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THE GRAIN YIELD OF CORN DEPENDS ON THE HYBRID

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УРОЖАЙНІСТЬ ЗЕРНА КУКУРУДЗИ ЗАЛЕЖНО ВІД ГІБРИДУ

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Abstract
The article presents research results on the impact of corn hybrids on grain yield. It is shown that on dark gray podzolic soils, the yield of Corinth hybrid corn was 79,4 quintals/ha, while the DKC 3050 hybrid yielded 86,0 quintals/ha.

Анотація
У статті наведені результати досліджень щодо впливу гібридів кукурудзи на урожайність зерна. Показано, що на темно-сірих опідзолених ґрунтах урожайність кукурудзи гібриду Коринт становила 79,4 ц/га, а гібриду ДКС 3050 – 86,0 ц/га.

Keywords: grain of corn, hybrid, yield
Ключові слова: зерно кукурудзи, гібрид, урожай

Пріоритетом кормовиробництва є покращення і збільшення кормової бази для стабільного забезпечення сільськогосподарських тварин доброякісними дешевими кормами. Серед фуражних злакових культур кукурудза, за продуктивністю, займає провідне місце [1, 5].

Проте, велику роль у збільшенні врожайності та покращанні якості зерна кукурудзи відіграє правильний підбір гібридів. Згідно даних вітчизняних науковців, упродовж найближчого часу збільшення виробництва продукції рослинництва буде реалізовано завдяки селекції, тобто нових, високопродуктивних сортів і гібридів та їх якісних показників.

Ґрунтово-кліматичні умови України сприяють селекції у веденні насінництва та виведення нових гібридів та сортів кукурудзи всіх груп стиглості.

Вітчизняними селекціонерами створено ряд нових сортів та гібридів кукурудзи які мають різні морфологічні ознаки, біологічні властивості, якісні показники, відрізняються за стійкістю до несприятливих чинників довкілля тощо [6].

У несприятливих умовах вирощування екологічна стійкість рослин суттєво впливає на формування біологічної продуктивності та урожайності культури. Тому для реалізації потенційної продуктивності сільськогосподарських культур необхідно підвищувати екологічну стійкість сортів [4].

Виведені нові гібриди рослин відрізняються скоростиглістю, урожайністю, резистентністю до хвороб, реакцією на проведення агротехнічних заходів та умов забезпечення вологою, здатністю зерна до швидкої вологовіддачі. Проте, на вибір гібриду впливає не тільки його висока врожайність, але і здатність протистояти несприятливим умовам вирощування, тобто адаптивний потенціал [3].

Для отримання високих урожаїв зерна гібридів кукурудзи важливе значення має пристосованість до умов навколишнє середовища. Важливо щоб гібриди могли поєднувати високу потенційну врожайність і стійкість до різних ґрунтово-кліматичних умов [2].

Екологічна пластичність визначає здатність гібриду з успіхом використовувати сприятливі чинники довкілля для забезпечення високого рівня урожайності. Особливо це актуально сьогодні, коли швидко змінюється клімат. Для одержання високих урожаїв зерна кукурудзи сучасні гібриди повинні забезпечувати високу і стабільну продуктивність та низьку збиральну вологість зерна.

Тому вивчення сучасних гібридів кукурудзи для визначення їх адаптивних властивостей у певних природно-кліматичних умовах є актуальним [7].

У дослідженнях, які проводили на темно-сірих опідзолених ґрунтах, використовували гібриди кукурудзи Коринт і ДКС 3050. На контрольній ділянці висівали кукурудзи гібриду Коринт, на дослідній - ДКС 3050.

Трилінійний гібрид кукурудзи Коринт (ФАО 230) вирощується на зерно, силос і біогаз. Характеризується відмінною адаптацією, високою і стабільною зерновою урожайністю та доброю вологовіддачею.

Гібрид ДКС 3050 (ФАО 200) характеризується високою урожайністю, швидкою енергією початкового росту та доброю вологовіддачею.

З даних таблиці видно, що урожайність зерна кукурудзи гібриду Коринт становила 79,4 ц/га, а гібриду ДКС 3050 - 86,0 ц/га, що на 6,6 ц/га (8,3 %) вище за контроль.

Таблиця

Вплив гібриду кукурудзи на врожайність зерна

Гібрид	Урожай, ц/га	До контролю	
		ц/га	%
Коринт	79,4	–	100,0
ДКС 3050	86,0	6,6	108,3

Отже, урожайність зерна кукурудзи гібриду ДКС 3050 була вища за врожайність зерна гібриду Коринт.

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ARTS

KNOWLEDGE SOCIETY IN AZERBAIJAN AND MUSEUMS: DEVELOPMENT PROSPECTS

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Abstract

One of the priority tasks facing us is the development of a knowledge society, a knowledge economy and its component, a creative economy, in Azerbaijan. The development of museums in the republic, the widespread use of modern technologies in the work of domestic museums, the implementation by museums of projects aimed at educating the population, providing cultural leisure and, at the same time, attracting additional financial resources – all these tasks are of particular relevance.

Along with the collection, storage, study and demonstration of museum objects, one of the areas of activity of museums is educational activities. In a period of constantly growing information flow, society needs comprehensive and accessible information. Museums are indispensable sources of such information. At this stage, it is necessary to conduct monitoring in order to find out the current state of affairs in this area, and to develop a unified concept for determining the prospects for the development of museums.

Keywords: knowledge society, knowledge economy, creative economy, Azerbaijan, culture, art, tourism, science, education, museums.

Guided by the call of the head of state to "transform oil capital into human capital", one of the priority tasks is the development in Azerbaijan of a knowledge society, knowledge economy and its component – the creative economy. The formation of a creative economy is closely related to the development of many industries, including tourism. The productive use of tourism potential is also associated with a number of issues, including the implementation of museum activities in accordance with the requirements of the time.

We believe that the development of a knowledge society directly depends on the integration of science and education. Museums occupy a unique place in solving this problem. When considering the numerous events implemented by museums, it becomes clear that currently these temples of culture and science perform many social functions, such as collecting, studying and displaying materials about current events, participation in the process of education and upbringing, recreational, communication, informational, aesthetic, economic functions, etc. [20, p. 61].

All of the above gives grounds to assert that museums play a major role in the formation of a knowledge society. In turn, we must implement various initiatives aimed at accelerating this process, direct the activities of the country's museums in the appropriate direction and create new museums that meet the requirements of the time.

Tourism sector and museums. Today tourism is one of the main sectors of the economy of the leading countries of the world. Therefore, the development of museum construction in the republic, the widespread use of modern technologies in museum affairs, the implementation by museums of projects aimed at educating the population, providing cultural leisure and, at the same time, obtaining additional financial resources – all these issues become of particular relevance.

In the "Strategic Roadmap for the Development of Specialized Tourism Industry in the Republic of Azerbaijan" notes that tourism has an impact mainly on three areas. Firstly, the direct impact of tourism companies on the Gross Domestic Product increases the importance of tourism; the tourism sector acts as the main locomotive of foreign exchange earnings for countries. Secondly, the development of tourism has a positive impact on increasing employment and socio-economic development of regions. And thirdly, the creation of a strong infrastructure in the country aimed at developing tourism becomes the reason for the development of infrastructure in various regions.

In addition, the tourism sector supports initiatives in the areas of environmental sustainability, cultural heritage, protection and development of local values. A successful tourism development strategy also helps to improve the country's image internationally, so tourism also acts as marketing tool for various countries [1, p. 8].

Scientists note that "the influence of tourism in general on specific countries, regions or tourist centers leads to the formation of three important factors in the long-term development of this area: a) environmental (ensuring environmental protection and diversity of biological resources); b) sociocultural (ensuring unity between the culture and values of the local population and the development of tourism and recreational policy); c) economic (ensuring economic productivity of development and resource management in order to meet the needs of next generations)" [7, p. 13].

Taking into account all of the above, it is necessary to emphasize that in the modern period the development of sustainable (long-term) and socially responsible tourism has acquired particular relevance.

The goal of sustainable tourism is to operate more efficiently and humanely, based on community interests and environmental opportunities. There are several factors that differentiate sustainable tourism from traditional tourism. Thus, tourism services are provided in accordance with the socio-economic and environmental capabilities of the territory, these opportunities determine the characteristics of tourism activities, tourists behave in accordance with the culture of the places they visit, respect natural objects, customs and traditions, have friendly relations with the local population on the basis of mutual respect [17].

Regarding socially responsible tourism, experts note that such tourism creates opportunities for tourists to make a real contribution to the sustainable development of the places they visit. The motto of socially responsible tourism is: "to improve the environment in which local people live and create attractive places for tourists". Through the implementation of large and small events, socially responsible tourism ensures the protection of nature, promotes the social and economic development of regions, and fosters a sense of respect for customs and traditions, historical and cultural heritage, and the environment [18, p. 13].

Thus, the creation of tourism products in accordance with the requirements of modern times will lead to the development of a creative economy in the republic. Taking into account the features of cultural and educational tourism, we note that the development of an important component of this type of tourism – museums – in accordance with the requirements of the time and the creation of new museums that meet the challenges of emerging realities will play a significant role in the formation of society and the knowledge economy. The creation of new museums is historically justified, as well as relevant and expedient both from the point of view of the development of tourism and the economy, and from the point of view of bringing the truth about Azerbaijan to the world community.

The role of museums in the integration of science and education. The role of museums in the formation of a knowledge society is not limited to their participation in the development of tourism. Speaking about the features that characterize the knowledge society, scientists note that at this time the role of science in society is increasing and, at the same time, fundamental changes are taking place in society itself, new scientific knowledge and technologies constitute the way of life of people, the essence of modern societies, space, in which people live [21, p. 65-66]. In this society, the mechanisms for applying scientific and technical knowledge are fundamentally changing, in other words, the integration of science, education and production is ensured.

The Law of the Republic of Azerbaijan "On Science", adopted on June 14, 2016, defines the basic principles of state policy in the field of organization, management and development of scientific activity in the republic, the goals of science and scientific-innovative activity, the rights and responsibilities of subjects of scientific activity, mechanisms for financing science, stimulation of scientific achievements and the organizational and legal basis for their application, as well as the leading role and tasks of science in ensuring the political, economic, social and cultural development of the country, the growth of well-being and the intellectual level of citizens, the acquisition of new knowledge by them, etc. This Law notes such principles, goals and priorities of state policy in the field of scientific activity as the integration of science into public life, transparency and accessibility of scientific results, ensuring integrative communication and dialectical unity in the relationships between science, education, economics and society, research the problems of forming based on knowledge of intellectual society and economics, etc. [6].

Museums play an exceptional role in solving all of the above issues, since, along with the collection, preservation, study and display of museum objects, one of the main areas of museum activity is education. In the modern period, when the information flow is constantly growing, society is in great need of information that reflects the truth, which is presented in a language it understands. Along with universities and research institutions, museums are indispensable sources of this information, which for many years have been collecting and displaying materials related to the experience of the evolution of society. Unlike academic institutions, museums are more accessible to the general public. Therefore, the possibilities of museums in the field of education are multifaceted; these cultural institutions are unique intermediaries between objects of historical and cultural heritage and subjects who accept cultural codes, that is, visitors [19, p. 3].

Museums operating in our country, to one degree or another perform the function of education. Naturally, large museums in Azerbaijan are most involved in this area. For many years, the National Museum of the History of Azerbaijan and the National Museum of Azerbaijani Literature named after Nizami Ganjavi functioned under the Azerbaijan National Academy of Sciences; they were not only temples of culture, but also scientific institutions of the republic, in which large-scale research was carried out and important scientific results were obtained. According to the relevant Decree of the head of state, these two museums were transferred under the authority of the Ministry of Culture of the Republic of Azerbaijan, however, scientific activity continues here, museums implement numerous events aimed at integrating science and education, and thereby actively participate in educational work.

Other major museums in the country are the Azerbaijan National Museum of Art, the Azerbaijan National Carpet Museum, the Azerbaijan State Museum of Musical Culture, the Museum of Modern Art, etc. These museums, as well as museums of art, literature, music and other profiles located in the capital and regions, try to take part in public life, especially to cooperate with secondary schools and higher educational institutions. Naturally, there are a number of problems, to identify and find ways to solve which, appropriate monitoring must be carried out, and for further activities a unified concept must be developed. We talked about the need for monitoring about ten years ago [2].

Improving museum activities in accordance with emerging realities. The Covid-19 pandemic that began in 2020 has created new realities in all areas, including in museum activities. One of the features of the pandemic and post-pandemic era is the accelerated development of electronic services. On the official websites of our major museums, their pages on social

networks Facebook and Instagram, as well as on YouTube channel, virtual tours and lectures are posted, in most cases in several languages. However, during the course of our research, it turned out that many museums in the republic do not have official websites and pages in the Wikipedia encyclopedia, or they exist, but are not updated. The limitation or complete absence of virtual activities of museums has a negative impact on their recognition within the republic, not to mention the global space. Our museums must operate in accordance with the requirements of the technological era. This will lead to their popularization both among the local population and among tourists.

In addition, we consider it necessary to create new museums that meet the requirements of the time. For example, in various regions of our republic, which are distinguished by their rich cultural and natural heritage, it is imperative to create ***ecomuseums and "green routes" (Greenways)*** . Ecomuseums are initiatives whose goal is both the development of tourism and the solution of socio-economic and cultural problems of the local population. Ecomuseums are often established along national, regional or international green routes.

The question of the need to create eco-museums in Azerbaijan was raised back in 2011 [13, p. 51-52], and later we made a proposal to create the first eco-museum in the village of Khinalig, emphasizing that this process would lead to the organization of the necessary archaeological and ethnographic research in the region, building the infrastructure necessary for the convenience of the rural population and creating new jobs, that is, improving the well-being of the local community as a whole, and also talked about the prospects for creating similar museums in Ivanovka, Lahic, Sheki, Ilisu, Gakh and other regions [15; 4].

Naturally, it is impossible to cover all physical and geographical regions of Azerbaijan at one time. From this point of view, specialists involved in the relevant industries must determine the regions in which the creation of "green routes" will be most productive, and decide in which areas eco-museums should be created, taking into account such factors as the villages located on these routes, the number of population and the state of infrastructure. Considering the creative work in the Karabakh region and upcoming goals, we consider it appropriate to create several "green routes" and eco-museums in this region. As experts note, "the creative economy that will be formed in the Karabakh economic region is of great importance in providing employment, increasing the share of creative goods and services in exports, achieving long-term economic growth... The transition from culture to economy, the creation of cultural and creative sectors will lead to the development of tourism [8, p. 172].

For the development of cultural and educational tourism, we also consider it necessary to create ***museums of the history of cities***. Speaking about museums of the history of specific cities, it should be noted that the main advantage of these institutions over other types of museums is that the subject of research of these museums is everything that surrounds them. Museums of the history of cities create an opportunity for people to get to know their hometowns more deeply and learn more about the history of their origins. These museums exhibit everything – photography, cinema, folklore, etc., various programs are being implemented [10, p. 6]. Museums of the history of cities tell the story of urban culture, popularize the uniqueness of communities, and engage in activities aimed at the cultural development of the population.

Only two museums of the history of cities are known to function in Azerbaijan. These are museums of the history of Sumgait and Mingachevir – two cities created in the 60-s XX century. It is interesting that in the same years a similar museum was created in Shusha, but it functioned for a very short time.

To date, we have developed and presented to the public the primary concepts of the history museums of Baku [12; 3], Shusha [9] and Nakhchivan [14]. We hope that these initiatives will soon find their solution.

And we explore the role of museums in the integration of science and education through the activities of scientific and technical museums and children's museums.

Scientific and technical museums should carry out work aimed at both protecting, studying and promoting scientific heritage, and popularizing scientific knowledge, as well as engaging in environmental education and training of people. Researchers include museums of this profile as museums that document the process of historical development of science and technology, have monuments of science and technology in their collections, promote the history of the development of technology and scientific knowledge, and also implement public events aimed at popularizing scientific and technical knowledge [5, p. 40] .

For years now, we have prepared the primary concept of the Museum of the History of Science, which was planned to be created at ANAS. We are taking certain measures to practically implement this initiative.

We have also developed and submitted to the Ministry of Culture of the Republic of Azerbaijan a project for a Children's Museum-Center. About ***children's museums*** we are talking since 2011 [11]. Let us note that children's museums perform more of an educational function than an entertainment one. During the game, children receive the necessary knowledge and try to master the world and determine their place in this world. As the author of the project for the Children's Palace Museum in Russia, Alexander Zelenko, wrote, a children's museum "should serve the interests of young citizens in the same way as modern museums serve adults." The idea of creating a children's museum is a very important idea, since "with the help of such a museum we bring pearls of material culture to children precisely in those years when they are enthusiastically interested in the world around them". The Children's Museum is a new and experimental event. He must be as mobile as possible, must be ready for various changes [16, p. 168].

The creation of special museums for children in Azerbaijan is a very important and necessary task. We believe that such museums should be created, first of all, in the regions of the republic, since in the capital adult museums implement special programs for children, but in the regions this is almost not observed. We also note that the creation of children's museums will be an important step not only in the upbringing and education of children and the organization of cultural family leisure, but also in the opening of new jobs in

cities and regions (teachers, educators, hall supervisors, stage directors, decorators, psychologists, etc.).

Conclusions and offers. Considering all of the above, we can confidently say that the role of museums in the formation of a knowledge society and the knowledge economy that develops in parallel with it cannot be denied. Expanding the functions of museums, the active participation of these institutions in the life of modern societies, their direct participation in both the collection and creation of knowledge - all this creates ample opportunities for close contact between museums and creative industries.

Like other countries in the world, Azerbaijan has entered a post-oil period. Thus, the further development of the republic no longer depends on the exploitation of natural resources, but on the development of agriculture and the non-oil industry, science, technology, tourism and other areas. All of the areas we have listed are based in one way or another on knowledge. Therefore, the issues of communicating information about scientific achievements, the results of ongoing research and experiments to the general public are of great importance and relevance. Museums play an important role in this matter. From this point of view, it is necessary to study the current state of the country's museums, for which monitoring should be carried out, and also to develop a unified concept aimed at determining the prospects for the further development of museums. And the creation of eco-museums, museums of the history of cities, scientific and technical and children's museums will play a significant role in the development of a knowledge society.

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EARTH SCIENCES

ORGANIC MATTE GEOCHEMICAL CHARACTERIZATION OF ACHIMOV DEPOSITS

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ГЕОХИМИЧЕСКАЯ ХАРАКТЕРИСТИКА ОРГАНИЧЕСКОГО ВЕЩЕСТВА АЧИМОВСКИХ ОТЛОЖЕНИЙ

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Abstract

The question of whether the Achimov clayey rocks belong to the oil-maternal rocks is still open due to the lack of sufficient factual material. The studied samples of argilllites have low or close to the lower limit of potentially oil-maternal rock Sorg content - 0.61-2.41%. The value of S1 (oil content in clayey rock), one of the main indicators of oil-generating properties of the rock, in these deposits is also very small and is 0.07- 0.57 kg of oil per ton of rock (on average about 0.20 kg / t), which is much lower than the emigration barrier of 4.5 kg / t (according to Tissot and Welte, 1981). In this connection, we analyzed additional geochemical factual material on the Achimov and Lower-Middle Jurassic sediments (data of V.A. Skorobogatov, 1997) and constructed a series of graphs illustrating geochemical features of oil and gas accumulation processes in the Jurassic and Lower Cretaceous sediments on the territory of the Yamal Peninsula.

Аннотация

Вопрос о принадлежности ачимовских глинистых пород к нефтематеринским до настоящего времени остается открытым из-за отсутствия достаточного фактического материала. Исследованные образцы аргиллитов имеют невысокое или близкое к нижнему пределу потенциально нефтематеринской породы содержание Сорг — 0,61–2,41%. Величина S1 (содержание нефти в глинистой породе), одна из главных показателей нефтегенерационных свойств породы, в этих отложениях также очень мала и составляет 0,07–0,57 кг нефти на тонну породы (в среднем около 0,20 кг/т), что значительно ниже эмиграционного барьера в 4,5 кг/т (по данным Тиссо и Вельте, 1981 г.). В этой связи нами был проанализирован дополнительно геохимический фактический материал по ачимовским и нижне-среднеюрским отложениям (данные В.А. Скоробогатова, 1997) и построена серия графиков, иллюстрирующих геохимические особенности процессов нефтегазонакопления в юрских и нижнемеловых отложениях на территории п-ова Ямал.

Keywords: Achimov sediments, geochemical characterization, organic matter, genesis, pyrolysis, sediment depth dependence.

Ключевые слова: Ачимовские отложения, геохимическая характеристика, органическое вещество, генезис, пиролиз, зависимость от глубины залегания отложений.

Основная часть

Общая оценка степени термической зрелости и типов ОВ проведена по соотношению изопреноидов и *н*-алканов. Изучена зависимость значений водородного индекса HI от Tmax с учетом типов ОВ и значений R0. Выводы, сделанные на основании УВ состава органического вещества (ОВ) с привлечением данных пиролиза подтверждаются при анализе зависимости Tmax от глубины залегания отложений на различных площадях (рис. 1). Изменение ОВ в ачимовских отложениях на площадях Малыгинская и Сядорская соответствует зоне "нефтяного окна". Эти данные могут свидетельствовать о возможности генерации нефтяных УВ непосредственно в ачимовской толще. Наличие нефтематеринских отложений и степень их катагенетического преобразования позволяют считать ачимовский продуктивный комплекс вполне самостоятельным. ОВ ачимовских отложений характеризуется умеренным катагенезом, смешанным сапропелево-гумусовым составом. На п-ове Ямал на глубинах 3800 м прогнозируются нефтяные, а ниже до 4500 м — газоконденсатнонефтяные скопления. На Уренгойском поднятии по данным пиролиза граница главной зоны нефтеобразования опущена до глубин 4250 м на Уренгойской и Тюменской площадях и до 4750 м на Самбургской и Геологической [4].

Распространение в ачимовской толще разномасштабных по запасам месторождений контролируется в основном литофациальным фактором — наличием депоцентральных клиноформных зон меридионального простирания.

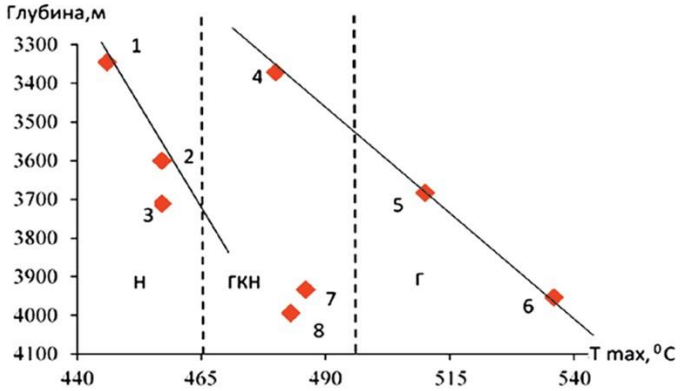

Рисунок 1. Зависимость Tmax от глубины залегания отложений Площади: 1. Малыгинская (ачим.); 2. Сядорская (ачим.); 3. Тарминская (J_{1-2}); 4–6. Харасавейская (J_{1-2}); 7, 8. В. Бованенковская (J_{1-2})

Высокий потенциал ачимовских отложений связывают с геологическими особенностями толщи. Развитие мощных пород-покрышек глинистого типа обеспечивает сохранность потенциальных залежей.

Нефтеносность же связана с особенностями генерации углеводородов. Так в работе [2] исследована северная часть Западно-Сибирской мегапровинции и сделан вывод о самостоятельности ачимовского продуктивного комплекса ввиду соответствия степени зрелости органического вещества и соответствия стадиям МК1-МК3 (стадии нефтяного окна).

Также о самостоятельности ачимовского комплекса уже на территории Широтного Приобья судит и Ю.Н. Карагодин в монографии [3], в которой отмечено, что идентичной точки зрения придерживается и академик А.А. Трофимук.

Если же не принимать во внимание возможность самостоятельного продуцирования углеводородов в ачимовской толще и придерживаться того мнения, что ачимовские отложения насыщены нефтью баженовской материнской толщи, то и в таком случае потенциал ачимовских отложений не вызывает вопросов. В рассмотренном варианте ачимовские толщи являются первыми на очереди вертикальной миграции углеводородов из более плотной баженовской толщи [1].

Таким образом, стоит отметить, что отложения ачимовской толщи обладают высокой перспективностью и могут являться самостоятельным объектов поисков углеводородов.

Анализ распределения залежей показывает, что преимущественная нефтеносность характерна для южных районов, смешанным характером нефтегазоносности отличаются северные и центральные районы Западной Сибири. Вместе с тем наличие нефтяных залежей на глубине 4 км требует объяснения их формирования. Согласно исследованиям Д.А. Соина и В.А. Скоробогатова уровень катагенеза пород ачимовской толщи практически полностью находится в интервале градаций МК1 – МК3, что соответствует «нефтяному окну» [2]. Вследствие высокой глинистости и весьма ограниченного распространения песчаных прослоев процессы эмиграции углеводородов из ачимовской толщи были незначительны. Процессы вторичной миграции также были ограничены внутрирезервуарным пространством отдельных линз-горизонтов без масштабных межрезервуарных перетоков углеводородов по латерали.

