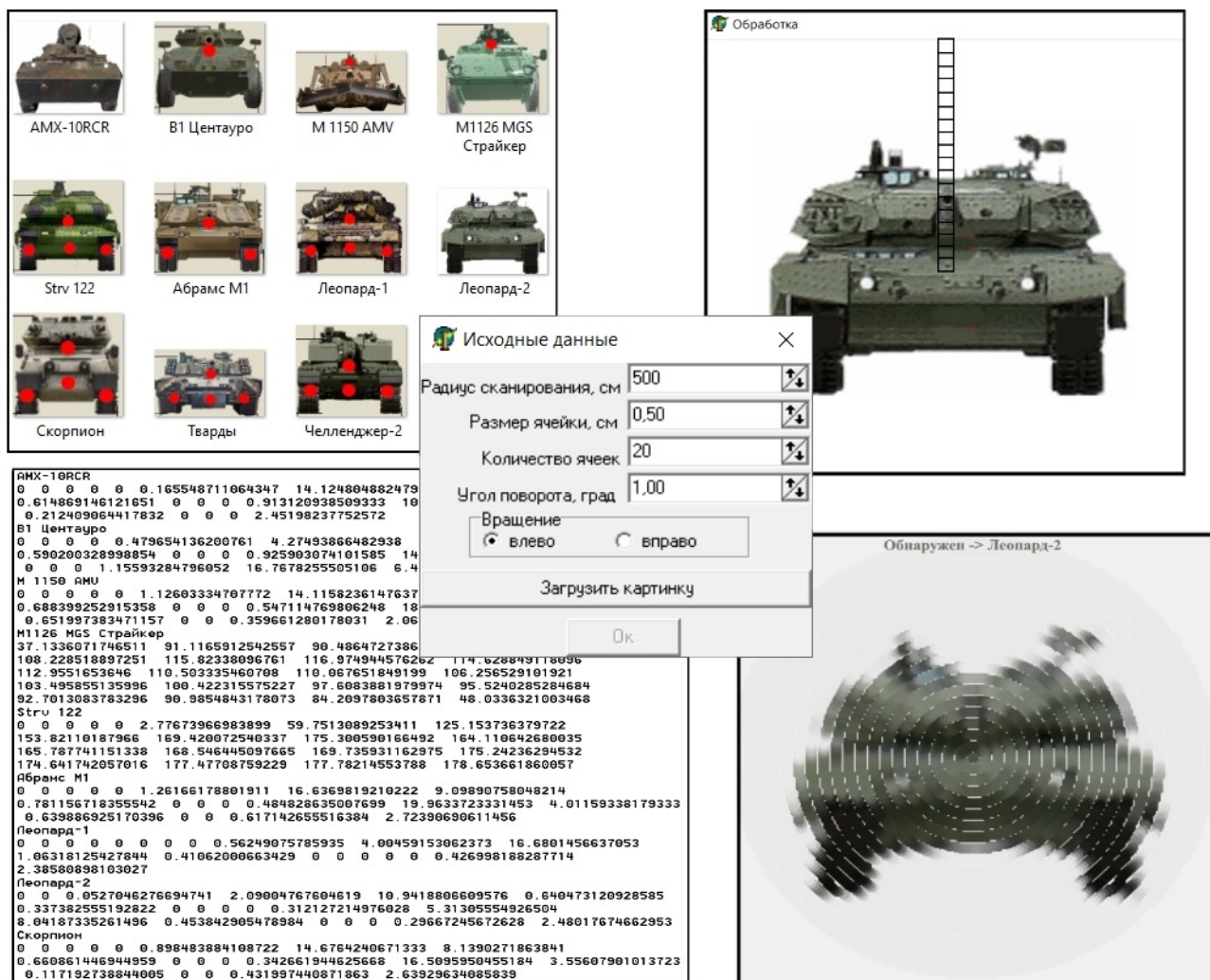


Figure – Structure of the program for recognizing a BTT based on its frontal projection using circular image scanning

There are several possible options for using the program during practical classes. In the first case, each operator is given a typical task of detecting and identifying armored vehicles, and is offered to use the developed program. In the second case, a solution to such a typical task is offered in the classical way, using known images of armored vehicles by manually sorting them. At the same time, the experience of conducting such classes has shown that the most interesting classes are those in which the first and second cases alternate. As a rule, students note the convenience and efficiency of using the program. It is worth adding that the activation of the students' thought process is observed when the practical class is enhanced by elements of competition, which can be ensured by monitoring the time of operators' performance of similar tasks, but with different initial data.

Taking into account the trends of digitalization of the educational environment of any educational institution, which requires each student to have a laptop or tablet, the program can be used when completing practical courses, preparing coursework and diploma projects.

Thus, the positive contribution of the developed program to the educational process is that the operator of the visual observation point acquires the skills of quick

and easy detection, recognition and identification of armored vehicles. This allows one to learn to demonstrate reasonable independence, make balanced decisions and move away from extremely undesirable template options for solving problems. For the practical use of this method in automated observation systems, additional research and testing according to specialized methods are certainly required, for example, for the aviation sector presented in [5, 6, 7, 8].

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APPLICATION OF DESIGN THINKING METHODS IN DESIGNING CRAFTS USING A HOUSEBOAT DEVELOPMENT PROJECT

Master's Degree Student **Chernetskii Nikita Alekseevich**,
Academic Advisor: PhD in Engineering,
CEO of "AN Marine Consulting"
Nazarov Albert Georgievich,
Moscow, Russian Federation

Abstract. The article discusses current methods of design thinking. The stages of empathy, analysis and formulation of the problem, idea generation, prototyping and testing are considered in more detail. The specifics of working on a conceptual project in marine design are illustrated. The relevance of the houseboat project is indicated in connection with the growing popularity of Russian water tourism and the development of a conceptual and legal framework by the State Duma. A number of differences in the design process of a house on the water from a classic vessel are indicated.

Keywords: design thinking, design process, marine design, houseboat, water tourism.

ПРИМЕНЕНИЕ МЕТОДОВ ДИЗАЙН-МЫШЛЕНИЯ В ПРОЕКТИРОВАНИИ СУДОВ НА ПРИМЕРЕ РАЗРАБОТКИ ХАУСБОТА

магистрант **Чернецкий Никита Алексеевич**,
науч. руководитель: канд. техн. наук,
генеральный директор «ООО АН Марин Консалтинг»
Назаров Альберт Георгиевич,
Москва, Российская Федерация

Аннотация. В статье рассматриваются актуальные методы дизайн-мышления. Более подробно рассмотрены этапы эмпатии, анализа и формулирования проблемы, генерации идей, прототипирования и тестирования. Проиллюстрирована специфика работы над концептуальным проектом в морском дизайне. Обозначена актуальность представленного автором проекта хаусбота в связи с ростом популярности российского водного туризма и разработкой понятийно-правовой базы Государственной Думой. Указан ряд отличий процесса проектирования дома на воде от классического судна.

Ключевые слова: дизайн-мышление, дизайн-процесс, морской дизайн, хаусбот, водный туризм.

In Russia more and more attention is paid to recreational and tourist vessels. There is an increase in state participation and interest in promoting the development of the industry [1, p. 29]. Growing competition leads to the improvement of old and the

emergence of new methods of vessel design. The purpose of this article is to improve the consumer qualities of crafts by improving, enhancing and finalizing the methods of their design. Objective: to consider the methods of design thinking and the possibility of their application for vessel design on the example of the houseboat project.

Design thinking as a method of synthesizing new ideas and solutions is widespread in various types of creative activities. It is popular among architects, engineers and industrial designers. The idea was formulated in 1969 by Simon Herbert in his lectures published in the book “Sciences of the Artificial” [2, p. 70]. I note that the word “design” in the title may lead to premature conclusions about the narrow focus of this method, its applicability only in the sphere of creative and mental labor. However, in this case the word “design” is used in a broader meaning – construction, design, creation of an artificial object or system with a set of new properties or a new combination of already known properties. Such synthesis is the goal of any professional discipline and distinguishes practical activity, which is marine design.

Contrary to popular belief, design is not only the aesthetic properties of the product and its subjective evaluation by the consumer (beautiful/ ugly design). Design is how the product works [3, p. 3]. In this sense, the activities of an industrial designer and, for example, an engineer are fundamentally similar – both create a system with a new set of characteristics – “consumer properties”, in the language of design. Although a designer may not have engineering education and skills, and an engineer may be far from understanding aesthetics, proportions, ergonomics and sense of beauty, both apply the same system of thinking. The author will discuss the individual elements of the design thinking system in more detail below, illustrating them with examples of the design stages of a houseboat concept – a floating house.

Stage 1: Empathy

It is necessary to look at the problem through the eyes of a particular person, to get into his role as a consumer, to find out what is important to him, what he wants, what his needs are. Empathy is the most important professional skill of a designer. Only with its help, one person can identify the needs of another person, and design a solution that will satisfy them. It is worth noting that it is of great importance what emotions the user will experience at different stages of interaction with the product. The first impression is no less important than basic consumer properties such as comfort and safety (Figure 1). Let us imagine a user scenario for operating a houseboat. A large group of friends or several families wants to stay at a reservoir for a weekend. For a comfortable stay of a few days and nights, they will need a large air-conditioned/heated area (from 100 square meters) including several cabins, separate bathrooms, a spacious common lounge with a large area of glazing, sofas and table, and a kitchen. Open upper deck also required – flybridge with mini-bar, seating, sofas and canopy. A provided outdoor area for grilling or dancing/photographing will also come in handy. Having made a list of leisure and possible activities on the houseboat, move to the next step.



Figure 1 – An example of a homemade houseboat. Comfort and safety may be high.
But would you want to stay in one?

Stage 2: Analyzing the situation, formulating the problem

After data collection, it is worthwhile to analyze the situation and problems of the consumer. In the case of houseboats and the concept of life over the water, the following potential difficulties, losses and benefits emerge:

- The appeal of living on the Mediterranean/in Karelia/Nizhny Novgorod/Kazan, but classic real estate has a high price/needs communications/construction permits;
- Dependence on power supply from land, necessity of pumping out the waste tank, deficit of qualitative realized offers on the market of houseboats, general low popularity of such way of life in Russia in comparison with abroad;
- Freedom of logistics within the vessel navigation period, floating real estate fund with great tourist and commercial potential in Russia, cheap rent of water area, comparable with new buildings in terms of price per square meter. At the same time more prestigious class of housing, taking into account the outperformance of real estate on the first shore line, a combination of city apartment with country dacha and river motor yacht, which together comes out cheaper than separately.

In addition, an extremely important factor is the proposal to consider and legalize the term “houseboat”, voiced on December 13, 2024 at the meeting of the working group on the development of river, cruise and yacht tourism at the State Duma Committee on Tourism and Tourism Infrastructure Development [4].

Bringing the stage of analysis to completion, the author concluded that the selected and voiced problems and needs are relevant, moreover – raised for consideration by representatives of the State Duma Committee on Tourism. Having had the data confirming the relevance of the topic under consideration, we think it advisable to proceed to the third stage - the generation of ideas.

Stage 3: Idea generation, creativity

While the situation analysis stage involves focusing on individual aspects, delving into details and decomposing into smaller and smaller aspects of design (What? For whom? How? Why? Why this way?), the creative generation stage requires a dramatic

expansion of the field of vision in terms of concepts, ideas and proposed designs under consideration (Figure 2).

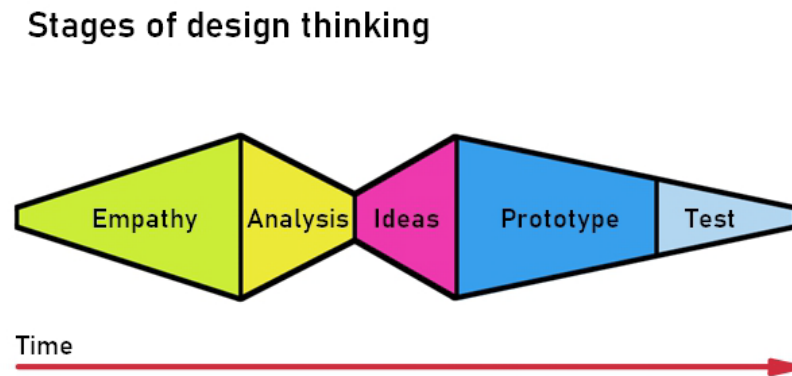


Figure 2 – Visual demonstration of the stages of design thinking

The main tool for generating ideas in industrial design, and in particular in marine design, are visual project notes. The more common and established name is sketches or doodles (from English doodle – quick notes, scribbles). With their help it is possible at an early stage not only to outline the general view of the projected object, but also to delve into some details thanks to the collected information (What is the layout on the plan? On the side view? What are the dimensions? What will be the shape and materials?) (Figure 3). It is also worth mentioning other equally popular creative techniques, such as brainstorming, in which participants propose as many ideas as possible in a short time, without criticizing them, and afterwards start to analyze whether each individual proposal solves the task at hand or should be discarded due to irrelevance/expensiveness/difficulty of implementation. If the collective mind of designers and constructors has reached an impasse, you can use auxiliary techniques that allow you to look at the problem from a new and unexpected angle. Among such techniques are SCAMPER (by the first letters Substitute, Combine, Adapt, Modify, Put to other use, Eliminate, Rearrange), “Workaround Strategy” question cards by Peter Schmidt and Brian Eno, and many others – you can find many variations of these and other techniques on the Internet.

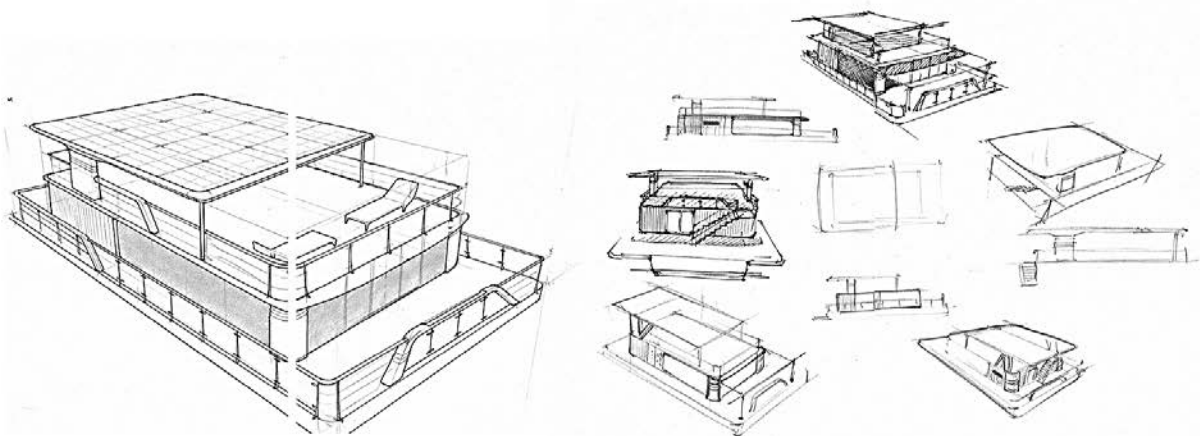


Figure 3 – Visual notes on the example of the houseboat project

Stage 4: Prototype

Once the layout and appearance of the houseboat is defined on paper, you can start designing in CAD. Based on sketches and layouts, a three-dimensional computer model is created, which is refined and supplemented with details. Postponed the minimum necessary dimensions: overall dimensions, width of decks, passageways, dimensions of doorways, lay the height of the ceiling and canopy over the flybridge. A bulwark with guard rails is built. If there are doubts about the availability of access to any nodes, an ergonomic mannequin model with the parameters of the 95th percentile is used, which demonstrates whether the access for the average person will be convenient. When the 3D model is complete, it is used to create clean drawings of the layout and plan. If necessary, images of the model can also be taken for a design patent application. Finally, clean presentation images of the concept (renderings) are created to show the customer and evaluate the work (Figure 4).

Stage 5: Test

In the above algorithm of work on the design project testing stage can be considered as collection of feedback, opinions and objections from the customer. At any stage of the process of design thinking ideas can be discarded, excluded as irrelevant or unrealizable, and then it is necessary to go back to previous stages. Sometimes, due to a sudden change of plans or circumstances, a decision has to be made: do we keep the concept, or is it easier to start again and return to the ideas, analysis or empathy stage?



Figure 4 – Presentation rendering of the 3D model of the houseboat

Design as an effective method for synthesizing new solutions

A houseboat is not a vessel in its classical sense, and also not an engineering structure, as it is said in classical textbooks and works on craft design. When designing a houseboat, it is necessary to apply not only engineering and technical thinking, but also design thinking, because it is the consumer characteristics that play a decisive role:

attractive appearance, comfort, functionality, satisfaction of the need for entertainment [5, p. 7]. The approach in which a ready-made architectural form designed for land is put on floats and adapted, as well as attempts to re-equip a classic vessel into a floating house do not allow to fully reveal the potential of houseboats and water tourism in Russia. A designer initially creates an object that organically combines the characteristics of a land and water surface object and possesses new properties. That is why design thinking as an algorithm is a method suitable for many tasks, including those outside of design as a professional practical activity.

Conclusion

In conclusion, it can be said that in the author's practice the method of design thinking has a proven value for the development of new, more modern vessels with improved properties and consumer characteristics. On the example of the design of a houseboat the advantages of such a method of thinking are demonstrated step by step. Based on the results of the work an application for a houseboat design patent has been filed.

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**THE DEVELOPMENT OF EMOTIONAL INTELLIGENCE
IN LITERATURE LESSONS IN HIGH SCHOOL (USING THE EXAMPLE
OF STUDYING THE NOVEL BY I.A. GONCHAROV "OBLOMOV")**

Student **Toropyno Danila Ivanovich**,
Bryansk State University named after Academician I. G. Petrovsky,
Bryansk, Russian Federation

Abstract. Modern scientific research shows that a person with high emotional intelligence demonstrates developed emotional management skills, which contributes to his adaptability and effectiveness in interpersonal communication. Today, the cognitive development of schoolchildren prevails in the education system, while insufficient attention is paid to emotional development. Using the example of I.A. Goncharov's novel Oblomov, the article presents a cycle of developed exercises that a modern teacher can apply in the classroom to form and develop emotional intelligence in students.

Keywords: emotional intelligence, empathy, self-regulation, I.A. Goncharov, Oblomov, literature lesson.

**РАЗВИТИЕ ЭМОЦИОНАЛЬНОГО ИНТЕЛЛЕКТА НА УРОКАХ
ЛИТЕРАТУРЫ В СТАРШИХ КЛАССАХ (НА ПРИМЕРЕ ИЗУЧЕНИЯ
РОМАНА И. А. ГОНЧАРОВА «ОБЛОМОВ»)**

студент **Торопыно Данила Иванович**,
Брянский государственный университет им. акад. И. Г. Петровского,
г. Брянск, Российская Федерация

Аннотация. Современные научные исследования свидетельствуют о том, что человек, обладающий высоким эмоциональным интеллектом, демонстрирует развитые навыки управления эмоциональной сферой, что способствует его адаптивности и эффективности в межличностном общении. На сегодняшний день в системе образования преобладает когнитивное развитие школьников, в то время как эмоциональному уделяется недостаточное внимание. На примере романа И. А. Гончарова «Обломов» в статье приведен цикл разработанных упражнений, которые современный педагог может применить на уроке, чтобы сформировать и развить в учащихся эмоциональный интеллект.

Ключевые слова: эмоциональный интеллект, эмпатия, саморегуляция, И. А. Гончаров, «Обломов», урок литературы.

Currently, the psychological terms "emotions", "feelings" and "emotional intelligence" are often found in methodology. Since the 90s of the last century, the concept of emotional intelligence (EI) as an alternative to the traditional understanding of intelligence has gained wide popularity in psychological science. Both foreign and domestic researchers continue to actively study the problem of emotional abilities, emotional and social intelligence (SI). Among them are R. Bar-On, A. T. Beck, D. Goleman, M. Gerald, D. R. Caruso, J. D. Mayer, P. Salovey, E. Austin, G. Orme, K. V. Petrides, D. Pizarro, A. Furnham, I. N. Andreeva, O. V. Belokon, I. I. Vetrova, D. V. Lyusin, M. A. Manoilova, E. L. Nosenko, E. A. Orel, E. A. Sergienko, D. V. Ushakov, G. V. Yusupova, and others.

The concepts of EI currently being developed are based on ideas put forward in the framework of SI research (Gardner, 1983 [14]; Eysenck, Eysenck, 1985 [13]; Sergienko and Vetrova, 2009 [8]). Thus, E. Thorndike, studying SI, repeatedly emphasized a person's ability to understand other people, act and act wisely towards them, considering the most important ability to predict their behavior. A similar approach was shared by G. Allport, who viewed SI as a social gift necessary for balanced behavior and harmonious relationships with people. J. Guilford understood SI as an integral intellectual ability that determines successful communication and social adaptation. It should be noted that emotions play a key role in these SI models, influencing the productivity of SI functioning and the effectiveness of the process of interaction with other people.

In the scientific works of Russian researchers, there is a constant interest in the relationship between intelligence and emotions. O. K. Tikhomirov explores the relationship between thinking and emotions, focusing on the role of intellectual emotions in thought processes and their specifics in different motivations of activity [10]. Over the past two decades, D. V. Lyusin has made a significant contribution to the study of EI by developing a two-component theory, according to which EI is the ability to understand and manage one's own and others' emotions [7]. E. P. Ilyin notes that unlike abstract and concrete intelligence, which allows a person to perceive the patterns of the external world, EI reflects the inner world of a person and its connection with behavior and interaction with reality [3]. V. A. Tolochev identifies the level of intelligence development and the emotional factor as essential internal conditions that ensure the regulation of activity [12]. Mental performance, according to V. A. It is a complex mental formation that integrates various functions (mnestic, mental, attention, etc.), as well as energy, cognitive and tonic components, etc. Mental performance ensures the successful solution of professional tasks associated with intellectual and emotional stress, but without subsequent professional deformations and destructions [11].