Процессы генерации нефти и газа в верхнем продуктивном комплексе изучены достаточно подробно. Рассеянное органическое вещество (ОВ) этих пород сапропелево-гумусового и гумусового типов. Содержание $C_{орг}$ значительно и составляет в среднем 1,2–2,0 %.

В глинистых и алевролитовых разностях сеномана-альба содержание Сорг снижается с запада на восток соответственно от 2,7 и 1,12 % на Ямале, 2,55 и 1,20 % на Гыдане до 1,50–2,40 % и 1,10–1,50 % в центральных районах Надым-Тазовской области. Степень метаморфизма ОВ отвечает бурогольной (отражательная способность витринита R0 равна 0,3–0,5 %) и длиннопламенной (R0 = 0,5–0,65 %) стадиям [5].

Результаты расчетов генерации газа и битумоидов породами альб-сеноманского комплекса показали [5], что только в породах альба и сеномана северных районов бассейна были генерированы грандиозные объемы УВ газов — около 1 490 трлн м³ и существенно меньшие объемы битумоидов, особенно легких, около 132 млрд т, то есть альб-сеноманская толща севера Западной Сибири явилась мощным газоматеринским комплексом, генерировавшим газ протокатагенетического генезиса (т. е. на низких стадиях катагенеза) [5].

Верхний продуктивный комплекс является преимущественно газоносным. Внутри него выделяется распространенный регионально альб-сеноманский НГК, аптский подкомплекс, развитый на Ямале, Гыдане и северо-западе Надым-Тазовской НГО и продуктивная газ-салинская пачка турон-сенона, установленная в восточной части Пур-Тазовской НГО и в Мессояхском нефтегазоносном районе.

Свободные газы верхнего продуктивного комплекса исключительно метановые, бесконденсатные или низкоконденсатные с очень низким содержанием тяжелых УВ (обычно не более 2–3 %, но чаще всего менее 1 %), бессернистые. Также очень низки содержания CO2 и азота. Для изученных скоплений характерны химические типы флюидов (по Ал.А. Петрову) Б-1, Б-1 и А-2. По содержанию микроэлементов конденсаты и нефти являются обедненными, а по преобладанию Ni над V образуют единый никелевый тип флюидов, характерных для слабопреобразованных УВ ранней генерации.

С глубиной от сеноманского подкомплекса к аптскому общее число залежей и количество газовых залежей сокращается. Меняется и их фазовое состояние: появляются газоконденсатные, газоконденсатнонефтяные и нефтегазоконденсатнонефтяные залежи. С ростом глубин и палеотемператур, т. е. с увеличением градации катагенеза пород и ОВ, состав газа утяжеляется, содержание метана снижается от 99–97 до 95–93 %, а содержание тяжелых УВ растет от 0,5 до 2,5–3,5 %; при этом состав жидких УВ облегчается: от нафтенового сменяется нафтеново-метановым и метано-нафтеновым.

Верхний продуктивный комплекс включает 93 месторождения (табл. 1, рис. 2, 3, 4, 5) и 168 залежей. Он представлен всеми категориями запасов (в тыс. т усл. т): мелкими (<5 000–15 000), средними (15 000–60 000), крупными (60 000–300 000), уникальными (>300 000) и месторождениями-гигантами (свыше 1 млрд т).

Таблица 1.

Количество залежей верхнего продуктивного комплекса по группам запасов и типам флюидов [8]

Тип флюида	Группа запасов				Общее количество залежей
	мелкие	средние	крупные	уникальные	
Газовый	26	17	7	5	55
Газоконденсатный	1	1	4	6	12
Нефтегазоконденсатный	-	1	1	1	3
Газонефтяной	2	2	4	3	11
Нефтегазовый	2	2	3	2	9
Нефтяной	2	1	-	-	3

Месторождения-гиганты — Медвежье, Русское, Заполярное, Бованенковское, Ямбургское и Уренгойское. По фазовому состоянию среди разнообразных УВ скоплений преобладают газовые (55 залежей). Их число максимально в классе мелких залежей (26), далее по классам они убывают (17, 7 и 5). С рангом класса запасов возрастает число ГК залежей (от 1 до 6); ГН (от 2 до 4); появляются НГК залежи.

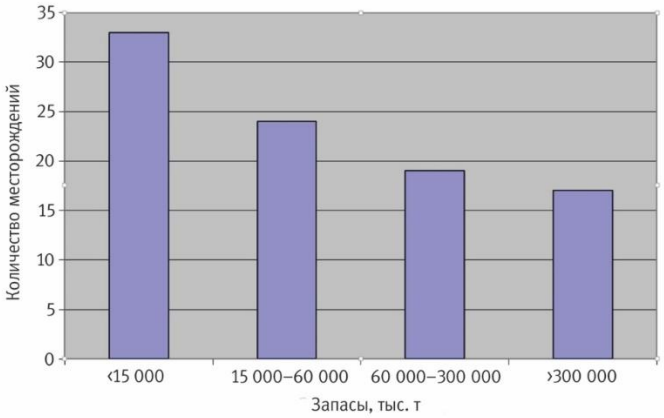

Рисунок 2. Частотный график распределения запасов УВ в верхнем продуктивном комплексе

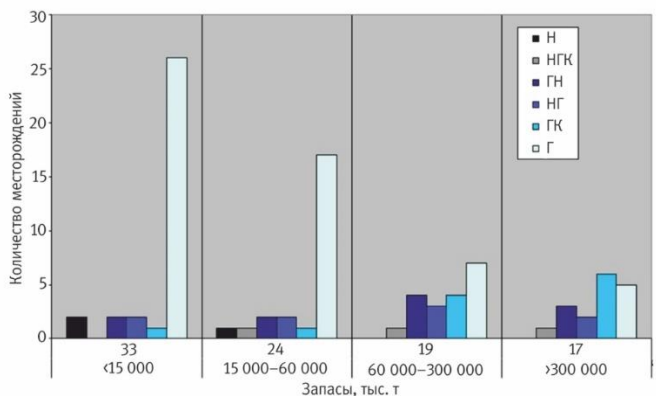

Рисунок 3. Частотный график распределения запасов УВ в верхнем продуктивном комплексе с учетом фазового состояния залежи

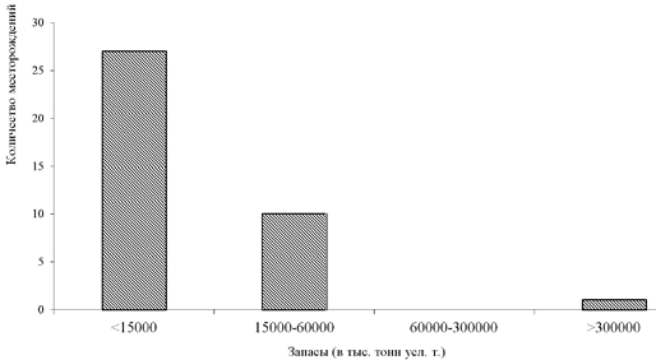

Рисунок 4. Частотный график распределения запасов УВ в ачимовских отложениях

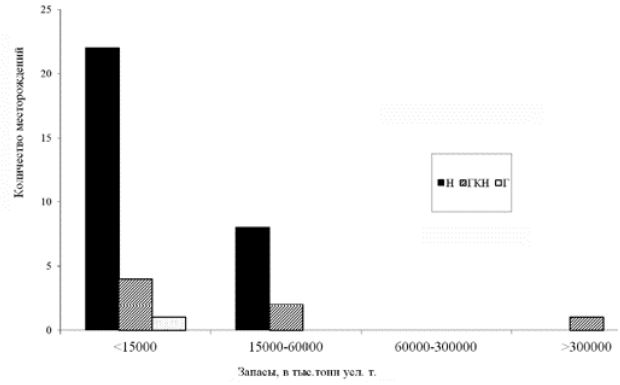

Рисунок 5. Частотный график распределения запасов УВ в ачимовских отложениях с учетом фазового состояния залежи

На схематической карте (рис. 6) размещения УВ скоплений с разной категорией запасов в верхнем продуктивном комплексе выделены три зоны: область развития месторождений-гигантов, область преимущественного развития крупных и уникальных по запасам скоплений и область преимущественного развития мелких и средних по запасам скоплений. [5].

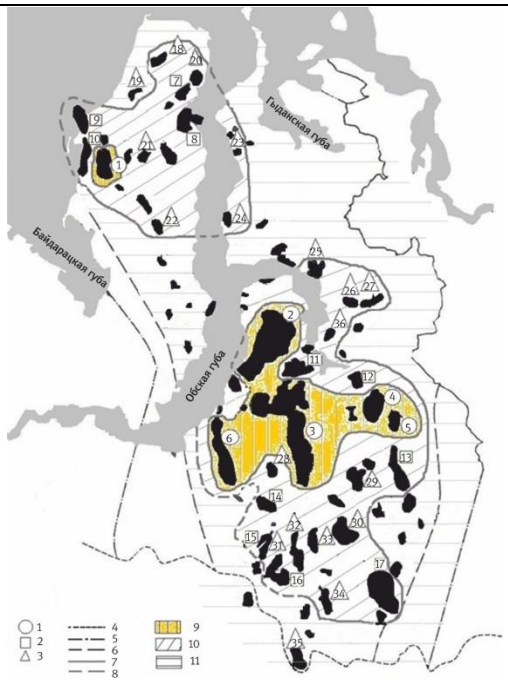

Рисунок 6. Схематическая карта размещения углеводородных скоплений с разной категорией запасов в верхнем продуктивном комплексе севера Западно-Сибирского НГБ Группы месторождений по начальным запасам:
1 — гиганты; 2 — уникальные; 3 — крупные; 4 — условная граница между северными и центральными районами; 5 — внешний контур проду-ктивности комплекса; 6 — граница между высоко- и низко-перспективными зонами.
Граница зон с различными запасами УВ: 7 — установленная; 8 — предполагаемая. Зоны преимущественного развития УВ скоплений: 9 — гигантских; 10 — крупных и уникальных; 11 — мелких и средних.
Месторождения по запасам. Гиганты: 1 — Бованенковское; 2 — Ямбургское; 3 — Уренгойское; 4 — Заполярное; 5 — Русское; 6 — Медвежье. Уникальные: 7 — Северо-Тамбейское; 8 — Южно-Тамбейское; 9 — Харасавэйское; 10 — Крузенштернское; 11 — Северо-Уре-нгойское; 12 — Тазовское; 13 — Южно-Русское; 14 — Ям-совейское; 15 — Северо-Комсо-мольское; 16 — Комсомольское; 17 — Харампурское. Крупные: 18 — Малыгинское; 19 — Сядо-рское; 20 — Тасийское; 21 — Вер-хне-Тиутейское; 22 — Арктическое; 23 — Утреннее; 24 — Геофизическое; 25 — Антипаютинское; 26 — Западно-Мессояхское; 27 — Восточно-Мессояхское; 28 — Юбилейное; 29 — Береговое; 30 — Восточно-Таркосалинское; 31 — Барсуковское; 32 — Губкинское; 33 — Западно-Таркосалинское; 34 — Етыпуровское; 35 — Вынгапуровское; 36 — Находкинское

Месторождения-гиганты приурочены к двум центрам, один из которых расположен в осевой части Надым-Тазовской НГО (Медвежье, Г, Уренгойское, ГК, Ямбургское, Г, Заполярное, Г, Русское, НГ), чьи максимальные запасы газа связаны с сеноманским комплексом, так же как и нефтяная залежь месторождения Русского, а другой — на Ямале (месторождение Бованенковское). Две другие зоны — крупных и уникальных, а также средних и мелких УВ скоплений широкими поясами окаймляют выделенные центры. Прогнозируемые зоны могут являться перспективными для поисков разномасштабных месторождений УВ скоплений.

Причина насыщения мегарезервуаров верхнего продуктивного НГК севера Западной Сибири гигантскими и уникальными запасами УВ сырья объясняется благоприятным сочетанием как геохимических, так и геологических особенностей региона. Это, по данным [5, 6], развитие в разрезе значительной по мощности угленосной толщи верхнего валанжин-сеномана с высоким содержанием ОВ существенно гумусового типа, способной генерировать огромные массы УВ; оптимальная для эффективного газообразования стадия катагенеза — показатель преломления витринита R0 изменяется от 0,40 до 0,55 %; высокая песчанистость разреза и отсутствие в нижнемеловом разрезе мощных достаточно протяженных глинистых покрышек; широкое развитие значительных по размерам и эффективной емкости валообразных и куполовидных поднятий; новейшее время окончательного формирования газовых скоплений; наличие мощной (500–900 м) турон-олигоценовой покрышки, слабо нарушенной разломами. Как считают некоторые исследователи [5, 6], в породах нижнего мела-сеномана была генерирована и достаточно большая масса битумоидов, однако скопиться образовавшиеся нефти первого этапа генерации в условиях мощного газообразования и накопления смогли только в неблагоприятных для сохранности газа локальных условиях. Как правило, они находятся там, где в альб-

сеноманском комплексе обнаруживается флюидопроводящий разлом или серия разломов, по которым газ мигрирует из залежи. Это нефтяные подгазовые залежи на месторождениях Русское, Тазовское, Северо-Комсомольское.

Среди упомянутых благоприятных факторов ряд исследователей для объяснения закономерностей размещения гигантских скоплений нефти и газа в верхнем продуктивном комплексе на исследуемой территории придают особенностям геодинамических процессов. Образование месторождений-гигантов в этом регионе обусловлено наличием крупных и гигантских структурных ловушек. Как отмечают многие исследователи, тектоника северных и арктических регионов в неоген-четвертичное время была на несколько порядков активнее центральных, и именно здесь проявились интенсивные структурно-формационные движения с образованием поднятий-ловушек с амплитудами более 200 м. Вероятно, значительное воздымание, способствующее выделению растворенного газа, а также активизация геодинамических движений, приведшая к формированию крупных структур-ловушек, типа мегавалов, валов, куполовидных поднятий и др., являлись благоприятными факторами для образования здесь уникальных и гигантских месторождений [6, 7].

Вывод

Ачимовская толща северных регионов Западно-Сибирского НГБ характеризуется резкой фациальной неоднородностью и клиноформным строением. Большинство залежей связаны со сложнопостроенными комбинированными неантиклинальными ловушками, а резервуарами для них служат литологически-экранированные песчаные пласты.

В границах северной части Западно-Сибирского НГБ в ачимовских отложениях выделены зоны распространения флюидов различного фазового состояния и различных физико-химических свойств: нефтяная и переходная ГКН. ОВ ачимовских отложений на п-ове Ямал характеризуется умеренным катагенезом и смешанным сапропелево-гумусовым составом и отвечает зоне «нефтяного окна». Здесь на глубинах до 3800 м прогнозируются нефтяные скопления, а ниже до 4500 м — ГКН.

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MATHEMATICAL SCIENCES

PROOF OF PHYSICAL REALITY OF IMAGINARY NUMBERS AND EXPLANATION OF THEIR PHYSICAL ESSENCE[1]

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Abstract

In the article it is shown that the version of the special theory of relativity (STR), stated in all textbooks of physics, is wrong as the relativistic formulas received in it are wrong, they are incorrectly with use of wrong principle of non-exceeding of speed of light are explained and from them wrong conclusions about physical unreality of imaginary numbers and also about existence in the nature of our only visible universe are made. This generally recognized version of STR is refuted experimentally proved as a result of research of transient processes in linear electric circuits by the general scientific principle of physical reality of imaginary numbers discovered 500 years ago. It is explained that imaginary numbers in astrophysics correspond to the world of invisible parallel universes in other dimensions. Its cognition is the task of future science. However, the neighboring universes can be seen on the starry sky in portals even now. The corrected relativistic formulas are obtained and the corrected version of STR corresponding to them is created.

Keywords: imaginary numbers, special theory of relativity, invisible universes, hidden Multiverse, Hyperverse

1. Introduction

Imaginary numbers were discovered 500 years ago by Scipione Del Ferro, Niccolo Fontana Tartaglia, Gerolamo Cardano, Lodovico Ferrari and Raphael Bombelli [1]. And perhaps even earlier than them such a scientific discovery was made by Paolo Valmes [2], who was burned alive at the stake for this by the verdict of the Spanish inquisitor Thomas de Torquemada. Even Sir Isaac Newton[2] was forced to take into account the opinion of the Inquisition about imaginary numbers, who therefore preferred not to use them in his works.

However, their physical significance remains unknown in science to this day. Indeed, everyone knows what 7 seconds, 12 meters, or 19 grams are, but no one knows what 7*i* seconds, 12*i* meters and 19*i* grams, where $i = \sqrt{-1}$, are. We all know that 7, 12 and 19 are simply numbers having no physical significance outside of their context. However, this knowledge was not enough to understand the STR.

2. The Problem of Understanding Imaginary Numbers

Works of famous mathematicians Abraham de Moivre, Leonhard Euler, Jean le Rond d'Alembert, Caspar Wessel, Pierre-Simon de Laplace, Jean-Robert Argand, Johann Carl Friedrich Gauss, Augustin Louis Cauchy, Karl Theodor Wilhelm Weierstrass, William Rowan Hamilton, Pierre Alphonse Laurent, Georg Friedrich Bernhard Riemann, Oliver Heaviside, Jan Mikusiński and others contributed to creation of a perfect theory of functions of a complex variable. However, the theory neither proves physical reality of imaginary numbers nor explains their physical significance[3].

Imaginary numbers are now widely used in all exact sciences, including radio engineering, electrical engineering, optics, mechanics, acoustics, etc. But in them also the physical reality of imaginary numbers is not proved and their physical meaning is not explained[4].

But in the generally accepted version of the special theory of relativity (STR) [3]-[5], which is rightly considered one of the most outstanding theories created in the 20th century and is therefore currently studied in all physics textbooks, it is even denied, since its creators were unable to explain the relativistic formulas obtained therein.

$$m = \frac{m_0}{\sqrt{1-(v/c)^2}} \quad (1)$$

$$\Delta t = \Delta t_0 \sqrt{1-(v/c)^2} \quad (2)$$

[1] This is reprint of the article "Antonov A. A. Proving physical reality and explanation physical nature of imaginary numbers". Norwegian Journal of development of the International Science".123. 26-36. https://doi.org/10.5281/zenodo.10451085

[2] In the atmosphere of the omnipotence of the Inquisition and intolerance of dissent that existed at that time, Newton's friend William Whiston was stripped of his professorship in 1710 for some of his careless statements and expelled from Cambridge University.

[3] Naturally, about physical reality and physical essence of imaginary numbers, as well as real numbers, we can speak only in relation to named numbers, equipped with indications on the used units of measurement of corresponding parameters of physical objects and processes.

[4] More precisely, in radio engineering and electrical engineering it is actually revealed in the process of their practical use, but nothing is written about this in textbooks, so as not to refute physics.

$$l = l_0\sqrt{1-(v/c)^2} \quad (3)$$

where m_0 is the rest mass of a moving physical body;

m is the relativistic mass of a moving physical body;

Δt_0 is the rest time of a moving physical body;

Δt is the relativistic time of a moving physical body;

l_0 is the rest length of a moving physical body;

l is the relativistic length of a moving physical body;

v is the velocity of a moving physical body;

c is the speed of light;

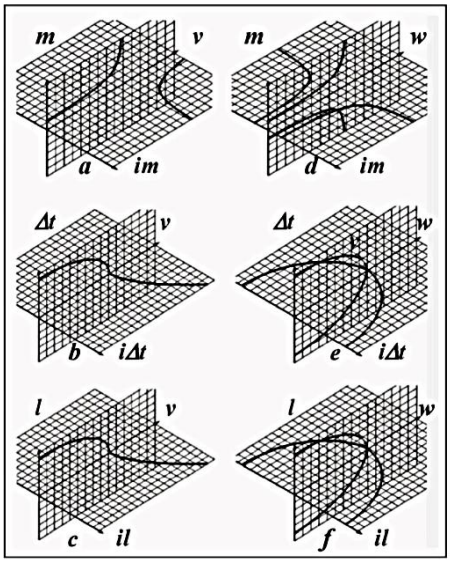

Fig. 1. Graphs of functions $m(v)$, $\Delta t(v)$ and $l(v)$ corresponding to the existing and the corrected versions of the STR in the subluminal $v < c$ and superluminal $v > c$ ranges

They could not explain physical significance of these formulas for the superluminal velocity range, where, according to these formulas, mass, time, and distance were measured in imaginary numbers (see Fig. 1a, b, c). However, since a theory that could not be explained even by its creators would be useless to anyone, in the STR had to introduce a postulate[5], known as the principle of light speed non-exceedance, the meaning of which is clear from its name.

In relation, for example, to the Lorentz-Einstein formula (1), it was explained as follows. The postulate asserted that since the situation at $v > c$ never occurred anywhere in the early 20th century, it did not need any explanation. Thus, imaginary numbers were unnecessary. i.e. non-existent. Moreover, they were even called imaginary

However, since the existing version of the STR was based solely on a postulate, that is, an unproven assumption, there was no complete certainty that it was correct. Actually, it turned out to be incorrect, since in 2008-2010 (i.e., even before publication of results of the unsuccessful OPERA experiment[6] conducted at the Large Hadron Collider in 2011), it was experimentally proven [6]-[10] that imaginary numbers are physically real.

3. Proof of Physical Reality of Imaginary Numbers

Thus, in the 21st century, a Hamlet's question has arisen in physics – is the generally accepted version of the STR correct or not correct? Consequently, does it require correction or not? To address this, it was necessary to answer another question – whether imaginary numbers discovered 500 years ago are physically real or not. And the response to this question required experimental confirmation, even though this issue falls within the realm of mathematics. However, Oliver Heaviside asserted on a similar issue, *"Mathematics is an experimental science."*

Let us further examine electromagnetic transient processes in linear electrical circuits[7] [10]-[15], which allow us to answer this question conclusively using simple experiments[8]. These experiments can be carried out by any engineer in less than a day in any radio engineering laboratory. Such processes in linear electrical LCR circuits are described by linear differential equations (or systems of such equations)

$$a_n\frac{d^n y}{dt^n} + a_{n-1}\frac{d^{n-1} y}{dt^{n-1}} + \ldots + a_0 y = b_m\frac{d^m x}{dt^m} + b_{m-1}\frac{d^{m-1} x}{dt^{m-1}} + \ldots + b_0 x \quad (4)$$

[5] Since it has never been proven theoretically or confirmed experimentally by anyone.

[6] Which was no longer needed

[7] Unlike the extremely complex and expensive MINOS, ORERA and ICARUS physics experiments, which were no longer needed

[8] In contrast to the extremely expensive physics experiments MINOS, OPEPA and ICARUS, which were no longer needed

where $x(t)$ is the input action (or the input signal);

$y(t)$ is the response (or the output signal);

$a_n, a_{n-1}, ...a_0, b_m, b_{m-1}, ...b_0$ are the constant coefficients;

$n, n-1, ...0, m, m-1, ...0$ is the order of derivatives.

A solution to the equation (5) is known to equal the sum of two components

$$y(t) = y(t)_{forc} + y(t)_{free} \quad (5)$$

where $y(t)_{free}$ is the free component of response, corresponding to the transient process;

$y(t)_{forc}$ is the forced component of response.

They are found in different ways. We are only interested in the free component of response.

Finding a specific type of a free component of response begins with writing and solving the so-called characteristic algebraic equation (usually of the second order) corresponding to the original differential equation (4)

$$a_n p^n + a_{n-1} p^{n-1} + ... + a_0 = 0 \quad (6)$$

where $a_n, a_{n-1}, ...a_0$ are the constant coefficients same as in the equation (4);

$n, n-1, n-2, ...1, 0$ are the degree indices, the magnitude of which is equal to the order of the corresponding derivatives in differential equation (4);

p is the variable, which is often called a complex frequency, when it takes values in the form of complex numbers.

Currently, two algorithms for solving algebraic equations (4) are used in mathematics. According to the first algorithm, solutions are found in the form of real numbers known to everyone. The second algorithm finds solutions to complex numbers that no one understands.

Then, one might assume that no one needs complex numbers because of their incomprehensibility. But, actually, the use of complex numbers greatly simplifies mathematical reasoning and many engineering calculations. Thus, when solving algebraic equations of power n according to the first algorithm, we would receive either n roots or $n-1$ roots or $n-2$ roots ... or even no roots, depending on the value of coefficients. $a_n, a_{n-1}, ...a_0$ And when using the second algorithm to solve the same algebraic equations of power n, we would always receive n roots. Therefore, for some combinations of coefficients $a_n, a_{n-1}, ...a_0$, the algebraic equation (6) might not have any solution within the first algorithm, and would always have n solutions within the second algorithm.

This definitely contradicts common sense and requires an answer to the question – which of the algorithms mentioned above provides the only correct solution in a particular situation? After all, two mutually exclusive statements cannot be simultaneously true. In the formal logics, the Latin aphorism *'Tertium non datur'*, i.e. there is no gap between them that corresponds to this situation.

However, the question is uneasy, otherwise, the answer thereto would have been received long ago. Since humans have a visual thinking, graphical solutions to algebraic equations would be the most helpful in explaining the situation.

For this purpose, we shall convert, for example, the algebraic quadratic equation $a_2 p^2 + a_1 p + a_0 = 0$ as follows

$$\begin{cases} y = a_2 p^2 + a_1 p + a_0 \\ y = 0 \end{cases} \quad (7)$$

Then its solution (see Fig. 2) would correspond to the intersection of the parabola $y = a_2 p^2 + a_1 p + a_0$ and the line $y = 0$, i.e. the abscissa axis p.

As can be seen depending on the parabola position relative to the axis p, which is determined by values of coefficients a_2, a_1, a_0, the parabola $y = a_2 p^2 + a_1 p + a_0$ can cut the axis p either at two or one or none of the points.

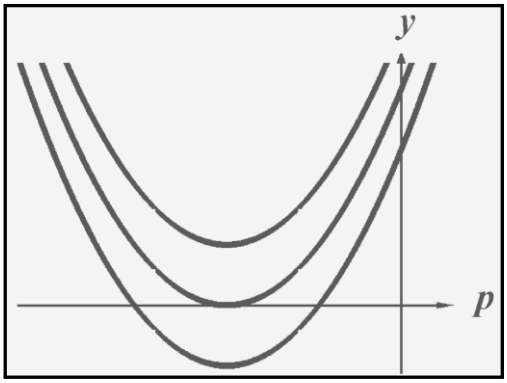

Fig. 2. *Graphical solution to the quadratic equation in the set of real numbers, explaining that the equation can have either or two or one or no solutions*

The result obtained is consistent with the corresponding analytical solution to the quadratic equation. Actually, if a discriminant of the equation $a_2 p^2 + a_1 p + a_0 = 0$ is positive, the equation has two different real roots $p_1 = -\sigma_1$ and $p_2 = -\sigma_2$. If a discriminant is equal to zero, i.e. $a_1^2 - 4a_2 a_0 = 0$, the equation has one real root $p = -\sigma_0$. And if a discriminant is negative, i.e. $a_1^2 - 4a_2 a_0 < 0$, the equation does not have any real root.

The result is so simple and obvious that it would seem to even serve as a proof of existence of the only right solution according to the first algorithm using real numbers. But this is not the case, since a no less clear graphical solution to the quadratic equation can also be obtained within

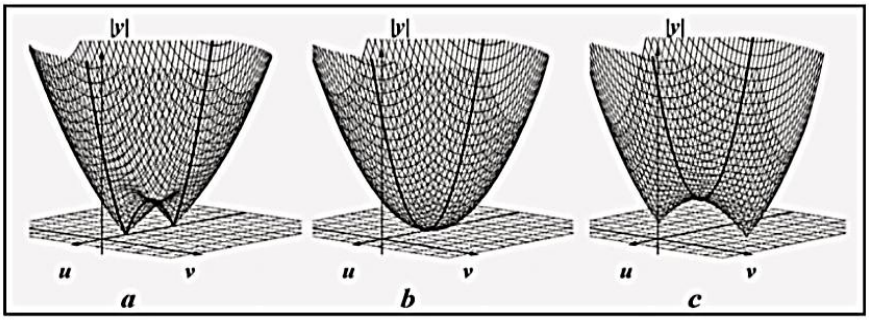

Fig. 3. *Graphical solution to the quadratic equation in the set of complex numbers, explaining that the equation can have two solutions or one double solution*

the second algorithm. It looks to be impossible at first sight, since the graph of function, where and are the complex quantities, should be four-dimensional. Humans can neither imagine nor de-pict four-dimensional graphs. Really, try to imagine and draw, for example, a four-dimensional cube (also referred to as a tesseract or octachoron). But mathematicians can do this.

However, the problem becomes quite solvable if a four-dimensional graph of the function of complex variable $y = f(x)$ is replaced by a three-dimensional graph of function $|y| = |f(x)| = |f(\sigma + i\omega)|$. Thus, within the second solution algorithm, the quadratic equation can be converted into a system of equations, corresponding to the Fig. 3.

$$\begin{cases} |y| = |a_2(\sigma + i\omega)^2 + a_1(\sigma + i\omega) + a_0| \\ |y| = 0 \end{cases} \quad (8)$$

Herewith, Fig. 3a would correspond to the case when a solution to the quadratic equation for $a_1^2 - 4a_2 a_0 > 0$ has two real roots of different values $p_1 = -\sigma_1$ and $p_2 = -\sigma_2$. In this case, the surface $|y| = |f(x)|$ would contact the plane of the complex variable $x = \sigma + i\omega$ at two different points $p_1 = -\sigma_1$ and $p_2 = -\sigma_2$ on the axis of real numbers σ.

Fig. 3b would correspond to the case when a solution to the quadratic equation for $a_1^2 - 4a_2 a_0 = 0$ has one double[9] real root $p_{1,2} = -\sigma_0$. In this case, the surface $|y| = |f(x)|$ would contact the plane of the complex variable $x = \sigma + i\omega$ at one point $p_{1,2} = -\sigma_0$ on the axis of real numbers σ.

Fig. 3c would correspond to the case when a solution to the quadratic equation for $a_1^2 - 4a_2 a_0 < 0$ has two complex conjugate roots $p_{1,2} = -\sigma \pm i\omega$. In this case, the surface $|y| = |f(x)|$ would contact the plane of the complex variable $x = \sigma + i\omega$ at two points that are not on the axis of real numbers σ.

Algebraic equations of the third and higher degrees can be solved graphically in a similar way. Fig. 4 gives an example of a graphical solution to the algebraic cubic equation $a_3 p^3 + a_2 p^2 + a_1 p + a_0 = 0$, which in the set of real numbers is converted as follows

$$\begin{cases} y = a_3 p^3 + a_2 p^2 + a_1 p + a_0 \\ y = 0 \end{cases} \quad (9)$$

[9] For example, for the equation $(x + \sigma_0)^2 = 0$

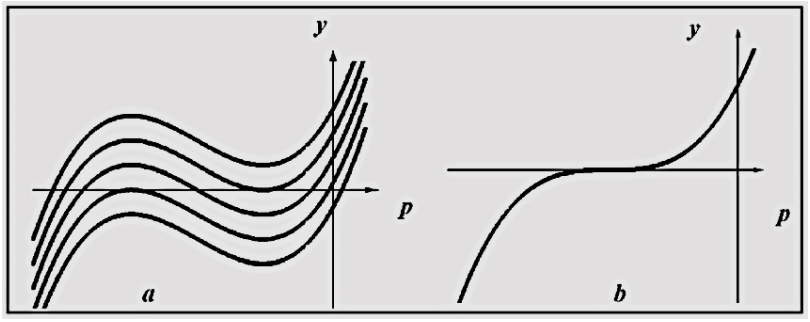

Fig.4. *Graphical solution to the cubic equation in the set of real numbers, explaining that this equation can have either one or two or three solutions*

Apparently, depending on the position of the curve $y = f(x)$ relative to the abscissa axis (i.e. depending on the value of coefficients a_3, a_2, a_1, a_0), the cubic equation can have either one or two or three real solutions within the first algorithm (see Fig. 4a,b). Fig. 5a,b,c,d,e shows graphical solutions to the cubic equation $a_3(\sigma+i\omega)^3 + a_2(\sigma+i\omega)^2 + a_1(\sigma+i\omega) + a_0 = 0$ in the set of complex numbers for the same combinations of coefficients a_3, a_2, a_1, a_0, as in Fig. 4, equivalent to the system of equations

$$\begin{cases} |y| = \left|a_3(\sigma+i\omega)^3 + a_2(\sigma+i\omega)^2 + a_1(\sigma+i\omega) + a_0\right| \\ |y| = 0 \end{cases} \tag{10}$$

As can be seen, a solution to the equation $a_3p^3 + a_2p^2 + a_1p + a_0 = 0$ has always three roots when using the second algorithm. But some roots can be double as in Fig. 4a, 5b, 5d, and even triple[10] as in Fig. 4b and 5f. In the latter case, in Fig. 3b, the graph is somewhat different, looking like a tangentoid (or cotangentoid).

And while the points of intersection of the curve $y = a_3p^3 + a_2p^2 + a_1p + a_0$ and the abscissa axis p correspond to solutions to the equation $a_3p^3 + a_2p^2 + a_1p + a_0 = 0$ in Fig. 4, the points of contact of the surface $|y| = \left|a_3(\sigma+i\omega)^3 + a_2(\sigma+i\omega)^2 + a_1(\sigma+i\omega) + a_0\right|$ of the complex plane $x = \sigma + i\omega$ correspond to solutions to the same equation $a_3p^3 + a_2p^2 + a_1p + a_0 = 0$ in Fig. 5. Moreover, both figures show the same particular cases of the situations mentioned. Consequently, equally convincing graphical solutions can also be proposed to the cubic equations (and equations of higher degrees) in the set of both real (Fig. 4) and complex (Fig. 5) numbers.

Thus, purely mathematical reasoning above do not allow us to make an indisputable conclusion about the truth of one and the falsity of another algorithm for solving algebraic equations; or, in other words, to draw a conclusion about physical reality or unreality of their solution expressed in the form of complex numbers.

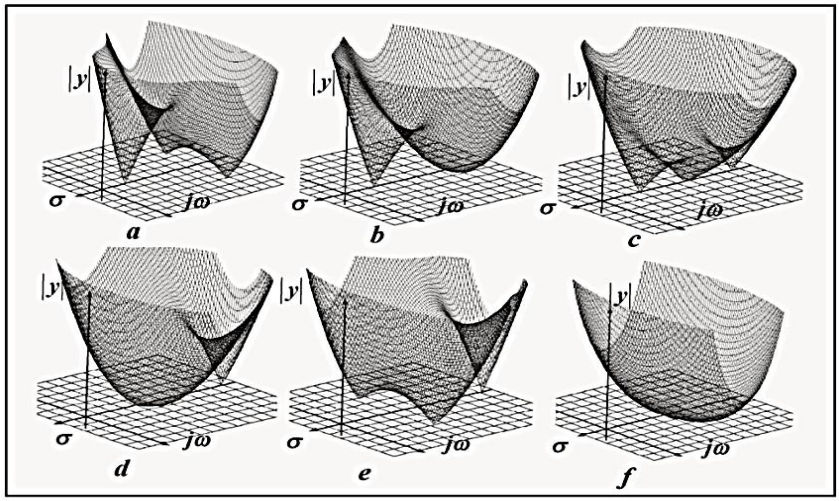

Fig. 5. *Graphical solution to the cubic equation in the set of complex numbers, explaining that in this case it has either three solutions or two solutions, one of which is double, or one triple solution, i.e. having always three solutions*

[10] For example, for the equation $(x + \sigma_0)^3 = 0$

It is clear that then the choice from the mentioned two algorithms for solving algebraic methods could be made differently - in accordance with the general scientific criterion called "Oc- kham's razor" [11]. According to this criterion, the theory that has the simpler explanation[12] must be accepted as true. And in accordance with this criterion, in all likelihood, sooner or later the second recognized algorithm would be true.

But the trouble is that this choice would require explaining physical significance of complex numbers. Physicists do not have an explanation. And, what is worse, instead of admitting this, they state without evidence that imaginary (and, consequently, complex and hyper-complex) numbers have no physical content, referring to the principle of light speed non-exceedance. Authority of the STR actually hinders the study of this important problem. Such a point of view turned out to be even terminologically[13] fixed in science, since one of components of complex numbers is called imaginary, i.e. supposedly non-existent, numbers.

That is why mathematics still uses both algorithms for solving algebraic equations, even despite the fact that

- solutions obtained by these algorithms often mutually exclude each other;
- the STR considers one of these solutions (in the form of complex numbers) to be physically non-existent[14].

So what is the answer to the question whether solutions to algebraic equations physically exist in the form of complex numbers? Since, as has just been shown, the use of purely mathematical[15] means cannot answer the question, let us try to figure it out relying solely on common sense.

For this purpose we try to understand what meaning the words 'solution exists' or 'solution does not exist' should have. Where does it exist? On paper? In computer? On a blackboard in a university classroom? We could say so, but "in nature, in the physical world we live in" would apparently be more correct answer.

Therefore, we should talk about existence of a solution as a physical reality. And it would be logical to conclude that answering the question requires physical experiments. What kind of experiments are these? And it turns out that such experiments have been done for a long time by both humans and nature. We meet them everywhere. They are well known to everyone. These are shock oscillations. In any form. In the form of sound of a piano or a tuning fork, in the form of tsunami or 'Indian summer', in the form of children's swing[16] rocking after being pushed by parents, etc.

In this regard, let us recall that only solutions in the form of complex numbers are always used in solving characteristic algebraic equations (6) while studying transient processes (for example, in electrical circuits). The first algorithm for solving algebraic equations using real numbers is never applied in relation to characteristic equations.

Why? The answer to this question is extremely important. Therefore, let us consider in more detail how this question is covered, for example, in the electrical circuit theory. It states that if a characteristic algebraic equation of the second degree has two different real roots $p_1 = -\sigma_1$ and $p_2 = -\sigma_2$, then an aperiodic transient process exists in an electrical circuit and is described by the time function

$$y(t)_{free} = Ae^{-\sigma_1 t} + Be^{-\sigma_2 t} \quad (11)$$

If roots of a characteristic equation of the second degree are real and multiple of $p_{1,2} = -\sigma_0$, then the so-called critical transient process exists in an electrical circuit and is described by the time function

$$y(t)_{free} = (A + Bt)e^{-\sigma_0 t} \quad (12)$$

And, finally, if roots of a characteristic equation of the second power are complex conjugate numbers $p_{1,2} = -\sigma \pm i\omega$, then an oscillatory transient process corresponding to them exists in an electrical circuit, and the quantities p_1 and p_2 are the complex frequencies of free oscillations. This transient process is described by the time function

$$y(t)_{free} = e^{-\sigma t}[A\cos(\omega t) + B\sin(\omega t)] \quad (13)$$

Herewith, integration constants A and B are determined from the initial conditions $y(0)$ and $y'(0)$ in all particular cases.

Solutions to characteristic algebraic equations of higher powers can include aperiodic, critical and oscillatory components. This is covered in detail in textbooks. However, they neither explain nor substantiate why characteristic equations are solved only using the second algorithm, which allows finding their roots in the form of complex numbers. And, it turns out, because only in such a case the transient can also exist in the form of shock oscillations (13). The use of the first algorithm would necessitate arguing that shock oscillations should not have existed. However, they do exist.

Thus, the point is that oscillatory transition processes exist in nature. And they can exist only if the

[11] 'Occam's Razor' is a principle formulated in the 14th century by the English monk William of Ockham: "More things should not be used than are necessary".

[12] As, for example, in astronomy the Copernican heliocentric system was recognized as true and the Ptolemaic geocentric system was recognized as false.

[13] Actually, long before the STR was created.

[14] Consequently, mathematicians have not recognized the principle of light speed non-exceedance postulated in the STR as scientifically sound.

[15] But we must not forget that names such as mathematics, physics, radio electronics, etc. were given by people specializing in some narrow research area subject to their limited intellectual capabilities. However, when it comes to Nature, all these names are replaced by the only name of Science.

[16] It is interesting to note that children's swing, on which children are rocking without the help of their parents, refutes another scientific misconception, which, according to information on the Internet, is shared by many authoritative scientists. The misconception suggests that unsupported motion devices, the so-called inertioids, cannot exist, and their existence is therefore denied by modern science, as it contradicts the law of conservation of momentum.

characteristic algebraic equations corresponding to them have solutions in the form of *complex numbers.* And only for this reason the unsolvable in pure mathematics question about which of the two mutually exclusive algorithms of solving algebraic equations is correct, turned out to be quite solvable with the help of simple physical experiments. And common sense.

It follows from the above that it is necessary to recognise solutions of algebraic equations[17] using complex numbers as the only correct and corresponding to physically real existing processes in the world around us. Therefore, complex frequencies $p_{1,2} = -\sigma \pm i\omega$ of free oscillations are physically real, including their imaginary components. And not only complex frequencies, but also any other imaginary and complex numbers. And as this statement is true for transients not only in the theory of linear electric circuits, but also for transients studied by all other sciences, i.e. it is general scientific, so we will call it the principle of physical reality of imaginary numbers.

And this experimentally provable principle of the physical reality of imaginary numbers naturally refutes the postulated principle of non-exceeding the speed of light, asserting from the unreality,

4. Explanation of Physical Essence of Imaginary Numbers

Hence, for relativistic formulas of STR (1)-(3) the results of calculations on them not only in the form of real, but also in the form of imaginary numbers should be explainable. Nevertheless, these formulas still cannot be explained for one more reason - as can be seen (see Fig. 1a,b,c) their graphs in sub light and hyper light ranges have essentially different form. Moreover, they correspond to physically unstable processes, which cannot exist in Nature. Therefore relativistic formulas (1)-(3) are still incorrect.

And so that the same patterns took place in nature in the subluminal $v < c$ and superluminal $v > c$ speed ranges, and, therefore, formulas describing the corresponding processes could be explained, the graphs $m(v)$, $\Delta t(v)$ and $l(v)$ should be as depicted in Fig. 1d,e,f. For this purpose, the function i^q should be introduced into the corrected relativistic formulas of the STR corresponding to them.

$$m(q) = \frac{m_0 i^q}{\sqrt{1-(v/c-q)^2}} = \frac{m_0 i^q}{\sqrt{1-(w/c)^2}} \quad (14)$$

$$\Delta t(q) = \Delta t_0 i^q \sqrt{1-(v/c-q)^2} = \Delta t_0 i^q \sqrt{1-(w/c)^2} \quad (15)$$

$$l(q) = l_0 i^q \sqrt{1-(v/c-q)^2} = l_0 i^q \sqrt{1-(w/c)^2} \quad (16)$$

where $q(v) = \lfloor v/c \rfloor$ is the "floor" discrete function of the argument v/c;

$w = v - qc$ is the local velocity of each universe.

This is the function convenient for explaining, as for integer values of the argument *0,1,2,3,4,5,…* it takes the required alternating values *+1,+i,-1,-i,+1,+i,…* corresponding to four types of universes alternating in space. Herewith local velocity $w = v - qc$ (Fig. 1d,e,f) of each universe takes finite values only in the range $0 \le w < c$.

But it's not hard to notice that Euler's formula takes the same values +1, +i, -1, -i, +1, +i..., corresponding to the integer values 0, 1, 2, 3, 4, 5,... of the argument q. And the right side of Euler's formula allows determining the values of this function also for non-integer values of the argument q. Therefore, considering this circumstance, we can conclude that the function i^q takes the form

$$i^q = \cos(q\pi/2) + i\sin(q\pi/2) \quad (17)$$ for both integer and non-integer values of the argument q.

The new formula thus obtained has an important advantage - it introduces into the mathematics of complex and hyper complex numbers the mathematical operation of raising imaginary numbers to a non-integer degree, which has been absent in it until now. In astrophysics, it therefore allows us to assert that the integer values of the quantity in formula (17) correspond to mutually invisible parallel universes[18], since they are relative to each other beyond the event horizon, and its non-integer values correspond to portals between such neighboring universes. And the invisible Multiverse containing these parallel universes has a spiral structure.

In other cases, described by other mathematical formulas containing imaginary numbers, other objects of the invisible world will correspond to them, determining the specific nature of these objects will require further specialized research. The research will significantly define the content of future science.

5. Conclusion

In the article ***by simple researches of transients in linear electric circuits***, carried out before publication of results of extremely difficult and expensive, but unsuccessful experiment OPERA, ***the physical reality of imaginary numbers is proved*** and, consequently, the fundamental principle of non-exceeding the speed of light in the generally recognized version of STR is refuted. ***And therefore, it is asserted that the version of STR stated in all physics textbooks used in the educational process of even the most prestigious universities is incorrect*** [16]-[72].

The existence of physically real imaginary numbers, discovered 500 years ago, shows that besides our visible world there is also a bigger, but invisible and unknown to us world. And cognition of physical essence of this invisible world will become the main problem of science of the future [73]-[96]. Moreover, this problem is now in relativistic physics astrophysics,

[17] And not only characteristic ones.

[18] Since, despite their boundlessness, they do not overlap anywhere, but they do dip slightly into each other in many places, forming portals.

overcoming the resistance of opponents, is already solved. And that's fine. One of the most authoritative philosophers of science of the 20th century Sir Karl Raimund Popper [97] wrote on this occasion that *"...the struggle of opinions in scientific theories is inevitable and is a necessary condition for the development of science"*. I.e., the development of science is possible only as a result of identifying incorrect statements in existing theories and their subsequent refutations [98]-[104].

This article identifies such false statements and ***demonstrates how the incorrect (due to the use of the erroneous postulate of light speed non-exceedance) version of the STR can be corrected.***

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MEDICAL SCIENCES

THE EFFECTIVENESS OF THE WIM HOF METHOD ON QUALITY OF LIFE PARAMETERS AND SATURATION IN PATIENTS WITH ASTHMA

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Abstract

The purpose of the research is to evaluate the effectiveness of the Wim Hof method on Quality of Life parameters and Saturation in patients with asthma. It used the SF-36 questionnaire and pulse oximetric method before and 2 months after the application of the Win Hof breathing method. The results showed, that Wim Hof breathing method improved some parameters of QOL and the SpO2 level. We conclude, that the use of Win Hof breathing method is one of the effective breathing techniques, that increase the level of oxygenation and Quality of Life in patients with asthma.

Keywords: Asthma, Win Hof method, Quality of Life, saturation

Introduction. Asthma affected an estimated 262 million people in 2019 (1), caused 455,000 deaths (2) and affectes Quality of Life (QOL) through physical, emotional, social and occupational impacts (3). Although asthma cannot be cured, exacerbations can be prevented by adequate patient counselling and proper management (4).

Breathing exercises have been widely used worldwide as a non-pharmacological therapy to treat people with asthma (5). Focused breath training can improve the strength and endurance of respiratory muscles, thereby improving breathing phenotype (6). The Wim Hof method (WHM) is a multidisciplinary approach to physical and mental well-being combining cold exposure, breathing exercises, and meditation (7). Breathing exercises consist of deep breaths and subsequent breath holds that are performed after exhaling. Each breath is performed using a yoga breath wave that starts in the abdomen and continues into the chest (8).

QOL is an important endpoint in medical and health research, and QOL research involves a variety of patient groups and different research designs (9) and this underlines the importance of studying the parameters of QOL as a tool for evaluating the effectiveness of the use of respiratory techniques in patients with asthma.

This study aimed to evaluate the effectiveness of the Wim Hof method on Quality of Life parameters and Saturation in patients with asthma.

Materials and methods. 42 participants with a diagnosis of asthma (12 men and 30 women) were included in the study. All participants completed the SF-36 questionnaire before and 2 months after the application of the Win Hof breathing method. SpO2 in the blood was evaluated by the pulse oximetric method (measurements were carried out for three consecutive days, 4 times a day) before and 2 months after the application of the breathing method.

Results. The descriptive statistics of the QOL parameters of the study participants before and after the Win Hof method are presented in Table 1.

Table 1.

Descriptive Statistics of the Quality of Life parameters before and after Win Hof method (M±SD)

Quality of Life parameters		Minimum	Maximum	Mean	Std. Deviation
Physical functioning (PF)	Before	15	100	77,74	17,745
	After	35	100	82,52	15,189
Physical role functioning (RP)	Before	0	100	51,19	25,870
	After	10	100	62,07	24,935
Emotional role functioning (RE)	Before	0	100	55,95	29,364
	Aafter	0	100	57,10	28,479
Vitality (VT)	Before	35	95	63,93	11,663
	After	40	100	68,81	11,884
Mental health (MH)	Before	32	84	53,71	10,194
	After	40	90	58,19	10,563
Social functioning (SF)	Before	12	100	77,08	16,546
	After	20	980	82,37	16,997
Bodily pain (BP)	Before	25	100	79,70	19,795
	After	25	95	73,87	18,306
General health (GH)	Before	20	70	48,45	9,337
	After	45	80	63,33	9,918

Comparative assessment of QOL parametrs according are presented in Table 2.

It was determined that after applying the Win Hof method, the following parameters of quality of life improved significantly: physical activity (p=0.000), role limitation due to physical health (p=0.006), role limitation due to emotional problems (p=0.009), vitality (p=0.000) mental health (p=0.000), pain intensity (p=0.000) and general health (p=0.000). The change between indicators of social functioning (p=0.000) was not statistically significant (p=0.22).

Table 2.