Over the past eighty years, there has been a significant increase in research in the field of psychology, which has focused on emotions. Since the 1940s, when D. Wexler introduced the concept of "non-intellectual" abilities into science [1] and interest in this field increased. As noted by D. Goleman [2] and D. V. Lyusin [5], [6], [7], Modern research focuses on the interaction of the emotional sphere with cognitive

functions. Special attention is paid to the influence of emotions on perception, as well as the processes of experiencing and processing emotional information.

Thus, the relevance of this study is due to the fact that it is currently necessary for teachers to carry out targeted and systematic work on the development of EI among students. Such work will not only contribute to their personal growth, but also improve the quality of education. EI serves as the basis for ensuring the psychological well-being of schoolchildren and prevents the spread of negative phenomena (bullying, deviant and auto-aggressive behavior, conflict, etc.). A high level of EI development will make it possible to establish effective communication between students and teachers, as well as between students themselves. This helps to master teamwork skills, increase confidence in expressing your own ideas without fear of being misunderstood.

M. Seidner's research [15] reveals the relationship between emotional competence and individual differences in self-regulation. The proposed model interprets these differences from the perspective of the individual's developmental characteristics and demonstrates the factors influencing the level of EI. These factors include: temperamental characteristics, the cultural and social environment that forms ideas about the emotions experienced, acceptable ways of expressing and managing them, and the ability to reflect, allowing oneself to realize oneself as a social subject integrated into a socio-cultural context, which, in turn, affects the emotional behavior of the individual and others around him.

In the works of M. Seidner, R. D. Roberts, J. Matthews and D. V. Lusin, a model of EI was proposed, consisting of four structural elements: temperament, information processing methods, confidence in one's own emotional competence, as well as emotional knowledge and skills. According to this model, temperament and information processing methods are relatively stable characteristics due to the peculiarities of the nervous system.

R. Leahy's theory of emotional schemas considers emotional competence as a set of human concepts about emotions and strategies for their control. This theory suggests that throughout life, a person forms emotional response patterns based on the experience of interacting with others (parents, peers, teachers, etc.). Such patterns can contribute to both assertive behavior (the ability to overcome negative situations and experiences) and maladaptation in the case of incorrect emotional patterns [4].

Thus, based on the analysis of existing concepts and theories about EI, the following key components can be identified:

1. Self-awareness is the ability to perceive and understand one's own emotions, to be aware of one's capabilities, values, and motives;
2. Self-regulation – the ability to manage your emotions and abilities;
3. Empathy – the ability to understand the emotions and feelings of others;
4. Managing the emotions of others and relationships - the ability to build relationships with people, inspire and captivate them.

It is worth noting that researchers have established some kind of connection between EI and academic performance, others do not confirm this relationship. This suggests that the influence of EI on academic achievement is mainly related to

motivation and self-regulation of behavior. In particular, it was found that in gifted children, academic performance correlates with mobile intelligence, but not with emotional intelligence. At the same time, students with lower intelligence scores have academic performance associated with both mobility and EI.

Despite this, correlations between EI and academic performance are not always found. Different diagnostic methods may produce different results when measuring the overall level of EI in the same group of people.

It is believed that EI as a cognitive ability is related to general intelligence, therefore, the relationship between EI and academic achievements is found when using techniques based on the ability model, rather than on a mixed model. However, there is currently insufficient research devoted to studying this relationship, mainly the contribution of emotional and general intelligence to various achievements (academic or professional), as well as their role in coping with stress, etc.

In today's world, where communication, empathy and adaptability are becoming increasingly important, the development of EI among schoolchildren is a priority task of education. Literature lessons, with their wealth of human experiences, can become a powerful tool for developing EI, providing unique opportunities to immerse oneself in the world of emotions and feelings. Literary works represent a palette of diverse human emotions. By analyzing the feelings and experiences of the characters, students have the opportunity to expand their emotional vocabulary, learn to recognize different shades of emotions and understand their causes.

For example, I. A. Goncharov's novel *Oblomov* provides rich material for the development of EI among high school students. Through the analysis of the characters' complex emotional states, their motives, actions, and relationships, students can learn to understand both their own and others' emotions, develop empathy, and self-regulation skills. Below are specific exercises that can be used in literature lessons when studying this work.

1. Oblomov's Emotional Dictionary

Students are asked to make a list of emotional states that the main character most often experiences (for example, apathy, laziness, longing, disappointment, hope). Then they must find examples in the text of the work that illustrate each of these states. The purpose of this exercise is to help children learn to recognize and name a wide range of emotions and analyze their manifestations in specific situations.

2. Emotional portrait of the characters

Students choose several characters from the novel (Oblomov, Stolz, Olga Ilyinskaya, Zakhar) and create their emotional portraits. They should describe which emotions are most characteristic of each character, as they manifest themselves in external behavior and speech. The purpose of this exercise is to develop the skills of identifying and describing the emotional states of different characters, understanding their motives and character traits.

3. A letter on behalf of the character

Schoolchildren write a letter on behalf of one of the main characters of the work, addressed to another (for example, a letter from Oblomov to Olga or Stolz to

Oblomov). In it, they must convey the feelings, thoughts and experiences of their hero. The purpose of this exercise is to develop empathy, understanding the inner world of characters, and the ability to express their thoughts and emotions on behalf of another person.

4. Relaxation technology for Oblomov

Students are asked to imagine that they work as psychologists and should develop a personal emotion management program for Oblomov. They should describe which relaxation techniques, breathing exercises, or meditation they would recommend to Oblomov. The purpose of this exercise is to develop self-regulation skills, the ability to apply emotional control techniques.

5. Motivational poster for Oblomov

Students are invited to develop a motivational poster for Oblomov, which would help him overcome his apathy and laziness. The poster should contain positive affirmations, inspiring slogans and images that could arouse his motivation. The purpose of this exercise is to develop the skills of using positive emotions to achieve goals, as well as the ability to motivate others.

Thus, the listed cycle of exercises can help modern schoolchildren to better understand and realize the emotional complexity of the novel, develop their EI and learn how to apply the acquired skills in real life. Using the novel *Oblomov* as a material for the development of EI can make modern literature lessons more interesting, exciting and useful for the personal growth of high school students. In conclusion, it is worth emphasizing that teachers and psychologists currently unanimously recognize the importance of developing EI in modern schoolchildren. They call for a systematic approach that brings together school, family, and community efforts to help students develop the emotional skills necessary for successful living, learning, and self-fulfillment. According to teachers and psychologists, a well-developed EI is the key to mental health, well-being and success of socialization and adaptation in the modern world. Literature lessons are fruitful ground, where the teacher studies the work of a particular Russian writer (for example, I. A. Goncharov's novel *Oblomov*). It can implement various types or cycles of exercises aimed at achieving this goal.

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A FOREIGN LANGUAGE AS A PERSONAL BRANDING TOOL

Master's Degree Student **Derkach Anastasia Andreevna**,

Academic Advisor: PhD in Philology, Associate Professor

Martirosyan Ekaterina Gennadievna,

Krasnodar Branch of the Plekhanov Russian University of Economics,

Krasnodar, Russian Federation

Abstract. This article examines the role of a foreign language in the formation and promotion of a personal brand. Key aspects such as increasing competitiveness, expanding professional and social networks, as well as the opportunity to communicate with an international audience in order to promote a personal brand are analyzed. Special attention is paid to how knowledge of foreign languages helps to create an image of an expert and authority in a particular field, helps to build trusting relationships with clients and partners, and also examines examples of successful personal brands that use foreign languages in their promotion strategies.

Keywords: foreign language, promotion, personal brand, communication, competitive advantage.

ИНОСТРАННЫЙ ЯЗЫК КАК ИНСТРУМЕНТ ЛИЧНОГО БРЕНДИНГА

магистрант **Деркач Анастасия Андреевна**,

науч. руководитель: канд. филол. наук, доцент

Мартиросьян Екатерина Геннадьевна,

Краснодарский филиал Российского экономического

университета им. Г. В. Плеханова,

г. Краснодар, Российская Федерация

Аннотация. В данной статье рассматривается роль иностранного языка в формировании и продвижении личного бренда. Анализируются такие ключевые аспекты, как повышение конкурентоспособности, расширение профессиональных и социальных сетей, а также возможность общения с международной аудиторией с целью продвижения личного бренда. Особое внимание уделяется тому, как знание иностранных языков помогает создать имидж эксперта и авторитета в определенной области, помогает построить доверительные отношения с клиентами и партнерами, а также рассматриваются примеры успешных личных брендов, которые используют иностранные языки в своих стратегиях продвижения.

Ключевые слова: иностранный язык, продвижение, личный бренд, коммуникация, конкурентное преимущество.

The relevance of this work is determined by several key factors that reflect modern socio-economic reality, such as the globalization of the labor market, increasing intercultural interaction, the development of online platforms and social networks, the growing importance of a personal brand, education and self-improvement, as well as adaptation to changes in the market. Thus, the study of the relationship between foreign language proficiency and personal brand is an urgent and important topic, which, in turn, contributes to the understanding of successful promotion strategies at the present time [1].

The research materials used information from various literature on the topic of personal branding, namely, scientific articles and books, case studies, which include an analysis of successful examples of personal brands, which, in turn, use foreign languages for their promotion, as well as various multimedia sources such as websites, blogs, social media, and more. Qualitative and quantitative methods based on the analysis of various indicators, etc. were used as research methods.

Knowledge of a foreign language not only improves communication skills, but also serves as a signal of professionalism. In the context of increasing competition in the labor market, employers often consider proficiency in one or more languages as an important advantage among candidates for many positions [2].

Learning a foreign language opens up access to information that is not always available in your native language. This will provide an opportunity to read specialized articles, participate in international conferences and webinars, as well as communicate with experts from different countries. This allows you to create content based on current global trends, which, in turn, strengthens your personal brand.

A personal brand is not just an image, but how others perceive you. A foreign language can significantly affect how your personal brand is built, especially in the international arena. First, knowledge of a foreign language implies high competence and education of a person, and, accordingly, forms a positive impression of you as a professional [3].

Each personal brand is based on three things, namely: professionalism, popularity and reputation, let us look at each of them in more detail.

1. Professionalism. A personal brand does not arise from scratch; it needs investments in the form of a desire to share existing knowledge, ideas, etc. with others. You don't have to be a broad – based professional – you can become an expert on one topic, but you need to know it much more deeply than the others.

2. Popularity. It comes when certain goals and results have already been achieved in the chosen activity.

3. Reputation.

The modern development of the labor market is at the stage when each individual professional treats both the company and the product for sale in a single person. Naturally, as in the case of goods, competition between specialists is so high that choosing between them becomes a laborious task. In addition, consumers are already accustomed to finding solutions based on the parameters provided by traditional brands, and thus form their own idea of a good offer. This was the reason why branding

migrated from the marketing of goods and services to the sphere of individual specialists who seek to monetize their name and thus increase personal income.

In addition, proficiency in a foreign language makes it possible to expand the horizons of online communication. Participation in various international conferences, seminars, forums, etc. allows you to establish contacts with industry leaders in all corners of the world. Knowledge of a foreign language makes it easy to communicate with people who may later become potential partners or clients, such connections in turn form a personal brand [4].

Knowledge of a foreign language has a direct impact on career prospects. Many companies are considering employees who will be able to work in an international environment in the future. Most companies invest in training their employees. Accordingly, proficiency in foreign languages gives an advantage when considering candidates for a new position in the company. Employers often look for employees in the company who strive to expand their horizons, and learning foreign languages contributes to this [5].

Nowadays, with the rapid development of social media, knowledge of a foreign language opens up new horizons for promoting your personal brand. Creating content not only in Russian, but also in foreign languages can contribute to significant audience growth. For example, blogging, social media posts, podcasts, video creation, and more.

In addition to all this, learning languages can lead to collaboration with other content authors, therefore, the audience will expand through collaboration with other bloggers, which, in turn, will strengthen your personal brand. It can also be joint participation in any projects, interviews, etc., in other words, anything that creates the impression of a more active person [6].

Let us look at the main advantages of knowing foreign languages that affect the development of a personal brand.

1. A wide audience. Knowledge of foreign languages allows you to reach a wider audience and interact with people from different countries.

2. Access to information. Much of the educational information, including various articles, studies, courses, and more, is available in foreign languages. This simplifies the learning and professional development process.

3. Participation in international projects. Knowledge of foreign languages opens up many opportunities, including participation in international webinars, conferences and other events, which, in turn, increases brand visibility.

4. Network capabilities. This advantage lies in the opportunity to communicate with professionals from different countries and cultures, and also allows you to expand your contacts, which in the future may lead to career growth and cooperation.

5. Image improvement. Proficiency in a foreign language can enhance professional reputation and trust in a personal brand, especially in an international environment.

However, along with the advantages of knowing foreign languages that influence a personal brand, there are certain disadvantages, such as:

1. The language barrier. If the level of knowledge of a foreign language is not

high enough, it can become an obstacle to effective communication and transmission of their ideas.

2. Dependence on translation. If you use different translators, this can lead to a distortion of meanings or misunderstanding between the interlocutors.

3. Competition. In an international environment, you will have to compete with many other professionals who also speak foreign languages, which, accordingly, makes it much more difficult to distinguish yourself from others.

4. Difficulties in adaptation. For some people, learning foreign languages can be quite a difficult process, which, in fact, can cause stress, as well as reduce self-confidence and their abilities.

5. The need for continuous training. The language is constantly evolving, and in order to maintain current knowledge, it is necessary to constantly learn and improve existing skills.

Knowledge of foreign languages is quite a significant advantage for developing a personal brand, but it requires a lot of effort and time to master and maintain it.

It is worth noting that many successful personal brands were formed precisely on the basis of language skills. For example, personalities like Elon Musk, Richard Branson, and many others use their language skills to interact with international communities to strengthen their personal brand.

A foreign language is a powerful personal branding tool that allows you to expand your opportunities and create a unique image. In the age of globalization and digitalization, knowledge of foreign languages is becoming the norm and opening doors to new markets, audiences, and career opportunities. All this makes it possible to establish new international relations, interact with different cultures and demonstrate their high level of competence [7].

English language proficiency is indicated in the candidate requirements in 88% of vacancies on the Job website.ru". Some of these vacancies are for professionals who have English as a core skill: for example, teachers and translators. But English is also required in other areas related to communication and negotiations. This is often a prerequisite for hiring journalists, PR managers, executive assistants, and project managers.

Using a foreign language in the context of a personal brand can help people expand their professional network and find clients or partners abroad, and much more. It is also worth noting that knowledge of foreign languages can increase trust and credibility, since the ability to communicate in several languages is often seen as a sign of competence and openness.

Thus, proficiency in a foreign language not only enhances professional skills, but also contributes to the creation of a successful personal brand, which, in turn, is taken seriously in the international arena.

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THE USE OF THE COLORATIVE “BLUE” IN R. BRADBURY’S SHORT STORIES

Student **Zubova Elizaveta Gennadievna**,
Voronezh State Pedagogical University,
Voronezh, Russian Federation

Abstract. This article examines the peculiarities of using the colorative “blue” in Ray Douglas Bradbury’s short stories. The focus is on analyzing examples of blue color mentions in descriptive and emotional-psychological functions. A conclusion is drawn about the purpose of use and functions of blue color symbols in Ray Douglas Bradbury’s short stories.

Keywords: colorative vocabulary, colorative, descriptive function, emotional-psychological function.

ИСПОЛЬЗОВАНИЕ КОЛОРАТИВА «СИНИЙ» В РАССКАЗАХ Р. БРЭДБЕРИ

студент **Зубова Елизавета Геннадьевна**,
Воронежский государственный педагогический университет,
г. Воронеж, Российская Федерация

Аннотация. В статье рассматриваются особенности использования колоратива «синий» в рассказах Рэя Дугласа Брэдбери. Основное внимание уделяется анализу примеров упоминания синего цвета в описательной и эмоционально-психологической функциях. Делается вывод о цели использования и функциях синих цветовых символов в рассказах Рэя Дугласа Брэдбери.

Ключевые слова: колоративная лексика, колоратив, описательная функция, эмоционально-психологическая функция.

In modern linguistics, considerable attention is paid to the study of linguistic features in literature. The issues of using colorative vocabulary in literary texts have been addressed in the works of K. N. Gushchina, O. A. Evseeva, E. A. Masolovova, G. R. Mugtasimova, T. A. Ponomareva, K. A. Nagina, O. N. Charykova, and other scholars.

According to A. V. Zubareva’s definition, colorative vocabulary is “a unique object of linguistic research, representing linguistic units whose root is semantically or etymologically related to the naming of a color” [1]. The renowned linguist A. Wierzbicka noted that a colorative is a “universal concept of similarity in conveying visual sensations” [2].

The scholarly interest in this layer of language is justified by the diversity of the cultural code that coloratives can encompass: stereotypes of thinking, peculiarities of

worldview, and moral values.

Authors of literary texts resort to using colorative vocabulary to imbue their text with emotions and details that need to be grasped between the lines.

Our attention will be focused on the literary works of the American writer Ray Douglas Bradbury. The writer's leading genre is science fiction. Texts of this genre abound in descriptive elements, among which colorative vocabulary occupies a special place. It makes the work more colorful, creates a special atmosphere, and the meaning of coloratives can be both literal and figurative.

The aim of our research is to describe the peculiarities of using the colorative "blue" in R. Bradbury's short stories. We examined 11 short stories selected randomly: «The Fire Balloons», «All Summer in a Day», «Here There Be Tigers», «In a Season of Calm Weather», «Dark They Were, and Golden-Eyed», «A Sound of Thunder», «Fever Dream», «Remember Sasha?», «A Medicine For Melancholy», «The Next in Line», «Jack-In-The-Box».

The choice of color is justified by the frequency of its use in the writer's stories. The main research task is to identify the functional load of colorative vocabulary in R. Bradbury's short stories.

It is known that coloratives perform a variety of functions – nominative, evaluative, descriptive, and many others [3]. The nominative (specification of color for description) and symbolic (transmission of symbolism through color association) functions were considered by us within the framework of a previous study devoted to the analysis of coloratives used in R. Bradbury's literary texts [4]. In this work, we will pay particular attention to the emotional-psychological and descriptive functions of coloratives in R. Bradbury's short stories.

According to E. Shtengelov, the emotional-psychological function "is realized by influencing human feelings with certain colors or their combinations" [5]. It is known that the non-verbal use of various colors can affect the human body, for example, by stimulating appetite through warm colors. Coloratives are also capable of influencing a person, evoking certain emotions.

The descriptive function is manifested through the reflection of the color diversity of the surrounding world. A.P. Vasilevich notes that color designations "are used mainly in describing a person's appearance or nature" [6]. Unlike the nominative function, the descriptive function not only states the fact of the presence of a certain color in nature but rather gives it vitality, making the text more vibrant.

Data from social surveys conducted by the scientific journal Live Science shows that blue is the most popular color in the world [7], therefore, it occupies high positions of use, including in literature. Blue is most often associated with masculinity, intelligence, knowledge, tranquility, and concentration. This colorative is often associated with the sky, mostly carrying positive emotions and feelings [8].

However, blue can also be associated with sadness. In the English language, the word "blue" has several meanings – both "blue" as a color and "sad" or "dejected" when referring to a person. Here's a quote from the Oxford Dictionary: "blue – 1) having the colour of a clear sky or the sea on a clear day; 2) sad, synonym depressed" [9].

Furthermore, blue is often associated with peace and in many cultures also has

religious significance (for example, the Virgin Mary is often depicted in blue robes) [8].

It should be noted that the color blue is one of the most common in use and mention in Bradbury's work. For example, in the collection of short stories "The Martian Chronicles," blue is the leader in usage among coloratives according to a study by Sokolova E. N.

The color blue in the writer's stories has such a large number of shades: defiantly blue (The Fire Balloons); amazing blueness (All Summer in a Day); electric-blue ironwork balconies (In a Season of Calm Weather); bluish liquids (Here There Be Tigers). This saturates the text, making it more memorable.

We observe that shades of blue can be formed using modifiers, for example, defiantly blue, while the modifier electric is used exclusively with the shade of blue electric-blue. Other coloratives are created mainly with the help of suffixes, forming both nouns blueness and adjectives bluish.

The author widely uses the color blue, which performs a descriptive function in literary texts:

For describing the environment:

A) Bodies of water: blue lake (The Fire Balloons), blue river (The Fire Balloons); the canal waters lay blue in the sun (Dark They Were, and Golden-Eyed).

B) Sky: the blue and tender sea (A Sound of Thunder); blue September sky (Fever Dream); sky was a blazing blue tile color (All Summer in a Day).

In most cases, the colorative only states the color necessary to describe and immerse the reader in the text. However, sometimes auxiliary words are added to it, embellishing its content, for example, blazing.

For describing the color of eyes:

R. Bradbury repeatedly resorts to the blue colorative in his works to expand the color palette of the characters' irises: eyes that for a brief moment flickered bright blue (Remember Sasha?); in the blue of his eyes (Dark They Were, and Golden-Eyed).

Special attention should be paid to the short story "A Medicine for Melancholy." We meet the main character, Camille, whose character is shrouded in all-consuming longing and sadness, the source of which remains a mystery. Here, we see the transfer of a blue hue from water to eyes to emphasize, among other things, Camille's emotional state, ready at any moment to burst into tears from her oppressive state of mind: clear-water eyes, water-blue eyes.

The emotional-psychological function is also widely reflected in this colorative: The blue colorative can denote cold: blue cool rain (Here There Be Tigers); all cold blue-black shadow (The Next in Line). This is because blue is the primary color in the cold category.

We can also notice that in this case, there are words meaning temperature, which deepens their emotional-psychological coloring.