Comparative assessment of Quality of Life parameters before and after the Win Hof method (according to the Student t-test)

Paired Samples Test							
	Paired Differences					T	Sig. (2-tailed)
Quality of life parameters	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			
				Lower	Upper		
Physical functioning (PF)	4,786	4,470	,690	6,179	3,393	6,939	,000
Physical role functioning (RP)	10,881	9,358	1,444	13,797	7,965	7,535	,000
Emotional role functioning (RE)	1,152	2,702	,417	1,994	,311	2,764	,009
Vitality (VT)	4,881	4,056	,626	6,145	3,617	7,799	,000
Mental health (MH)	4,476	3,240	,500	5,486	3,466	8,953	,000
Social functioning (SF)	26,714	139,046	21,455	70,044	16,615	1,245	,220
Bodily pain (BP)	5,833	7,919	1,222	3,366	8,301	4,774	,000
General health (GH)	14,881	10,904	1,682	18,279	11,483	8,845	,000

The results of blood oxygen saturation assessment before and after the fitness rehabilitation program are presented in Figure 1.

Figure 1.

Blood oxygen saturation assessment before and after the fitness rehabilitation program are presented in

A comparative assessment of the SPO2 index before and after the Wien Hof method is presented in Table 3.

Table 3.

Comparative assessment of the SPO2 index before and after the Wien Hof method (Student's t-test)

Paired Samples Test							
	Paired Differences					T	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			
				Lower	Upper		
SpO2 before - after	,952	2,284	,352	1,664	,241	2,702	,010

According to the study, blood oxygen saturation significantly improved after using the method (p=0.01).

Some studies determined that deep breathing and breathing exercises may have some positive effects on quality of life, hyperventilation symptoms, lung function and improve the saturation (SpO2) (5,10,11). Karam et al., showed, that a simple program of breathing exercises was found to be effective and could be completed in less than 10 minutes per day (12).

The results of our study also showed that Wim Hof breathing method improved some parameters of QOL and the SpO2 level.

Conclution. We conclude, that the use of Win Hof breathing method is one of the effective breathing technics, that increase the level of oxygenation and quality of life in patients with asthma.

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PEDAGOGICAL SCIENCES

IMPORTANCE OF LEARNING ENGLISH LANGUAGE AND ROLE IN PERSONALITY DEVELOPMENT

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Abstract

The article mentions the advantages of studying the English language in modern times and the fact that it plays an important role in the formation of a person's personality and personal development. The relevance of the English language grows every year. This is the main tool of communication in the international arena. Therefore, at any age, you should start studying and improving your knowledge, as the learning process in our country takes place throughout life. The modern world is strongly dependent on communication, especially in the context of international relations. English as the language of international communication provides a convenient platform for exchanging information and ideas. The topic is relevant today.

Keywords: English language, personality development, learning, international communication.

At all times, the main language in demand has been and remains English. According to many people, learning a foreign language is easy, because grammar and vocabulary are the basis for understanding it. In today's world, the knowledge and use of English is very important, because about 650 million people study it as an additional subject in educational institutions. That is why English is taught in almost all educational institutions of the country. We can say that English is more important than others. Since it is an international language, it should be known at least at a basic level. Today, people start learning English not only at school or university, but also at preschool institutions. It is important to understand that teaching this subject is carried out, first of all, for the development of a person, his personality, so that he can use these skills in his profession in the future [1].

In fact, many people do not understand how necessary a foreign language is in the 21st century. Nowadays, it is no secret that languages play a major role in employment. Most of the professions and positions are prestigious and highly paid, but this is only accompanied by knowledge of an additional language, mainly English. It cannot be said that this is how you can learn a language for yourself for the purpose of self-development and self-improvement. We live primarily for ourselves, which means we decide how we feel best. It is much more pleasant for anyone to talk about something with a foreigner than through an interpreter. After all, it will be a great experience in learning a foreign language.

In the world of high technologies, it is impossible not to notice the trend of development and creation of various inventions and programs. Most of them have foreign software and settings. Whether it's a laptop, tablet, phone, printer, or any program, all of them are originally foreign products, and even have foreign user manuals, mostly written in English. Therefore, everyone who wants to master the technique must know English [2].

Young people are the main category of people who know English fluently. Usually, this process takes place during the lesson in computer games. Teenagers spend a lot of time on the computer, and since all popular games are world hits, the manual is in English. Therefore, children unconsciously learn a foreign language without knowing it. Another way to learn a language is movies and music. Currently, the main product of consumption among young people is foreign films. They are very popular not only among European countries, but also in Kazakhstan. Most of them come in English format. The desire to hear and see something new drives young people to learn a language to understand what it is all about.

Learning English is not easy, but it is important both in everyday life and in science, technology and business, because it is an integral part of them. Most scientific research, technical publications and business documents are published in English. The advantages of learning English are many and we will give you some proofs to make it convincing:

- Global connectivity: the internet and social media have further connected the world, and knowing English allows us to actively participate in global dialogue, exchange ideas and share experiences.
- Education: many scientific studies, academic articles, books and online courses are available for reading in English. This allows us to learn directly from world experts, gain new knowledge and deepen our understanding of various fields.
- Career prospects: knowing English takes time and effort, but it becomes an important advantage in the job market. Expands the range of foreign jobs, opens opportunities to work abroad, cooperate with foreign colleagues and develop international business contacts.
- Developing personality and self-confidence: learning English requires perseverance, patience and

self-discipline. This process contributes to our ability to overcome difficulties and achieve our goals [3].

Knowing a foreign language, getting to know the culture and traditions of other countries contributes to development, and also allows you to communicate freely with people in any corner of the world. It is estimated that approximately one billion people worldwide use English as their mother tongue or as a foreign language. The use of English as an official or semi-official language is widespread in more than 70 countries and plays a very important role in another 20 countries. More than 1,400 million people live in countries where English is traditionally spoken. About 75% of the world's mail and information is stored in English. Most of the approximately 50 million Internet users use English.

I believe that English has a lot of potential as a future foreign language teacher. Training of the future teacher, in particular foreign language teacher, is based on the use of modern knowledge, methods and innovative technologies during the organization of professional training. In addition to mastering communicative competence in a foreign language, a foreign language teacher must have professional and general cultural competence. Learning a foreign language is in demand in the labor market, therefore, the training of specialists in the field of pedagogical education, in particular, in the field of teaching foreign languages, is of particular importance [4].

The main activity of the teacher is pedagogical communication. It is necessary to create a suitable atmosphere in the classroom in order to organize communication in order to encourage the student to share personal information with you, his opinion, his point of view. Pedagogical relationship usually means the professional relationship of a teacher with students in the process of education and training aimed at creating a favorable psychological climate and psychological optimization of general educational activities and relations between teachers and students. All professional functions are carried out in the framework of pedagogical relations, the main ones of which are teaching and education. The content of pedagogical communication includes the methods and skills of interaction between the teacher and the student team, which is the exchange of information, the demonstration of the educational effect and the organization of mutual understanding. The teacher acts as the initiator of this process, organizes and manages it [5].

These features impose a certain responsibility on the foreign language teacher, who must not only have a good linguistic knowledge and good methodological training, but also be an excellent speech partner who can convey his love for the language he teaches to the culture it offers. The teacher should be able to create an atmosphere of trust and comfort that promotes the motivation to study, the liberation of students, overcoming the language barrier, overcoming feelings of insecurity, the desire to communicate, and share their thoughts.

The teacher's role is this: organizing the foreign language learning process, talking on various topics, stimulating students' communication, he tries to instill in them moral qualities that are somehow related to the content of the material read and discussed in class. The teacher strives to develop in students a sense of responsibility, respect for others, loyalty to work, pride in their country, people, culture and language, and at the same time to form a positive attitude towards foreign language culture. The educational possibilities of the subject, in addition to the content, are included in the methodological system of teaching and the teacher's personality and behavior. It is clear that the introduction of a text with learning opportunities into the textbook still does not give adequate results. It needs an appropriate interpretation and a teacher's attitude towards it. This teacher and his professional qualities (lesson planning, creative approach to the organization of communication, objective assessment and explanation of the student's answer, the ability to choose interesting materials and tasks) allow to direct the learning process in the right direction [6].

The best prerequisites for foreign language education are created when the teacher has experience in intercultural communication. The teacher's participation in international conferences, competitions and projects, publication in foreign magazines, active citizenship, professional development in the framework of seminars and courses, meetings of foreign delegations and the experience of a translator are invaluable, which can be used as an illustration of a certain aspect of the organization of intercultural communication, not only linguistic, but also cultural experience. lessons. Thus, modern teaching of foreign languages is connected with the reforms in the field of general education and the change of the paradigm of foreign language education. It is important to learn English, which has its own place in the world arena. I believe that it contributes to personal development and work.

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EFFECTIVENESS OF USING INNOVATIVE TEACHING METHODS IN TEACHING THE RUSSIAN LANGUAGE TO A FOREIGN LANGUAGE AUDIENCE

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ЭФФЕКТИВНОСТЬ ИСПОЛЬЗОВАНИЯ ИННОВАЦИОННЫХ МЕТОДОВ ОБУЧЕНИЯ В ПРЕПОДАВАНИИ РУССКОГО ЯЗЫКА В ИНОЯЗЫЧНОЙ АУДИТОРИИ

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Abstract
The article discusses the effectiveness of using innovative teaching methods in the educational process, as one of the important aspects in teaching the Russian language to a foreign-language audience. Particular attention is paid to innovative “learning technologies”, the use of which contributes to the intensification and, therefore, optimization of the entire educational process.

Аннотация
В статье рассматриваются вопросы эффективности применения инновационных методов обучения в образовательном процессе, как одного из важных аспектов в преподавании русского языка в иноязычной аудитории. Особое внимание уделено инновационным «технологиям обучения», применение которых способствуют интенсификации, следовательно, и оптимизации всего учебного процесса.

Keywords: integration of the educational system, reform of higher education, communicative-oriented learning, rational method.
Ключевые слова: интеграция образовательной системы, реформи-рование высшего образования, коммуникативно-ориентированное обучение, рациональный метод.

Проблема совершенствования подготовки специалиста в высшей школе актуальна на всех этапах развития общества. Особенно важной она представляется сегодня в связи с потребностью общества творческих личностях, умеющих быстро адаптироваться к изменяющимся условиям, владеющих разными способами и средствами добывания и анализа информации.

Интеграция образовательной системы в Казахстане диктует необходимость внедрения в практику преподавания инновационных технологий, которые позволят поднять на качественно новый уровень подготовку специалиста в различных областях профессиональной деятельности.

Реформирование высшего образования предполагает разработку и внедрение новых научно обоснованных средств и учебных предметных обучении, рациональных методов, организационных форм, педагогических технологий, обеспечивающих эффективную организацию и управление учебно-воспитательным процессом [4].

Центром коммуникативно-ориентированного обучения языку является ситуация как универсальная форма процесса общения. Относительно русского языка как иностранного в вузе предполагается подбор ситуаций, включающих каждого обучающегося в процесс общения, а также обеспечение коммуникативности заданий благодаря подбору речевых и условно-речевых упражнений, создающих ситуации реального речевого общения. Каждая ситуация наделена смыслом, она включает мотивы и потребности обучающихся, учитывает взаимоотношения собеседников. Коммуникативность предполагает наличие определенных коммуникативных интенций, таких, как обращение, приветствие, благодарность, просьба, сочувствие, соболезнование, реализацию путем использования определенных речевых формул.

Сущность коммуникатативного обучения заключается в том, что процесс обучения служит моделью процесса общения.

Важной составляющей частью коммуникативной компетенции является также прагматическая компетенция, которая предполагает развитие умений строить высказывания в соответствии с коммуникативными ситуациями и фактором адресата. А.Н.Щукин определил прагматическую компетенцию как желание и умение ориентироваться в ситу-

ации общения и строить высказывание в соответствии с коммуникативным намерением говорящего и возможностями собеседника, умение выбрать наиболее эффективный способ выражения мысли в зависимости от условий общения и постановленной цели [1].

По мнению Е.В.Орлова, прагматическая компетенция должна включать следующие способности и готовности:

Строить высказывание (текст, дискурс) в зависимости от его письменной или устной формы, в зависимости от жанра, в зависимости от темы, цели, фактора адресата, то есть кому предназначен данный текст. Адресат (аудитория, субъект, воспринимающий речь) оцениваются с точки зрения количества, возраста, образования, социально-профессиональный состав, подготовленности к восприятию темы.

Использовать средства аргументации в зависимости от адресата, анализа характера аудитории;

Использовать средства привлечения внимания адресата: использование средств эмоциональной и рациональной оценки: уверенности-неуверенности, предположения, переформулирования мысли, выражение собственного мнения и выяснение мнения партнеров по общению;

Использовать риторические средства воздействия, тропы и фигуры речи;

Последовательно строить высказывание в соответствии со схемами взаимодействия. Коммуникативная деятельность предполагает четко организованную последовательность действий ее участников, а любой процесс общения можно представить схематично. Например, структура двойных реплик может выглядеть так: утверждение – согласие или несогласие; просьба (предложение, извинение) – принятие или непринятия и др. Наиболее распространённой моделью общения служат так называемые тройные реплики, включающие: слова первого собеседника –реакцию второго собеседника – ответную реакцию первого собеседника [2].

Инновации в обучении языку специальности связанны с поисками нового содержания образования и новых форм и средств обучения. Инновационные модели обучения могут быть технологическими и поисковы- ми. Так, в инновационном обучении выделяют инновации – модернизации и инновации – трансформации. С помощью первых достигается гарантированный результат в рамках традиционной репродуктивной ориентации. Преобразования же, заложенные во вторых, направлены на обеспечение исследовательского характера учебного процесса. На современном этапе развития педагогической мысли предлагается новая поисково - технологическая модель. Она позволяет сохранить технологичность процесса обучения и построить учебное взаимодействие с выходом запределы репродуктивной ориентации, при этом учитывается не только рациональная, но и эмоционально-ценностная сторона познания [4].

Один из возможных путей изменения организации работы преподавателя и студентов – инновационное обучение – процесс познания теории языка и развитие речи, в котором знания усваиваются одновременно с умениями, что обеспечивается особой организацией изучения языка: способом развития речи, специальными дидактическими средствами и особой методикой и технологией.

Главная задача инновационных методов – устранение противоречий между целью обучения и его содержанием.

Инновационная методика – новый подход к организации этапа включения в деятельность, к развитию положительной мотивации учения,

к возможностям интенсификации и оптимизации обучения.

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PHILOLOGICAL SCIENCES

SUBSTANTIVATION OF THE PARTICIPLE IN MODERN GERMAN

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SUBSTANTIVIERUNG VON PARTIZIPIEN IN DER DEUTSCHEN GEGENWARTSSPRACHE

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Abstract

Substantivation of the participle in modern German. The article is devoted to the comprehensive study of the substantive participle (SP) in the modern German language. The main goal is to clarify its lexical-semantic and grammatical features. In the German language both the first and second participles can be substantivized. This feature is related to the need to name a person according to his qualities (anthroponomination), given by the nature of his activity.

Being the nominative form of the verb, the participle names a person and the results of his activity according to such grammaticalization algorithm as transposition, i.e. by transferring it to a position usually relevant to a noun with the acquisition of the corresponding nominative categories. In this way, there is a symbiosis of the categories of a noun (gender, number, case, definiteness / indefiniteness), an adjective (degrees of comparison) and a verb (tense, state). While preserving the lexical and general action semantics of the verb, SP loses the formal indicators of verbal categories. By granting the semantics of the verb with the forms of nominal categories, transposition exposes the participle in a completely new role: neither a name nor an action, but an action-name, where the three autosemantic parts of speech interact and intersect. At the same time, the SP acquires almost all the formal indicators of the name, while the formal indicators of the verb are either removed (person, manner) or softened (tense, species, state).

The substantivization in the German language is permanent and is given by two types – usual and occasional. Actively occurring at the level of occasional formations, transposition can contribute to the lexicographic determination of individual SPs, where they are either usualized or terminologicalized and thus replenish the lexical stock of natural language. Occasional SPs remain an important means of creative language production, language play, and stylistic expressiveness.

Abstrakt

Der Artikel widmet sich der umfassenden Untersuchung von substantivierten Partizipien (SP) in der deutschen Gegenwartssprache mit dem Ziel, ihre lexikalisch-semantischen und grammatischen Eigenschaften zu klären. In der deutschen Sprache können sowohl das erste als auch das zweite Partizip substantiviert werden, was mit der Notwendigkeit verbunden ist, eine Person nach den durch die Art ihrer Tätigkeit gegebenen Eigenschaften zu benennen (Anthroponomymie).

Als Nominalform des Verbs benennt das Partizip eine Person und die Produkte ihrer Tätigkeit nach dem Grammatikalisierungsalgorithmus der Transposition von Wortarten, d. h. durch Überführung des Partizips in die normalerweise nur für das Substantiv charakteristische Position mit dem Erwerb der entsprechenden Nominalkategorien. Auf diese Weise kommt es zu einer Symbiose der grammatischen Kategorien des Substantiv (Genus, Numerus, Kasus, Bestimmtheit / Unbestimmtheit), des Adjektivs (Komparationsstufen) und des Verbs (Tempus, Genus). Vor dem Hintergrund der Beibehaltung der lexikalischen und allgemeinen Aktionssemantik des Verbs verliert SP die formalen Indikatoren verbaler Kategorien. Indem der Inhalt des Verbs mit den Formen nomineller Kategorien ausgestattet wird, entblößt die Transposition das Partizip in einer völlig neuen Rolle: weder ein Name noch eine Handlung, sondern ein „Handlung – Name“, bei der drei autosemantische Wortarten interagieren und sich überschneiden. Gleichzeitig übernimmt das SP fast alle formalen Indikatoren des Nomens, während die formalen Indikatoren des Verbs entweder abgeschnitten (Person, Modus) oder gedämpft (Tempus, Genus, Aktionsgrad) sind.

Der Prozess der Substantivierung von Wortarten in der deutschen Sprache ist permanent und erfolgt in zwei Arten – usuell und okkasionell. Aktiv auf der Ebene okkasioneller Bildungen stattfindend, kann die Transposition zur lexikografischen Fixierung einzelner SP beitragen, wo sie entweder usualisiert oder terminologisiert werden und auf diese Weise den Wortbestand der natürlichen Sprache auffüllen. Dabei bleiben okkasionelle SP ein wichtiges Mittel zum kreativen Sprachgebrauch, zum Sprachspiel und zur stilistischen Ausdruckskraft.

Keywords: substantive participle, part of speech, grammatical category, anthroponomymie, transposition, grammaticalization, usualization, occasionality.
Schlüsselwörter: Substantiviertes Partizip, Wortart, grammatische Kategorie, Anthroponomymie, Transposition, Grammatikalisierung, Usualität, Okkasionalität.

Einführung. Das Studium des Mechanismus der grammatischen Synkretisierung ermöglicht es, die sprachlichen Mittel, die zur Benennung von Objekten und Phänomenen der Welt verwendet werden, tiefer aufzudecken. Dieser Mechanismus ist in das Phänomen eines höheren Grades integriert, in die Transposition, den Prozess der Übertragung eines Zeichens von einer Wortartkategorie in eine andere. Sie ist mit tiefgreifenden Veränderungen auf verschiedenen Existenzebenen des Wortes verbunden und bezieht sich nicht nur auf lexikalische Einheiten des etablierten Wortartregisters, sondern auch auf deren Derivate – hybride Nominaleinheiten, die mit ihrer Hilfe gebildet werden.

Die Transposition als Ergebnis des Übergangs einer Einheit bestimmter Wortart in eine andere unter Beibehaltung der Haupteigenschaften beider erregte und erregt weiterhin die Aufmerksamkeit vieler Wissenschaftler [Babaytseva 2000; Bally 1956; Kuryłowich 1962; Mel'chuk, 1997; Plunhyan 2003 u.a.], wobei das Hauptaugenmerk auf ihre Varietäten wie Konversion und Substantivierung gelegt wird. Hierbei ist in der wissenschaftlichen Literatur das deutsche substantivierte Adjektiv besonders ausführlich beschrieben [Engel 1991; Fleischer 1995; Kinakh 2013; Paul 1956 u.a.]. Es kann nicht gesagt werden, dass das substantivierte Partizip (im Folgenden: SP) /das Substantivpartizip, der Partizipsubstantivat/ nicht die Aufmerksamkeit von Fachleuten auf sich gezogen hat [Blatz 1895; Paul 1956 u.a.], aber es geschah nie ohne Trennung vom substantivierten Adjektiv, mit dem es viele Gemeinsamkeiten hat, sich aber im Wesentlichen unterscheidet. Wenn das erste das Ergebnis der Synkretisierung zweier Wortarten (Substantiv & Adjektiv) ist, dann sind es beim zweiten drei (Substantiv & Adjektiv & Verb). Mit anderen Worten: Als Nominalform des Verbs oder Verbalform des Substantivs umfasst SP kategoriale Eigenschaften von mindestens drei oben genannten Wortarten.

Die außergewöhnliche Kapazität des Inhalts gepaart mit der Kompaktheit der Form tragen zur hohen Produktivität der Verwendung des Substantivpartizips in der Sprache bei, was vor dem Hintergrund seiner unzureichenden Erforschung die Relevanz des Problems beweist. Wenn ein Partizip zum Substantiv wird, erhält es Nomen-, Adjektiv- und Verbeigenschaften, die sich auf seine grammatische und semantische Spezifik auswirken. Daher sollte die Untersuchung der „wortartlichen", kategorialen Eigenschaften von SP unter Berücksichtigung letzterer durchgeführt werden.

Wie ein substantiviertes Adjektiv [Kinakh 2013; Plunhyan 2003] ist SP eine nominale Einheit, die als Ergebnis einer Wortarttransposition gebildet wird, die zu einer synkretischen Diffusion von kategorialen Eigenschaften des Substantivs („Gegenstand"), des Adjektivs („Merkmal") und des Verbs („Geschehen / Sein") führt, worauf es sinnvoll ist, die Aufmerksamkeit zu lenken.

Es sei dabei erwähnt, dass zur Gruppe mit der lexikalisch-grammatischen Funktion „SP" die Spracheinheiten gehören, die als Partizip I und Partizip II bekannt sind, welche nicht in ihrer primären Funktion (Nominalteil des Prädikats), sondern in der sekundären (Subjekt, Objekt) verwendet werden. Diese Unterscheidung hat auch eine grafische Fixierung, denn nach den Regeln der Orthographie werden sie mit Großbuchstaben geschrieben (*der/die Liebende*, *der/die Geliebte*). Beobachtungen zeigen, dass SP nicht nur ein Bestandteil der Rede, sondern auch ein Bestandteil der Sprache sind und in dieser Rolle in deren lexikalischen Fundus enthalten sind. So verzeichnet das Wörterbuch von G. Wahrig [Wahrig 1997] 114 und das Universalwörterbuch [Duden 1996] bereits 248 solcher Einheiten. Obwohl diese Wörterbücher unterschiedliche Anzahl von SP angeben, liegt die Hauptsache in der Festlegung selbst, denn sie bescheinigt den „offiziellen" Eintrag einer bestimmten Anzahl von SP in die lexikalisch-semantische Schatzkammer der Sprache, d.h. den Übergang von ihren syntagmatischen zu ihrem paradigmatischen Status.

Es ist klar, dass wir in unserer Analyse die Daten von Duden verwenden, von denen 25 % Erst- und 75 % Zweitpartizipbildungen sind. Solche Nominationen können und sollen als usuell angesehen werden. Im Gegensatz dazu erhöht sich ihre Zahl in der Sprache durch gelegentlichen / okkasionellen Gebrauch um ein Vielfaches. Sowohl gewöhnliche als auch gelegentliche SPs werden jedoch nicht willkürlich gebildet und funktionieren auch nicht willkürlich, sondern nach einem Algorithmus, der durch das System und die Struktur der Sprache vorgegeben ist.

Substantiveigenschaften der SP. Obwohl es keine eindeutigen Entsprechungen zwischen Grammatik und Wortschatz gibt, gibt in unserem Fall die Grammatik den Ton an, indem sie den Kreis der verwendeten SP-Einheiten klar abgrenzt, dessen Korpus in zwei Cluster unterteilt ist – eine Gruppe von SP, die auf Anthroponyme spezialisiert sind, und eine Gruppe von SP, die keine Anthroponyme sind.

Der lexikalisch-semantische Cluster von SP, die als ***Anthroponyme*** verwendet werden, umfasst 90 % lexikalischer Einheiten, die weiter unterteilt sind, je nachdem ob sie inhärente oder referenzielle Eigenschaften einer Person angeben. Dabei wird die Kategorie „Gegenständlichkeit" auf der Grundlage der Kategorie „Merkmal" konstituiert: Ein einzelnes Merkmal einer Person aus der Vielzahl von denen, die ihr eigen sind, wird zur Grundlage für die Schaffung eines vollständigen Bildes und dadurch für die Benennung. Es kann sowohl subjektive als auch objektive Prinzipien haben.