The color blue can be used to convey a threat, most often from nature: blue and terrible lightning (All Summer in a Day); blue April morning (A Sound of Thunder); Blue Period at twilight (In a Season of Calm Weather); half of the world was blue and endless (Jack-In-The-Box).

Thanks to the cold undertone of the color blue from nature, the author successfully manages to describe the picture, making it more complete and memorable.

The analysis of literary texts allows us to conclude that the author in a descriptive

function most often uses the color blue. R. Bradbury masterfully paints the objects of the surrounding reality blue, most often denoting natural phenomena. In R. Bradbury's work, the color blue acts as a synonym not only for the word sadness, but also denotes coolness and tension. At the same time, in its emotional-psychological form, the colorative "blue" conveys negative emotions, reflecting impending danger.

Thus, we understand that coloratives play a significant role in R. Bradbury's literary works. Color vocabulary makes the works more colorful by influencing the emotional-psychological component of the reader.

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PSYCHOLOGICAL REALISM IN MODERN ANGLO-AMERICAN PROSE

Student **Stroy Maria Alexandrovna**,
Student **Hudyakova Irina Mikhailovna**,
Academic Advisor: PhD in Pedagogy, Associate Professor
Sukhareva Natalya Aleksandrovna,
State University of Management,
Moscow, Russian Federation

Abstract. In Anglo-American literature, psychological realism focuses on the study of the inner world of characters, their experiences, feelings, thoughts and motives that determine their actions. It seeks to convey the subjective perception of reality using the stream of consciousness technique, working out psychological aspects in detail, which makes the works a living reflection of human existence.

Keywords: psychology, realism, influence, approaches, consciousness.

ПСИХОЛОГИЧЕСКИЙ РЕАЛИЗМ В СОВРЕМЕННОЙ АНГЛО-АМЕРИКАНСКОЙ ПРОЗЕ

студент **Строй Мария Александровна**,
студент **Худякова Ирина Михайловна**,
науч. руководитель: канд. пед. наук, доцент
Сухарева Наталья Александровна,
Государственный университет управления,
Москва, Российская Федерация

Аннотация. В англо-американской литературе психологический реализм сосредоточен на изучении внутреннего мира персонажей, их переживаний, чувств, мыслей и мотивов, определяющих их поступки. Он стремится передать субъективное восприятие действительности, используя прием потока сознания, детально прорабатывая психологические аспекты, что делает произведения живым отражением человеческого бытия.

Ключевые слова: психология, реализм, влияние, подходы, сознание.

Modern Anglo-American prose is an important cultural phenomenon that reflects both universal and specific social, cultural and political problems of our time. One of the leading trends that determine the characteristics of the literature of the 21st century is the appeal to psychological realism, which studies the inner world of characters, their psycho-emotional experiences and interaction with the surrounding reality. This tradition has deep historical roots, however, in modern conditions it is undergoing significant transformations, which is due to the development of new scientific approaches, social changes and rapid changes in the perception of personality and its psychology.

This topic is relevant, because nowadays the study of psychological characteristics of a person in literature is of particular importance and modern Anglo-American prose is increasingly delving into the depths of the inner world of the characters, conveying their emotional experiences, thoughts and internal conflicts with particular accuracy. This approach to the depiction of characters makes literature more sensual and intimate, contributing not only to a deeper understanding of the characters, but also to the self-knowledge of the reader.

The purpose of this article is to study the features of psychological realism in modern Anglo-American prose. The study will examine the main problems faced by writers and propose new approaches to the analysis of this phenomenon. The most important objectives of the article are: a review of theoretical and practical sources on the topic of psychological realism in literature, a study of the methodology used in psychological analysis research, identification of current problems of psychological realism in modern Anglo-American prose⁶, and the development of new approaches and proposals for solving the problems under study.

Psychological realism as a literary approach emerged inside the 19th century, whilst writers commenced to pay greater attention to the internal global in their characters. This was a kind of response to the need for a deeper and greater straightforward depiction of human nature. Before this, literature often centered on external occasions, but authors found out that real drama and struggle came about within a person. Jane Austen in *Pride and Prejudice* and *Emma* masterfully discovered the diffused mental nuances of relationships, displaying how non-public prejudices and social expectancies affect the destinies of people [1]. Hawthorne in *The Scarlet Letter* explored the subject of guilt and condemnation, displaying how social strain and inner stories can damage a person. Henry James in *The Portrait of a Lady* and *The Turn of the Screw* created multi-layered mental pics of heroes, specializing in their belief of truth. And George Eliot in “*Middlemarch*” confirmed the complexity of human characters, their ethical dilemmas and inner struggle [2].

In the 20th century, with the development of psychoanalysis, psychological realism developed. Sigmund Freud proposed a brand new approach to the take a look at of the human psyche, which had a significant effect on literature. The works of such authors as James Joyce, Virginia Woolf, and William Faulkner became the premise for the further development of mental analysis in literature.

Thus, in the work “*Ulyss*” James Joyce used a circulation of cognizance, allowing the reader to look into the chaotic teach of concept of the characters, and Virginia Woolf within the novel “*Mrs. Dalloway*” deeply immersed herself inside the studies of the characters, displaying how their thoughts are intertwined with recollections and feelings. William Faulkner in “*The Sound and the Fury*” and “*As I Lay Dying*” created complicated narrative structures, conveying the arena via the eyes of different characters, every of whom perceived reality of their very own way.

Modern researchers highlight several factors of psychological realism in the literature of the 21st century. This is, first of all, attention to the individual psychology of the heroes, the study of their inner world, not only at the level of emotional experiences, but also through the prism of cognitive and neurobiological processes. This determines the complexity and versatility of the characters, which requires the

reader to actively interact with the text and recognize numerous subtexts.

Modern literature, where psychological realism occupies an important place, relies on a variety of theoretical concepts that combine both traditional approaches and the latest achievements of psychoanalysis, cognitive psychology and neuroscience.

Psychoanalysis continues to play a key role in understanding the psychological characteristics of literary heroes. Works created with psychoanalytic concepts in mind open the way for us to study how unconscious aspirations, secret impulses and suppressed feelings shape the behavior of characters. The focus is on the archetypes, symbols, and metaphors that authors use to express the deep layers of their characters' psyches.

Cognitive mechanisms studied within the framework of cognitive psychology open up new horizons for understanding how characters perceive and interpret the world around them. Neuropsychological approaches allow us to study the relationship between cognitive functions, such as attention, memory, and perception, and the psychoemotional state of characters. This perspective allows us to depict more accurately how characters perceive their environment and what mental mechanisms underlie their decisions and actions.

Neurobiology, which is the basis for research on the functioning of the brain, also influences modern psychological realism [3]. Writers, realizing the importance of neurobiological research, are beginning to work with how the physical state of the brain and its structures affect the characters' perception of reality, their behavior, and relationships with others.

The study of psychological realism in modern Anglo-American prose requires a comprehensive approach, since the inner life of characters in such works is reflected through many interconnected factors. The most important methods for analysis are psychoanalytic, cognitive, neurobiological and cultural approaches, each of which helps to reveal different aspects of the human psyche and behavior.

The psychoanalytic approach, traditionally used in literary studies, focuses on the unconscious characters' internal processes, their internal conflicts and suppressed desires. By analyzing symbols and metaphors, as well as studying psychological defense mechanisms such as repression and projection, it is possible to identify hidden motives and reasons for the characters' actions. This approach helps to understand how psychological trauma or unconscious experiences affect the characters' behavior and their relationships with the outside world.

Cognitive psychology, in turn, pays attention to the processes of perception, thinking and memory that affect the behavior of characters. Studying how characters perceive and interpret reality helps to understand how internal experiences, such as trauma or depression, affect their perception of the world and decision-making [4]. This also includes the analysis of cognitive distortions – changes in perception caused, for example, by anxiety or stress.

No less significant is the neurobiological approach, which allows us to study psychological processes through the physiological mechanisms of the brain. This approach focuses on how neuropsychological processes, such as neurotransmitter or hormonal activity, affect the emotional state and perception of characters. For example, stress or traumatic experiences may manifest themselves through physiological

reactions, such as increased heart rate or changes in brain activity.

In addition, cultural and sociological approaches are actively used to analyze the impact of the sociocultural environment on the inner world of characters. Social factors such as class, gender or ethnic identity can significantly affect how characters perceive themselves and others [5]. This approach helps to understand how social norms and expectations shape the personal experiences of characters, causing them internal conflicts or contradictions, especially in the context of changing social situations or pressure from society

Using these different approaches in combination gives a more complete understanding of psychological realism. The interdisciplinary method allows us to synthesize data from psychoanalysis, cognitive psychology, neuroscience and cultural studies, which significantly enriches the understanding of how various aspects of human life interact and shape personality. This comprehensive approach allows for a deeper understanding of how characters' inner experiences, behavior, and perception of the world around them are the result of multiple interrelated factors, both biological and social.

Psychological realism in contemporary Anglo-American fiction is an important area that continues to develop despite constant changes in literary and cultural contexts [6]. The problems and directions of research in this area are related to several principles, including the ways of depicting characters' inner worlds, the influence of sociocultural factors on the psychology of heroes, and the relationship between literary method and psychoanalytic, cognitive, and neurobiological theories.

One of the most important problems is the difficulty of conveying characters' psychological depth in a rapidly changing world. Contemporary writers face the challenge of how to depict a hero's inner experiences in the context of a postmodern break with traditional narrative structures and stereotypes. In this context, the problem of realistically depicting a person's inner world, which is subject to multifaceted and sometimes contradictory experiences, becomes relevant. A modern hero, often in search of identity, faces internal conflicts, which requires the author to understand deeply psychology and the ways of conveying it through the text.

The difficulty also lies in how to actualize psychological realism in the context of various cultural and social changes [6]. For example, in the context of globalization and multiculturalism, it becomes necessary to take into account the influence of sociocultural factors on the perception of an individual, their psychology and behavior. Constant social and political changes affect the perception of an individual and their internal experiences, which becomes an important topic for research. Researchers focus on how different groups of people (for example, minorities, migrants, and women) experience their identity in the context of changes and pressures from the external environment, which is a new challenge for literary works striving for psychological realism.

The difficulty also lies in mastering new ways of telling stories that go beyond traditional narrative methods. Contemporary writers, such as Jonathan Franzen and Healy Flanagan, are increasingly experimenting with non-linear narratives, where psychological authenticity is achieved not through the direct presentation of the characters' internal monologues and feelings, but through their interaction with the

world and external factors. The hero's inner world is revealed through his responses to certain events or details of the environment, which forces the researcher to look for new ways of analyzing such works.

Research areas focused on modern psychological realism also touch upon issues of multidisciplinary analysis. More and more attention is paid to the integration of various theories of psychology, psychoanalysis, neurobiology and sociology for a deeper understanding of the psychological state of the characters [7]. Texts focused on psychological realism require a new approach to analysis, which takes into account not only literary means and stylistics, but also biological, psychophysiological, cognitive and cultural aspects of the perception of reality. Thus, in recent decades there has been a tendency towards a comprehensive approach in the study of psychological realism, when both individual experiences and external social and cultural contexts are taken into account.

Thus, the problems and areas of research into psychological realism in modern Anglo-American prose continue to develop and be enriched with new approaches. The complexity of displaying the inner world of a character in the context of modern reality requires flexibility from researchers, which implies the need to take into account not only traditional methods of analysis, but also the latest achievements in the field of psychology, neurobiology and cultural studies.

One of the significant problems that arise when analyzing psychological realism is the complexity of understanding and interpreting the emotions and mental states of characters in conditions of social instability and uncertainty. In response to this, researchers offer several new approaches, among which are:

- An interdisciplinary approach that combines psychology, sociology, neurobiology and literary criticism. This approach allows for a more complete coverage of the problems of psychological analysis.
- Multimodal methods of analysis that use not only text, but also visual, auditory, cinematic and other elements of culture for a deeper understanding of the psychology of the character.

Psychological realism in modern Anglo-American prose continues to be an important literary tradition, actively developing and adapting to modern social and cultural changes. The problems of the inner world of the individual, his/her relationship with the outside world and the influence of social factors on the psychological state remain relevant for many writers and researchers. With the development of new approaches in psychology, neurobiology and sociology, as well as in response to the challenges of the postmodern era, literary psychological realism continues to expand its boundaries. In the future, it is important to continue studying this phenomenon, deepening the understanding of how the inner world of the character reflects changes in the social context.

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THE PSYCHOLOGY OF TIME PERCEPTION: HOW INDIVIDUAL DIFFERENCES SHAPE OUR EXPERIENCE OF TIME AND ITS IMPACT ON DAILY LIFE

Student **Kuznetsova Kristina Andreevna**,
Student **Karimova Arina Damirovna**,
Academic Advisor: PhD in Pedagogy, Associate Professor
Sukhareva Natalia Alexandrovna,
State University of Management,
Moscow, Russian Federation

Abstract. This article examines the psychological mechanisms of time perception and the impact of individual differences (temperament, stress levels, mood) on subjective time estimation. It analyzes the role of temporal perception in decision-making and quality of life. Special focus is given to the relationship between psychological traits and temporal perception distortions. The study's relevance stems from the need for effective time management and adaptation to accelerating modern life pace, which is crucial for both personal and professional domains.

Keywords: time perception, individual differences, stress, mood, decision-making, productivity, well-being.

ПСИХОЛОГИЯ ВОСПРИЯТИЯ ВРЕМЕНИ: КАК ИНДИВИДУАЛЬНЫЕ РАЗЛИЧИЯ ФОРМИРУЮТ НАШ ОПЫТ ВРЕМЕНИ И ЕГО ВЛИЯНИЕ НА ПОВСЕДНЕВНУЮ ЖИЗНЬ

студент **Кузнецова Кристина Андреевна**,
студент **Каримова Арина Дамировна**,
науч. руководитель: канд. пед. наук, доцент
Сухарева Наталья Александровна,
Государственный университет управления,
Москва, Российская Федерация

Аннотация. В данной статье исследуются психологические механизмы восприятия времени и влияние индивидуальных различий (темперамент, уровень стресса, настроение) на субъективную оценку времени. Анализируется роль временного восприятия в принятии решений и качестве жизни. Особое внимание уделяется взаимосвязи психологических черт с искажениями временной перцепции. Актуальность исследования обусловлена необходимостью эффективного управления временем и адаптации к ускоряющемуся темпу жизни, что имеет важное значение для личной и профессиональной сфер.

Ключевые слова: восприятие времени, индивидуальные различия, стресс, настроение, принятие решений, продуктивность, благополучие.

Time perception is a subjective experience that varies significantly among individuals. Research shows that neural mechanisms of time estimation are linked to attention and prefrontal cortex activity [1, p. 755]. While time itself is a constant, the way we perceive its passage can feel either accelerated or prolonged, depending on psychological and environmental factors [2, p. 304]. This article investigates how individual differences, such as personality traits, emotional states, and cognitive processes, shape our perception of time. It also explores the practical implications of these differences for decision-making, productivity, and well-being. Understanding time perception is crucial in a world where efficiency and time management are highly valued. By examining the psychological underpinnings of temporal perception, this article aims to provide insights into how individuals can better align their subjective experience of time with their goals and responsibilities.

Time perception is a complex cognitive process influenced by both internal and external factors. Internally, psychological traits such as temperament, emotional state, and stress levels play a significant role in shaping how we experience time. Externally, environmental stimuli, task engagement, and cultural context can alter our perception of its passage. One of the key theories in this field is the internal clock model, which suggests that the brain has a neural mechanism that tracks the passage of time [3, p. 227]. This mechanism can be influenced by factors such as attention, arousal, and emotional state. For example, when individuals are highly focused or engaged in a task, time may seem to pass quickly – a phenomenon known as “time flies when you're having fun” [4, p. 127]. Conversely, during periods of boredom or stress, time may feel as though it is dragging. Individual differences in time perception are also linked to personality traits. For instance, individuals with a high level of neuroticism may perceive time as passing more slowly during stressful situations, while those with a more optimistic outlook may experience time as flowing more smoothly. These differences highlight the subjective nature of time perception and its connection to broader psychological characteristics.

Stress and mood are among the most significant factors influencing time perception. Research has shown that high levels of stress can distort our sense of time, making it feel as though it is passing more slowly [5, p. 464]. This is because stress activates the body's fight-or-flight response, heightening awareness and causing individuals to focus intensely on their immediate environment. Mood, on the other hand, can either accelerate or decelerate our perception of time. Positive emotions, such as joy or excitement, are often associated with a faster perception of time, while negative emotions, such as sadness or anxiety, can make time feel as though it is dragging [6, p. 10369]. These effects are particularly relevant in everyday life, where fluctuations in mood and stress levels can impact productivity, decision-making, and overall well-being. For example, in high-pressure work environments, employees who experience chronic stress may struggle with time management, perceiving deadlines as more urgent than they actually are. This can lead to rushed decisions, decreased performance, and burnout. Conversely, individuals who maintain a positive mood and effective stress management strategies are better equipped to perceive time accurately

and use it efficiently.

The way we perceive time has profound implications for our behavior and decision-making. In professional settings, accurate time perception is essential for meeting deadlines, managing workloads, and maintaining productivity. Individuals who perceive time as passing quickly may be more likely to procrastinate, while those who perceive it as dragging may struggle with motivation and focus. In personal life, time perception influences how we prioritize activities, set goals, and maintain relationships. For instance, individuals who perceive time as limited may place greater emphasis on meaningful experiences and long-term planning, while those who perceive it as abundant may be more prone to procrastination or indecision. Understanding these dynamics can help individuals develop strategies to optimize their time perception and improve their quality of life. Techniques such as mindfulness meditation, stress management, and goal setting can help individuals align their subjective experience of time with their objectives and responsibilities.

Time perception not only influences how we experience moments but also plays a critical role in shaping our decisions and actions. The way we perceive time can affect our ability to plan, prioritize, and execute tasks, ultimately affecting our personal and professional lives. This section delves deeper into the relationship between time perception and decision-making, exploring how individual differences in temporal perception can lead to varying outcomes in behavior and productivity.

One of the most significant ways time perception affects behavior is through procrastination. Individuals who perceive time as abundant or who underestimate the time required to complete tasks are more likely to delay starting or finishing projects. This phenomenon, known as the planning fallacy, occurs when people underestimate the time needed to complete a task, leading to last-minute rushes and suboptimal outcomes. For example, students who perceive deadlines as distant may postpone studying, only to find themselves overwhelmed as the deadline approaches. Similarly, professionals who misjudge the time required for a project may miss deadlines or deliver work of lower quality. Understanding the role of time perception in procrastination can help individuals develop strategies to counteract this tendency, such as breaking tasks into smaller, manageable steps and setting intermediate deadlines.

Time perception also influences risk-taking behavior. Individuals who perceive time as limited or who feel a sense of urgency are more likely to take risks in pursuit of immediate rewards. This is particularly evident in financial decision-making, where impulsive investors may prioritize short-term gains over long-term stability. Conversely, individuals who perceive time as expansive may adopt a more cautious approach, focusing on long-term goals and avoiding unnecessary risks. These differences in temporal perception can lead to varying outcomes in areas such as career development, financial planning, and personal relationships. By recognizing how time perception shapes risk-taking behavior, individuals can make more informed decisions that align with their long-term objectives.

The way we perceive time also affects how we set and pursue goals. Individuals

who perceive time as limited are more likely to prioritize meaningful, long-term goals, such as career advancement or personal growth. This sense of urgency can motivate individuals to take action and make the most of their time. On the other hand, those who perceive time as abundant may struggle with goal setting, often delaying action or focusing on short-term, less significant objectives. This can lead to a lack of direction and a sense of unfulfillment. By understanding the relationship between time perception and goal setting, individuals can develop strategies to align their temporal perspective with their aspirations, such as creating detailed action plans and regularly reviewing progress.

Time perception is not solely an individual phenomenon; it is also shaped by cultural and social factors. Different cultures have varying attitudes toward time, which can influence how individuals perceive and manage it. For example, cultures that emphasize punctuality and efficiency, such as those in North America and Western Europe, tend to view time as a valuable resource that must be used wisely [7, p. 183]. In contrast, cultures with a more relaxed attitude toward time, such as those in parts of Latin America and the Mediterranean, may prioritize relationships and experiences over strict adherence to schedules. These cultural differences can lead to varying approaches to time management, decision-making, and behavior. Social influences, such as peer pressure and societal expectations, can also shape time perception. For instance, individuals in high-pressure environments, such as competitive workplaces or academic institutions, may perceive time as scarce and feel compelled to maximize productivity. This can lead to stress, burnout, and a diminished quality of life. By recognizing the impact of cultural and social factors on time perception, individuals can develop a more balanced and personalized approach to managing their time.

Given the profound impact of time perception on behavior and decision-making, it is essential to develop strategies that align our temporal perspective with our goals and responsibilities. Here are some practical approaches to achieving this alignment:

Mindfulness and Time Awareness: Practicing mindfulness can help individuals become more aware of their perception of time and of how it influences their behavior. By focusing on the present moment, individuals can reduce stress and improve their ability to manage time effectively.

Time Blocking: Allocating specific blocks of time for tasks and activities can help individuals structure their day and reduce the tendency to procrastinate. This approach encourages a more conscious use of time and promotes productivity.

Goal Setting and Prioritization: Setting clear, achievable goals and prioritizing tasks based on their importance can help individuals align their time perception with their objectives. Regularly reviewing progress and adjusting plans as needed can ensure that time is used effectively.

Stress Management: Managing stress through techniques such as exercise, meditation, and relaxation can help individuals maintain a balanced perception of time. Reducing stress can prevent the distortion of time perception and improve overall well-being.

Cultural Awareness: Recognizing the influence of cultural and social factors

on time perception can help individuals develop a more flexible and adaptive approach to time management. By understanding different perspectives on time, individuals can navigate diverse environments more effectively.