Zu den ***inhärenten*** gehören SP-Nomen, die ein dauerhaftes oder als dauerhaft geltendes Merkmal einer Person signalisieren. Solche Merkmale lassen sich augrund unterschiedlicher Eigenschaften realisieren, wie z. B. Religion und Kultus (*die Gebenedeite, der Gekreuzigte, der/die Eingeweihte, der/die Gesalbte, der/die Taufgesinnte*), Familienzustand (*der/die Verwandte, der/die, der/die Verheiratete, der/die Geschiedene*), Militärstatus (*der Oberkommandierende, der Alliierte, der/die Bewaffnete, der/die Gefangene, der/die Ungediente*). Auch manche körperliche Eigenschaften gehören dazu: Gesundheit (*der/die Gelähmte, der/die Überlebende, der/die Ausgebombte, der/die Verletzte, der/die Behinderte, der/die Verwundete, der/die Kriegsversehrte*); Geburt (*der/die Neugeborene, der/die Erstgeborene*); Tod (*der/die Abgeschiedene, der/die Verstorbene, der/die Gefallene, der/die Ertrunkene, der/die Gehenkte*) usw.

Zu den ***referenziellen*** SP-Nomen (Status-SP) zählen diejenige, welche die Eigenschaften widerspiegeln, die eine Person durch Beziehungen zu anderen Personen erwirbt, oder solche, die als vorübergehend gelten. Dies können Anthroponyme sein, die einen bestimmten Status anzeigen: Sozialstatus (*der/die Auserkorene, der/die Außenstehende, der/die Eingeborene, der/die Erwachsene*), juristischen (*der/die Angeklagte, der/die Totgesagte, der/die Beschwerführende, der/die Bevollmächtigte, der/die Minderbemittelte, der/die Verdächtigte, der/die Verschworene*), Verwaltungslage (*der/die Beamtete, der/die Angestellte, der/die Bedienteste, der/die Abgeordnete, der/die Gekündigte*) usw. Eine beträchtliche Anzahl von Referenzstatus-SP spiegeln die Art und / oder das Ergebnis der Tätigkeit einer Person wider: berufliche (*der/die Arbeitssuchende, der/die Ausbildende, der/die Kulturschaffende, der/die Studierende*), akademische (*der/die Allwissende, der/die Gelehrte, der/die Graduierte, der/die Halbgebildete*), religiöse (*der/die Eingeweihte, der Gebenedeite, der Gekreuzigte, der/die Gesalbte*) u.a.

Die zweite Gruppe von SP (10 %) hat nichts mit Anthroponymie tun und wird nicht durch die Parameter „Zeitlichkeit" oder „Permanenz" charakterisiert, sondern bringt die im Usus fixierten Konzepte zum Ausdruck. Dabei geht es vor allem um SP zur Bezeichnung abstrakter (*der Verschnittene, das Geleuchte, die Resultierende, die Winkel-, Seitenhalbierende*) und konkreter Werte – vorrangig gastronomischer (*das Eingemachte, das Eingesottene, das Geröstete, das Gebratene, das Gefrorene*) und geologischer Art (*das Liegende, das Rot-, Weißliegende*) sowie einige Nominierungen zur Bezeichnung von Druckerzeugnissen (*die Remittende, die Illustrierte*). Wie wir sehen können, sind die meisten SP dieses Clusters als Begriffe in einem bestimmten Wissensgebiet in den Wortschatz der deutschen Sprache und ihrer Varianten eingegangen.

Bei der Substantivierung erhält das Partizip sowohl die für Substantive typische Verbindlichkeit als auch einen für sie untypischen Kontext. Dies wird durch die Spezifik grammatischer Kategorien im Allgemeinen erklärt, nämlich durch die Tatsache, dass in ihrem sprachlichen Verhalten Obligatorisches mit Selektives verbunden ist, das heißt: eine Kategorie ist immer nur für eine bestimmte Unterklasse von Lexemen einer bestimmten Sprache obligatorisch [Plunhyan 2003: 238]. Sie alle können und sollen jedoch durch den Erwerb eines spezifischen morphologischen Status verstanden bzw. beschrieben werden, also durch die rein substantivischen Kategorien – die des Geschlechts, die des Numerus, die des Kasus und die der Bestimmtheit / Unbestimmtheit.

Es ist bekannt, dass die ***Kategorie des Genus*** für alle Substantive des Deutschen charakteristisch ist, mit Ausnahme von pluralia tantum, wo sie als unabhängiger grammatikalischer Indikator fungiert. Die in die Klasse der Substantive übergehenden SP erben dabei auch die Geschlechtskategorie mit. So verzeichnet Dudens Wörterbuch 83 % der SP männlichen und weiblichen Geschlechts, 5 % – nur maskulin, 4 % – nur feminin und 8 % – neutral. Also ist das SP der deutschen Sprache in erster Linie eine lexikalisch-grammatische Klasse von Wörtern mit doppeltem Geschlecht – Maskulinum und Femininum. Wenn die Geschlechtskategorie des Substantivs den Substantivkorpus dieser Sprache generell in drei Gruppen unterteilt, die sich nicht überschneiden (männlich, weiblich, neutral), dann gibt SP den Nomeneinheiten die Möglichkeit, aus diesem Kreis auszubrechen. Sie ordnet diese Nomina in mindestens zwei Geschlechtern je nach Kommunikationssituation, wobei das biologische Geschlecht dem grammatischen möglichst nahe gebracht wird. Es stellt sich heraus, dass das grammatische Geschlecht von SP eine wortverändernde Kategorie ist – im Gegensatz zum Substantiv, dessen Geschlecht klassifizierend ist.

Das substantivierte Partizip als lexikalisch-grammatische Wortklasse eignet sich recht gut zur Bennenung jener nichtsprachlichen Phänomene, die je nach Kommunikationsbedarf im Sinne des biologischen Geschlechts verstanden werden können – entweder /sowohl „männlich" oder / als auch „weiblich". Es ist klar, dass es sich vor allem um Lebewesen handelt, die sich entweder aufgrund ihrer anthropologischen Bedeutung (*der/die Anwesende, der/die Auserkorene, der/die Enterbte, der/die Emigrierte*) oder ihrer physischen bzw. beruflichen Eigenschaften (*der/die Gelähmte, der/die Sonderbeauftragte, der/die Studierende, der/die Vorsitzende*) im Sprachbewusstsein etabliert haben. Diese Geschlechtsdualität hängt mit der Geschlechtsunempfindlichkeit von SP zusammen, im Gegensatz zu Substantiven, bei denen sie auf einer Kombination aus formaler und semantischer Ableitung weiblicher Substantive von den maskulinen (*der Chef → die Chefin, der Maler → die Malerin*) basiert.

Allerdings hat der vierte Teil der lexikographisch fixierten SP (27 %) nur ein Geschlecht – beispielsweise männlich (*der Gefallene, der Gelehrte, der Gesandte,der Wehrbeauftragte*). Einige Fälle exklusiver „Männlichkeit" lassen sich durch bestimmte Berufs- oder Tätigkeitsmerkmale (der Alliierte, *der Oberkommandierende, der Ungediente, der Schriftgelehrte*) oder biblische Tatsachen (*der Gekreuzigte*) erklären. Für das weibliche Geschlecht sind ähnliche Überlegungen möglich: physiologische Merkmale (*die Erstgebärende, die Spätgebärende*), biblische Überlieferung (*die Gebeneidete* 'Mutter Gottes'), Charakter der ausgeübten Aufgaben (*die Hausangestellte, die Prostituierte, die Frauenbeauftragte*). Allerdings gibt es unter

SP auch solche, deren Geschlecht sich nicht logisch erklären lässt: *der Wehrbeauftragte, der Gefallene* (obwohl die betreffende Person auch weiblich sein kann).

Die Gruppe der SP-Nomina des Neutrums wird in den Wörterbüchern durch die Namen abstrakter Begriffe (*das Nichtzutreffende, das (Zu)nächstliegende*), oder gastronomischen Begriffe (*das Eingekochte, das Eingemachte, das Eingesottene* 'Marmelade', *das Faschierte* 'Hackfleisch', *das Gebratene*, das *Gedünstete / das Gesottene* 'gedämpft', *das Geschnetzelte* 'Züricher Eintopf') repräsentiert. Eine Ausnahme von diesem System bilden mindestens zwei SP: *der Gerebelte* 'Wein aus ausgewählten Trauben', wo Maskulinum durch die Ellipse des Substantivs 'Wein' verursacht wird, und *die Gerösteten* 'gebratene (Toasts)', wo Plural mit der Weglassung des Substantivs 'Brotschnitte' verbunden ist. Allerdings lässt sich das elliptische Begründungssubstrat nicht immer beweisen. Dies tritt auf, wenn eine Diskrepanz zwischen dem Geschlecht des SP und dem Geschlecht des Substantivs besteht, mit dem der Name verknüpft ist: *die Illustrierte* statt 'das Illustrierte' (das Journal, das Magazin). Im Plural ist SP neutralisiert, kann aber sowohl aus dem Kontext als auch durch die Umgebung von anderen lexikalischen Mitteln identifiziert werden.

Die ***Kategorie des Numerus*** in SP spiegelt den quantitativen Ausdruck der bezeichneten Objekte wider. Es wird durch entsprechende Singular- und Pluralformen erklärt: *der Gekündigte – die Gekündigten, die Abgesandte – die Abgesandten*. Die Kategorie der Zahl in den SP unterscheidet sich nicht von der in den Substantiven, weist jedoch gewisse Unterschiede in der Art ihres Ausdrucks auf. Wenn dieser Unterschied in gebräuchlichen Substantiven mit Hilfe wortbildender und lexikalischer Mittel in Kombination mit analytischen Mitteln ausgedrückt wird, dann tritt im SP-System als Marker dieser Kategorie Artikel auf.

Die meisten SP haben korrelative Singular- und Pluralformen. Dabei handelt es sich vor allem um zählbare Gegenstände und Personen (*der/die Besiegte – die Besiegten, eine Deputierte – viele Deputierte, eine Delegierte – zwei Delegierte*). Einige SP sind jedoch nicht quantifiziert und haben dementsprechend keinen Plural. Dazu gehören auch einige „zweigeschlechtliche" SP vom Typ *der/die Angebetete, der/die Angetraute, der/die Erstgeborene, der/die Alleinerziehende*), SP-Unika feminin (*die Gebenedeite*) und maskulin (*der Gekreuzigte*) sowie neutrale SP zur Bezeichnung von Abstraktionen (*das Nichtzutreffende, das Gewünschte, das Gedachte, das Resultierende*) und Mineralien (*das Liegende, das Rot-, Weißliegende*).

Alle diese SP gehören zur Gruppe der singularia tantum als solche, denen die Möglichkeit genommen wird, den zu bezeichnenden Gegenstand oder das enesprechende Phänomen nach dem Prinzip „Einzelheit – Mehrheit" gegenüberzustellen. Aus semantischer Sicht ist die Zahl in diesen SP leer. Stattdessen gehört eine kleine Anzahl von SP zur Kategorie pluralia tantum, was auf die Semantik dieser Einheiten (*die Gerösteten*) oder den Plural des weggelassenen Substantivs (*die Lernbehinderten*) zurückzuführen ist.

Die Kategorie des Kasus, die eine eigenständige wortverändernde Kategorie mit syntaktischer Prägung ist, wird im SP wie beim Substantiv durch eine Endung und einen Artikel gekennzeichnet. Die Deklination des ersteren unterscheidet sich jedoch von der Deklination des letzteren dadurch, dass der entsprechende Algorithmus, angepasst an das Adjektiv, auf unterschiedlichen Deklinationsmodellen basiert, die vom begleitenden Determinativwort abhängen (*ein Bekannter; der Beamte; die Liebenden; alle Geladenen; viele Gelehrte; zwei Bekannte.; solche Beamte*) oder aus seiner Abwesenheit (*für eine Frierende; das Entscheidendenste ist; eine Gruppe Fliehender*). Man kann nicht übersehen, dass die wie Adjektive deklinierenden SP gleichzeitig die grammatischen Eigenschaften des abgeleiteten Wortes beibehalten.

Aufgrund seiner ternären Natur unterliegt die Deklination von SP häufig Variationen. Insbesondere wenn es auf eine Präposition mit einem Determinativ folgt, wird es als Substantiv wahrgenommen und dementsprechend wie das Substantiv dekliniert: *Deine Auserwählte...* /H. Arlt/; *...diese Ausgestoßenste...* /S. Zweig/; *Und dann habe ich all mein Erspartes verloren...* /H. Fallada/; *Sie folgte uns mit dem beleidigten Gesichtsausdruck einer zu Unrecht Übergangenen* /J. Kehrer/; *Er als vollständig Geimpfter sollte allenfalls eine Maske tragen, wenn er sich mit jemand Gefährdetem in einem Raum befände* /W. Schmitz/. Steht dem SP ein Adjektiv voran, wird es parallel dazu dekliniert: *...unser höchster pädagogischer Vorgesetzter...* /H. Arlt/; *…meine kleine ungezählte Geliebte...* /H. Böll/; *Der sich mühsam aufrappelnde Gestrauchelte…* /R. Bartsch/; *Die beim Hofe von Versailles akkreditierten Gesandten...* /L. Feuchtwanger/; *…die Welt, die es dem dummen Privilegierten so leicht und dem begabten Unprivilegierten so schwer macht* /L. Feuchtwanger/.

Substantivierte Wortarten nehmen die kategorialen Bedeutungen des Substantivs an, einschließlich die der ***Bestimmtheit / Unbestimmtheit***. Da diese Kategorie kommunikativer Natur ist, ist sie für alle SP charakteristisch und hängt mit dem Informiertheitsgrad der Teilnehmer des Kommunikationsakts über den Gesprächsgegenstand zusammen [Jespersen 2003: 231]. In diesem Sinne stimmt der Algorithmus für die Verwendung bestimmter, unbestimmter und Nullartikel mit SP vollständig mit dem Algorithmus ihrer Verwendung mit Substantiven überein. Beobachtungen zeigen, dass diese Kategorie ohne Einschränkung, Ausnahme oder Abweichung dem Substantiv entlehnt ist.

Da die obige Kategorie mit der aktuellen Gliederung des Satzes (Thema-Rhema-Gliederung) eng verbunden ist, findet die Bestimmtheit / Unbestimmtheit ihre volle Ausprägung in der Rede, wo es mit ihrer Hilfe möglich ist, einen bestimmten Grad der Individualisierung oder Generalisierung der zu bezeichnenden Objekte sowie den Grad der Intensivierung der zu bezeichnenden Merkmale zu erreichen. Wenn jedoch die grammatikalische Markierung dieser Kategorie im Bereich des Substantivs nicht immer das Aussehen seiner Morphen (*der Mann – ein Mann, die Männer – Männer*) beeinflusst, so steht ihr Ausdruck in SP in direktem Zusammenhang mit der Notwendigkeit, Flexionen zu ändern (*der Bekannte – ein Bekannter, die Bekannten –*

Bekannte). Die Kategorie „Bestimmtheit / Unbestimmtheit“ ist für SP nicht klassifizierend, sondern ebenso wortverändernd wie die des Genus.

Adjektiveigenschaften der SP. SP sind nicht nur mit Substantiv-, sondern auch mit Adjektiveigenschaften ausgestattet. Erstens werden sie auf die gleiche Weise wie ein Adjektiv dekliniert. Zweitens werden sie nach ihrem kategoriellen Inhalt in qualitativ und relativ unterteilt. Die ersten geben die absolute Qualität des Signifikats an (im Fall von SP – eine Person: *der/die Erwachsene, der/die Verrückte, der/die Dienstleistende, der/die Liebende, der/die Vorsitzende, der/die Zugereiste*). Die zweiten geben die relative Qualität an, d. h. die im Zusammenhang mit einem Gegenstand bzw. Thema erworbene Qualität (*der/die Gefangene, der/die Verewigte, der/die Entrechtete, der/die Liierte,*). Es wird angenommen, dass der Hauptunterschied zwischen qualitativen und relativen Adjektiven in der Anzahl der Valenzpositionen liegt: die erste öffnen eine Leestelle (*der/die Erwachsene → der/die erwachen ist*), die zweiten öffnen zwei Stellen (*der/die Gefangene → der/die von j-m gefangen ist*).

Der Gedanke, dass die Grenze zwischen qualitativen und relativen Adjektiven (und dementsprechend SP) in der Fähigkeit oder Unfähigkeit liegt, Komparationsstufen zu bilden, verdient besondere Aufmerksamkeit. Da die Vergleichskategorie rein grammatischer Natur ist und Teil des lexikalisch-grammatischen Bereichs der Abstufung ist, der die Merkmalsintensität angibt, kann man von seinen drei Erscheinungsformen sprechen: eigentlich grammatischer (Komparation), lexikalisch-grammatischer (Graduierung) und wortbildender (Derivation). SP veranschaulicht alle drei Möglichkeiten am besten, ohne einer von ihnen den Vorzug zu geben.

Qualitative SP werden nach dem klassischen Schema der Komparationsstufen unter Verwendung der Formen Positiv (Endung *-e*), Komparativ (*-er*) und Superlativ (*-ste*) graduiert. Vgl.: *der/die Bewaffnete – der/die Bewaffnetere – der/die Bewaffneteste*. Als Adjektiveinheiten qualitativer Art sind diese SP in der Lage, die Qualitäten der angegebenen Anthroponyme zu verstärken. Und obwohl es sich bei allen um Ableitungen des zweiten Partizips handelt, ist der semantische Umfang der gebildeten Gradanten nicht derselbe. Somit ist *der Bewaffneter* ein Name einer Person mit einer stärkeren Ausprägung des qualitativen Merkmals des Partizips „bewaffnet“ als in der *Bewaffnete*, und das SP *der Bewaffneteste* ist ein Name mit der stärksten Ausprägung des qualitativen Merkmals. Natürlich werden solche Superlativformen selten lexikographiert. Der einzige Fall des im Usus verankerten Vergleichs bietet das Wortpaar „*der/die Bediente – der/die Bedienteste* dar. Hierbei aber hat nicht Grammatik, sondern Lexik die Hand im Spiel: Das erste ist der veraltete Name für „Diener“, das zweite heißt „Angestellter im öffentlichen Dienst“ [Duden 1996: 217]. Es gehen also um eine gewisse Verbleichung des Intensitätsmerkmals und sein Übergang zum „Ruhestand“ – dem Positiv.

Allerdings kann man sich einigermaßen die SP in ihren Komparationsreihen vorstellen (*der/die Bekannte – der/die ?Bekanntere – der/die Bekannteste, der/die Erwachsene – der/die ?Erwachsenere – der/die Erwachsenste, der/die Gelehrte – der/die ?Gelehrtere – der/die Gelehrteste, der/die Verdächtigte – der/die ?Verdächtigtere – der/die Verdächtigste* usw.), aber die sprachliche Wirklichkeit sträubt sich dagegen. Von drei üblichen Komparativformen werden SP im Positiv und Superlativ gebraucht, während die zweite – der Komparativ – in der Rede kaum vorkommt. Es ist anzunehmen, dass das Komparationsparadigma des deutschen SP im Vergleich mit dem des Adjektivs nicht dreigliedrig, sondern potentiell zweigliedrig ist.

Die Zweigliedrigkeit des Komparationsparadigmas des deutschen SP ist potential, aber nicht real. Die Sprachpraxis zeugt davon, dass die Vergleichsgrade in SP eher die Ausnahme als die Regel sind: In der absoluten Mehrheit der Fälle sind Vergleichsgrade unmöglich. Die Unmöglichkeit eines grammatischen Vergleichs (Komparation) im Bereich SP schließt jedoch einen lexikalisch-grammatischen Vergleich (Graduierung) nicht aus. Die Unmöglichkeit der Komparation und die Möglichkeit der Graduierung hängen mit rein sprachlichen Faktoren zusammen, von denen mindestens zwei – morphologische und lexikalische – mit aller Offensichtlichkeit in Erscheinung treten.

Der morphologische Faktor verhindert den Vergleich von SP, wenn es sich um Komposita handelt (*der/die Zuhausegebliebene, der/die Zivildienstbeauftragte, der Wehrbeauftragte, der/die Versorgungsberechtigte*), bei denen die erste Komponente bereits eine gewisse Qualität anzeigt und keine Visualisierung des Manifestationsgrades des jeweiligen Merkmals erfordert. Dies gilt auch für solche SP, die durch verschiedene Wortbildungsprozesse zu habituell festen Einheiten mit einem Geschlecht (m, f oder n) ohne qualitatives Substrat geworden sind und daher grundsätzlich keine Vergleichsgrade bilden können (*die Winkelhalbierende, die Seitenhalbierende, das Rotliegende, das Weißliegende*) usw.). Auch können die SP mit den Halbpräfixen (Präfixoiden) *halb-, meist-, minder-, leicht-, schwer-, erst-, nach-, all-, allein-* u.a. keine Komparation bilden, weil die bereits eine Gradationskomponente enthalten. Vgl.: *der/die Halbgebildete, der/die Alleinreisende, der/die Schwerverwundete, der/die Allwissende, der/die Minderbemittelte*). Ein Vergleich da ist nicht nur redundant, sondern auch unmöglich.

In manchen sehr begrenzten Fällen kann trotzdem das entsprechende Merkmal in Kombination von Komparation (Superlativ) und Graduierung (lexikalisch) zum Schein kommen: *der/die Schwerverwundete – der/die Schwer**st**verwundete – der/die **Mehrfach**verwundete*; *der/die Schwerbehinderte – der/die Schwer**st**behinderte – der/die **Mehrfach**behinderte*; *der/die Schwerbeschädigte – der/die Schwer**st**beschädigte – der/die Schwer**krieg**sbeschädigte.* Solche Fälle sind aber durch die Semantik der “zunehmenden Körperbeschädigung” begrenzt, denn die abnehmende Semantik hat da keine Relevanz (vgl.: *der/die Leichtverwundete – der/die *Leicht**est**verwundete – der/die *Kriegsleichtverwundete*).

Der lexikalisch-semantische Faktor kann auch den Vergleich anderer SP verhindern: solche, die Abstraktionen bezeichnen („eingeschlechtige“ SP wie z.B. *das Nichtgewünschte, das Eingerichte, das (Zu)nächstliegende*), sowie solche, die Personen nach sozialer Tätigkeit (*der/die Beamtete, der/die Angestellte, der/die Teilzeitbeschäftigte*), nach Familienzustand (*der/die Verheiratete, der/die Verwandte, der/die Geschiedene*) u.ä. bezeichnen. Aufgrund ihrer Wortsemantik sind diese SP nicht in der Lage, die Merkmalsintensität anzugeben und sind daher weder komparierbar noch graduierbar.

Daher haben Modifikationen eines Merkmals oder einer Qualität ein ungleiches Potenzial für die Bildung von Komparationsstufen der SP, und ihre Abstufung hängt mit unterschiedlichen lexikalischen Faktoren zusammen. Die Möglichkeit der Nominalisierung eines bestimmten Merkmals durch Substantivierung wird durch die Semantik des Partizips und seine Fügungspotenz (Kompatibilität) bestimmt. Eine Verstärkung oder Abschwächung von Qualitätsmerkmalen dieser Art von Substantivaten kann nur unter den Bedingungen der qualitativen Bedeutung der ihnen zugrunde liegenden Partizipien erfolgen, sowie dem Fehlen von Komponenten, die den Qualitätsgrad dieser lexikalischen Einheit anzeigen. Im Allgemeinen ist die überwiegende Mehrheit der SP nicht in der Lage, die Intensität des zu verbalisierenden Merkmals zu signalisieren und daher kann die lexikalisch-grammatische Kategorie der Komparation / Graduierung nicht Teil des SP-Paradigmas sein.

Verbale Eigenschaften der SP. Da die Partizipien I und II aus Verben gebildet werden, erben ihre SP-Derivate einige Eigenschaften vom Verb, ebenso wie sie bestimmte Substantiv- und Adjektiveigenschaften erben. Es gibt morphologische und semantische Ansätze zum verbalen Verständnis von SP.

Substantivpartizipien weisen bestimmte ***morphologische Merkmale***, unter denen Bildungsmodelle das wichtigste ist. Das Partizip I (das Neutral-Partizip / das Partizip Präsens) wird durch Anhängen des Suffixes *-d* an den Infinitiv gebildet. Genau wie Partizip I beinhalten die auf seinem Grund gebildeten SP die Idee der Gegenwart sowie die des Aktivs. Dies bedeutet, dass die meisten SP im Bereich der Antroponymie verbreitet sind, wo sie aktiv handelnde Personen (Agentivität) bezeichnen. Agentive Erstpartizipialableitungen geben die Dauer oder Systematik eines Geschehens / Seins in der Gegenwart an und können nur im aktiven Zustand auftreten: *der/die Abwesende*, *der/die Arbeit(s)suchende, der/die Ertrinkende, der/die Zuspätkommende*. Diese und andere SP machen die überwiegende Mehrheit der sowohl usuell als auch okkasionell benutzten Einheiten aus. Einige von ihnen erweisen sich als agentive Ableitungen mit kausalem Untergrund (*der Oberkommandierende, der/die Filmschaffende, der/die Studierende*). Es ist klar, dass sie alle gleichzeitig von phasischen Verben der durativen Semantik (Verben mit langer Wirkung) abgeleitet sind.

In sehr seltenen Fällen kann das SP auch passive Semantik aufweisen. In unserem Material ist nur ein einziger erstpartizipieller Derivat verzeichnet, der aus einem Gerundium gebildet wird: *der/die Auszubildende* (*der/die Azubi*). Da er eine Neubildung darstellt, ist anzunehmen, dass die Sprache das usuell agentive Kompetenzgebiet der SP-I allmählich auf das patientive ausbreitet. Dabei kommen die SP-I im Bereich der Nicht-Antroponymie selten vor, wo sie auf Bezeichnung von abstrakten (*das (Nicht)zutreffende*) und geologischen (*das Liegende*) Begriffen spezialisiert sind. Dabei sind sie tempus- bzw. genusindifferent.

Bei der Substantivierung des Partizips II (das Partizip Präteritum) wird den bekannten Formen die Endung *-e* hinzugefügt, wenn das SP mit dem bestimmten Artikel (*der Gefallene, die Illustrierte, das Eingemachte*), und *-e, -(e)r, -(e)s*, wenn das SP mit einem unbestimmten Artikel verwendet wird (*ein Angestellter, ein Eingesandtes, eine Erstgeborene*) oder ohne Artikel (*Gelehrter, Frauenbeauftragte*). Dabei sind dem Prozess der Substantivierung praktisch alle Strukturtypen von Verben offen. Es geht um zweitpartizipielle Derivate.

Die zweitpartizipielle Derivate werden praktisch von allen Strukturtypen der deutschen Verben gebildet: schwachen (*der/die Gebildete, der/die Geliebte*), starken (*der/die Gefallene, das Gebratene*), Verben mit trennbaren (*der/die Abgeordnete, der/die Ausgestoßene*) und untrennbaren (*der/die Beklagte, der/die Verreiste*) Präfixen. Unter allen Affixen ist aber das Suffix ***-ier-*** am aktivsten für beide SP-Formen (*der/die Studierende, die Resultierende, der/die Arrivierte, der/die Konföderierte, der/die Liierte*).

Aus der inhaltlichen Sicht erben die SP-II solche ***semantischen Eigenschaften*** von Verben wie Dauer oder Abschluss eines Geschehens / Seins sowie Genus (Diathese). Substantivpartizipien II geben an, dass die Handlung in der Vergangenheit stattgefunden hat und zum Redemoment abgeschlossen ist oder dass das Nomen die Bedeutung der Gegenwart hat und aktiv oder passiv sein kann. Vgl.: *der/die Verwundete* (Gegenwart, Passiv), *der/die Abgeschiedene* (Vergangenheit, Aktiv), *der/die Ertrunkene* (Verg., Akt.), *der/die Auserwählte* (Verg., Pas.), *der/die Besiegte* (Verg., Pas.), *der/die Gekündigte* (Verg., Pas.), *der/die Totgesagte* (Verg., Pas.) ect.

Indem die SP-2 als Verbableitungen eine abgeschlossene Handlung angeben und folglich ausschließlich patientiv-resultierende Semantik aufweist, die eng mit der Idee der Perfektivität verbunden ist: Die Handlung hat in der Vergangenheit stattgefunden, bleibt aber aktuell für die Gegenwart. Vgl.: *der/die Angeklagte, der/die Heimatvertriebene, der/die Ausgebombte, der/die Kriegsgefangene, der/die Neubekehrte, der/die Abgesandte, der/die Delegierte, der/die Verbannte, das Gefrorene.* Dabei wird ihr Korpus durch das völlige Fehlen von ingressiven / inchoativen Bedeutungselementen gekennzeichnet.

In Anlehnung an grammatische Semantik kann ein paar Worte über Wortbildung der SP und ihre lexikalische Bedeutung gesagt werden. Die häufigsten Wurzeln hierbei sind: ***-behinder-*** (der/die Köpferbehinderte, der/die Lernbehinderte), ***-berechtig-*** (der/die Stimmberechtigte, der/die Wahlberechtigte), ***-gebär- / -gebor-*** (die Erstgebärende, der/die Eingeborene), ***-ordn-*** (der/die Beigeordnete, der/die Bezirksverordnete), ***-reise-*** (der/die Weltreisende,

der/die Zugereiste), ***-schädig-*** (der/die Geschädigte, der/die Zivilbeschädigte), ***-steh-*** (der/die Alleinstehende, der/die Außenstehende), ***-such-*** (der/die Arbeitsuchende, der/die Wohnungssuchende), ***-vorsitz-*** (der/die Vorsitzende, der/die Ratsvorsitzende) u.a.

Im lexikalischen Fundus der Sprache gibt es auch solche SP, die ihre ursprünglich vom Verb erworbene Bedeutung bereits verloren haben oder dabei sind, sie einzubüssen. Dadurch dass sie in die Kategorie des Substantivs übergehen, werden viele von ihnen letzten Endes terminologisiert. Vgl.: *der/die Alleinerziehende*, *das Liegende*, *das Weißliegende*, *die Seitenhalbierende*, *die Winkelhalbierende*, *der/die Angetraute*, *das Eingerichte*, *das Eingesandte*, *das Eingekochte*, *das Eingemachte*, *das Eingetropfte*, *das Faschierte* etc. Es ist schwierig, die genaue Anzahl solcher Einheiten zu nennen, zumal erstens nicht alle von ihnen in den Wörterbüchern erfasst sind und zweitens einzelne Varianten und Dialekte des Deutschen verfügen über ihre eigenen SP-Lexeme. Indem sie aber den neuen, terminologischen Status erwerben, verliert jedoch die überwiegende Mehrheit von ihnen nicht ihre ursprünglichen verbalen Eigenschaften.

Schlussfolgerungen. Das Korpus der substantivierten Partizipien der deutschen Sprache stellt ein Cluster lexikalisch-grammatischer Einheiten dar, die auf Anthroponominationen spezialisiert sind – die Übertragung der bestimmten Eigenschaft einer Person auf ihren Namen. Dies wird dadurch versprachlicht, dass dem entsprechenden Nomen die usuellen Substantivkategorien wie Genus, Numerus, Kasus und Bestimmtheit/Unbestimmtheit zugewiesen werden. Dadurch verwandelt sich die kategoriale Bedeutung „Merkmal“ (Adjektiv) zur kategorialen Bedeutung „Gegenstand“ (Substantiv). Dabei wird die erste nicht neutralisiert, sondern zusammen mit der zweiten zu einem lexikalisch-grammatischen Hybrid verschmolzen. Dieser Hybrid enthält auch die dritte semantische Bedeutungskomponente – „Handlung“, welche die SP mit den Kategorien des Tempus (Gegenwart, Vergangenheit), des Genus (Aktiv, Passiv), des Aktionsgrades (Dauer, Abgeschlossenheit) „versorgt“, sowie zusätzlich mit manchen „nichtgrammatischen“ Impulsen (Ergebnis, Kausalität, Intensität usw.).

Die morphologische Struktur von SP setzt sich nicht aus einer einfachen Summe der entsprechenden Nomen- und Verbalkategorien zusammen. Es füllt einzelne „lexikalische Lücken“ und zeichnet sich durch eine gewisse grammatische Selektivität aus, indem es aus dem Substantiv, dem Adjektiv und dem Verb nur das übernimmt, was zu den ausdrucksstärksten und detailliertesten Merkmalen der objektiven Welt gehört. SP ist ein anschauliches Beispiel für die Objektivierung des Subjektiven, der Verallgemeinerung des Einzelnen, der Vergegenständlichung des nicht Gegenständlichen. Vielleicht ist SP eines der Phänomene, die das Deutsche immer noch im analytisch-synthetischen Sprachtypus festhalten.

Das SP erscheint als synkretische lexikalisch-grammatische Wortklasse mit einem spezifischen Set grammatischer Kategorien, die insgesamt größer sind als bei jeder von drei obig genannten Wortarten, aber mit einem erwartungsgemäß kleineren Set von Grammemen, die der entsprechenden Kategorie untergeordnet sind: Verkürzung des Genusparadigmas (SP im Neutrum sind unproduktiv), Einschränkung bei der Bildung von Komparationsstufen (Positiv und Superlativ), Ausfallen der zukünftigen Zeitwerte usw. Dennoch war und bleibt die Substantivierung des Partizips sowohl eine Tatsache der Sprache als auch eine Tatsache der Rede. Da es sich um die Einheit eines grammatisch flexiblen Spektrums handelt, kann sie die benennenden Möglichkeiten der Sprache im Bereich der Personenbezeichnung und der Produkte menschlicher Tätigkeit aufgrund der Detaillierung und Nuancierung von spezifischen Eigenschaften unbegrenzt erweitern.

Nicht nur die gut untersuchte adjektivische Substantivierung, sondern auch ihre partizipielle Hypostase ist eine sehr produktive Weise der transpositiven Wortartenderivation in der modernen deutschen Sprache. Gleichzeitig handelt es sich bei einem Teil von SP um stabile Substantive, die fest in der Sprache verankert und durch Wörterbücher fixiert sind (usuelle SP), und bei dem anderen Teil geht es um gelegentliche / okkasionelle Substantive, die als kontextuelle Nomina fungieren, sind dabei aber ein wichtiges Mittel zum kreativen Sprachgebrauch, zum Sprachspiel und zur stilistischen Ausdruckskraft. Spontan in der Rede auftauchend, können okkasionelle SP beim entsprechenden sozialen Bedarf lexikographiert bzw. terminologisiert werden.

Folglich ist die weitere Untersuchung von SP, wie die Wortartentransposition im Allgemeinen, nicht nur mit Wörterbuchmaterial, nicht nur mit seiner Paradigmatik, sondern auch mit seiner Syntagmatik verbunden. Es kann und soll auf die regionale Sprachvarianten bzw. Dialekte des Deutschen, auf die Sprache bestimmter sozialer Schichten, auf verschiedene diskursive Formationen ausgedehnt werden. Und das gilt nicht nur für Deutsch, sondern auch für mehrere natürliche Sprachen der Welt.

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PSYCHOLOGICAL SCIENCES

GENERAL CHARACTERISTICS OF METHODS AND METHODS OF RESEARCHING THE INFLUENCE OF PERSONAL SECURITY ON THE UPDATE OF EMOTIONAL RESOURCES

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ЗАГАЛЬНА ХАРАКТЕРИСТИКА МЕТОДІВ ТА МЕТОДИК ДОСЛІДЖЕННЯ ВПЛИВУ ОСОБИСТІСНОЇ БЕЗПЕКИ НА АКТУАЛІЗАЦІЮ ЕМОЦІЙНИХ РЕСУРСІВ

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Abstract

In the article, the author substantiates the need for the selection of appropriate methods for determining the methods and methods of researching the impact of personal safety on the actualization of emotional resources. To carry out an empirical study of the generalization of all indicators of personal safety, the author singled out the following components: cognitive-behavioral, motivational-value, emotional-volitional components. To study the cognitive-behavioral component of personal safety, the author suggests using R. Ketel's "16-factor questionnaire" and S. Hobfol's "Strategic Approach to Coping Scale (SACS)" method. The level of neuropsychological stability will be investigated using the "Prognosis" method. It is proposed to carry out risk readiness research using A. Schubert's "Diagnostics of the level of risk readiness". It has been proven that a high level of emotional intelligence allows a more positive attitude to critical situations, situations of uncertainty, better coping and resisting stress, thereby maintaining a sense of personal security. That is why the author suggests using the following methods: "Characteristics of emotionality" by V. Ilyin, "Questionnaire of emotional expression" by O. Bogin, "Diagnostics of emotional intelligence" by N. Hall. Considering the importance of motivation in the structure of personal security in the context of the motivational-value component, we consider it relevant to study the motivational sphere and motivational profile of the individual using the methodology "Study of the motivational profile of the individual" by Sh. Ritchie and P. Martin. To study the motivational and value component, the author suggests using the methodology "Determining the life goals and values of the individual" by P. Ivanov, E. Kolobova. To understand the general level of satisfaction of the need for security, we use the methodology "Evaluation of satisfaction of the need for security" by O. Zotov.

Анотація

У статті автор обґрунтовує потребу в підборі відповідних методик для визначення методів та методик дослідження впливу особистісної безпеки на актуалізацію емоційних ресурсів. Для виконання емпіричного дослідження узагальнення усіх показників особистісної безпеки автор виокремив такі компоненти: когнітивно-поведінковий, мотиваційно-ціннісний, емоційно-вольовий компоненти. Для дослідження когнітивно-поведінкового компоненту особистісної безпеки автором пропонується до використання *«16-факторний опитувальник»* Р. Кетела та методику *«Стратегії долання стресових ситуацій (SACS)»* С. Хобфол (Strategic Approach to Coping Scale, SACS). Рівень нервово-психічної стійкості буде досліджено методикою *«Прогноз»*. Дослідження готовності до ризику пропонується виконати за допомогою методики *«Діагностика рівня готовності до ризику»* А. Шуберта. Доведено, що високий рівень емоційного інтелекту дозволяє більш позитивно ставитись до критичних ситуацій, ситуації невизначеності, краще справлятися і протистояти стресу, тим самим зберегти відчуття особистісної безпеки. Саме тому автор пропонує застосувати наступні методики: *«Характеристика емоційності»* В. Ільїна, *«Опитувальник емоційної експресії»* О.Богіна, *«Діагностика емоційного інтелекту»* Н. Холла. Враховуючи важливість мотивації у структурі особистісної безпеки в контексті мотиваційно-ціннісного компоненту, вважаємо актуальним дослідження мотиваційної сфери та мотиваційного профілю особистості за допомогою методики «*Вивчення мотиваційного профілю особистості»* Ш. Річі і П. Мартіна. Для дослідження мотиваційно-ціннісного компоненту автор пропонує використати методику *«Визначення життєвих цілей та цінностей особистості»* П. Іванов, Є. Колобова. Для розуміння загального рівня задоволеності потреби у безпеці нами – методику «*Оцінка задоволеності потреби у безпеці»* О. Зотова.

Keywords: psychological safety, emotional resources, psychological components of personal safety, psychological research methods, empirical research.

Ключові слова: психологічна безпека, емоційні ресурси, психологічні компоненти особистісної безпеки, психологічні методи дослідження, емпіричне дослідження.

Вступ. Феномен особистісної безпеки сьогодні в Україні як ніколи надзвичайно актуальне. Адже ось уже впродовж останніх десяти років українці перебувають у стані постійних екстремальних подій різної інтенсивності. У світі також збільшується кількість терористичних актів, техногенних та природних катастроф, підігріваються міжнародні та релігійні ворожнечі, загальна незадоволеність умовами життя. Саме тому щоразу більшає кількість осіб, які зазнали травматичного досвіду, проте попри все змушені пристосовуватись до надзвичайно динамічного соціуму, навчитись створювати приватний соціальний та особистісний досвід.

Поняття «особистісна безпека» у психологічній науці розглядається як стан повного соціального, фізичного, психічного благополуччя, який зумовлено психологічними та соціальними чинниками [3].

У попередніх наукових пошуках ми проаналізували теоретико-методологічну базу поняття психологічної безпеки в науковій літературі [1]. Саме тому **метою** нашої статті є здійснення підбору методів дослідження особистісної безпеки та обґрунтування доцільності їх застосування.

Виклад основного матеріалу. На основі теоретичного аналізу було встановлено, що особистісна безпека є одним із важливих безпекових аспектів життєдіяльності, як і соціально-психологічна безпека, емоційно-вольова безпека, когнітивна (інформаційно-психологічна) безпека, психофізіологічна безпека.

Відчуття особистісної безпеки значною мірою залежить від багатьох показників, зокрема від мислення, емоцій, поведінки, мотивації, цінностей, сили волі та інших рис та якостей. Проте, необхідно зазначити, що порушення особистісної безпеки чинить вплив на ті самі показники та підвищує ризик неадекватного їх вияву. З метою узагальнення усіх показників особистісної безпеки, нами було виокремлено наступні компоненти: когнітивно-поведінковий компонент, мотиваційно-ціннісний компонент та емоційно-вольовий компонент.

Для дослідження когнітивно-поведінкового компоненту особистісної безпеки необхідно встановити основні поведінкові характеристики, особистісні якості. Вважаємо, що в даному випадку доцільно до використання *«16-факторний опитувальник»* Р. Кетела. Оскільки даний опитувальник дозволяє визначити велику кількість актуальних показників, які виражені у таких шкалах: шкала A: замкнутість – товариськість шкала B: інтелект шкала C: емоційна нестабільність – стабільність шкала E: підпорядкованість – домінантність шкала F: стриманість – експресивність шкала G: низька – висока нормативність поведінки Шкала H: боязкість – сміливість шкала I: жорстокість – чутливість шкала L: довірливість – підозрілість шкала M: практичність – мрійливість шкала N: прямолінійність – дипломатичність шкала O: спокій – тривожність шкала Q1: консерватизм – радикалізм шкала Q2: конформізм – нонконформізм шкала Q3: високий – низький самоконтроль шкала Q4: розслабленість – напруженість.

Одним із важливих аспектів особистісної безпеки доцільно вважати не лише відсутність потенційних небезпек, а й здатність адекватно реагувати та поводитись у ситуаціях небезпеки. Безумовно, важливим завданням підготовки та психологічного супроводу фахівців будь-яких професій, є вивчення механізмів і факторів, що зумовлюють високу індивідуальну стресостійкість. Ефективна міжособистісна взаємодія та якісне виконання професійних завдань значною мірою буде залежати від вибору адекватних стратегій подолання негативних переживань. За допомогою певних психологічних прийомів та наявності необхідних особистісних ресурсів матимемо змогу проявляти стресостійкість у складних ситуаціях [5].

Тому, в контексті когнітивно-поведінкового компоненту, доцільно буде дослідити основні стратегії подолання стресових ситуацій за допомогою методики *«Стратегії долання стресових ситуацій (SACS)»* С. Хобфол (Strategic Approach to Coping Scale, SACS). Дана методика використовується з метою визначення основних поведінкових стратегій подолання стресових ситуацій та дозволяє визначити дев'ять моделей стрес-долаючої поведінки: асертивні дії, встановлення соціального контакту, пошук соціальної підтримки, обережні дії, імпульсивні дії, уникнення, маніпулятивні дії, асоціальні дії, агресивні дії.

У багатьох аспектах на вибір стратегій стрес-долаючої поведінки матиме вплив рівень нервово-психічної стійкості. Рівень нервово-психічної стійкості дозволяє оцінити ризик дезадаптації особистості в умовах стресу та в критичних ситуаціях, викликаних зовнішніми та внутрішніми чинниками [5].

Саме тому вважаємо за необхідне використання методики *«Прогноз»*. Дана методика призначена для виявлення осіб з нервово-психічною нестійкістю та дозволяє виявити окремі початкові симптоми порушень нервово-психічної стійкості особистості, а також оцінити ймовірність їх розвитку й прояву в поведінці та діяльності людини. Методика «Прогноз» дає можливість оцінити чотири рівні нервово-психічної стійкості: високий рівень нервово-психічної стійкості (прогноз сприятливий), нормальний рівень нервово-психічної стійкості (прогноз сприятливий), задовільний рівень нервово-психічної стійкості (прогноз умовно сприятливий), низький рівень нервово-психічної стійкості (прогноз несприятливий).

Деякими науковцями наголошується, що особистісна безпека характеризується відсутністю страху та готовністю до ризику. Існує думка, що «ризик» невід'ємно пов'язаний з розумінням та уявленням про дії суб'єкта, характеристика цих дій, а також може визначатися як погляд на дію. Ризик виступає як реальна можливість здійснення дії, спрямованої на досягнення результату для забезпечення власної особистісної безпеки, що ймовірно сприятиме активізації ресурсів особистості.

Українська вчена Т. Титаренко розглядає ризик як складний феномен у контексті звичних та особливих умов життєдіяльності особистості. Науковиця виділяє два зовсім різних аспекти ризику: перший – можливість переходу на новий рівень розвитку з періоду стагнації (ризик виходу з одного періоду), другий – можливість ефективно вирішити критичну ситуацію [4]. Враховуючи наведені аргументи, необхідно здійснити дослідження готовності до ризику за допомогою методики *«Діагностика рівня готовності до ризику»* А. Шуберта, яка дозволяє оцінити цей ступінь.

Для забезпечення дослідження емоційно-вольового компоненту потрібно визначити особливості емоційності досліджуваних, їх експресивність і особливості вияву емоцій, а також здатність розуміти емоції оточуючих, контролювати власні емоції, загалом рівень емоційного інтелекту. Успішність особистості в житті та професійній діяльності, на думку І. Приходька, часто залежить від рівня розвитку емоційного інтелекту. До прикладу, емоційний інтелект набуває особливої значущості у здійсненні аварійно-рятувальної діяльності, оскільки певні професійно-важливі якості рятувальників є основними компонентами його емоційного інтелекту [2].

На основі аналізу наукової літератури було встановлено, що високий рівень емоційного інтелекту дозволяє більш позитивно ставитись до критичних ситуацій, ситуації невизначеності, краще справлятися і протистояти стресу, тим самим зберегти відчуття особистісної безпеки. У зв'язку з вище наведеними аргументами вважаємо за доцільне застосувати наступні методики: *«Характеристика емоційності»* В. Ільїна, *«Опитувальник емоційної експресії»* О.Богіна, *«Діагностика емоційного інтелекту»* Н. Холла. За допомогою методики «Характеристика емоційності» В. Ільїна зможемо визначити такі показники: емоційна збудливість; емоційна реактивність (інтенсивність, тривалість); емоційна стійкість (вплив емоцій на ефективність діяльності).

Проведення методики «Опитувальник емоційної експресії» О. Богіна, дозволить виявити вісім експресивних каналів вираження емоцій: гучність голосу, темп мови, образність мови, мовні помилки («збій» мови), інтонаційна виразність мови, рухова активність, зайві рухи, міміка. Крім того, шляхом комбінації питань виділяються три фактори експресивності: зовнішня виразність емоцій, активність поведінки під впливом емоцій і порушення мови та поведінки під впливом емоцій.

Методика «Діагностика емоційного інтелекту» Н. Холла призначена для виявлення здібностей особистості розуміти відносини, що репрезентуються в емоціях, і керувати своєю емоційною сферою на основі прийняття рішень. Вона містить в собі п'ять шкал: емоційна обізнаність, управління своїми емоціями, самомотивація, емпатія, розпізнавання емоцій інших людей, а також дозволяє визначити загальний рівень розвитку емоційного інтелекту.

Одне з провідних місць у структурі особистості займає мотивація. Вона виступає важливою умовою успішної професійної діяльності особистості. Також мотивація є одним із показників того, що у людини присутнє відчуття особистісної безпеки – вона прагне та має можливість розвиватись. Наукові праці свідчать, що поняття мотивації найчастіше розглядається у двоякому сенсі: як поняття, що визначає формування системи факторів, які детермінують поведінку особистості, здійснюючи вплив на її потреби, мотиви, цілі, наміри, прагнення тощо; як особливість процесу будь-якої діяльності, який визначає та характеризує поведінкову активність на тому чи іншому рівні [6]. Враховуючи важливість мотивації у структурі особистісної безпеки в контексті мотиваційно-ціннісного компоненту, вважаємо актуальним дослідження мотиваційної сфери та мотиваційного профілю особистості за допомогою методики *«Вивчення мотиваційного профілю особистості»* Ш. Річі і П. Мартіна.

Життєві цілі та цінності є важливим аспектом у життєдіяльності особистості, оскільки суттєво визначають особливості міжособистісної взаємодії, свідомий прояв у стосунках, особисті кордони, здатність до вольових дій спрямованих на досягнення власної мети тощо. Адекватні життєві цінності, а також здатність ставити та досягати цілей сприятимуть підтримці особистісної безпеки. Тому, для забезпечення повноцінного дослідження мотиваційно-ціннісного компоненту постає необхідність використати методику *«Визначення життєвих цілей та цінностей особистості»* П. Іванов, Є. Колобова.

Для розуміння загального рівня задоволеності потреби у безпеці нами було використано методику «*Оцінка задоволеності потреби у безпеці»* О. Зотова.

За умови, що усі компоненти відповідатимуть належному рівню, буде міцна основа для вирішення практичних завдань, а також сприятиме формуванню знань, вмінь і навичок, які допоможуть особистості справлятися із загрозами для життя, ефективно взаємодіяти із оточуючими, впевнено та якісно виконувати професійні завдання, зберігати індивідуальну та колективну безпеку.

Висновки. Проблема особистісної безпеки завжди було в колі наукових досліджень психологів, особливої актуальності вона набуває в період війни. Визначені особливості та характеристики дозволили виокремити компоненти особистісної безпеки, зокрема такі: когнітивно-поведінковий компонент, мотиваційно-ціннісний компонент та емоційно-вольовий компонент. Для забезпечення повноцінного вивчення кожного із виокремлених

компонентів нами було підібрано методики дослідження та обґрунтовано їх доцільність.