The psychology of time perception is a rich and multifaceted field that offers valuable insights into how we experience and manage time. By understanding the factors that influence time perception, such as individual differences, stress, mood, and cultural context, individuals can develop strategies to align their temporal perspective with their goals and responsibilities. In a world where time is often perceived as a scarce resource, the ability to manage our perception of time is crucial for achieving personal and professional success. By leveraging insights from psychological research and adopting practical strategies, individuals can cultivate a healthier relationship with time, enabling them to navigate the complexities of modern life with greater ease and resilience.

The study of time perception continues to evolve, offering exciting new possibilities for both scientific understanding and real-world applications. Recent technological advancements are revolutionizing how we investigate and apply knowledge about our temporal experiences.

Modern brain imaging techniques now allow scientists to observe time perception processes with unprecedented clarity. We are discovering that the brain handles time through complex networks involving multiple regions working together, not just isolated areas. This deeper understanding helps explain why time perception varies so much between individuals and in different situations.

Cutting-edge virtual reality systems create immersive environments where researchers can study time perception in lifelike scenarios. These technologies do not just help scientific studies – they are being adapted for practical uses like improving time management skills and helping people with conditions that affect their sense of time.

Perhaps most fascinating are the discoveries about how flexible our time perception really is. Just as we can train our bodies through exercise, emerging evidence suggests we might be able to train our sense of time through specific mental exercises. This could lead to new approaches for helping people who struggle with time-related challenges in daily life.

The cultural dimension of time perception is receiving well-deserved attention. As researchers study more diverse populations worldwide, we are learning that concepts of time vary far more than previously thought. These findings are not just academically interesting – they are proving valuable for international business, education, and cross-cultural communication. Looking ahead, the most promising developments may come from combining these different approaches.

The future of time perception research promises not just deeper knowledge, but tangible ways to improve how we live with and experience time in our increasingly fast-paced world. This evolving understanding reminds us that time is not just something we measure it is something we experience, and that experience can be shaped and improved.

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THE ROLE OF THE ENGLISH LANGUAGE TEACHER AS A CULTURAL EDUCATOR IN GENERAL EDUCATION SCHOOL AT THE PRIMARY EDUCATION LEVEL

Student **Rozhkova Ekaterina Vyacheslavovna**,
Academic Advisor: PhD in Philology, Associate Professor
Balakina Irina Alexandrovna,
Ural State Pedagogical University,
Yekaterinburg, Russian Federation

Abstract. The article deals with the role of the English language teacher as a cultural educator in the primary education system. The key concepts such as cultural educator and intercultural communication are studied, as well as the importance of transferring country information about the culture and life of English-speaking countries. The article presents a developed set of pedagogical activities aimed at transferring country-specific information about the culture, traditions, lifestyle and peculiarities of the peoples of the USA and Great Britain.

Keywords: cultural education, country information, intercultural communication, English language, primary education, junior schoolchildren.

РОЛЬ ПРЕПОДАВАТЕЛЯ АНГЛИЙСКОГО ЯЗЫКА КАК КУЛЬТУРНОГО ПРОСВЕТИТЕЛЯ В ОБЩЕОБРАЗОВАТЕЛЬНОЙ ШКОЛЕ НА УРОВНЕ НАЧАЛЬНОГО ОБРАЗОВАНИЯ

студент **Рожкова Екатерина Вячеславовна**,
науч. руководитель: канд. филол. наук, доцент
Балакина Ирина Александровна,
Уральский государственный педагогический университет,
г. Екатеринбург, Российская Федерация

Аннотация. В статье рассматривается роль преподавателя английского языка как культурного просветителя в системе начального образования. Исследуются ключевые понятия, такие как культурный просветитель и межкультурная коммуникация, а также важность передачи страноведческой информации о культуре и жизни англоязычных стран. В статье представлен разработанный комплекс педагогических мероприятий, направленный на передачу страноведческой информации о культуре, традициях, образе жизни и особенностях народов США и Великобритании.

Ключевые слова: культурное просвещение, страноведческая информация, межкультурная коммуникация, английский язык, начальное образование, младшие школьники.

Relevance of the problem under study. In the context of globalization and cultural exchange, the role of the English language educator becomes particularly

significant not only as a language speaker but also as a cultural educator. Modern learners are faced with a multitude of cultural influences, and the educator's task is to help them not only to master the language but also to understand the cultural context in which the language functions.

The English language educator, as a bridge between different cultures, fosters cultural competence in learners. This includes exposure to the traditions, customs, and historical heritage of English-speaking countries, which greatly enriches the educational process and helps students develop a deep understanding of it and respect for the diversity of cultures.

The problem of insufficient cultural education of junior schoolchildren about English-speaking countries is that the curriculum pays insufficient attention not only to linguistic aspects, but also to cultural traditions, customs and values. This leads to a limited understanding of the diversity of cultural heritage and social life of native speakers. As a result, students not only lose the opportunity to develop intercultural competences, but also do not acquire the necessary knowledge to communicate effectively with people from other cultures. The lack of a rich cultural education program can also negatively affect children's motivation to learn a language, as they do not see its significance in the context of the global world.

In this paper, we will theorize such a concept as cultural education activities and propose a set of pedagogical activities to integrate elements of cultural education into the language course.

Material and research methodology. The comparative analysis of available definitions of the term intercultural communication in the literature has shown that their authors emphasize the common characteristic features of this definition – relations between people who are bearers of different cultures. Let us consider some definitions.

In the work by Habibulina we can find the following definition of *intercultural communication*: “Intercultural communication is a communicative environment, a cultural space in which subject-subject relations are manifested and opportunities for understanding another culture on the basis of comparison with one's own” [1, p. 7].

In the work by Frick “*intercultural communication* is a set of various forms of relations and communication between individuals and groups belonging to different cultures” [2, p. 54].

Effective will be considered that intercultural communication, which contributed to the achievement of the goal set before entering into communicative activity. One of the problems of ineffective intercultural communication is the lack of cultural understanding between its participants. Communicators in the course of their communication should not only demonstrate a sufficient command of the language, but also understand the cultural characteristics of the country on behalf of which their opponent speaks.

In the Russian Federation, at present, junior schoolchildren in general education schools begin to study British English as a foreign language from Grade 2. Real practice has shown that the English language curricula place greater emphasis on subject outcomes on the part of communicative and linguistic abilities and skills. By the end of the foreign language course, junior schoolchildren should possess the following sociocultural knowledge and skills (Bitter and Simbirtseva): “to possess

sociocultural elements of speech behavioral etiquette accepted in the English-speaking environment, in some situations of communication; to know the names of the country/countries of the studied language; to know some literary characters; to know small works of children's folklore" [4]. Textbooks, acting as a means of implementing the curriculum, are also practically not equipped with material that allows students to get acquainted with the culture of the countries of the target language. Thus, junior schoolchildren at the end of the basic foreign language course in elementary school are practically unaware of the peculiarities of life in foreign countries.

The relationship between language and culture is inherent, since language appears not only as a system of rules and lexical units, but also acts as a carrier of culture itself. The cultural context in language education plays an important role, as it not only enriches the learning process, but also "realizes the principle of preservation and dissemination of values and meanings of culture in different social conditions" [3].

Based on this, for the basic definition of the concept of cultural and educational activity of a teacher, we will understand a set of activities devoted to the formation of "value attitude to culture, art, science, national and world traditions" [5, p. 2207-2210]. This kind of activity contributes to the development of personal culture, formation of stable value orientations and active participation of schoolchildren in further intercultural communication. Within the framework of the implementation of cultural and educational activities of teachers N. Y. Moskvina and I. A. Temirova offer the following ways of organizing the activities of students for their cultural enlightenment: "visiting exhibitions, concerts, theaters, cinemas; developing and conducting thematic lectures, master classes; classes devoted to learning about the history and culture of different countries and peoples, discussing cultural differences and common values; compiling a recommended list of literature and films, holding discussions and debates, organizing cultural and educational activities, organizing cultural and educational activities for students" [5, p. 2207-2210].

On this basis, we can say that teachers should not only curate experiences, but also create learning environments that encourage students to reflect on cultural materials. For example, when organizing visits to museums or cultural performances, teachers can provide pre-visit discussions and post-visit reflections that help students make sense of their experiences and connect them to broader cultural and historical stories. Moreover, incorporating technology into these activities can further enrich students' understanding of diverse cultural contexts. Digital platforms can be used to create virtual tours of exhibitions or to host interactive discussions with artists and cultural figures from around the world.

In addition, the role of interdisciplinary approaches cannot be overemphasized. By incorporating literary reading, environmental studies, music and visual arts lessons into cultural education, teachers can help students make connections between disparate cultural artifacts and the socio-political contexts in which they exist.

Consistent with the above strategies, assessment methods must also evolve to reflect the goals of cultural education activities. Traditional testing may not adequately reflect students' reflection, understanding, and engagement with cultural content. Alternative forms of assessment, such as portfolios or creative projects, may provide a more complete picture of student learning and engagement with cultural content.

Finally, fostering collaboration between educators, cultural institutions, and community organizations can greatly expand the reach and impact of cultural and educational activities. Partnerships with local artists, museums, and cultural organizations can provide authentic experiences and mentoring opportunities for students, thereby reinforcing the importance of cultural education in their lives.

Thus, the effectiveness of cultural education activities depends on a multifaceted approach that combines experiential learning, technology integration, interdisciplinary connections, innovative assessment methods, and collaboration with community organizations. By utilizing these elements, educators can develop a generation of culturally aware and engaged individuals who are prepared to navigate and contribute to a diverse and interconnected world.

The results of the study and their discussion. Within the framework of this work we have conducted a study to clarify the level of initial awareness of junior schoolchildren about the culture of the countries of the target language. The pupils of 2nd-4th grades of a municipal comprehensive school in Yekaterinburg were asked to answer questions about their awareness of national traditions, cultural heritage and geographical position of Great Britain and the United States of America.

The results showed that the students are aware of the geographical position of the countries of the studied language, some peculiarities of their political system, but only a few (12 out of 150) of the surveyed junior pupils were able to answer the questions related to the cultural heritage and peculiarities of the organization of social life of people in Great Britain and the United States of America.

Then we developed and put into practice pedagogical activities that contribute to increasing cultural awareness of the countries of the target language. The themes of the lessons were: “English-speaking countries: the USA and Great Britain”, “Famous cultural figures of the USA”, “Famous cultural figures of Great Britain”, “Great Britain and the USA: holidays and traditions” “Familiarization with the creative work of cultural figures of the USA and Great Britain”, ‘Jeopardy: Great Britain and the USA – English-speaking countries’. The materials contributing to the realization of pedagogical activities can be found by going to the QR code below. The offered materials consist of the developed presentations for conducting the lessons, as well as one technological map as an exemplary example of the lesson on the theme “The English-speaking countries USA and Great Britain”, explanatory note. The materials can also be accessed by clicking on the link provided in the list of references for this paper [6].



Figure – Materials of a set of pedagogical activities

These pedagogical activities were carried out in a complex for the same children who participated in the primary diagnostics aimed at assessing the children's knowledge of the countries of the target language.

During the classes, the students not only actively participate in the discussion and learn from the teacher, but also work on the creation of a “tourist passport”, which are left with the students after the course. The development of the “tourist passport” allows us to work in several directions:

- development of language skills: development of reading and comprehension skills in English; improvement of oral and written speech;
- development of critical thinking: development of the ability to analyze and compare information, highlight the main things, draw reasonable conclusions;
- formation of cultural awareness of junior pupils: familiarization with cultural features, history and modern realities of the USA and Great Britain; formation of respect and interest in other cultures;
- development of creative abilities: creating an original tourist passport involves a creative approach, which develops children's artistic skills.

Afterwards, the tourist passports developed by the children are kept by the children. Junior schoolchildren can use them in their further work at lessons when the teacher continues work related to cultural and educational activities. You can read more about the work involved in creating a “tourist passport” in our supplementary materials.

At the end of these pedagogical activities, we conducted a follow-up questionnaire aimed at identifying the students' picture of the world about some foreign countries where English is the official language.

The results of the repeated questioning of students confirmed the effectiveness of the undertaken approach. The data analysis showed that the level of students' knowledge about the culture and life aspects of these countries has significantly increased. More than 80 % of the participants indicated that they had a better understanding of cultural differences and customs. The number of questions related to cultural aspects also increased, indicating an increased interest in the topics studied.

In addition, in the questionnaires, students indicated the positive impact of the activities on their motivation to learn foreign languages and cultures. Many stated that now they are more interested in learning English, as it gives them access to a deeper understanding of the culture of native speakers.

Thus, it can be concluded that the set of pedagogical activities was successful, contributing not only to the expansion of students' knowledge, but also to their interest in the culture and languages of the countries. It is recommended to continue such initiatives, expanding them to other aspects of culture and life of different countries.

Conclusion. The cultural-educational activities of an English teacher in the primary grades play an important role in the development of younger students. Thanks to the active activity of the teacher, aimed at forming cultural awareness of junior schoolchildren about the foreign countries of the target language and the cultural code of their peoples, students not only master the English language system, but also understand cultural differences, which is especially important in a multinational society.

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THE PORTRAYAL OF AN ACTRESS OF 18TH CENTURY IN THE FRENCH AND ENGLISH ENGRAVING ART THROUGH THE WORKS OF A. WATTEAU AND W. HOGARTH

Master's Degree Student **Baglay Polina Yevgenyevna**,

Academic Advisors: PhD in Arts, Associate Professor

Zeitlina Marina Vladimirovna,

PhD in Philology, Associate Professor

Nazarchuk Yulia Ivanovna,

Saint Petersburg State University of Industrial Technologies and Design,

Saint Petersburg, Russian Federation

Abstract. Through the centuries actresses had an uncertain place in Europe culture. Although, they always revealed the public intentions. Their images in graphic art are significant and shows how the public fascination with the theater has influenced on their perception in society. Two powerful countries of the 18th century, France and Britain, had its own portrayal of theatrical women. Different in terms of stylistic features, and close in the transmission of fashion trends, those works are indicative of the public's tastes.

Keywords: actress, theatre, Commedia dell'Arte, Watteau, Hogarth, engraving, engraved portraits.

ОБРАЗ АКТРИСЫ XVIII ВЕКА В ФРАНЦУЗСКОЙ И АНГЛИЙСКОЙ ГРАВЮРЕ НА ПРИМЕРЕ РАБОТ А. ВАТТО И У. ХОГАРТА

магистрант **Баглай Полина Евгеньевна**,

науч. руководители: канд. искусствоведения, доцент

Цейтлина Марина Владимировна,

канд. филол. наук, доцент **Назарчук Юлия Ивановна**,

Санкт-Петербургский государственный университет

промышленных технологий и дизайна,

Санкт-Петербург, Российская Федерация

Аннотация. На протяжении веков актрисы занимали неопределенное место в европейской культуре. Однако они всегда отражали намерения публики. Их изображения в графическом искусстве показательны и демонстрируют, как увлечение публики театром влияет на их восприятие в обществе. Две могущественные страны XVIII века, Франция и Великобритания, по-своему представляли женщин театра. Разные по стилистическим особенностям и близкие по передаче модных тенденций эти работы отражают вкусы публики.

Ключевые слова: актриса, театр, Комедия дель Арте, Ватто, Хогарт, гравюры, гравированные портреты.

18th century opened a new phase in French cultural history. After absolute monarchy of Louis XIV with its strict courtyard rules, the democratic values introduced by The Duke of Orleans started to spread. The Duke himself was fond of a frivolous and hedonistic lifestyle, which became the mark of that period. Due to social changes, the public began to crave for escapism and entertainment, which was noticeable in art in general. The paintings depicted mainly pastoral scenes, mythological and love stories, the music was dominated by light melodies, and even literary characters resembled actors, as, for example, in the novels of Pierre de Marivaux. Everything needed to be light and pleasant for the eyes. Theatre became one of the most important part of French culture. The so called *masks of Commedia dell'Arte* were real social roles which damsels and cavaliers tried on at gatherings such as feasts, balls, and promenades. The bright, jolly, and free Italian theatre, as French people saw it, even displaced more conservative and classical *Comédie-Française*. Comedy replaced tragedy, and carelessness emerged as a new truth.

In this environment, women took a significant place in cultural life. They were welcomed guests in salons, and were an object of worship and adoration for writers and artists. Every aristocrat tried on the image of an innocent shepherdess or a timid muse, while the real-life images of those pure adorable creatures were theatre actresses. Here we need to distinguish then popular Italian actresses, who exuded lightness and joy, and French dramatical ones, who played more complex characters and opened psychological realism for the national scene. In view of the interests of the Enlightenment era, dramatical theatre did not disappear, but comedy caught on with the general public. That is why *Comédie-Française* took material from *Commedia dell'Arte* including characters. Therefore, actresses began to transform their theatrical images in connection with fashion trends. They perfectly combined the beauty of the Rococo era, pallor and fragility, and the exotic masks of Italian heroines, revealing to France a new image of a woman.

However, their social status was peculiar and seemed similar to that of fallen women. Rococo theatre was associated with entertainment and free morals which contradicted the traditional notions of female virtue. Despite the idleness of the era, a woman who was too socially “free” was considered immoral. The age contradicted itself, combining incongruities: religiosity and licentiousness, morality and immorality. For example, Jean-Jacques Rousseau considered women as modest, self-sacrificing and domesticated by nature whilst actresses – vain, artificial and corrupt [1, p. 5].

Even the articles in the French language of that time indicated a certain position in society. In the 17th and 18th century there was an article *la* that mostly referred to the people of the third estate. Actors and actresses were the part of this estate, but only actresses had this article as a pretence of nobility. Actors were usually referred to as *monsieur or sieur* and by their stage name but never with *le*. The article *la* was not an honourable title but a dishonourable substitute [2, p. 198]. However, in the 18th century the address of *mademoiselle* began to take place. Actresses were important for theatre life. This ambiguous treatment did not interfere with its popularization, but, on the contrary, contributed to it. Jeanne-Marie Capron, Sophie Arnoux, Adrienne Lecouvreur and Claire Joseph Hippolyte Leris are women who became famous in the French society. Further, theatre scenes became a fashionable subject for engravings.

The phenomenon of fashionable pictures – small-format engravings depicting people as actors, once again proves the widespread passion for the theatre [3, p. 7]. Damsels and cavaliers not only copied the way actors behaved on the stage, according to a certain role, they also bought those art works depicting themselves or the people of the third estate in theatre costumes. As for actresses, it became a common occurrence to create engraved portraits, often for the sake of advertising. As a rule, they were depicted in their roles and theatrical costumes. For example, the portrait of Adrienne Lecouvreur as Cornelia from the *The Death of Pompey* tragedy (Figure 1). Here, the member of the troupe *Comédie-Française* is pictured in a dramatic role. In contrast to rococo frivolity, she is embodying tragedy and inner suffering. In this example, the spectator could easily distinguish an actress, because aristocratic women were barely that dramatic in their portraits and especially plot paintings. The engraver used special details to point out the main role of Adrienne Lecouvreur. First of all – her clothes that referred the viewer to Roman times and yet classical tragedy. Second of all, her upward gaze, expressing suffering and sorrow.

Distinct types of portraits were more secular. Therefore, German engraver Georg Friedrich Schmidt depicted Adrienne in a different way (Figure 2). In this small-format paper, she is represented as a lady in a rococo manner. It needs to be mentioned that actresses, on the contrary to the church's opinion, took significant place in French cultural life. They attended or arranged intellectual salons, participated in philosophical life and also inspired artists and writers. That means that especially famous theatrical women, to some extent, can be considered as being a part of aristocratic society.

By the way, Adrienne Lecouvreur herself was a link between the aristocracy and the philosophers. She proved that she could both be a celebrated artist and a respected participant in philosophical discourse [2, p. 203]. Lecouvreur truly changed the way actresses were treated among intellectual circles. She was friends with Voltaire and helped popularize his ideas through theatrical performance. Especially because of Adrienne, his philosophical texts became available to the general public (she was the first to play roles in Voltaire's plays *Zaire* and *Oedipus*). Lecouvreur was the owner of a salon which was often visited by Diderot, d'Alembert and Montesquieu, and where the ideas of the Enlightenment were discussed. Her apartment became a laboratory for the Enlightenment thought, where actors and philosophers debated the social role of theatre [4, p. 147]. In this exact position of a legitimate member of the society, we can see Adrienne Lecouvreur on Schmidt's engraving. Pale, round-faced and with a slight smile she also represents the rococo female beauty ideal.

In spite of all her merits, she still had quite a scandalous reputation (for example because of her affair with The Duke de Bouillon). Her private life, unfortunately, just like her colleagues', was put on display. This fact prevented her from becoming a real aristocrat, because there was no place for actresses among the nobility. However, her glory paradoxically increased the influence of the theatre on the public debate on morality.



Figure 1 – Drevet P. A. (based on the original by Charles-Antoine Quapelle) Portrait of Adrienne Lecouvreur as Cornelia in Corneille's "La Mort de Pompée". 1730. Etching and burin. 43.2 x 31.5. Paris, National Library of France



Figure 2 – Schmidt G. F. Portrait of Adriana Lecouvreur in an open dress with a scarf draped over her shoulders. XVIII. Etching with a chisel. 13.8 x 9.5. Saint-Petersburg, The State Hermitage Museum

No less frequent plot for engravings were masks of the *Commedia dell'Arte* as well-established theatrical images – Harlequin, Pierrot and Columbine. No one could better depict such, from the first site joyful, but truly sophisticated characters as the master of *fêtes galantes* Antoine Watteau. In his engraving Italian comedians, we can observe the Watteau's principle – theater as a metaphor for life (Figure 3). Anxiety, tragedy, but admiration is taking place here. One can also guess the sharpness of Hogarth's future satires here. The brightest feature of Watteau's characters – eternal sadness [5, p. 12]. On this engraving the contrast between actor's stage costumes and tired poses is noticeable (it reminds theatre without backstage). Absence of colour only help to absorb the special feel of disturbance. Watteau professionally depicted facial expression of each character of theatre troop. Focusing on actresses, they, as the others, presented in the moment of rest after the performance. They both pose in front of invisible viewer and try to keep on masks despite the exhaustion [6, p. 78–82]. Actress in the middle – Columbine appears as a graceful, enigmatic figure, embodying the duality of *Commedia dell'arte*'s playful yet melancholic spirit. Unlike the saucy, scheming heroine of Italian comedy, Watteau's version reflects French Rococo ideals. She is almost a lady with a pretty face and tender look. Her pose suggests both coquetry and detachment. Nonetheless, her emotions are barely perceptible, but the glance is quite deep and says it all. The willing to amuse in spite of own wishes, too unnatural

posing and melancholic eyes distinct Columbine from French aristocrats.