Перспективним вбачаємо проведення емпіричного дослідження компонентів особистісної безпеки за допомогою підібраних методик та висвітленні його результатів у наступних публікаціях.

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SOCIAL SCIENCIES

AN ALTERNATIVE TO THE TRANSITION TO THE ESTONIAN MODEL OF THE PROFIT TAX OF COMMERCIAL BANKS OF GEORGIA

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Abstract
This paper examines the feasibility of transitioning to a new model of profit taxation for commercial banks in Georgia. The analysis is based on financial data from Georgian and European banks and compares effective tax rates, provisioning practices, and other relevant indicators. The study recommends strengthening horizontal monitoring between banks and tax authorities as an alternative to adopting the Estonian model of profit tax in Georgia.

Keywords: Banking Sector, Effective Tax Rate, Estonian Model, Georgia, Profit Tax.

Introduction

Georgia began implementing elements of the Estonian model in 2017. Initially, it applied to small and medium-sized businesses (SMEs) with annual revenues below 10 million GEL. In 2021, the eligibility was extended to large companies. Positive impacts observed: A) Increased investment. Studies suggest the model has led to increased investment in Georgian businesses. B) Enhanced business growth. Reinvesting profits has contributed to business expansion and job creation. C) Simplified tax system. The model is seen as simpler and more transparent than the previous system. Challenges and concerns: A) Limited impact on large businesses. Some argue the model primarily benefits SMEs and has limited impact on large corporations. B) Potential for profit shifting. Concerns exist that companies might shift profits to avoid taxation. C) Potential decrease in government revenue: With delayed tax collection, government revenue might be impacted in the short term.

The Georgian banking system has witnessed significant growth in recent years, with net profits exceeding 2 billion GEL in 2021-2022. However, concerns remain regarding the relatively low effective tax rates paid by commercial banks, which average around 11.87%. This raises questions about the fairness and efficiency of the current tax system and has led to discussions about transitioning to the Estonian model of profit tax.

1. Effective Tax Rate

The general idea for estimating effective tax rates is to measure the bank's actual income tax liability relative to the size of its taxable income. If the effective tax rate is significantly lower than the statutory tax rate, it indicates that the company benefits from special tax benefits or a preferential tax regime applicable in its country of operation.

Erosion of the corporate tax base due to profit hiding is a significant and persistent problem that can lead to government spending cuts, budget deficits, and the introduction of new forms of indirect or direct taxes to reduce corporate tax revenues. In this context, assessing the true size of profit is crucial. Quantifying the redistribution of profits provides insight into the income escaping the tax system.

It is worth noting that since 2014, European financial institutions have begun disclosing their activities by country, in accordance with the European Union Directive (Directive 2013/36/EU). These disclosures include net banking income, profit before tax, the amount of taxes paid, and the number of full-time employees for each country where the bank has a subsidiary. The data was collected manually and covers 51 European banking groups between 2014 and 2020, as well as several foreign banks operating within the EU. This new data enables us to address some crucial questions, such as: Do banks choose to have subsidiaries in low-tax locations?

Several studies have analyzed the country-by-country reporting imposed on European banks. For instance, Vincent Bouvatier, Gunther Capelle-Blancard, and Anne-Laure Delatte, in their 2019 work titled "After the Crash," used a gravity model to estimate profit shifts based on individual country reports published by the 37 largest European banks. Their research database combines OECD macro CbCR (Country-by-Country Reporting data) and micro-level CbCR data.

Even with this research, tax savings for EU banks are estimated to be between €1 billion and €3.6 billion. Notably, the study by Fatika and Gregory (2020) is closely related to this paper. Their research attempts to estimate the change in European banks' profits. However, their sample comprises 27 banks headquartered in 8 different EU countries, while the data for this study encompasses 51 European banks headquartered in 18 different European countries. Additionally, their sample spans only two years, while this study covers a broader period of seven years, from 2014 to 2020.

Furthermore, it is crucial to consider circumstances where a portion of a banking institution's profit remains untaxed or is reduced due to various factors. This includes the artificial manipulation of increased expenses or the reduction of the taxable profit base through the increase in expenses incurred during asset revaluation.

The effective tax rate is calculated as the ratio of the profit tax (Tax on profit or loss) to the pre-tax profit amount. This can be expressed as follows: Effective tax rate = Tax on profit or loss/(Profit or loss before tax).

According to official data from 2021-2022, based on the official statistics of the National Bank of Georgia and the annual reports of leading Georgian commercial banks, an analysis of the Georgian banking system reveals an effective tax rate ranging from 7% to 16% for the five largest Georgian commercial banks, encompassing at least 5% of total assets. The average median rate stands at 11.87% (table 1). For comparison, the average global level is 26%. For example, in Spain, where the corporate tax is 19%, a leading bank, BBVA, reported an effective tax rate of 24% in 2021. Similarly, in Germany, where the corporate tax is 15%, Commerzbank, another leading bank, reported a much higher effective tax rate of 30.5% in 2022.

Table 1.

2022	Pre-Tax Propfit (GEL)	TAX (GEL)	ETR, %	Tax stationary Rate, %
TBC Bank	24,135,160,161	1,156,970,328	16%	
Bank of Georgia	26,625,502,407	1,070,901,875	8%	
Liberty Bank	3,623,271,954	72,189,742	7%	
Procredit bank	1,726,760,909	55,139,005	16%	
Basis Bank	3,092,391,711	60,052,087	11%	
Total	59,203,087,142	2,415,253,038		
Share to system	84 %			
Medium			11.87 %	<15%

According to Table 1, despite having one of the highest pre-tax profit rates and being the first bank in terms of assets, "Bank of Georgia" has an average profit tax efficiency ratio of only 8%. This is even higher than the corporate profit tax rate, but still falls behind by 2 times.

The indicator for "Liberty Bank," the third largest bank in terms of assets, is practically similar. Its profit tax efficiency ratio was 7.27% in 2022 and zero in 2021.

TBC Bank has effective tax rates closer to the corporate profit tax, although it was 11% in 2021. Among the presented banks, Procredit Bank, with German capital, was relatively close to the current tax norm, with a range of 14-16%. In terms of net budget losses, based on the profit tax level, the budget loses at least 290 million GEL.

2. Net Income Before Provisions (Operating Profit) Efficiency Rate:

Another coefficient used to assess tax payment efficiency is the Net Income Before Provisions (Operating Profit) Efficiency Rate. This rate is directly related to the commercial bank's net profit and the profit tax efficiency rate. It is calculated as the ratio of Total Provisions for Possible Losses to Net Income Before Provisions.

As is known, the reserve for possible losses of assets is a reserve account established for a commercial bank's assets. It represents the amount intended to cover potential losses of loan and non-loan assets and contingent liabilities. This reserve includes both special and common reserves. This issue is regulated in international banking practice by special provisions on asset classification and the creation of special reserves.

Similarly, in Georgia, the instruction "On the Approval of the Rules for the Classification of Assets and the Creation and Use of Reserves for Possible Losses by Commercial Banks" is in force. This instruction was issued on the basis of a relevant order from the President of the National Bank.

Commercial banks are obligated to spend the created reserves and any subsequent increases in expenses under the "Loss according to Possible Losses of Assets" category. This will be shown on their balance sheets under the "Reserves for Possible Losses of Assets" line. Additionally, according to the risk classification of assets, the necessary reserves must be created during the accounting period, regardless of the income received.

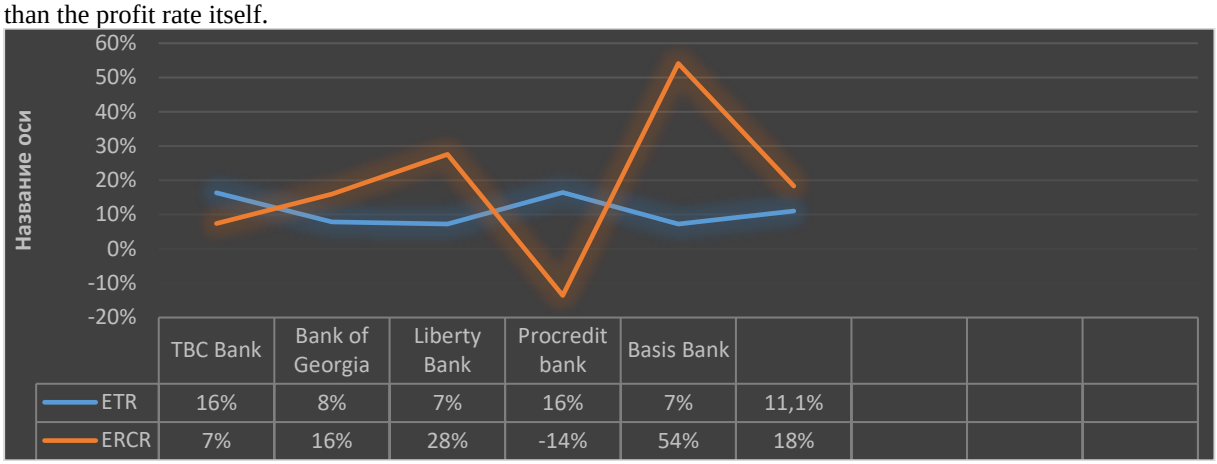
The main problem here is twofold. On the one hand, there is the market price formation for real estate, and on the other hand, the sale price of the property, including sales to third parties. Not infrequently, the property is sold at auction at a lower price, which increases the amount to be reserved and reduces the profit tax.

The Net Income Before Provisions (Operating Profit) Efficiency Rate shows the ratio between reserved funds and profit before provisioning. This is important to the extent that reserved funds are carried out in expenses, as a high rate reduces the taxable profit base. For comparison, the indicators of individual banks are used in relation to the average system indicator, as well as by individual banks in relation to the banking systems of other countries. The said coefficient is calculated as:

Net Income before Provisions $effective\ rate$ **= Total Provisions for Possible Losses / Net Income before Provisions**

These two coefficients are complementary. In general, a bank's tax base can be considered normal if both conditions are met: the effective tax rate is higher than the current corporate tax rate, and the effective rate

of profit before provisions is also low, ideally lower than the profit rate itself.



	TBC Bank	Bank of Georgia	Liberty Bank	Procredit bank	Basis Bank				
ETR	16%	8%	7%	16%	7%	11,1%			
ERCR	7%	16%	28%	-14%	54%	18%			

Diagram 1. Effective tax rates in leading commercial banks, 2022, %

Source: National bank of Georgia, Annual reports of listing banks

Diagram 1 shows that the effective tax rates of Georgia's leading commercial banks, whose assets exceed 5% of the total system and constitute 84% of the system's assets, are lower than the current corporate tax in 2022. The average effective tax rate for these banks is 18%. Notably, the rate is significantly lower for the top 3 system-forming banks. TBC Bank's rate is 7%, while Bank of Georgia's is 16%.

For the effective tax rate of profit before provisioning, the average rate is higher than the current rate and almost twice the average system rate of 28%. Procredit Bank is the only bank with a rate close to the potential tax rate.

Losses based on possible asset losses arise from the provision of negatively classified assets. Among these losses, even the two leading systemic commercial banks, which own 74% of the banking sector's assets, experience an average of 90% loan losses. The loss in terms of investment fees is practically zero, which is natural due to commercial banks' small investment portfolios and the underdeveloped capital market.

In general, losses on possible asset losses mainly come from loan losses and other asset losses, which periodically increase in percentage terms.

For comparison, we can look at the data of European banks. EU Tax Observatory Working Paper No. 9, issued in 2022, estimates that the effective tax rate for all European banks, combining both tax and non-tax havens, is 19.6%, based on a sample of 5271 institutions. This is lower than the legislated tax rate of 22.9%.

However, for relatively large and system-forming individual commercial banks, the effective tax rates are higher than the statutory tax rates. For example, according to the 2022 financials of Komerční banka, one of the leading Czech banks, the effective tax rate was 18.3%, and the effective rate of profit before provisions was 5%, with a corporate profit rate of 19%. Komerční banka's net interest margin is 2.42%.

Similarly, RABO Bank, a leading Dutch bank, reported an effective tax rate of 26% and an effective rate of profit before provisions of 5% in its 2022 financial data, with a corporate profit rate of 24%. The net interest margin of RABO Bank is 1.35%.

Finally, BBVA, a well-known Spanish bank, had an effective tax rate of 31% and an effective rate of profit before provisions of 20% in its 2021 financial data, with a corporate profit rate of 25%. BBVA's net interest margin is -0.45%.

As this analysis shows, the Georgian banking sector's tax risk profile is significantly higher than that of European banks. This high tax risk is linked to both high credit risk and high lending rates compared to the annual growth of the gross domestic product, which is discussed in detail in the relevant part of the report.

The objectivity of the taxable profit base calculation is a separate issue, particularly relevant for the pre-provisioning profit portion. It is important for Georgian commercial banks, which report to the National Bank using the IFRS standard, to strengthen horizontal monitoring to reduce tax risk. This refers to balanced cooperation with tax authorities regarding corporate taxes, including a transition to a platform of mutual trust and transparent communication, which is an accepted practice in EU countries.

In European countries, commercial banks have a tax department responsible for all tax affairs and even strategy development, along with the internal audit committee. While a similar structure exists in Georgian commercial banks, we believe that improving and expanding horizontal monitoring is a matter of urgency.

3. Net Interest Margin and its Impact on Tax Policy

The primary determinant of any bank's performance is the net interest margin (NIM). This ratio represents the net interest income relative to the average working assets. In other words, the interest spread should cover losses on the reserve for possible loan losses (PLL), taxes, and interest costs on raised funds. It's noteworthy that Georgian banks have a significantly higher net interest margin compared to European banks.

The net interest margin reflects two key aspects:

- Ratio of net interest income to bank assets: This indicates the rate of return on profit to assets.
- Real spread of interest income and expenses: This shows the difference between the

interest income generated and the interest expense incurred.

The high interest margin in Georgia stems from two primary factors:

- High credit risk: This risk is significantly higher compared to European countries.
- High tax risks: While credit risk receives more emphasis in Georgian commercial banks' risk management, tax risks deserve greater attention and effort.

For comparison, the global average net interest margin across all types of banks in 135 countries was 3.61% in 2020. In contrast, Georgian banks recorded a 5.3% net interest margin, the highest globally. The highest value was observed in Zimbabwe (12.83%), and the lowest in Iraq (0.17%). In 40 European countries, the average net interest margin in 2020 was 1.97%, with the highest in Moldova (4.79%) and the lowest in France (0.52%).

While the Georgian commercial banks' net interest margin decreased to 5.3% by the end of 2022, it still remains considerably high. Compared to European countries, including Moldova (4.79%), Turkey (3.29%), and Ukraine (3.69%), Georgian banks still have a relatively high net interest margin as of 2021.

4. Net Profit Growth Exceeds Asset Growth

The net profit of the Georgian banking system grew 2.4 times between 2018 and 2022, significantly exceeding the 77% increase in assets during the same period. In 2018, the total assets were 39.6 billion GEL, and by 2022, they had reached 70.3 billion GEL.

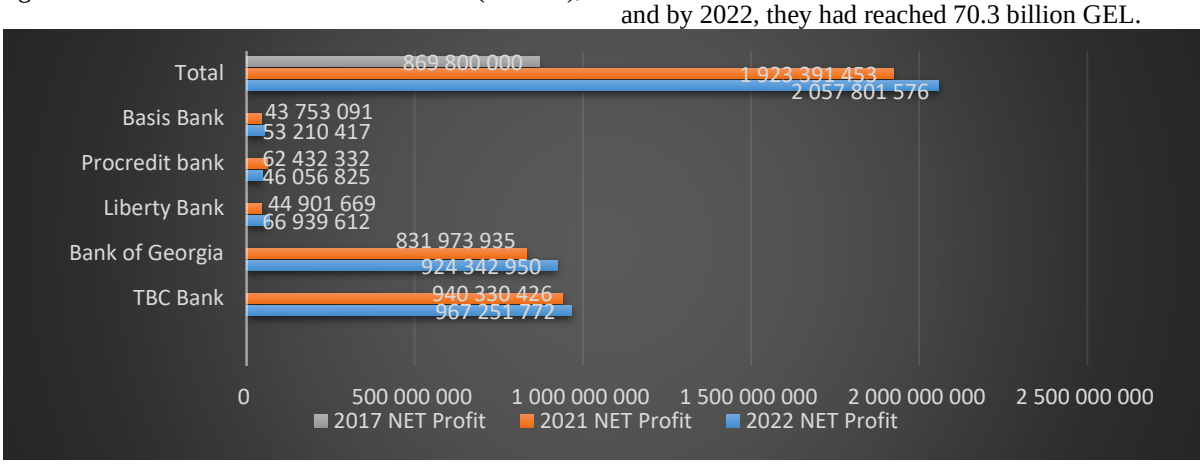


Diagram 2. Annual profit in the joint banks of Georgia, 2021-2022 %

Source: National Bank of Georgia

In contrast, the indicators of return on assets (ROA) and return on equity (ROE) in Georgia's leading commercial banks are significantly higher than the European average.

The global average ROA in 2021, based on data from 136 countries, was 1.57%. The highest value was observed in Syria (8.83%), and the lowest in Greece (-1.82%). In Europe, the 2021 average across 41 countries was 0.87%, with the highest rate in Moldova (2.34%) and the lowest again in Greece (-1.82%).

Regarding the bank's ROE, the European average in 2021 across 41 countries was 12.72%. Kazakhstan had the highest value at 34.96%, followed by Georgia at 26.18%. In other European countries, such as Estonia (9.26%), Bulgaria (10.5%), Hungary (11.43%), Turkey (12.68%), Ukraine (12.25%), Lithuania (12.98%), Romania (14.86%), and Azerbaijan (16.27%), the rate was lower than in Georgia.

Furthermore, this trend is even more pronounced among the leading Georgian commercial banks. In 2021-2022, TBC Bank's ROE was 36.12%, and Bank of Georgia's ROE was 37.6%. This is significantly higher than the average rate of systemic banks (26%) and surpasses other countries such as Azerbaijan (16.27%), Moldova (14.05%), Belarus (9.47%), and Turkey (12.68%). However, the profit tax indicator shows less correlation with profit growth rates, as is evident from the efficiency indicators discussed earlier.

5. Pre-Tax Profit Margin

Pre-tax profit margin is another important indicator used to assess the profitability of banks. It reflects how effectively taxes are paid based on the company's total turnover. Several methods can be used to calculate profit margin, depending on the desired level of profit measurement (gross profit, operating profit, profit before tax, or net profit).

Pre-tax profit margin (margin) indicates the percentage of profit (or loss) before tax liability relative to the total turnover. It is calculated using the following formula:

Pre-Tax Profit Margin = Profit or Loss Before Tax / Turnover

The pre-tax profit margin indicator allows banks in different countries to assess how much their profit is burdened by taxes. It helps them identify whether they are effectively utilizing their profits for tax purposes or if they are engaging in artificial manipulations to reduce their tax burden.

Additionally, the pre-tax profit margin can be compared to the net profit margin to identify the difference between the two. A significant difference indicates a high profit tax burden. This relationship holds true, assuming no unforeseen costs significantly impact the net profit.

As shown in Diagram 3, the leading three banks within the system-forming group generated a total income of 6.3 billion GEL, representing 92% of the total income for this group. Their pre-tax profit amounted to 2.3 billion GEL,

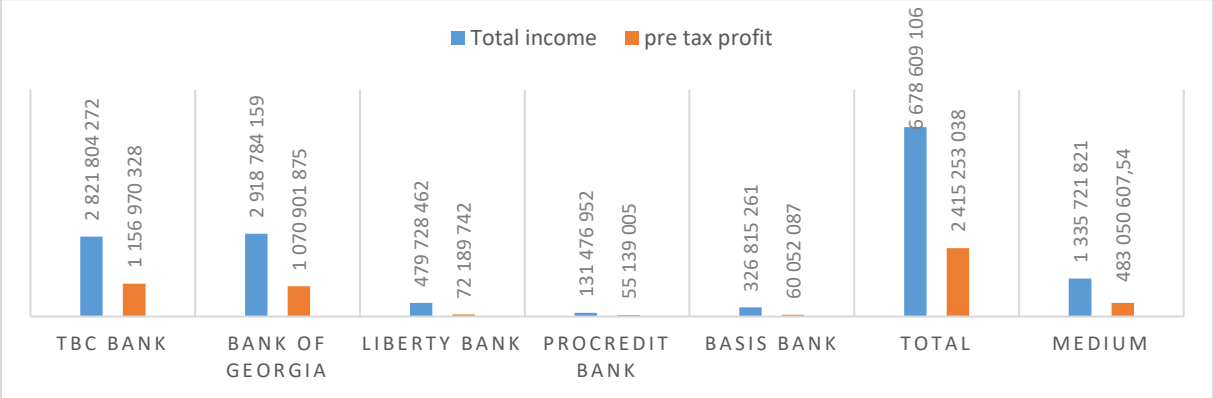


Diagram 3. Total revenue and profit before tax 2021-2022

Source: National Bank of Georgia,

This means that the ratio between turnover and profit is higher in banks with lower costs. These costs include not only regular expenses but also unforeseen events that can reduce the net profit. Conversely, the ratio is lower in banks with high profit deviations or significant costs. In the context of banking institutions, such expenses can include provisioning expenses for potential loan losses.

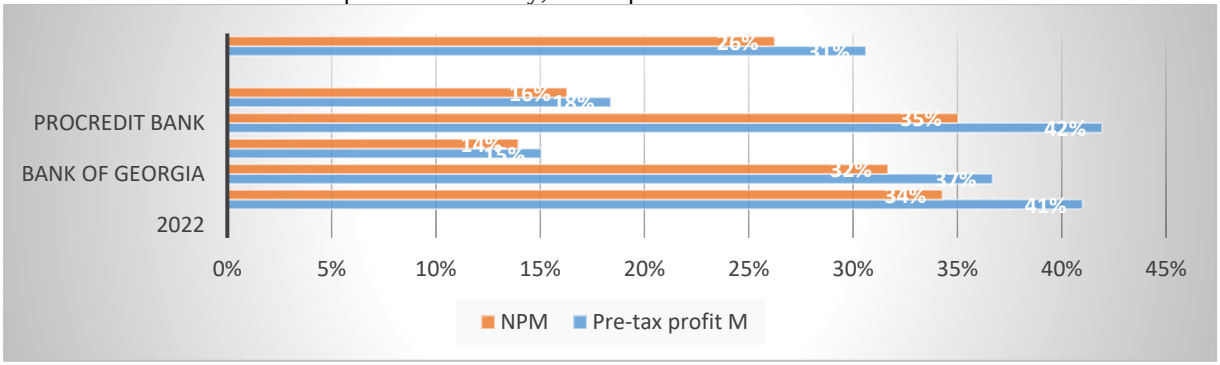


Diagram 4. Pre-tax and net profit margins of Georgian banks, %

Source: National Bank of Georgia

As shown in Diagram 4, large commercial banks like Bank of Georgia and TBC Bank operate with a turnover four times higher than the system average. Consequently, their profit margin based on the net enterprise scale effect is also higher than the system average. While the percentage difference between their margins and the systemic average (5%) is slightly higher, it is not significant. For TBC Bank, the difference is 7%, and for Bank of Georgia, it is 5%.

For comparison, we can look at the data of European banks. According to the 2022 financials of BBVA, a leading Czech bank, the pre-tax profit margin was 42% and the net profit margin was 26%. The leverage is quite high at 16%, with a corporate profit rate of 19%.

Similarly, RABO Bank, another leading Dutch bank we reviewed, reported a pre-tax profit margin of 30% and a net profit margin of 22%, with a 24% corporate profit rate. The pre-tax profit margin was quite high, and the percentage difference with the net interest margin was 8%.

6. Bank Tax Structure

A comparative analysis of Georgian commercial banks and leading foreign banks from the perspective of tax structure during the pre-COVID pandemic period (2017-2019) reveals an interesting picture. The income tax of bank employees holds the highest share in the Georgian banking sector's tax structure, accounting for 51%. The share of profit tax is on average 34%, and VAT comes in third with a 9% share. This trend has continued into the current year (Diagram #5).

However, it is important to note that financial services provided in European countries are exempt from VAT. In contrast, the collection, which is included in financial services in Georgia, is considered separate in European countries and therefore subject to VAT. This is because international legislation does not classify it as a financial service.