Sometimes the images were indistinguishable from real people, and the line between acting and life was blurred. Therefore, even contemporaries could hardly tell whether they saw an actress in front of them or a young aristocrat. On another example based on Watteau's work *Belle n'écoutez rien, Arlequin est un traître...* it vividly presented (Figure 4). Emotions of all characters here are feigned and yet theatrical. The characters, surrounding the girl, behave according to their roles – Harlequin entertains, and Pierrot stands sheepishly behind the heroine's back, as if justifying his misconduct [3 p. 9]. Heroine itself has quite ambiguous role. Is she an aristocrat's daughter caught fooling around in Harlequin company? She also can be Harlequin's lover Columbine taking part in *mise en scene*. According to the name of engraving it can be assumed that the girl is the young aristocrat. She fully immersed in Harlequin's speeches and simply not bothered by her father's (or probably husband's) appearance. Surrounded by masks heroine is trying on a mask too.

In 18th century France, the masks and characters of *Commedia dell'arte* became a cultural obsession among young aristocrats, blending theatrical fantasy, social rebellion, and Rococo decadence. Masquerade balls were extremely popular. Young nobles wore Harlequin, Pierrot, and Columbine costumes to private balls, parodying the lower-class origins of these characters while protested against the social norms. Harlequin became a symbol of rebellious nature, flouting the norms of etiquette. Pierrot had an image of sad clown and perfectly resonated with the era's cult of sensibility. Columbine symbolized women's sexual freedom and coquetry. They all translated delusional freedom which young people craved so much.



Figure 3 – Watteau A. (modified by Charles-Nicolas Cochin the Younger) Italian comedians. 1717-1726. Incisor engraving on copper, etching. 20.8 x 29.7. Paris, National Library of France



Figure 4 – Cochin C. N. (based on Watteau's lost work) *Belle n'écoutez rien, Arlequin est un traître...* (Beauty, don't listen to anyone, Harlequin is a traitor...) 1684–1721. Etching. 22.5 x 27.8. Paris, Louvre

Meanwhile, there were other trends in British culture. After the Stuart Restoration British theater became a court phenomenon, both in terms of the repertoire and tastes, as well as in terms of the audience. Plays were expected to be joyful and pleasant. There appeared actresses on the stage – previously, all women parts had been performed by young boys. This was a significant part of the British theatre history. At the same time, theatrical atmosphere became similar to the house of tolerance. British morals were as ambiguous as French ones: puritanical moralizing and outright eroticism went hand in hand. Theatre was the living proof of society's hypocrisy. On the one hand, there were bright and witty plays by Wycherley and Vanbrugh and, on the other hand, vulgar remakes of Shakespeare's plays [7, p. 28].

Actresses' place in cultural life was different that in France. Here should first mention some aspects of women's morals in general. Alexander Pope's quote "Open fairest in the shade", close to the words of Rousseau mentioned before, can summarize the image of a British lady back in the 18th century. It was always a quiet, prudent and modest woman. Major part of philosophers, reverends and writers venerated in society truly believed that ladylike behaviour was natural and God-given for upper- and middle-class women. It was considered charming, when ladies had perfectly natural tender feelings. Also, it strongly condemned when they faked it. Throughout the period, wealthier women in most large towns attended assemblies, the theatre belonged to circulating libraries, and clubs, participated in urban walks, and viewed sporting events. The popularity of such activities, as well as increased opportunities for philanthropic and political activity, indicates a gap between the theory and practice of proper feminine conduct, as it was described by writers [8, p. 1-18]. However, the status of a lady and appropriate behavior were compulsory. Actresses were the worst of offenders of such a moral image. As opposed French gentlemen, British ones would be feared to notice actresses' features in the women of their social circle. Female artists embodied different and more complex picture of female nature, and it roughly contradicted ladylike image. British actresses, like French theatrical women, brought groundbreaking popularity to the national theatre at the cost of their reputation. Among the public they were considered as immodest women capable of obscene action.

Although, being socially vulnerable, they became the first professionally independent women in the public sphere, and their artistic images influenced the formation of mass culture. For example, Fanny Abington considered as a real trendsetter. Headdress of hers, which public saw on the stage or advertising portraits, called the Abington cap (or a la Abington) was very widely worn. Also, famous Sarah Siddons popularized her costume from Racine's play *Athalie*. The costumes of the Jewish priests served as a source of inspiration for this flowing dress. Nevertheless, popularity of this play among British aristocrats turned theatrical costume into fashionable item. Actresses had a reasonable influence on society's tastes. Their names were used in product advertisements (for example fans and perfumes), and their faces looked from theater posters. They did everything to be noticeable.

As popular persons they also were welcomed to pose for portraits – widespread genre of art among the public. Official theatrical portraits were produced for advertising of specific actresses which were more or less recognizable among the spectators. Usually in the form of engraving, as well as French pieces, they depicted

them in certain significant role. Here an ideal example would be portraits of Sarah Siddons. Rightfully called the queen of tragedy, she visualized theatrical pathos and it became a cultural phenomenon. Sarah was an innovator in terms of the system of gestures and facial expressions. She made gestures more geometrical, for example, the pose with arms outstretched and chin up. Also, her poses were inspired by Antique statues, which brings her comparison with Greek muses. All Sarah's body language on the stage expressed a climax in static – she faded in key moments. Pictures of her in brightest role of Lady Macbeth shows the intense tragedy in her acting. In this scene of Shakespeare's play Lady Macbeth reads her husband's letter and decides to help him become king by committing a murder. Here heroine appears as cruel and ambitious on the contrast with her spouse. On the engraving by James Parker Sarah Siddons appears in this very moment (Figure 5). She presses the letter to her chest. Her pose is tensed, and her face expresses all the determination she found in her intention («Come, you spirits / That tend on mortal thoughts, unsex me here»). Engraving made in mezzotint technique. Shadows on the face enhance the feeling of a nightmare. The folds of Sarah's clothing imitate Roman togas, a technique that emphasizes the eternity of the tragedy [9, p. 82-94]. Her clenched hand becomes the center of the composition due to the tonal solution. Thus, it turns into a gesture of cruelty and resoluteness. Sarah herself mentioned that Shakespeare demands greatness even in madness, and she established this greatness on the scene and became iconic Lady Macbeth.

On the contrary to official portraits, there were cheaper mass products – postcard prints. There were two main engraving techniques: mezzotint for more expensive ones, usually depicted some theatrical scene, and etching for caricatures. Not every actress gave consent to the image. So, Sarah Siddons refused to pose for such pieces, finding them vulgar. At the same time many actresses were models for postcards because it was cheaper and guaranteed public recognition. Many of their admirers wanted to collect those engraved portraits.

Kitty Clive was one of the notorious celebrity from such portraits. She was extremely popular by her roles in comedies, usually piquant and extravagant. This fact made her an outrageous person – she was either loved or hated. Alexander Pope mentioned her in *The Dunciad* as symbol of vulgar comedy, whilst Henry Fielding admired her talent in the play *Self-Portrait*. With her roles, Kitty made people talk about herself. Her genius lay in physical comedy – the raised eyebrow, the strategic stumble – which translated perfectly to visual media like prints [10, p. 45-62]. In the example of Kitty Clive as Lady Easy in *The Careless Husband* her image can be considered (Figure 6). *The Careless Husband* is a comedy of morals, ridiculing adultery and secular conventions. Here Clive playing her typical role – a “frivolous soubrette” (a cunning but charming schemer). As well as Hogarth's works, engraving made as the theatrical *mise en scene*. Faber depicted moment from Act 3, Scene 2 where Clive's heroine covers drunk Sir Charles with her handkerchief. From the first site – it's an innocent gesture of care, but theatrically it's a clever trick. The main character covered with Lady Easy's handkerchief which smells of her perfume. That's a sign of intimacy and intrigue. Her posture harbors a hint of predation. All this conveys the duality of the heroine's perception. In this example, we can see the similarity between ambiguous role of Kitty Clive in culture as well as Lady Easy's.



Figure 5 – Parker. J. (After Richard Westall) Lady Macbeth (Shakespeare, *Macbeth*, Act 1, Scene 5). 1800. Etching and engraving. 56.7 x 40.6. New York, The Metropolitan Museum of Art



Figure 6 – Faber J. Jr. (After Philip Mercier) Kitty Clive as Lady Easy in *The Careless Husband*. 1739. Mezzotint. 36.2 x 25.4. London, National Portrait Gallery

There is no doubt that William Hogarth is considered to be the main denouncer of the vices of society in English engraving. He always preferred to depict life without embellishments. His images, sometimes roughly satirical yet sarcastic, embodied human vices and influenced on the tastes of society. Hogarth's pictures could form thoughts, because nobody wanted to find themselves in those plots. His composition is a *mise en scene*, an interpretation of characters based on actor's images, and a comparison of life events to drama [11, p. 3]. Thus, Hogarth's pictures influenced on the perception of actresses in culture. In spite of the sophisticated roles which Hogarth gives to his heroines, public began to consider them even more immodest. All that, because artist's vision were complex – he combined satire and sympathy. Hogarth vacillates between admiring the talent of actresses and condemning their social status. His engravings are a mirror of the double standards of the era [12, p. 45].

There is an opinion, that work *The Rake's Progress*, Plate III Tavern Scene depicts not only harlots around main character but actresses too (Figure 7). Hogarth specially mixes the audience in the tavern, pointed out the resemblance between these two female social strata. Actresses are portrayed as depraved women and, at the same time, victims of the system. One of them is stealing Tom's watches. It's a sign of meanness but also of need. Here Hogarth pays attention of spectator to female artists' financial position which was unenviable. The girl near main character is an accomplice to the robbery, but her smile betrays her own dependence on patrons. Also, on the

background Hogarth leaves a message in the form of portraits of the opera diva Faustina Bordoni and the actress Anna Oldfield as a hint of a connection between art and debauchery.

Brightest images of theatre Hogarth presented in the work *Strolling actresses dressing in a barn* (Figure 8). The whole subject is a fair of glory and falsehood. Here theatre workers who should bring the audience fun forced to change clothes in the barn without even getting a dressing room. The proximity of bright outfits with a shabby room eloquently indicates the actresses' social status. There is also a theme of exploitation of women in this field – they are admired only on stage. One actress drinks gin, the other tries on a crown – symbols of vanity and escape from reality. The one in the centre reveals the stereotypical image – a woman who changes clothes without being embarrassed by the viewer. There is also a kids in this scene. They symbolize vicious succession in theatre – kids who's growing up in such conditions simply can't be worthy members of society. Hogarth highlights the absurdity – Diana's nymphs in a filthy stable. This is a parody of the French gallant Watteau's theater [13, p. 92-93]. Scene with lots of significant details depicts the false idleness of the theater, where gaiety is juxtaposed with poverty.



Figure 7 – Worthington W.H.
(After W. Hogarth painting) *The Rake's Progress, Plate III Tavern Scene*. 1838.
Incisor engraving on copper, etching.
63.5 x 47. London, The British Museum.



Figure 8 – Hogarth W. *Strolling actresses dressing in a barn*. 1738. Etching and engraving. 38,5 x 50,5. London, The British Museum.

Analyzing the work of the engravers, an important similarity in the image of the actresses becomes noticeable, both in England and in France, – they are presented as people of but strongly connected with art and the ideal of a woman. Using Watteau's example, we can see the French gaze, where theatrical women compared to muses. Through the pathos of images, the artist reveals the complex inner world of his beautiful but sad heroines. Watteau does not cross the fine line of fun and pretense, although he perfectly notices the falsity. Even his smoky technique in engraving creates a sense of a surreal performance, where everyday acting is taking place. Antoine

Watteau is always a celebration of melancholy and grace. Oppositely to this approach, Hogarth creates his naked satire. In his works he reveals English reality, where actresses create superficial mass culture and considered too frivolous. Hogarth's technique is rougher and the etching contains more sharp shadows, which emphasize the drama. Actresses here are the objects of moral criticism, but also sorrow. Sometimes they are so pathetic, that the viewer sympathizes with their situation. Watteau turned actresses into nymphs, Hogarth into harlots and both were right. The thing that unites both images, English and French, are masks. More vulgar in Hogarth's works and sadder in Watteau's, they perform similar functions – hiding feelings and playing to the public even off the stage.

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PECULIARITIES OF THE DEVELOPMENT OF CREMONA ART IN THE XV CENTURY

Student **Shatalova Alexandra Evgenievna**,
Academic Advisor: PhD in Philology, Associate Professor
Nazarchuk Yulia Ivanovna,
Saint Petersburg State University of Industrial Technologies and Design,
Saint Petersburg, Russian Federation

Abstract. The article analyses the artistic culture of Cremona in the 15th century, especially formation of the local tradition. The article analyses the specifics of Northern Italian and Lombard art, the basis for the art of Cremona. The paper reflects the peculiarities of miniature painting, the artistic heritage of the Bembo family and works created at the end of the century. The article focuses on the pictorial tradition and graphics and does not reflect the specifics of other art forms.

Keywords: painting, Northern Italy, Cremona, International Gothic, book miniature, manuscripts, Bembo family, Renaissance.

ОСОБЕННОСТИ РАЗВИТИЯ ИСКУССТВА КРЕМОНЫ В XV ВЕКЕ

студент **Шаталова Александра Евгеньевна**,
науч. руководитель: канд. филол. наук, доцент
Назарчук Юлия Ивановна,
Санкт-Петербургский государственный университет
промышленных технологий и дизайна,
Санкт-Петербург, Российская Федерация

Аннотация. В статье анализируется художественная культура Кремоны XV века, особое внимание уделяется формированию местной традиции. Рассматривается специфика североитальянского и ломбардского искусства, в рамках которых начинало развиваться искусство Кремоны. В работе отражены особенности миниатюрной живописи, художественного наследия семейства Бембо и произведений, созданных в конце века. Статья посвящена живописной традиции и графике и не отражает специфику других видов искусства.

Ключевые слова: живопись, Северная Италия, Кремона, интернациональная готика, книжная миниатюра, манускрипты, семейство Бембо, Ренессанс.

Cremona is a city in the Italian region of Lombardy, located in the centre of the Po Valley on its left bank. Cremona was originally the site of an Etruscan settlement. Over time, the city developed and became an important economic centre due to its location. The art of 15th century Cremona is inextricably linked to the traditions of Lombardy and Northern Italian art in general.

The artistic language of early fifteenth-century Northern Italy continues to exist within the medieval ideas and traditions of the International Gothic. Painting is more connected with France and Germany than with Tuscany. Its distinctive features were – domestic concreteness, fairy-tale, some naivety, decorativeness, attention to detail. The art of this region developed slowly. The transition from Gothic to Renaissance was associated only with the arrival of visiting masters – Fra Filippo Lippi (1406-1469), Andrea del Costagno (1421-1457), Donatello (1386-1466). The new trends created a style much freer, more plastic, more balanced than the Gothic. Many artists in this area are characterised by eclecticism. This is due to the numerous influences and communication with the masters of other regions.

Northern Italy, like the country as a whole, was not unified politically and economically. One of the regions of Northern Italy is Lombardy. Its culture, along with the Venetian tradition, formed a powerful stratum of Northern Italian art. It was one of the outstanding centres of Late Gothic art. It had a very strong courtesan medieval culture. In painting, the commonality of the artistic methods used developed in the fourteenth century. In the first half of the XV century, its art is characterised by conservatism. Characteristic features were – plastic clarity of composition, gentle shades, increased attention to light and shadow modelling of form and ‘realism of details’.

Located in the centre of the Po valley, at the crossroads of transport routes, Cremona combined these trends. Its economic prosperity favoured the development of local art. It possessed a number of unique features, but failed to develop a style distinct from Lombard trends.

From the fourteenth century onwards, the church was the most important customer for art in Cremona. Art was always at the service of the Christian religion. It had to emphasise the grandeur and splendour of the liturgy, the divine service. All forms of art were at the service of the Church to reveal the pathos of the liturgy and to create a coherent image. Manuscript books decorated with illuminated images became a specific liturgical art, because they were inextricably linked with the Masses celebrated daily in the temples [1, p. 6].

In Cremona the first liturgical books appeared under Bishop Offredo Offreda (1168-1185), but none have survived to this day. At the end of the first half of the fifteenth century, the Catholic Congregation in Italy felt a special need for liturgical literature for the rites. The production of such manuscripts peaked in the second half of the fifteenth century. Cremona was no exception. Craftsmen created texts and decorated their pages with gilded letters. They decorated the pages with flowers, trees, precious stones, birds and animals, and medallions with images of saints. All the artists of fifteenth-century Lombardy had a hand in creating miniatures; even calligraphers could create them, which was often the case. They may not have been outstanding illustrators, but they were certainly masters. So, gradually, simple scriptoriums became art workshops.

Every major religious centre was obliged to have its own scriptorium. In Cremona there were several such workshops. The most fruitful and interesting in terms of artistic design were the scriptorium of the Cathedral and the workshop at the reclusive monastery of St Augustine. Books were also produced in the monasteries of

Sant Domenico and SantSigismundo. By now, the largest collection of manuscripts has found a home in the Cathedral. These codices are Gothic miniatures of the 'choral' type. They are choral books created to accompany festal Masses. Other forms of liturgical literature related to the period under consideration have not survived in the Duomo [1, p. 16]. In the Chorales, miniature plays the role of decoration to the more significant elements of the manuscript – text and music. All Cremona manuscripts were created in a relatively short period of time. We can see this through the expenditure books. These books allow us to date the works accurately and to speak of more precise attribution. More of these records are preserved in the Duomo, there are not so many in the monastery.

The collection totals 24 items. Twelve of them were created in the workshop of the cathedral, the rest in the monastery of Sant'Antonio. They are all written in two types of ink – black, for the main text, and red, used for markings. The composition of the text is impeccable. The cathedral codices have more durable and expensive framing than their monastic counterparts [1, p. 21]. In addition, the sheets of cathedral manuscripts are assembled in quinterns, and those of Augustinian manuscripts – in tetrads. Such details make it possible to distinguish the scriptoria even without opening the manuscripts. All manuscripts were decorated with illuminated miniatures, i.e., gilding – they shone like the light of God's enlightenment and grace [2]. The Cremonese usually used hot gold leaf to fill the space between the inscription and its 'frame'. The graphic lines of the capital letters were patterns of plants, zoomorphic and anthropomorphic characters, architectural elements, ribbons or stripes, often complemented by fine white ornate natural ornamentation. The choice of what the letter would be 'dialed' from depended partly on the content of the book, but to a greater extent on the preferences of the master, his unique accent. The cavity inside was filled with a story composition or an image of a particular saint.

Let us consider some of these manuscripts. This will allow us to identify the distinctive features of the miniature painting of Cremona and the two workshops. Let us examine the capital letters in detail.

The 'Scriptorium Gadio' is what we can conventionally call the cathedral workshop. It can be called a workshop only because the works have similar formal qualities. We find no continuity, which prevents us from calling it a 'school'. Giovanni Gadio, who can be called the head of this centre, did the writing and drawing. He was the first to call himself a 'miniaturist' [1, p. 26]. The texts of the whole group (except for codices I-III, created in 1443-1444), as well as some other works, can be attributed to his authorship.

The first artistic works by Giovanni Gadio date back to 1480. They are illustrations for Codices IX and VIII. Giovanni Gadio's works are filled with dynamics created by sharp diagonals. These sharp lines are softened by the smooth curves of nature. The expression created continues beyond the letters. This abundance is harmoniously complemented by small images of celestial luminaries located nearby. The author skilfully uses reverse perspective (all Cremona miniaturists use reverse perspective in their works). His works are detailed, lush and representative.

The next group of four manuscripts was executed in 1482-1483. Their miniatures

are more harmonious in colour and composition, indicating the development of the workshop. All the manuscripts are written by Gadio, but they do not resemble his manner. This can be misleading. This is a kind of problem with all medieval manuscripts. There was a group of people working on the works, each doing their own thing. In the case at hand, things turned out to be somewhat simpler. Thanks to the records in the financial book of the cathedral and comparison of miniatures with other works of local artists [1, p. 22-23]. Giovanni Gadio was the chief scriptor – he was engaged in writing texts, and his name is signed all the codices. Artistic design belongs to Baldassari de Coldiradi, Antonio Cicognara (before 1480-after 1500) and Alessandro Pampurino (1460-1523). Lorenzo Fordi's name also appears in accounts of payments to artists. He did writing and illustration work, but was an assistant rather than an independent craftsman. From this we can infer that there were more craftsmen on the cathedral staff whose names have not survived because of the insignificance of their contribution.

Baldassari de Coldiradi is credited with the murals of Codex VI. His palette is somewhat limited, but the colours are always saturated and the shades precise and delicate. His art is characterised by restraint and stateliness. Diagonals are short and flowing, compositions are harmonious and balanced. Almost all of them have a vertical division. De Coldiradi's characters are pensive, the folds of their clothes are soft and smooth. The plot unfolds either surrounded by landscape or on a rich blue background, always filled with ornamentation. The architecture of the time is depicted. The motif of divine light is frequent – it is interpreted by the golden bands around the figure of the Saviour. The mentioned motif is also used to depict God the Father, but supplemented with wavy lines. The letters are in pink colour and are always complemented by white patterns, large leaves, flowers, fruits and some other details. They are arranged on a gold background in the shape of a square with slightly 'pinched' edges. The characters may obscure the letter. In addition to the manuscript mentioned above, he is also responsible for the miniatures of codices X and XII, executed two years later.

The chorale under the inventory number Gov. 198 (Fig. 1) in the collection of the State Library of Cremona is also by Baldassari de Coldiradi. The work is in the same style – restrained in construction, sonorous in colour. The book was intended for the Monastery of St Anthony and contains images of saints especially venerated by this Congregation. The solution of the first page is quite interesting – the text has its own large frame. The tendency to such filling takes place in the Northern Italian art of the second half of the 15th century [2, p. 29]. The manuscript Gov. 182 belongs to the masters of his circle and is marked by similar features.

Antonio Cicognara was a significant master who worked not only on miniatures, but also on a number of paintings. For the Cathedral of Cremona he executed two codices, IV and V. They date from 1482. All the letters of manuscript IV (Fig. 2) are written in three colours – pink, blue, light green. They are 'typified' by scaly stems, horns, large leaves, flower rosettes, and small balls. Such elements are found in the works of Baldassari de Coldiradi. The letters are enclosed in gold squares. They are a rigid framing for the scenes. The colour scheme is somewhat pale, sparse and

monotonous. The compositional solution is laconic, but lacks variety. A number of schemes pass from theme to theme. He also transfers the composition 'Baptism' (Fig. 2) to Codex V. The faces of the characters express sadness rather than overflowing with wisdom, knowledge and intimacy; they are inexpressive and monotonous. The bodies are very jagged and clumsy. The delicacy of the lines, the expressiveness of the forms and the general patheticness are far below the level of other masters. There is an opinion that this manuscript, because of the mediocrity of the image, was worked on mainly by his pupils [1, p. 29]. This theory is refuted by his first documented easel work – 'Madonna and Child' of the early 1480s. It is clearly visible that the artist still lacks skill. The composition is simple, but the emphasis on the relationship between mother and child is fresh.



Figure 1 – Baldassaride Coldiradi.
Gov. 198. 1489

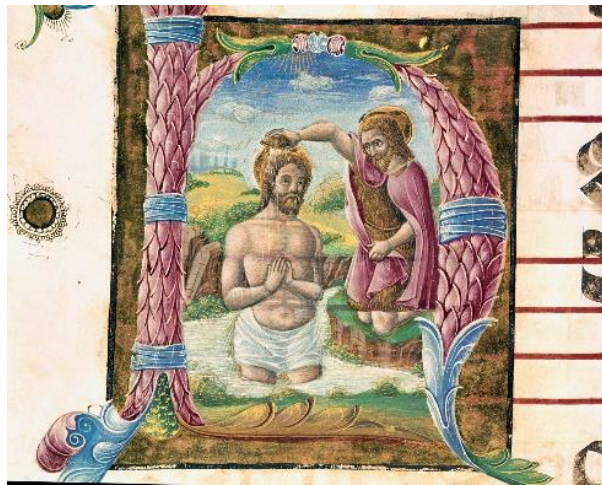


Figure 2 – Antonio Cicagnara.
Baptism of Jesus Christ. 1482

Codex XI (Fig. 3) was executed in 1484. It was executed in the circle of Boniface Bembo (1447-1480) and reflects the stylistics of this outstanding master. This can be seen in the borrowings (Fig. 7). They are somewhat simple and archaic compared to those of Gadio's workshop. The miniatures have a different variant of the Lombard 'star' in form. Having studied all the miniatures, we can conclude that they could have been made by different masters. The style of execution of vestments, work with space, borrowings and general mood are too different. The graphic line of the letters is not unified, but all of them are well readable and somewhat dominate the inner image. Here already the letter covers the character rather than the other way round. Compared to the works of the inspirer they represent works with a lower level of professionalism and are characterised by simplicity.

Work on the liturgical books also took place in the monastery of St Augustine. The lack of clear documentation of the working process makes it difficult for researchers to establish the authorship of the works [2, pp. 33-35]. As for the texts themselves, the calligraphic elements in them are identical. The main one was the brother of Apollonio da Calcivano. He was first of all a scribe and only then the best artist among the Augustinians. He illuminated six codices (XVI, XVIII, XIX, XX, XXI,

XXII). One can sense a single underlying idea in all, in the uniformity of colour and the perspective of the background. The works of Apollonio da Calcivano are characterised by precision and subtlety, flawlessness of landscape, vividness and mobility of figures (Fig. 4). The inscriptions become exquisite jewellery or sumptuous architectural details. The fields are filled with a multitude of patterns. The subjects are filled with narrative and everyday life. Naturalism rather than stylisation predominates. The draperies are sculptural and somewhat heavy fitting to the figures.



Figure 3 – Bonifacio Bembo Circle.
David and St Imerio. Cod. XI. 1482



Figure 4 – Apollonio da
Calzivino. Tibino.
Cod. XVI. About 1498

Manuscripts XIII, XIV, XV look quite different – they were executed by Augustinian monks without the participation of Apollonio da Calcivano. The work was begun after 1456 and finished in 1495. Their simplicity gives them a special charm and accessibility in understanding (Fig. 5). They are as generalised and stylised as possible. All the backgrounds are light, slightly yellowish, which in combination with the gilded elements creates the feeling of a sunny day. Stylistically they are close to the works of some masters from Milan and Pavia. In addition to Lombard influences, the moods of Venice and the special relationship with France can be traced. Codex XVII was executed by a Ferraran master whose images are directly linked to the Ferraran tradition. This manuscript brought new, fresh ideas to the Cremona environment [3, pp. 21].

Completely unique for Cremona was the miniature created by Giovanni da Bellano for the chorale of St Agatha (Fig. 6). It is very bright colours, sublime chromatic scale, unique harmony and simplicity of a complex compositional solution. The master used the form so characteristic of this region – a star, decorated the surrounding space with thin stems and lush buds. He united the space inside the inscription, inscribed in the swirling figure of a dragon, and the background. The figure of St Agatha protrudes slightly forward, overlapping the dragon's tail. The author also creates an understated horizon line to emphasise the heroine. The angels holding the crown, a symbol of martyrs, are clearly borrowed from Verona art [4, p. 11].



Figure 5 – Augustinian monks.
Resurrection of Christ. Cod. XIV. 1495



Figure 6 – Giovanni da Bellano.
The Saint Agatha. 1453

Having dwelt in detail on some of the miniatures of the Cremona masters, we can come to the conclusion that each of them looked at the task in his own way and all of them had their own preferences. All their works gravitate towards soft, somewhat whitened colours, which distinguishes the Lombard school of miniature painting. They particularly like the calm green colour of foliage, often creating a depth of space in the initials. The architecture of the time – towers, castles, cathedrals – is often depicted. Cathedral miniaturists prefer golden outlines, rich colours and expressive compositions, while monks frame their manuscripts with friezes, foliage and small images of animals. The modelling of cathedral figures wrapped in soft folds that repeat the body is qualitatively superior to the efforts of the monastic attendants, who treat the draperies stiffly, creating the feeling of paper clothes [2].

Such fragmentation does not allow us to speak of a direct unity of the artistic endeavours of the Cremonese artists. Consequently, their associations cannot be called a school of miniature painting. They are workshops that continue to exist within the framework of general Lombard tendencies, despite their own artistic language. It is an interesting fact that Girolamo da Cremona (1451-1483) began his development here. This master was linked to the local tradition, but in many ways surpassed it.

The activity of the Bembo family is important for the art of Cremona in the 15th century. Masters from this family worked in the territory of Lombardy from 1425 to the early 1600s. Boniface Bembo showed his talent most clearly. In his search the artist relied on the legacy of the Milanese masters Gentile da Fabriano (1360-1427), Masolino da Panicale (c. 1383- c. 1440) and Anthony Pisanello (c. 1392/5-1455) [5]. His first work is the painting of one of the chapels of the church of San Augustino in Cremona in 1447. The artist immediately demonstrates his professionalism. Fine lines and refined, saturated colours distinguish his manner. The compositional solution is interesting – the scenes are placed on a Gothic vault in the gaps formed by a bunch of columns. Its whole essence is addressed to the International Gothic in its late manifestation.

In the fifteenth century, the masters of Cremona produced many graphic items, and Boniface was no exception. He began with illuminated manuscripts and created a number of charming miniatures that became a mainstay for many Cremona miniaturists of this time [3, p. 18]. The pinnacle of the artist's graphic career, was the creation of

Tarot cards for the court of Milan. This series is called ‘Tarot Visconti-Sforza’ after the names of the customers. They were produced between 1442 and 1470. During the Renaissance, Tarot cards did not have today's significance; it was a common card game whose rules have not survived. This came later. All the cards (Fig. 7) are richly decorated. Each deck is decorated in its own style, but they are all united by a gilded background complemented by geometric ornamentation. Most of the works are compositionally simple. The handiwork is evident in the slight carelessness and asymmetry. The works under consideration give an extraordinary insight into the court life of mid-century Milan. Their plots ‘remind us of the position and entertainment of gentlemen, they give a lively reflection of the ceremonial, fashion of clothes, hairstyles, furnishings of residences, menageries, parks, chivalric and court context, that is, they are modelled on medieval novels about Arthur, Lancelot or Tristan’ [6, pp. 11-12]. Besides him, Antonio Cicognara and Francesco Zavattari (active 1417-1483) had a hand in the series.



Figure 7 – Bonifacio Bembo. Taro Visconti-Sforza. 1442-1470

The patronage of the Milanese ruling family allowed Boniface Bembo to work in many cities of the duchy, learning new things and sharing his experience. Bembo's works include the portraits of the Sforza couple. In these works, his mastery of portraiture – meticulous, accurate and truthful – is evident. The inimitable style of the master left its imprint on all the art of Cremona in the second half of the XV century.

Brothers Boniface and Benedetto practically did not interact with each other. They did not work together. The exception is the frescoes of the court chapel in Rocca di Monticellid'Ongina. It is often referred to as the Bembo Chapel. The attribution of these frescoes is a matter of debate among scholars. Some say they co-operated, others, on the contrary, attribute the work to one or the other master [6]. Nevertheless, the composition of the vault is copied from the Chapel of St Agatha. It is altered because of the size of the surface – the verticals of the thrones resting on the quadrifolium bases are shifted to the left and do not have the same perspective reduction as in the prototype. The perspective, in general, is not given as clearly as before.

Benedetto Bembo was the first to go beyond the experience of Lombardy and Verona, on which all late Gothic Cremonese culture was based. He turned to Padua and the school of Squarcione (1397-1468). He was also interested in the culture of Ferrara and the traditions of Antonio Vivarini, cmDonatello. In the 1450s Benedetto is most active. The work Madonna and Child is eclectic (Fig. 8). The grass in the

foreground is reminiscent of French millefleur, Mary's robes seem cut from Ferraran cloth, and the landscape is similar to that of Cremona. The mousing angels are too plastic and expressive, referring us to Central Italy or the Romana region, especially Bologna, and the group of angels above is a quotation from Verona art. The local tradition of Cremona was constantly supplemented by new inserts.

A major commission for Benedetto Bembo was the painting of the 'Golden Hall' (Fig. 9) in the castle of Terrechiera in the 1560s. It was based on a romantic love story of the owners of the estate. It is one of the last manifestations of a declining courtesan culture. It is a tale of a beautiful lady and her noble knight. The figures of the main characters are static. They are idealised and dressed in richly embroidered outfits of their era. Small domestic scenes in the background add vividness to the action. The frescoes are allegorical in nature. The composition of the upper part with verticals converging to the centre has already been seen in the artist's works. Of particular interest is the architecture – these are Italian buildings made at different times and in different styles. The painting is complemented by sculptural inserts to create more volume and expressiveness.



Figure 8 – Benedetto Bembo.
Bianca presents Madonna with
child and mousing angels.
1450-1455



Figure 9 – Benedetto Bembo.
Bianca presents Pierre Maria
with a sword. 1460s

The years after the seventh decade are a big black hole for all members of the Bembo family who lived in the fifteenth century. It is known that the artists continued to create, but the entire legacy of this period has been lost or is still awaiting attribution and discovery.

The works created by members of the Bembo family, namely Bonifacio and Benedetto, had a significant influence on the artistic culture of Cremona. The older brother's ideas immediately resonated (Fig. 3) with his contemporaries, as his work reflected the mood of the international Gothic that dominated the territory of Lombardy during this period. He was the last artist to express Gothic ideals so vividly and rapidly. The works of his younger brother, who worked in the same style, are enriched by the experience of neighbouring territories and bear witness to some features of the Renaissance (Fig. 9), whose ideas had already begun to spread across northern Italy. It was to his legacy that Cremona craftsmen turned in the last decades of the 15th century.

The transition to Renaissance tendencies for Cremona did not go smoothly. Its artistic culture was closely linked to medieval images. The search for a new style was extremely slow and inconsistent. Above all, the Cremonese had to abandon deeply rooted media and search for new forms and impulses. The new generation of artists was 'aimed at purification from the legacy of Lombard Gothic, it sought to separate from it, starting with Benedetto Bembo, in which there was a rupture towards squarcianism' [3, p. 5] [3, c. 5]. It was the Paduan school led by the gift of Andrea Mantegna (1431-1506) that became the main reference point of the city in the last decades of the century.

The study of this period of Cremona painting is extremely difficult due to the lack of sufficient works and bibliographic information [3]. Based on documentary sources, it is clear that by the end of the century the Bembo family was winding down and Antonio Cicognara was probably already in Ferrara. A new generation of artists, Antonio dellaCorna and Francesco Tacconi (c. 1440-after 1490) left behind few works.

Della Corna produced an extremely interesting painting in 1478 (Fig. 10). It bears the author's signature and is therefore one of the few confirmed paintings by him. Apart from the obvious mantism expressed in the particular arrangement of the sleeping figures, it shows formal features of Francesco Cossa (c. 1436-1477) and Baldassare d'Este (1461-1504). It is a further confirmation of the importance of Ferrara culture to the Po Valley. The painting depicts a scene from the life of St Julian – he has come to kill his sleeping parents, mistaking them for his wife and lover. The figures are three-dimensional and the shadows are properly placed. The pictorial style is dry and meticulous, and the composition is horizontal. The lush, swollen folds of the Saint's cloak are intended to show the hero's determination, his expression and dynamism. They are treated so theatrically and rigidly that the feeling of impulse dissipates, frozen by a tonal stain of orange-brown shades. The subject matter is carried over from the 15th century house – the four-poster bed with its antique portico, the garlands on the walls and the semi-circular window opening. The headboard of the bed is a continuation of the landscape motif developing both in the window and in the space to the right.

Another artist of this period, Francesco Tacconi, was born in Cremona and in 1464, together with his brother Filippo, painted the loggia of the town hall. The fresco has not survived, as all works before 1489 [3, p. 7]. He was a pupil of Benedetto Bembo and continuer of his ideas. Most likely, he helped him in the painting of the castle of Torrechiare. Thanks to this work, marked by the winds of St Mark's capital, the artist was much closer to Venice than other Cremonese of the time. The fresco Madonna on the Throne is an example of a favourite composition of Giovanni Bellini (c. 1430/3-1516). Some researchers suggest that Francesco Tacconi was the first to bring Bellini's influence to Cremona [3, p. 7], but the castle of Torrechiare is in Parma, and the master himself had already been in Venice before 1491, and it is not known whether he returned to his homeland. The lack of reliable information about the artist's progress casts doubt on this theory.

Some of the first secular works painted directly in Cremona were the murals of the Casa Maffi vault (Fig. 11). They were created by Alessandro Pampurino, who was also involved in the manuscripts. In the middle cross itself, one recognises a rather

familiar motif – the Camera degli Sposi in the Palazzo Ducale by the hand of Mantegna. Pampurino's version is a primitive repetition of the original. The rest of the space is taken up by grisaille in circular medallions and the depiction of busts on lurnes. At that time, it was very common to paint in gradations of a single colour. The master coped with the task perfectly – the volume is impeccably transferred – it is as if a sculpture appeared on the plane. The work under consideration allows us to conclude that the artist had sufficient skill, but was highly dependent on the solutions already found by other masters.



Figure 10 – Antonio della Corna. St Julian the Hospitaller, determined to surprise his wife and mistress, kills his parents. 1488



Figure 11 – Alessandro Pampurino. Casca Maffi ceiling. Around 1500

Unique and perhaps the only one of its kind was the fresco 'Madonna on the Throne with Child' or otherwise 'Madonna of the Chapter', located in the Bishop's Palace. Its author is unknown, as well as the date of its creation. It is attributed to the end of the 15th century. Its author was familiar with the innovations of Pietro della Francesca (c. 1420-1492). Puerari, a researcher of Cremona and art, claimed that 'this is the most solemn announcement of the revival of the city in the Po Valley' [3, p. 8] [3, c. 8]. This fresco does not belong to the Cremonese tradition and is a call for its renewal.

Based on the analysed works we can conclude that the art of Cremona of the XV century was strongly dependent on other regions. Initially it developed exclusively in the Lombard tradition, but later it turned to other regions as well, which shows its development and secondary character at the same time. It lacked the ability to create its own, unique style and was forced to expand the geography of borrowings. Cremona painting continues to follow medieval trends and is conservative from this. Despite the assiduous attempts of recent decades, it has never been able to become truly Renaissance. Although formally it came close to it, the ideological component was closer to Gothic sentiments. Cremona's culture lagged too far behind the latest trends. While Ferrara had consolidated its advantage as the leading art school of Northern Italy and was already beginning to approach its crisis, and Leonardo da Vinci was painting one of his most famous works – The Last Supper – in Milan, the Cremona masters were just beginning to realise the need for change in artistic culture. Despite this, fifteenth-century art provided a solid foundation for the next century and future development.

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THE OBSERVER EFFECT: WHY DO WE BEHAVE DIFFERENTLY WHEN WE ARE BEING WATCHED?

Student **Volkova Valeria Vitalievna**,
Lecturer **Nagradova Maria Robertovna**,
Academic Adviser: Lecturer **Bobruiko Ekaterina Sergeevna**,
Torez College (branch) of the Federal State Budgetary Educational Institution
of Higher Education "Donetsk Academy of Management and Public Administration"
Torez, Donetsk People's Republic

Abstract. The article examines the features of changing human behaviour under the influence of observation. The realization that they are being watched makes people control their actions, emotions, and even decisions and thoughts. This is evident in different areas of life: at work, in society, and in the digital environment. The attention of others can both help to comply with norms, and cause tension, limiting naturalness. The psychological mechanisms of this phenomenon are related to social adaptation, fear of evaluation, and internal attitudes.

Keywords: behaviour, observation, emotions, assessment, social norms, fear.

ЭФФЕКТ НАБЛЮДАТЕЛЯ: ПОЧЕМУ МЫ ВЕДЕМ СЕБЯ ПО-РАЗНОМУ, КОГДА ЗА НАМИ СМОТРЯТ?

студент **Волкова Валерия Виталиевна**,
преподаватель **Наградова Мария Робертовна**,
науч. руководитель: преподаватель **Бобруйко Екатерина Сергеевна**,
Торезский колледж (филиал) федерального государственного
бюджетного образовательного учреждения высшего образования «Донецкая
академия управления и государственной службы»,
г. Торез, Донецкая Народная Республика

Аннотация. В работе рассматриваются особенности изменения поведения человека под влиянием наблюдения. Осознание того, что за нами следят, заставляет людей контролировать свои действия, эмоции и даже решения, мысли. Это проявляется в разных сферах жизни: на работе, в обществе, в цифровой среде. Внимание окружающих может как помогать соблюдать нормы, так и вызывать напряжение, ограничивая естественность. Психологические механизмы этого явления связаны с социальной адаптацией, страхом ответственности и внутренними установками.

Ключевые слова: поведение, наблюдение, эмоции, оценка, социальные нормы, страх.

The observer effect is one of the most amazing and mysterious phenomena studied in various fields of science. This is a concept that has attracted the attention of

scientists, philosophers, and psychologists for many decades. The essence of this effect is that the very fact of observation or the presence of an outside observer can influence the behavior of the observed object or subject [1]. A phenomenon in which a person's behavior changes depending on whether he is aware that he is being watched. This effect has a significant impact on everyday life, as in various social situations we often encounter the fact that our behavior is controlled or evaluated by other people. People behave differently in the presence of others and in private. When a person knows that they are being watched, they tend to conform to social norms and more often control their emotions and reactions. This effect concerns not only direct observation, but also forms such as the opinions of others on social media, popular culture, and even the media space, where everyone can become the object of attention.

Understanding how awareness of the presence of other people changes behavior is of great importance for studying the mechanisms of social adaptation and personality formation. Indeed, in any society there are certain norms and expectations that an individual must meet. The observer effect is related to concepts such as social influence and personal adaptation. Social influence is manifested in the fact that others, including acquaintances and strangers, can significantly change our behavior, and not always consciously. This influence works both in small groups and in larger ones (for example, at the level of collectives, corporations, and even in global social interactions such as the Internet and the media).

It is also important to note that the observer effect can cause both positive and negative deviant behavior changes in a person. On the one hand, realizing that he is being watched can help him comply with social norms and increase his level of self-control. On the other hand, it can cause stress and anxiety, lead to disruption of natural behavior and increase social anxiety. Thus, the impact of surveillance is not always positive, especially in conditions where a person does not feel confident or is in a high-pressure situation. That is why it is important to study how and under what conditions awareness of observation can have a negative impact on a person.

The purpose of the work is to examine in detail how the observer effect affects human behavior, as well as to understand what psychological mechanisms underlie this phenomenon. It is important to identify how the social environment, culture, role of the group, and other factors can enhance or weaken the influence of surveillance.

"But alone and left to himself, plunged in the depths of his own thoughts and sensations, he is wholly himself..." – Arthur Schopenhauer, translated by Thomas Bailey Saunders [2]. This thought of the famous German philosopher perfectly conveys the essence of the phenomenon under consideration, the difference between a person's behavior when he is alone with himself and how he behaves when under the attention of others. When people are alone, their behavior is not limited by social expectations and is not subject to external evaluation, they are free from the framework of possible condemnation and disapproval. In this context, a person feels his individuality and authenticity, since there is no need to adapt to other people's views or standards of society. However, as soon as the presence of other people becomes apparent, it immediately affects behavior. Knowing that there are "viewers" behind us always affects our actions, reactions, and even our perception of ourselves. This phenomenon is commonly known as the observer effect. When a person realizes that his behavior

can be evaluated, he begins to change his reaction and behavior, trying to meet social expectations.

This effect is associated with a deep human survival instinct. Throughout the history of evolution, the survival of an individual has largely depended on the ability to be part of a group. Recognition and approval from other people provided not only social support, but also access to resources: food, protection from external threats, and the possibility of reproduction. This pattern, which has its origins since the Paleolithic period, creates a natural human need to meet the expectations of others and be accepted in a social environment today, which in turn reduces the risk of social isolation and increases the likelihood of survival. Therefore, the desire to be accepted and appreciated by others is not just a desire to gain recognition, but also a biological necessity supported by instinctive mechanisms. Under surveillance conditions, we subconsciously strive to observe social norms and demonstrate qualities that will be positively evaluated, as this guarantees us the best conditions for integration into the group. Failure to meet these expectations can cause stress and a sense of threat, as an individual who is not approved by society loses the social protection and resources that the group provides to its members.

One of the key mechanisms that are activated under the influence of observation is self-control. The realization that a person can be watched makes him behave within the frame work of established social norms and expectations. Self-control in this case includes both physical self-regulation (for example, control of facial expressions or posture) and emotional restraint (limiting the expression of anger, excitement or joy). This allows a person to maintain their social status and avoid criticism, which is especially important in a society where public image and social interactions are of great importance.

In addition, in such situations, the mechanism of social comparison is activated. Social comparison is a universal human need related to the search for criteria for an accurate assessment of one's own personal qualities, judgments and abilities [3]. This is a mental process when a person evaluates himself through the prism of how others perceive him or how he perceives other people. He begins to compare his actions with the behavior of those around him, and tries to understand whether his actions comply with generally accepted norms. Under observation, a person often evaluates himself in the context of a group, which can lead to increased feelings of social anxiety or, conversely, to a desire to demonstrate his superiority. For example, during an interview or public speaking, a person may begin to pay more attention to how they are perceived by the audience and try to make the best impression on them. This comparison can cause a person to feel both satisfied (if he feels that he is "winning" in the eyes of others) and a feeling of anxiety or insecurity (if he feels that he is not meeting high standards).

This social comparison also plays a key role in shaping self-esteem. When a person notices that others rate him positively, his self-esteem increases, which encourages him to behave in a certain way. If the attention of others is accompanied by criticism or appreciative looks, it can reduce self-confidence, cause stress, and even lead to social anxiety. In such situations, a person may begin to hide or downplay their true thoughts and feelings, which also contributes to a change in their behavior.

Knowing about the presence of other people inevitably forces an individual to adjust to social norms, being very careful in choosing words and actions. This leads to the desire to conform to the external to meet expectations and control their behavior in order to create the impression of conformity to the ideal. As a result, a person finds himself trapped in social approval, which often forces him to be someone he really is not. Obsession with recognizing and asserting one's social status becomes a defensive reaction aimed at preserving inner harmony and avoiding possible conflicts. This process, in turn, undermines the foundations of individuality and personal freedom, leading to a sense of incongruity and internal conflict. The problem is compounded by the fact that excessive attention and expectations from others can limit genuine self-expression, creating tension and stress, especially if the individual feels that his behavior does not meet public standards and expectations. In this so-called cycle of social evaluation, some people become unwitting victims, losing their sense of identity and freedom.

The history of the observer effect research begins with the first experiments that showed how awareness of the presence of other people can change behavior. One of the earliest manifestations of the observer effect in social psychology is considered to be an experiment at the Western Electric factory in the USA. A group of scientists led by psychologist George Elton Mayo has been changing working conditions in a factory, trying to figure out which ones have the greatest impact on productivity. The experiment was conducted in several stages and lasted a total of 8 years. Even in cases where working conditions were difficult and unusual, factory workers maintained productivity, and in some cases even began to work more efficiently. The researchers concluded that the workers' behavior was positively influenced by the presence of observers and the understanding that they were participating in an important experiment. In other words, people changed their behavior because they were being watched. This phenomenon was later called the "Hawthorne effect"[4].

Another, but not so unambiguous step in the history of experiments on the topic under study, may be a series of Milgram experiments. The essence of one of the experiments (the most popular and often used in various scientific arguments) was that initially the subjects thought they were helping in a study aimed at studying the effect of pain on memory. Three people participated in the experiment: a "teacher", a "student" and an experimenter. The drawing of lots was rigged in such a way that the subject always turned out to be the "teacher" and the experimenter's accomplice was the "student" (both pieces of paper had the word "teacher" on them). The "student" had to memorize pairs of interrelated words that the "teacher" read to him. For each incorrect answer, the "teacher" had to punish the "student" with the help of a generator that electrocuted him (in fact, there were no blows, the decoy actor only portrayed pain). Each time, the current discharge became stronger by 15 volts: the minimum discharge was 15 volts, the maximum was 450 volts. The experimenter monitored the progress of the experiment and insisted on its continuation if the subject refused to participate further [5]. These experiments have made a significant contribution to the study of social mechanisms of subordination. The participants, being under the close attention of researchers and authority figures (experimenters), demonstrated behavior that was dramatically different from their usual decisions. These observations allowed

us to understand that the presence of an observer can cause not only an external change in actions, but also affect the inner sense of responsibility, encouraging participants to adhere to established norms.

The observer effect, or the "spectator effect," reflects a person's amazing ability to change their behavior depending on who is watching them. Based on experiments such as Milgram's research, it has become obvious that the presence of authority figures or even the simple knowledge that a person is being watched can greatly influence his decisions. Under the influence of such observation, participants began to show more submission, often violating their own moral beliefs in order to meet the expectations and attitudes of authorities.

The parallels with real social and historical phenomena are obvious. The observer effect can often be seen in countries or former associations with authoritarian and totalitarian regimes, where people, obeying strict rules and authoritarian leaders, can commit terrible acts devoid of morality, under the pressure of force and surveillance. This effect is also seen in the context of terrorist acts, when the perpetrators may sincerely disagree with the ideology, but, being under group pressure and strict control, they follow orders, even if this order goes against human values.

The situation is reminiscent of Pushkin in "Boris Godunov", where the people, despite the obvious cruelty of the tsar, still obey his authority, which to a certain extent indicates the impossibility of going against the established, albeit sinister order. "No, no! We cannot pray for King Herod – the Mother of God does not order!" [6], – this phrase vividly illustrates the protest against the adoption of false moral norms and the refusal to follow despotic power. Even in the ancient Greek Iliad of Homer, when one of the heroes, Thersites, although he was a minority, opposed not only the thoughtlessness and love of power of the main commander Agamemnon, but also the suppression of his own opinion in society. Despite the possible threat of punishment, he continued to defend his position. This example, although it does not lead to active resistance in an explicit sense, emphasizes the importance of the fact that sometimes, even in conditions of dominance of certain ideologies, an individual may not succumb to the "spectator effect" and violate established but in correct norms. This raises the question of the human ability to maintain internal independence and not blindly obey public expectations when they contradict personal beliefs or even basic morality (not talking about illegal and lawful actions that violate individual rights or undermine the structure of the state with the priority of human life and humanism).

Milgram and other researchers have shown that pressure from others or authorities can lead to serial submission, but examples from literature and real life remind us that the possibility of resistance still exists and the problem of this issue is, in a sense, eternal.

Over time, the concept of the observer effect began to develop and deepen. Research in the field of social psychology has shown that not only external observation, but even the feeling of potential observation affects behavior. Scientists have begun to look at this effect in a broader context, including concepts such as social comparison and group influence. Modern research shows that people can change their actions, not only realizing that someone is watching them, but even knowing that their behavior can be evaluated by other people in the future, for example, on social networks. These

early studies played a key role in shaping the modern understanding of social psychology. They helped to reveal the importance of social factors in regulating human behavior and showed how strongly external influences can change a person and her behavior. The study of this phenomenon has become the basis for broader research in the field of social psychology, which explores issues such as the influence of a group on personality, self-esteem, and the influence of the social environment on decision-making.

The observer effect can be considered as a kind of psychological mechanism. This is due to self-awareness, because the realization that someone is watching you makes you more attentive to your own actions. Self-awareness plays a key role, as a person begins to think about how his behavior is perceived by others. This process is also related to social comparison: people tend to evaluate themselves through the prism of how they look in the eyes of others. If a person feels that they are being watched, they may begin to strive for a more positive perception from others, which in turn affects their behavior.

The theory of social control explains how observation by other people contributes to compliance with social norms. When a person understands that his actions can be evaluated, he usually tries not to violate social rules. This is because following the norms helps to avoid judgment and supports social acceptance. In this context, social control acts as a kind of "filter" that restricts certain forms of behavior.

Social identity also plays an important role in the observer effect. Belonging to a certain group affects how a person perceives himself in the context of public observation. Within a group where there is a clear idea of how to behave, a person will most often strive to meet these expectations, especially if he believes that his behavior will be evaluated by other members of the group. This can change his actions in a situation where he realizes that his behavior may affect his status in the group or the attitude of others towards him.

The influence of the social environment on the perception of observation is evident in how a person behaves in different contexts. For example, the difference between behavior in public and in private is very obvious. When a person is in a public place, they usually realize that their behavior can be noticed by other people. As a result of this consciousness, self-censorship often occurs: for example, in a store, on the street or in transport, a person may be more restrained in their actions, avoid loud conversations or external manifestations of emotions. In contrast, when a person is alone, for example, at home or in a private office, their behavior becomes less limited by social norms. He can relax, talk to himself, sing, dance, or perform any other actions that would seem strange in a public place.

Behavioral characteristics also depend on the type of group a person is in. For example, in a work environment where certain social roles and expectations are set, a person will be more careful in their statements and actions. He will make sure that he does not violate the formal norms of communication and keeps his distance, especially if he is being watched by colleagues or superiors. People in such conditions often avoid openly expressing their personal preferences, and their behavior will be focused on maintaining a professional image. For example, in a meeting, employees will strive for restraint, minimizing personal conversations or expressions of emotion, as awareness

of the presence of management forces them to follow the norms of business etiquette. In contrast, in a small group of friends, a person can feel more at ease and their behavior will be much less restricted. For example, in a circle of close people, when everyone knows each other and shares similar values, a person may express more explicit thoughts, joke, or do something that might be perceived as inappropriate in more formal situations. In such a group, knowing that they are being watched may not have a strong impact, as people tend to focus on personal preferences and mutual acceptance rather than external social expectations.

Knowledge of surveillance also strongly influences behavior in specific situations, such as exams or business meetings. Therefore, during exams, as a rule, students often experience stress and anxiety due to the presence of the examiner, and this affects their results. Realizing that the teacher is watching their actions may encourage them to check their answers more carefully, even if they are confident in their knowledge. Students may also subconsciously strive to comply with academic standards, for example, avoid a time gap or incorrect answers to make a good impression. At business meetings or in a corporate environment, the knowledge that not only superiors but also colleagues are watching every action motivates people to adhere to the established communication format. This is especially evident in meetings, where participants are often concerned about how their suggestions and reactions will be perceived by others. For example, if one of the colleagues starts discussing a new idea, others may agree with it not because it is the best, but because they are under pressure from social norms or hierarchy. In such a situation, the participants in the meetings will monitor their behavior and choose their words so as to look competent, confident and worthy of respect.

Behavior in social networks occupies a special place among all situations. This is a relatively new area of human habitation. Posts, likes, comments – all this happens against the background of the realization that thousands of people can follow every action, which was unthinkable and fantastic a few decades ago. Social networks impose an unprecedented number of labels and frames on people (not talking about messengers). This is not just a change of behavior, but even a redistribution of self-perception. When people post photos or comments, they not only express their personal opinion, but also analyze how it will be perceived by their subscribers, colleagues, or even strangers. An example is how many social media users strive to create an idealized image of themselves, for example, in photos of travel or a successful career. This does not always reflect reality, but rather becomes part of a game with social expectations.

The influence of surveillance is not only an external factor that forces people to follow norms, but also subtle mechanisms of social pressure that people respond to by adapting their behavior depending on the context.

The observer effect has a significant impact on the teaching environment and the learning process. As already mentioned, when students realize that their work and behavior are being observed by teachers, this can increase their attention and motivation (as well as anxiety, stress under strict criteria and excessive excess of their duties by supervisors due to personal relationships or other motives). For example, in the classroom, many students begin to work harder, realizing that their results will be appreciated and noticed. This can lead to them becoming more accurate in completing

tasks, less distracted, and trying to demonstrate their knowledge in the best possible way. At the same time, the teacher's attention can encourage students to maintain discipline, order, and standards of behavior in the classroom. The same mechanisms work in group classes, where students realize that their actions are visible not only to the teacher, but also to other classmates. Effect, in this case, an observer can be a powerful tool for maintaining order and organizing the learning process.

Social trends play an important role in professions where decisions made by employees affect the fate of other people, such as medicine or law. For example, in medicine, the observer effect can manifest itself in the way medical staff act in the presence of senior colleagues or patients, which increases workers' responsibility and motivation. Doctors and nurses can strive for higher standards of care when their actions are monitored not only by colleagues, but also by patients. Here, knowing that their work is being evaluated can encourage them to take a better and more analyzed approach to treatment and attention to patients. In law, the situation is similar: lawyers and advocates often focus on how their actions are perceived by judges or colleagues in order to achieve the desired results while saving face, because their actions can influence their work style and decision-making. Social trends and public expectations related to the ethical norms of professions also play a role in how professionals shape their decisions and behavior in situations where they know that their actions will be monitored by society.

Cultural differences also play an important role in how people perceive and react to the observer effect. In different cultures, people may perceive attention from others in different ways. For example, in countries with strong collectivist traditions, such as Japan or South Korea, people often attach more importance to social norms and the interests of the group. Here, knowing that someone is watching can cause a strong desire to meet expectations, since individual behavior is perceived as a reflection of the entire group. In such societies, a person may feel more responsible not only for himself, but also for the well-being of others and this knowledge forces him to follow social norms and avoid actions that could damage the reputation of the group. In individualistic cultures, such as in the United States or most Western European countries, attention from others may be perceived differently. Hereby, the emphasis on personal autonomy and independence can reduce the impact of the observer effect. People who have grown up in individualistic societies may be less inclined to adapt their behavior in response to external observations, as they focus more on personal goals and values. In such cultures, social control may be perceived as an interference with personal freedom, and in response to surveillance, there may be greater resistance or even disregard for external standards.

An example of cultural differences in the perception of personal freedom and social responsibility is the attitude towards public actions in different countries. For example, in countries with a collectivist orientation, such as China or India, citizens may be more inclined to observe social norms, realizing that their behavior affects the perception of the family or even the nation as a whole. Whereas in countries with an individualistic culture, such as the United States, a person may feel less responsible to society, perceiving their freedom as the most important value. Here, observation by others may be perceived as a restriction of personal rights, which may reduce its impact

on behavior. Depending on whether personal freedom is valued more or collective well-being, people will react differently to attention from others.

The observer effect is a kind of popularized and common psychological trauma. As a result, everyone has to deal with both the massive and individual consequences of it. What causes the trauma of the observer: many people may feel physically unwell, as the nervous system makes itself be felt through the body; psychosomatic diseases may manifest; bad habits may increase; uncontrolled recurring disturbing thoughts, dreams, constant feeling of depression appear; feeling helpless; excessive excitability, irritability, outbursts of anger may occur; an altered sense of reality may appear - as if everything around what is happening has somehow become unreal or slowed down, and others [7].

To learn how to deal with the effect of the observer effect on behavior, it is necessary to realize that such an observation affects us, and how we can control our reaction to it. One way to minimize its impact is to develop self-awareness and self-regulation skills. When a person realizes that his behavior is changing under the influence of external observation, he can consciously control his reactions, focusing not on other people, but on his own actions. To do this, it can be useful to develop self-confidence, focus on the task, and not on how others perceive it. Practicing meditation, mindfulness, or even simple deep breathing can help reduce anxiety and reduce the impact of external control on behavior. It is also important to work with the perception of social norms and expectations. When a person feels that their behavior is constantly being evaluated, it can cause stress and tension. In order to minimize this stress, it is important to learn to disconnect from the evaluation from others. One of the ways – this is the creation and maintenance of internal motivation based on one's own goals and values, and not on the desire to please others. When a person focuses on inner satisfaction rather than external evaluations, the influence of the observer effect becomes less noticeable.

Creating a favorable atmosphere for natural behavior requires realizing that it is important not only to work on oneself, but also on the environment. For example, in a work environment, in order for employees to act freely, it is important to create an atmosphere of trust where their actions are evaluated not strictly, but as part of an overall process aimed at improving the work of the team. This is especially true in a teaching or therapeutic environment, where an atmosphere of support and acceptance can help reduce the stress associated with supervision.

The methods used in therapy are aimed at reducing stress and increasing confidence. For example, cognitive behavioral therapy (CBT) often helps people become aware of their reactions to the effects of surveillance and learn how to deal with them. Therapists can use various techniques, such as role-playing or exposure therapy, to help patients face their fears and learn to act naturally in situations where they feel supervised. An important part is working with beliefs that increase anxiety, as well as developing self-confidence.

"And who are the judges?" –with these words by Alexander Chatsky from the play by A. S. Griboyedov "Woe from Wit" precisely to draw a conclusion [8]. This phrase is a criticism of false social norms that dictate their own rules and set their own standards, often without taking into account a person's personal beliefs and values. In

the context of the discussion of the observer effect, this quote becomes a kind of appeal for inner freedom and independence from external assessments.

The influence of society and observing the behavior of others certainly have a strong effect on a person, but ultimately it is their own assessment of themselves that should be a priority. It is important to remember that in the process of social interaction, each person is subjected to a variety of external assessments and views. However, by giving in to these assessments, a person risks losing their identity and undermining their confidence. The negative impact of the observer effect is manifested precisely in this – in the desire to please others, adapting to their standards, instead of relying on their own moral principles and beliefs. It is equally important to realize that social norms and expectations often contradict personal goals and inner values. So, a person, trying to meet the requirements of society, may begin to feel an internal conflict. This can manifest itself as stress, anxiety, or even loss of meaning in their actions. It is important to understand that an external view of a person is only an opinion, often limited by social boundaries, and it does not always reflect his inner essence.

We need to learn how to separate external assessments and internal values. A person should, first of all, trust his internal assessment, based on his own beliefs, and not on what others think of him. As Chatsky notes, true understanding and value are not those who "judge", but those who decide what is right for themselves. This is the only way to avoid manipulating public expectations and preserve your authenticity.

Thus, it is important to develop the ability to self-reflect and maintain personal beliefs without being overly influenced by others. Otherwise, a person risks losing his independence and confidence, obeying the opinion of society, which often does not take into account his individuality. Ultimately, it is the inner voice and one's own assessment that enable a person to remain true to himself and act in accordance with his own moral principles.

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INTERPRETATION OF THE DREAM MOTIF IN THE WORK OF DAVID LYNCH

Student **Kholamkhanova Yana Alievna**,

Academic Advisor: Senior Lecturer **Vasilyeva Maria Alexandrovna**,
Saint Petersburg State University of Industrial Technologies and Design,
Higher School of Technology and Energy,
Saint Petersburg, Russian Federation

Abstract. The article is devoted to the study of the motif of dreams in David Lynch's cinema. It examines the author's artistic methods. The evolution of the director's work is highlighted, with the cult television series "*Twin Peaks*" being singled out. The conclusion emphasizes the key importance of dream elements for the perception of the aesthetics of Lynch's films and indicates the direction of further research on this topic.

Keywords: dream motif, dream interpretation, artistic method, reality and dreaming, dream images, boundary between the real and the supra-worldly, doppelgangers and dissolution of personalities, inner world of heroes, the TV series "*Twin Peaks*", dream phenomenon in art.

ИНТЕРПРЕТАЦИЯ МОТИВА СНОВ В ТВОРЧЕСТВЕ ДЭВИДА ЛИНЧА

студент **Холамханова Яна Алиевна**,

науч. руководитель: ст. преподаватель **Васильева Мария Александровна**,
Санкт-Петербургский государственный университет
промышленных технологий и дизайна,
Высшая школа технологии и энергетики,
Санкт-Петербург, Российская Федерация

Аннотация. Статья посвящена изучению мотива сновидений в кинематографе Дэвида Линча. В ней подробно рассматриваются авторские художественные методы – создание визуальных образов и звуковой атмосферы, подчеркивающие размытость границы между миром сна и явью. Освещается эволюция творчества режиссера, отдельно выделяется культовый телесериал «*Твин Пикс*». В заключении подчеркивается основное значение элементов сна для восприятия эстетики фильмов Д. Линча и обозначаются направления дальнейших исследований по этой теме.

Ключевые слова: мотив снов, интерпретация сновидений, художественный метод, реальность и сновидение, образы сновидений, граница между реальным и надмирным, двойники и растворение личностей, внутренний мир героев, сериал «*Твин Пикс*», феномен сновидений в искусстве.

David Lynch is an award-winning director, producer and screenwriter known for his unconventional cinematic style. His works such as *Eraserhead*, *Twin Peaks* and *Inland Empire* break traditional narratives by offering surrealistic and nightmarish perspectives. Although he challenges viewers, throughout his career he maintained a broad audience due to his unique individual storytelling style.

David Lynch's films reflect a basic truth about the absurdity of human existence, where the director manipulates reality and logical paradoxes to create a unique worldview. While his work may be perplexing due to its brutality, sexual explicitness and symbolism, there are numerous layers of meaning hidden within them that require multiple viewings to be fully understood. The logic of D. Lynch's world seems confusing at first, but to those who inhabit it, everything makes sense. The director creates a controlled reality, even if it seems illogical to the viewer, by manipulating scenes and characters who see no irony in their actions.

The dream motif in David Lynch's works fulfils important semantic and structure-forming functions, creating a unique artistic universe in which the boundaries between reality and dream are blurred, and the inner world of the characters is revealed through symbols, images and emotional states. By analyzing his filmography, we can identify key aspects of the role of dreams in the structure and meaning of D. Lynch's works.

The creator explores complex themes of human nature through the lens of dreams, which makes his work multi-layered and rich in symbolism.

Lynch's philosophy begins with his view that, as a filmmaker, he is able to create a new reality, a new world for the audience [1, p. 112]. The dream-like narrative structure in David Lynch's work occupies an important place, especially in his early works, such as the short films *Eraserhead* (1977) and *The Elephant Man* (1980). These works demonstrate a distinctive approach to story organization and visual style, where dreams, visions and associative images act as key elements that shape the viewer's perception.

In *Eraserhead*, Lynch uses the technique of dreaming to create an atmosphere of uncertainty and inner fragmentation. In this film, the plot develops through a chain of associative images that appear to be unrelated logically but are united by an emotional and symbolic connection. Visual metaphors, such as a face turning into an eraser or disappearing into the fog, create a sense of transition between reality and dream (Figure 1). This technique allows the viewer to plunge into the inner world of the protagonist, where the boundaries between reality and fantasy are blurred. As a result, perception becomes more subjective: the viewer is forced to interpret images, search for hidden meanings and feel emotional tension without a clear logical sequence.



Figure 1 – Eraserhead

Like most of Lynch's films, *The Elephant Man* elicits strong reactions either positive or negative. Central to many reviews are discussions about the relationship between Merrick and his doctor, Frederick Treves, and Mrs. Kendall, the actress, who shows Merrick a world of beauty and artifice in the theatre away from the horrors of everyday reality [2, p. 17]. In *The Elephant Man*, Lynch also uses dreams to convey the psychological state of the characters and to heighten the contrast between the beautiful and the terrible. Images of dreams or visions serve not only to reveal the character's inner world, but also to reinforce feelings of anxiety and uncertainty. In this film, dreams act as a means of penetrating the subconscious, where symbols and metaphors help to understand the character's underlying feelings. Visual techniques – slow motion, bizarre images, use of light and shadow – create an effect of hypnotic immersion, reinforcing the sense of shaky boundaries between reality and dream (Figure 2).



Figure 2 – The Elephant Man

The technique of dreaming affects the viewer's perception in the following way: it gives the audience a sense of mystery and the multi-layered nature of what is happening. The viewer becomes a participant in the inner world of the characters, encounters their fears, desires and repressed emotions through symbolic images. This approach encourages active interpretation of what is seen: the viewer is forced to search

for meaning in abstract scenes on their own, which makes viewing a more subjective and personal experience. In addition, the use of dreamlike structure creates a hypnosis or trance effect – the scenes seem more emotionally intense and memorable due to their unusual visual style.

Thus, in D. Lynch's early works, the dream sequence serves not only as an artistic means of enhancing emotional impact, but also as a structural element of the narrative. It helps to create a unique atmosphere of uncertainty and inner depth, making the viewer's perception more sensual and intuitive. This feature is later developed in his feature films and TV series, where dream motifs continue to play a key role in shaping the meaning of the works.

Like the early-twentieth-century German Expressionist and French Surrealist filmmakers, Lynch is fascinated by the dreamlike quality of streaming cinematic images and sounds, and their ability to present intangible inner states of being as palpable audio-visual experiences for the audience [3, p. 45].

Inspired by the experience of European filmmakers, Lynch encapsulates the semantic function of dreams as follows: dreams serve as a window into the characters' subconscious, allowing them to explore their inner fears, desires, and repressed emotions. In *Twin Peaks*, dreams and visions often act as prophetic images or clues, revealing hidden sides of the personality and foreshadowing developments (Figure 3). For example, scenes with mystical visions of Laura Palmer or Dale Cooper are filled with symbolism and allegory, which help to understand the deep conflicts of the characters and their inner transformations. The dream motif also emphasizes the theme of duality – between good and evil, reality and illusion – which is a central concept of the series.



Figure 3 – *Twin Peaks*

Blue Velvet is a postmodern camp noir, mixing the aesthetics of tabloid novels and soap serials with the preserved, but now slightly veiled by D. Lynch with the element of the unconscious [4, p. 72]. In *Blue Velvet*, the dream motif fulfills the function of immersing the viewer in the psychological world of the protagonists, especially in the state of inner fragmentation and the search for truth. The dream images

here serve as a structural element linking the different levels of the narrative: reality, fantasy and subconsciousness. The lack of historical verisimilitude, namely the use of clothes, techniques and cars from different eras, droning sounds and ambiguous characters amplify the impression of alienation from reality. They create an atmosphere of mystery and uncertainty, reinforcing the sense of shaky boundaries between reality and dream. In this context, dreams act as a means of exploring the darker sides of human nature, violence, sexuality and moral dilemmas.

Of particular importance is the role of doppelgangers and the dissolution of personalities in these works. D. Lynch's dreams often contain images of doppelgangers or split personalities, emphasizing the theme of identity and its blurring. These motifs reinforce the sense of internal fragmentation of the characters and create the effect of metaphorical dissolution of the boundaries between the personality and its twin.

The structure of consciousness in David Lynch's films is a complex and multi-layered system in which dreams, reality and inner experiences intertwine to create a unique artistic universe. Consideration of these aspects in the examples of the films *Mulholland Drive*, *Inland Empire* allows us to highlight the change of the director's approach to the depiction of consciousness and unconsciousness in the director's late work.

The structure of consciousness in the film *Mulholland Drive* shows the inseparability of sleep and wakefulness.

Mulholland Drive is one of the most striking examples of the use of dream structure to depict the inner world of the characters and their psychological state. In this film, the boundaries between dream and reality are blurred, creating a sense of inseparability of consciousness. In the beginning, the viewer is confronted with a mysterious story about a female actress who has lost her memory and a mysterious girl who appears in her life. Gradually the plot turns into a kaleidoscope of images, scenes and associations, where real events intertwine with fantasies, dreams and hallucinations (Figure 4).



Figure 4 – *Mulholland Drive*

This structure emphasizes the inner instability of the characters: their perception of the world becomes fragmented, and events become symbolic. There is no clear linearity in the film: scenes may repeat or change places, which reinforces the sense of internal fragmentation. The dream acts as a key to understanding the characters' underlying fears, desires and repressed emotions. It reveals their subconscious motivations, which often contradict their outward behavior or conscious beliefs.

In the *Inland Empire*, dreams are seen as the key to understanding reality.

Inland Empire is Lynch's experimental film in which the narrative structure is built around dreams, illusions and metaphorical images (Figure 5). In this work, the dream becomes not only a means of expressing the inner world of the characters, but also a tool for penetrating the deeper layers of reality. On the one hand, characters who are not human but have almost human appearance and certain human qualities are introduced into the narrative, on the other hand, unnatural features are deliberately created in the appearance and play of the actors, which move them from the human space to the space of 'other' [5, p. 88].

The film shows the inner conflict of the protagonist, an actress named Betty, through a series of dream scenes and fantastic images. These scenes serve as a key to understanding her psychological state: fears, desires, feelings of alienation from her own personality. The dream here acts as a bridge between subjective reality and the subconscious; it helps to understand the heroine's true motives behind superficial events.



Figure 5 – *Inland Empire*

Lynch uses the technique of blurring the boundaries between dream and reality to emphasize the subjectivity of the perception of reality. In this context, the dream becomes an integral part of the narrative structure: it reveals hidden meanings and creates a sense of multilayered perception of the world. The viewer is forced to interpret the images as real or fantastic, which enhances the effect of mystery and psychological depth.

Thus, the dreamlike experience in D. Lynch's late work reflects his view on the nature of reality and human perception.

The director's later works continue to develop the theme of reflecting on the nature of reality through the lens of dreams and inner experience. In these films, dream motifs become a tool for exploring the human perception of the world as multilayered and subjective. His later scripts emphasize that the perception of the world depends on one's inner state: what appears to be objective reality to one may be an illusion or a dream to another.

These reflections emphasize the idea that human perception is always a subjective construct; reality is not an absolute entity, but the result of the interaction of subconscious processes and external circumstances. D. Lynch's dreams serve as a metaphor for this internal dialogue: they show us the depths of the human psyche and force us to consider how much we can trust our sensations.

The structure of consciousness in the works of D. Lynch is thus a complex network of interconnected elements: dreams, hallucinations, memories and fantasies. In *Mulholland Drive*, it manifests itself through the inseparability of sleep and wakefulness; in *Inland Empire*, sleep becomes the key to understanding the hero's inner truth; in later works, Lynch reflects on the nature of human perception as a subjective construct. These techniques create a unique atmosphere of uncertainty and multi-layered perception of the world, making the director's films not only artistic works, but also philosophical explorations of the human psyche.

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AXIOLOGICAL ASPECT OF ALLUSION IN CHINESE SOCIAL ADVERTISING DISCOURSE

Student **Shadrin Daniil Fedorovich**,

Academic Advisor: PhD in Philology, Associate Professor of the Department of Sinology, Associate of the Research Center for Transdisciplinary Regionology of Asia-Pacific Region

Sadovnikova Olga Nikolaevna,

Irkutsk State University, Institute of Philology, Foreign Languages and Media Communication, Irkutsk, Russian Federation

Abstract. This paper discusses profiling values in the axiosphere of contemporary Chinese society through the construction of allusion in social advertising discourse. As a result of the analysis, two main categories of prospective values characteristic of modern Chinese society (universal values – “health”, “labor”, “beauty” and national values – “wealth”, “harmony”, “civilization”) are identified.

Keywords: axiology, value, discourse, advertising discourse, social advertising, allusion.

АКСИОЛОГИЧЕСКИЙ АСПЕКТ АЛЛЮЗИИ В КИТАЙСКОМ СОЦИАЛЬНОМ РЕКЛАМНОМ ДИСКУРСЕ

студент **Шадрин Даниил Федорович**,

науч. руководитель: канд. филол. наук, доцент кафедры китаеведения, сотрудник Научно-исследовательского центра трансдисциплинарной регионологии Азиатско-Тихоокеанского региона

Садовникова Ольга Николаевна,

Иркутский государственный университет, Институт филологии, иностранных языков и медиакоммуникации, г. Иркутск, Российская Федерация

Аннотация. Данная работа посвящена изучению профилирующих ценностей в аксиосфере современного китайского общества посредством конструирования аллюзии в социальном рекламном дискурсе. В результате анализа выявляются две группы перспективизирующихся ценностей, характерных для современного китайского общества – общечеловеческие ценности («здоровье», «труд», «красота») и национальные ценности («богатство», «гармония», «цивилизованность»).

Ключевые слова: аксиология, ценность, дискурс, рекламный дискурс, социальная реклама, аллюзия.

As the renowned French image-maker Jacques Séguéla asserts, advertising is “*not just a word in commerce. It is a word in politics, public relations, a word in*

morality” [1, p. 252]. In this statement, one detail is particularly significant for us – namely, *public relations*: advertising, as a social phenomenon with a social context and an endless array of social connections, influences society by disseminating positive social norms, values, and behavioral models.

The discourse of social advertising is a branch of advertising discourse. This subtype is also aimed at influencing and persuading the audience, but its goals extend beyond commercial interests [2, p. 514]. The primary focus of social advertising is predominantly socially significant themes, such as health, family, education, ecology, public safety, and others. Its main objective is to change people’s behavior by promoting moral and ethical principles in society.

When discussing Chinese social advertising, a comprehensive and accurate analysis requires identifying its *socially significant agenda* – the agenda that holds the greatest importance and value for the Chinese people. Philosophy can help us answer this question. In philosophy, *value* is defined as “*the social, cultural, or personal significance (importance) of certain phenomena in reality*” [3, p. 495]. Values possess their own “*value orientation*” – “*the set of the most essential and meaningful qualities within an individual’s internal structure*” [3, p. 497].

Every sociocultural type of society possesses its own unique and specific values [4, 2017]. Such values shape individual behavior, dictating lifestyle patterns and particularities. The Eastern tradition – which includes the Middle Kingdom we are examining – is characterized by “the unity of society and the individual, justice, humaneness, benevolence, and respect for parents and elders.” Consequently, “the socialization of the individual is oriented toward self-improvement and is primarily connected with family, while society is viewed as one large family” [3, p. 500].

This raises a fundamental question: why do certain value orientations appear more pronounced, prevalent, and significant compared to others? This is where axiology comes into play – “the abstract general philosophical theory concerning meanings, values (pleasantness, utility – positive significance for humans), anti-values (harmfulness, displeasure – negative significance for humans), and value judgments – evaluations” [5, p. 7].

Axiology examines the formation, transformation, and influence of values on human behavior and worldviews. The values of Chinese society substantially determine the content of social advertising texts in China. We will analyze these values from an axiological perspective by addressing two key questions: what role did they play? And what meaning do they carry?

Contemporary Chinese social advertising represents a unique phenomenon where centuries-old cultural traditions (Confucian teachings, principles of philosophical Daoism, and Buddhism) [6, 7] – organically blended with socialist ideals – have played a pivotal role in shaping the Chinese worldview. At the core of this synthesis lies the employment of linguistic devices, among which allusion holds particular significance in our study. Following scholarly definitions, we understand allusion as “a reference to a well-known statement, fact from literary, historical, or more frequently political life, or to a work of art” [8, p. 28].

It is no secret that the Chinese language consists of a vast number of homographs and homonyms. This linguistic feature allows for creative modifications of expressions

and wordplay, serving to enhance the persuasive and attractive function of communication [9, p. 64].

Among all types of literary allusions, such as “*reminiscences*”, “*transformations of sayings by scholars, cultural figures, politicians, and other prominent individuals*,” “*biblical references*,” “*song lyrics (including modified ones)*,” “*adapted popular sayings*”, and “*titles of artworks altered to fit the context*” [10, p. 28] – the most prevalent in social advertising texts, where values are conveyed through allusion, is the “*adapted popular sayings*” type. However, analysis reveals that not all modified expressions containing allusions are necessarily “popular sayings”; more often, they are fixed four-, five-, or six-syllable phrases.

The key characteristic of using allusions in Chinese social advertising lies in how the implicit meaning, emerging from a subconsciously substituted component in an expression, either reinforces a particular value or redirects attention to another value, thereby expanding the “value framework” of a given advertising slogan.

To facilitate analysis, we have categorized the values examined within Chinese society into two distinct groups:

1) *Universal human values* – “a system of axiological maxims whose content is not directly tied to a specific historical period of societal development or a particular ethnic tradition. While acquiring unique contextual meaning within each sociocultural tradition, these values nevertheless recur across all cultural types as fundamental values” [11, p. 845-846];

2) *National values* – “the constellation of spiritual ideals characteristic of particular ethnic communities, reflecting their historical distinctiveness, where values function as socially and normatively-cultural axioms of behavior for people sharing the same ethnic identity” [12, p. 135].

Universal human values include such concepts as “family”, “beauty”, “labor”, “love”, and “health”.

National values, in our classification, comprise those officially codified by the PRC State Council in 2013 under “Core Socialist Values”, including: “honesty” (“诚信”), “prosperity” (“富强”), “equality” (“平等”), “harmony” (“和谐”), “civility” (“文明”) etc. These values have evolved through nearly a century of Marxism's development in China [13] and other ideological transformations.

Let us examine several examples that demonstrate universal human values through allusions in Chinese social advertising:

“琴有独钟” (qín yǒu dú zhōng) – translated as “The qin unites hearts” – is a slogan from a campaign promoting musical education in China. In this example, wordplay is used to enhance the emotional perception of the instrument (the qin), emphasizing how this beautiful instrument evokes powerful feelings and inspires people to engage with music. By replacing the character “琴” (qín, “zither”) with “情” (qíng, “emotion, feeling”), the phrase transforms into the well-known expression “情有独钟” (qíng yǒu dú zhōng), meaning “to have a special fondness for, to particularly love.” Undoubtedly, through this allusion, the value of “love” is reinforced.

“鳖来无恙” (biē lái wú yàng) – translated as “In good turtle health” – is an

advertising campaign emphasizing the importance of healthy lifestyle and disease prevention. The use of the turtle image “鳖” as a symbol of longevity and health reinforces the focus on health and wellbeing. By replacing “鳖” (“turtle”) with the phonetically similar “别”, the phrase transforms into the common expression “别来无恙”, meaning “long time no see” and “in good health”, “everything's fine”, making the advertisement more expressive.

The slogan “君子好球” – “*Sport is your noble mentor*” – is used in the campaign to promote a healthy lifestyle and participation in sports. Replacing “球” – “ball” with “逑” – “couple, spouse, spouse” forms the expression “君子好逑” – “a fine pair of noble husband”, emphasizing the importance of sports in shaping personal qualities and strengthening family bonds. The advertisement emphasizes harmonious personal development and family values.

Thus, having selected 41 examples of Chinese social advertisements that represent universal human values by allusion by means of solid sampling method, we found that the value “health” (“身体”) is the most perspectivizing value with 60.98 %. The less perspectivizing values expressed by means of allusion are:

The value “labor” (“劳动”) – 17.07 %;

The value “beauty” (“美”) – 9.76 %;

The value “family” (“家”) – 7.32 %;

The value “love” (“爱情”) – 4.88 %.

These results allow us to conclude that the most widespread and significant for Chinese society universal value expressed through allusion is the value of “health”. Most likely, this is due to the increasing interest in healthy lifestyles, human comfort and well-being, as well as the greatest effectiveness and demand for advertising that promotes health among Chinese society.

Let us consider the examples that represent national values by means of allusions with reference to the classification “Core Socialist Values”:

“繁荣娼盛” – “*Instead of prosperity, a brothel*” – is one of the examples of advertising headlines vividly reflecting prostitution as one of the main problems of moral decay in the conditions of economic prosperity of the country. The component “娼” – “public woman, a prostitute” is consonant with the component “昌” – “blooming, lovely, beautiful”, its substitution results in the expression “繁荣昌盛”, which means “prosperity and power, mighty flourishing, rich and prosperous”. In this case, the allusion to such a value as “富强” – “wealth, power” encourages the reader to think about the main thing, points to the need to reduce the level of prostitution as much as possible or to eradicate it completely, so as to prevent the “nuisance” (replace the linguistic component, dig deeper into the meaning of the expression; eliminate prostitution to solve, in particular, social problems) and contribute to the mighty prosperity, rapid development of the Middle Kingdom.

“前腐后继” – “*Those in front engage in corruption, those following them follow*” is an example of an advertising campaign reflecting the problem of corruption in Chinese society. When the component “腐” – “rotten, fester; engage in corruption”

is replaced by “赴” – “rush, rush [into battle]; spare no effort to work”, the expression “前赴后继” – “the front rushes to the attack and the others follow them; rush into battle, fight heroically” is formed accordingly. The allusion in this example points to the proper behavior of a person in society, based primarily on honesty and constant work.

Thus, having selected 45 examples of Chinese social advertisements that represent national values through allusion by means of a continuous sampling method, we found that the group of state-level values (“富强”, “文明”, “和谐”) was the most perspectivized one, with 42.2 %. Most of the state-level examples analyzed are related to the PRC's economic growth themes.

Less perspectivized national values expressed through allusion are groups of values at the social level (“公正”, “民主”, “法治”, “平等”, “自由”) – 35.6 %, at the civil level (“友善”, “敬业”, “诚信”, “爱国”) – 22.2 %. In the social and civic contexts of the “Basic Values of Socialism” such themes as “criticism of corruption” and “criticism of materialism” are dominant, there is often a play on words with the replacement of characters with homonyms related to money (“钱”), gold (“金”) or corruption, “rot” (“腐”).

These results allow us to conclude that the most widespread and significant group of values for Chinese society is the group of values at the state level. More than 40 % of examples are associated with such concepts as “economic prosperity”, “cultural heritage” and “social harmony”. This reflects the official agenda of the People's Republic of China, where the emphasis on the country's power and stability is reflected in social advertising not only as a key value, but also as a value represented through allusion.

Social values such as “justice” (“公正”) “democracy” (“民主”) or “rule of law” (“法治”) take the second place in terms of frequency. However, it is worth noting that it is not direct or indirect (through allusion) praise of these or those values that prevails here, but, on the contrary, criticism of violations of these values in the form of allusive wordplay with a clear ironic connotation. Allusions of this type allow touching upon acute topics and pointing out the shortcomings of government officials, while maintaining loyalty to the system.

The least represented through allusion are civic values such as “patriotism” (“爱国”) or “honesty” (“诚信”, although, based on our analysis, “honesty” often goes side by side with social-level values), values that often represent proper behavior in society by contrasting it with its antipodes (selfishness, deceit, decay) and ridiculing self-serving motives.

In general, this approach demonstrates how Chinese propaganda combines the rigid framework of official rhetoric with flexible linguistic techniques that allow it to speak to the public in a language they understand. Allusions have different functions: from the perspective of national values, they serve as a tool for discreet criticism, while from the perspective of universal values, they are rather an effective means of positive propaganda.

Chinese social advertising, using a rich arsenal of allusive techniques, creates a

complex system of values, where traditional cultural forms are filled with modern content. This synthesis makes it possible to effectively solve urgent social tasks, while preserving the connection with the cultural heritage. The revealed regularities are of significant interest both for specialists in the field of advertising and communications, and for researchers of modern Chinese culture in general.

The study confirms that social advertising in China has a dual function of promoting the official agenda and simultaneously providing a channel for society to discuss current, acute, pressing social issues.

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