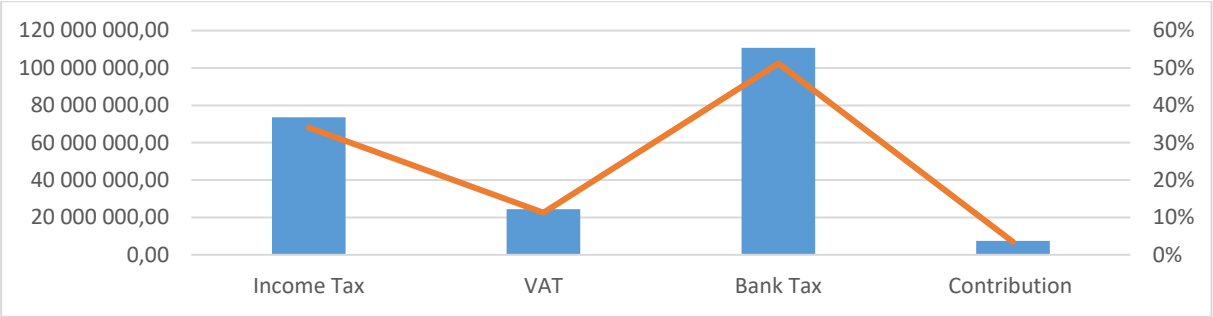


Diagram 5. Tax structure of Georgian banks, 2017-2019, GEL

Table 2.

Different indicators

		2017	**2019**	
Income Tax	73,680,990.30	34%	97,285,259.70	39%
VAT	24,403,225.00	11%	25,748,602.00	10%
Bank Tax	110,794,154.40	51%	118,039,781.20	48%
Contribution	7,463,820.10	3%	6,233,984.00	3%
	216,342,189.80	100%	247,307,626.90	100%

If we compare these data with the tax figures of the leading Dutch bank RABO Bank (Diagram 6), we can see that 54% comes from profit tax, and the share of VAT is 18%, and the share of contributions, including contributions to pension funds and other The share of bank charges is -25%.

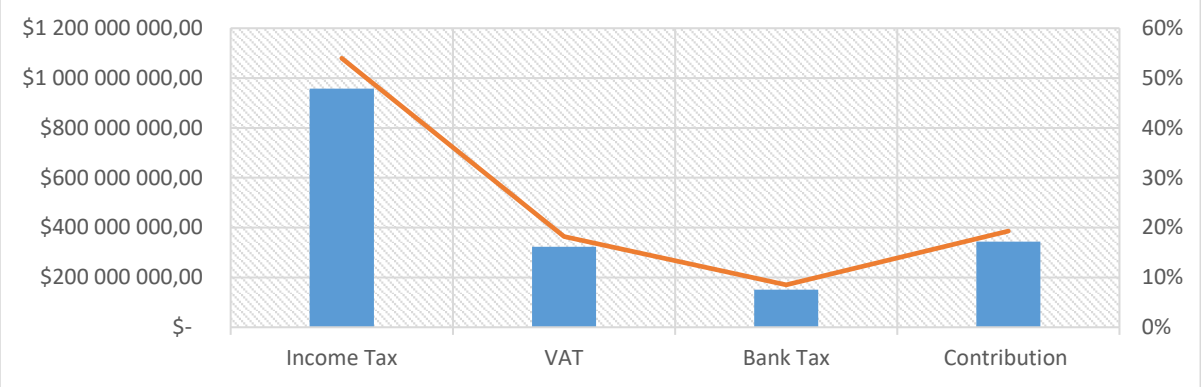


Diagram 6. Tax structure of RABO Bank, 2017, mln. Euro

7. Current Effective Tax Rate

Another way to measure effective tax rates is through the current effective tax rate. Similar to the effective tax rate but focusing on current tax obligations, it is calculated as the ratio of current tax on profits to pre-tax profits:

Current Effective Tax Rate = Current Tax on Profit or Loss / Profit or Loss Before Tax

Income tax expenses encompass both current tax expenses (taxes paid regardless of future developments) and deferred tax expenses (taxes on profits or tax benefits from losses that will be paid in future years, sometimes depending on future occurrences).

Companies may sometimes enter into special arrangements to postpone paying taxes indefinitely or for a very long time. This can lead to an increase in the income tax base through deferred taxes. Conversely, a company (or bank) can use future tax benefits to decrease its tax expenses, including deferred tax liabilities. Non-taxable one-off expenses can also reduce the taxable profit base.

Calculating the current effective tax rate (excluding deferred taxes) is only possible if banks distinguish between current and deferred income tax expense in their financial data. The leading Georgian system-forming bank, Bank of Georgia,

Table 3.

Different indicators for 2020, 2021, 2022 years

	2022	2021	2020
Current income tax expense	137,430	111,652	4,539
Deferred income tax (expense)	53,221	36,828	26,094
Profit tax (expense)	190,651	74,824	21,555

The income tax rate applied to most of the income of Georgian banking groups is the same as the income tax rate applied to the income of subsidiaries, ranging from 15% to 25% (2021: 15% to 25%, 2020: 15% to 25%). For reference, on June 12, 2018, a change to the current corporate taxation model applied to financial institutions, including banks and insurance businesses, came into force.

The change involves a zero corporate tax rate on undistributed profits and a 15% corporate tax rate on distributed profits effective January 1, 2023. Under the amendment, which will take effect on January 1, 2023, the existing taxation rules for financial institutions, including banks, will remain unchanged. Additionally, from 2023, the current corporate tax rate for banks will increase from 15% to 20%. Furthermore, beginning in 2023, taxable interest income and deductible expected credit losses (ECLs) on customer loans will be determined by International Financial Reporting Standards (IFRS) instead of SEB local regulations.

Transitional differences in ECLs will be taxed at a one-time rate of 15%. The amended law does not define "transitory differences in interest income." This change had an immediate effect on the deferred tax asset and deferred tax liability attributable to previously recognized temporary differences arising from prior periods.

For example, in the case of Bank of Georgia, the balances of deferred tax assets and liabilities were restated as of December 31, 2022, in accordance with the updated legislation. This change resulted in a substantial one-time deferred tax charge, as banks previously recognized deferred tax only to the extent they expected to do so until January 1, 2023.

The effective income tax rate is different from the statutory income tax rates. As of December 31, 2022, December 31, 2021 and December 31, 2020, a reconciliation of income tax expense at statutory rates and actual expense is as follows:

Table 4.

Different indicators for 2020, 2021, 2022 years

	2022	2021	2020
Profit before income tax expense	1,634,650	801,942	316,498
Statutory tax rate in Georgia	15%	15%	15%
Theoretical income tax expense at average tax rate	245,198	120,291	47,475
Non-taxable income	115,636	50,671	35,910
Non-deductible expenses	3,229	2,931	6,425
Correction of prior year declarations	2,846	15	3,343
Tax at the domestic rates applicable to profits in each country	1,991	2,401	525
Effects from changes in tax legislation	53,074		
Other	51	143	303
Income tax expense	190,651	74,824	21,555
Effective tax rate	12%	9.3%	6.8%

Taxes in Georgia and Belarus include corporate income tax (profit tax), personal income tax, property tax, and value-added tax. This creates significantly higher tax risks in these countries compared to those with more developed tax systems.

The provided example clearly demonstrates that, over the past three years, the current effective tax rate, including deferred taxes, has remained low at an average of 7% per year. This is nearly two times lower than the official profit tax rate of 15%.

Conclusion:

Our research indicates that Georgian commercial banks operate under high spreads and interest margins. While this insures risks like potential asset losses, it also leads to high lending rates. This, in turn, can trigger increased asset losses and reduced taxable profits. Furthermore, effective tax rates for Georgia's leading system-forming commercial banks are significantly lower than the European average, both for the entire banking system and individual banks.

The Georgian banking system operates with higher banking concentration and lending interest rates than the European average. This ensures high profitability for the system, but it also indicates a low level of competition. One of the main challenges for the development of the banking sector should be to increase competition, including preventing the entry of European banks into the Georgian banking market.

Additionally, we believe that reducing interest rates would be more effectively achieved through non-interest expense optimization rather than additional tax benefits. While the proportion of non-interest expenses in total revenues is lower in Georgian banks than the European average, due to low salaries, banks can adjust their non-interest expense structure by improving digital platforms. This would also increase non-interest income.

Specifically, the distributed profit rule, effective January 1, 2023, will maintain existing taxation rules for financial institutions, including banks. Additionally, the current corporate tax rate for banks will increase from 15% to 20% starting in 2023. We believe this increase is justified, and the banking sector does not need further tax liberalization incentives. The Estonian model of profit tax, which allows reinvested profits to be used for working capital, has proven effective in stimulating business, particularly for medium and small businesses. However, this issue is less relevant to the banking sector today. The main obstacle preventing interest rate reductions lies in insufficient banking competition, as mentioned earlier.

The current tax model of the Georgian banking system already provides a high return on capital and assets, ensuring investor attractiveness and facilitating access to credit resources from international markets. Therefore, under the existing high interest margin conditions, increasing the effective tax rate to 20%

would have minimal impact on reducing loan interest rates, which remains the primary focus.

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TECHNICAL SCIENCES

1 KG IRON VS 1 KG COTTON WOOL: THE OBJECTIVITY OF EXAMINATION TESTS

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Abstract
The well-known school question-joke about weighing of a kilogram of iron and a kilogram of cotton wool is considered. The correct answer takes into account the influence of Archimedean force, the the Earth's magnetic field, the gravity and the centrifugal force caused by Earth rotation. Rated assessments of these factors under some external conditions are given. On the example of this task are illustrated the possible problems of evaluating real knowledge of the student, based on the results of closed type examination tests.

Keywords: mass, weight, density, Archimedean force, magnetic field, gravity, centrifugal force, examination tests.

Trap question: "What is heavier – a kilogram of iron or a kilogram of cotton wool?" provokes an intuitive wrong answer about the greater weight of iron, but the "correct" answer that both are equall heavy does not take into account the difference between the concepts of "kilogram" and "heavy". The kilogram is a unit of mass, and heaviness represents the force exerted by a body on a support, in particular on a scale platform. Semantically, the word "heaviness" generally is a definition of the force required to lift an object from a surface. When weighing an object under normal earthly conditions, several factors influence the weighing results:

1) Archimedean force, which depends on the volume of the body and the specific gravity of air.

2) The Earth's magnetic field affects ferromagnetic materials.

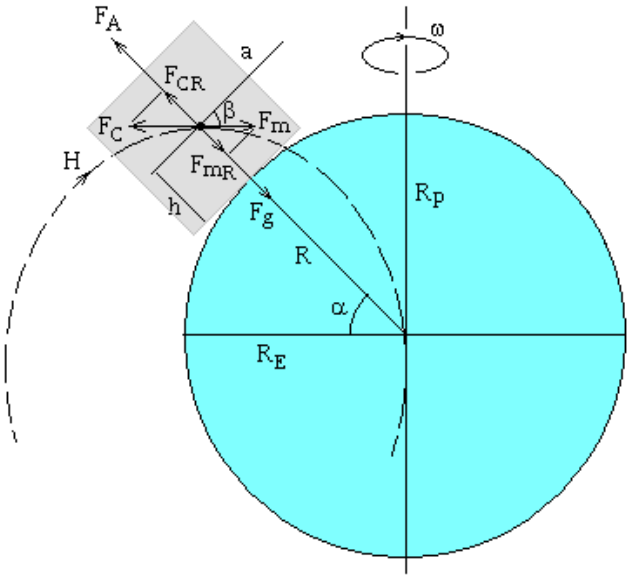
3) The force of gravity of Earth itself depends on the distance of the center of mass of the body; the distance is greater for a larger object.

4) The centrifugal force caused by the rotation of Earth also depends on the distance of the center of mass of the body.

Let's imagine a thought experiment of the process of weighing bodies with a mass of 1 kg made of iron and cotton wool in the natural conditions of the earth, taking quite common simplifications:

- the bodies are cubic in shape;
- bodies are located on same horizontal surface at the level of the Earth's radius;
- we assume that the axis of rotation of Earth - the geographic pole coincides with the magnetic pole.

In Fig. 1. A drawing of the influence of various forces on a body lying on the earth's surface is presented. Of course, to ensure clarity, the scales of geometry and vectors of physical quantities are not observed.



Pic. 1. Drawing to represent the influence of various forces on weight

The following discussions and calculations do not exceed the science knowledge requirements for student of a technical/engineering college. The numerical values of various physical quantities needed for calculations are easily found on the Internet, for this reason all references are given in the form of quick links to Internet resources.

Below are given the initial data and some accepted assumptions for the calculations.

Mass of bodies m =1 kg.

Air density under normal conditions: temperature T=273.15 K and atmospheric pressure P =760 mm Hg = 101325 Pa is equal to [1] ρ_{A0} = 1.293 kg/m3. Under other conditions:

$$\rho_A = \rho_{A0} \frac{273.15 \cdot P}{T \cdot 101235} \quad (1)$$

Density of iron and cotton wool respectively [2]: ρ_{Fe} = 7874 kg/m^3, ρ_{Cot}= 30 kg/m^3. Based on the hygroscopicity of cotton wool, we assume that the cubic packing of cotton wool is airtight sealed, the net mass is taken into account and the density refers to the entire porous volume.

Mean, polar and equatorial radius of the earth respectively [3]: R_M =6371 km=6 371 000 m, R_P =6357 km=6 357 000 m, R_E =6378 km=6 378 000 m.

Average value of acceleration due to gravity g =9.807 m/s^2.

Angular frequency of earth rotation:

$$\varpi = \frac{2\pi}{24 \cdot 3600} = 7.27 \cdot 10^{-5} \text{ s}^{-1}$$

The average strength of the earth's magnetic field is accepted [4] H =40 A/m.

Magnetic susceptibility of iron for weak field [5] κ =1100.

For calculations, the force value for 1 A/m is used [6] f_A=2·10^{-7} N [6].

We accept middle geographic latitude α =45 °C, magnetic inclination β is simplified to equate to geographic latitude $\beta = \alpha$, but generally $\beta > \alpha$, for example for Moscow: α=55°, β=70°; for Odessa: α=46°, β=60° [7,8,9].

Body volume calculated as: $V = \frac{m}{\rho}$ (2)

Cube edge size $a = \sqrt[3]{V}$, respectively: $a_{Fe} = 0.050$ m, $a_{Cot} = 0.322$ m.

Center of mass height $h = \frac{a}{2}$, respectively

$$\Delta h = \frac{a_{Cot} - a_{Fe}}{2} = 0.136 \text{ m}.$$

The difference between the corresponding forces is represented by a positive value $\Delta F = F_{Fe} - F_{Cot}$. As $\Delta h << R$, for distance dependent forces finite differences ΔF, Δh(same ΔR) are assumed as differentials $dF = F'dr$. The g change with the local radius R of the earth is taken into account.

Archimedean force difference calculated:

$$\Delta F_A = \rho_A (V_{Cot} - V_{Fe}) g \frac{R_M^2}{R^2} \quad (3)$$

Magnetic force affects only ferromagnetic iron, the radial (local vertical) component of the force vector calculated:

$$\Delta F_{mR} = F_{mRFe} = \kappa H^2 f_A a_{Fe}^2 \sin(\beta) \quad (4)$$

Gravitational force difference calculated:

$$\Delta F_G = mg \frac{R_M^2}{R^2} \cdot \frac{2\Delta h}{R} \quad (5)$$

The radial component of centrifugal force vector difference calculated:

$$\Delta F_{CR} = m \varpi^2 \Delta h \cos^2(\alpha) \quad (6)$$

Calculation results are given in table 1. For clarity, the values are presented in common technical units kgf.

Table 1.

Calculated difference in weighing of 1 kg iron and cotton wool

Values	Middle latitude	Polar region	Equatorial region
Earth radius R, km	6371	6357	6378
Temperature T, K	273.15	250	303
Latitude (magnetic) α(β)), , °	45	90	0
Archimedean force ΔF_A, kgf	4.29·10^{-2}	4.71·10^{-2}	3.38·10^{-2}
Magnetic force ΔF_m, kgf	6.41·10^{-5}	9.07·10^{-5}	0
Gravity force ΔF_G, kgf	4.26·10^{-8}	4.29·10^{-8}	4.25·10^{-8}
Centrifugal force ΔF_C, kgf	3.66·10^{-11}	0	7.32·10^{-11}

It follows that for middle latitude and normal conditions in order: Archimedes force - magnetic force - gravitational force - centrifugal force, each next value decreases by about 1000 times. Calculations were carried out for extreme latitudes of the earth as well.

From these calculations it is clear that the influence of the last two factors is less than the deviation (up to 100 μg) between the control samples of the kilogram mass standard [10]. The theoretical influence of centrifugal force on the weighing difference is less than the accuracy of the modern unit of mass according to the Planck constant, which is defined to the 9th digit [11], although the absolute magnitude of the influence on earth's gravity is significant to take into account the direction and location of spacecraft launches.

If we imagine that a student on an exam must answer such a “simple” question in the form of a closed

test without additional clarification, both the student and the examiner will encounter difficulty, but in the case of an open question, a competent student could briefly state a conceptually correct idea. The same task in the form of homework or a project can easily be solved using quantitative assessments, as presented above.

The real problem of weighing a person weighing 100 kg (assumed: Z_{Man}= 1.85 m, h=0.55Z; ρ_{Man}= 1000 kg/m^3) using scales, precisely calibrated by 5 pieces of iron weights of 20 kg each ($a_{Fe} = 0.136$ m), is also considered. During the calibration process, the weights are located parallel to the scale platform. The calculation results are shown in Table 2.

Table 2.

Calculated error in determining the mass of a 100 kg person by weighing

Values	Middle latitude	Polar region	Equatorial region
Archimedean force ΔF_A, kgf	$1.13 \cdot 10^{-1}$	$1.24 \cdot 10^{-1}$	$1.02 \cdot 10^{-1}$
Magnetic force ΔF_m, kgf	$2.36 \cdot 10^{-3}$	$3.34 \cdot 10^{-3}$	0
Gravity force ΔF_G, kgf	$2.98 \cdot 10^{-5}$	$3.00 \cdot 10^{-5}$	$2.97 \cdot 10^{-5}$
Centrifugal force ΔF_C, kgf	$2.56 \cdot 10^{-8}$	0	$5.12 \cdot 10^{-8}$

Conclusions. Conceptually strong answer takes into account the influence of Archimedean force, the the Earth's magnetic field, the gravity and the centrifugal force caused by Earth rotation. The influence of the Archimedean force and magnetic field factors on weighing are noticeable, but not the difference in gravitational forces and, even less so, the centrifugal forces.

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SOLVING TYPICAL LOGISTICS TASKS USING THE STAMM APPLICATION

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Abstract
The features of solving logistical problems using modern computer modeling tools are considered. The use of specialized software allows you to obtain the results of optimization or risk assessment in logistics management in the shortest possible time. The paper analyzes various application software packages designed for this purpose. The problems of developing logistics models are considered, a methodology for solving logistics problems in the Stamm 4.3 system based on an object-oriented approach, UML modeling and tabular simulation is presented.

Keywords: simulation modeling, logistics, optimization of inventory management, object-oriented approach, UML modeling

Introduction

The use of computer modeling in solving logistics optimization problems involves some features [3, 4, 8, 12]:

1. Automation of the decision-making process. Computer modeling allows you to quickly create and analyze various scenarios, which simplifies the decision-making process.

2. Taking into account a large number of factors. Logistics systems can be very complex and include many factors, such as delivery time, cost of transportation, cargo volume, etc. Computer modeling allows you to take into account all these factors and optimize the operation of the system as a whole.

3. The possibility of conducting experiments. With the help of computer modeling, experiments can be carried out and various hypotheses can be tested, which makes it possible to improve the operation of the logistics system.

4. More accurate data analysis. Computer modeling allows for more accurate data analysis and identification of hidden patterns, which can lead to more effective optimization of the logistics system.

5. Risk reduction. Computer modeling allows you to predict possible problems and risks associated with the logistics system, which allows you to take measures to minimize them.

There is a significant amount of software that can be used to solve logistical problems. We note among the most famous, highlighting the features:

1. Excel is one of the most popular tools for this purpose. It allows you to create tables, graphs and charts, as well as perform data analysis and optimization.

2. MATLAB is a powerful tool for solving mathematical problems, including logistical ones. It provides a wide range of functions and tools for data analysis, modeling, and optimization.

3. GAMS (General Algebraic Modeling System) is a software that is used to model and optimize logistics systems. It allows you to create and solve complex mathematical models using a special modeling language.

4. Llamasoft is a software that is used to optimize logistics systems and supply chain management. It allows data analysis, modeling and optimization, as well as provides tools for risk management and decision-making.

5. Simul8 is a software that is used to model and optimize business processes and logistics systems. It allows you to create simulation models, analyze data, and optimize.

6. AnyLogic is a simulation environment used for modeling and optimizing complex systems, including logistics. It provides a wide range of tools for modeling, analysis and optimization, and also allows you to use various modeling methods, including system dynamics, agent-based modeling and discrete event modeling.

In addition, there are many software products that solve a strictly limited list of tasks [2, 7, 13].

According to XJ Technologies (the manufacturer of the Anylogic package mentioned above), it is the simulation models implemented for the field of logistics that are in the greatest demand today [1].

The software packages discussed above solve the identified problems to one degree or another in computer modeling of logistical tasks, while having certain disadvantages. For example, all of the above are commercial products with a decent price [9].

Object and methods of research

The object of research in this paper is typical logistic tasks. The non-commercial product Stamm 4.3 is used to solve them.

Visual design of models

This application has been developed and improved by the author for more than 20 years, and if the system was originally intended to organize the simplest simulation using spreadsheets, a number of functions are currently available that allow you to solve a variety of tasks [5, 6, 10, 11, 14].

As an example, let's consider the simplest inventory optimization task implemented using Excel. This model takes into account the single-period inventory management model. It is necessary to determine the size of the ordered batch of Part for some future period of time, if it is known that demand D is a random variable with a normal distribution law (the average value is Ms, the mean square deviation is Ss). In the event that

the demand is less than the batch that was ordered, the costs will amount to

$$C = Ch \cdot (Part - D)$$

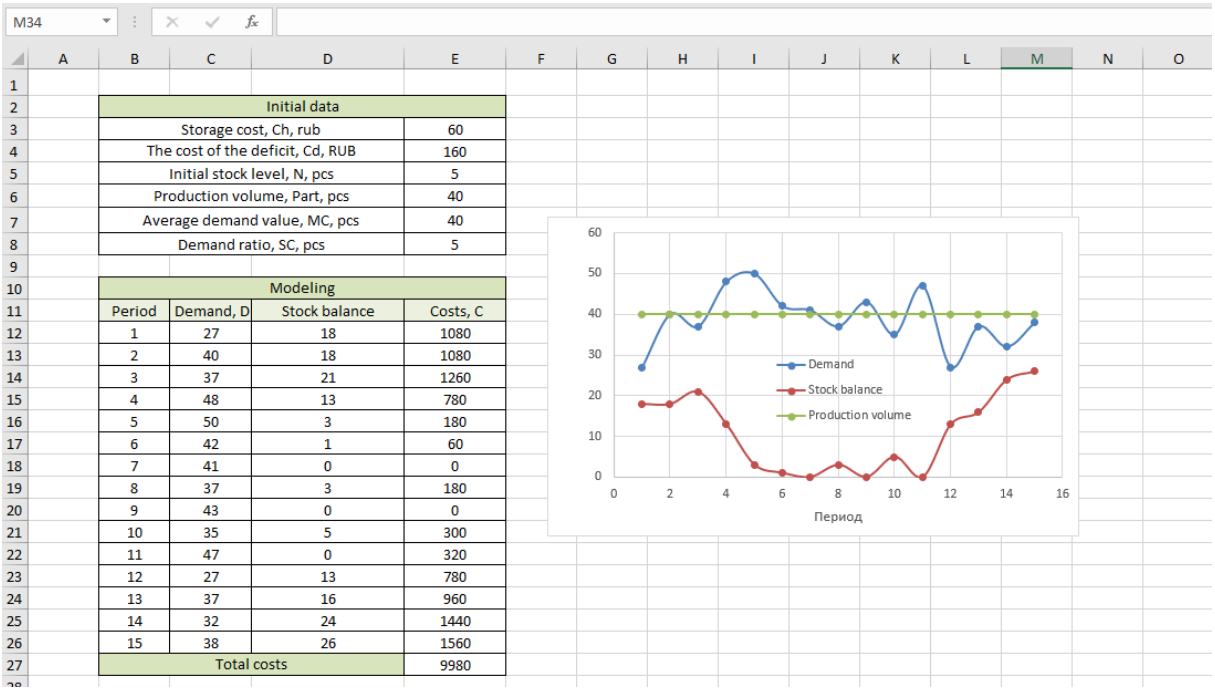
where Ch - the cost of storing a unit of goods.

If the ordered lot is not enough to meet the demand, then the costs will include the costs of the deficit

$$C = Cd \cdot (D\text{-}Part),$$

where Cd - penalty for shortage of a unit of goods.

The problem is solved by repeatedly replaying the situation in the warehouse, taking into account the given law of demand distribution. In the case of using Excel, pseudo-simulation takes place, since demand variation is carried out as a result of changing related cells in adjacent rows, and model parameters such as the initial stock level and production volume are entered into the model manually (Fig. 1). This is due to Excel's limitations on the use of cross-references.

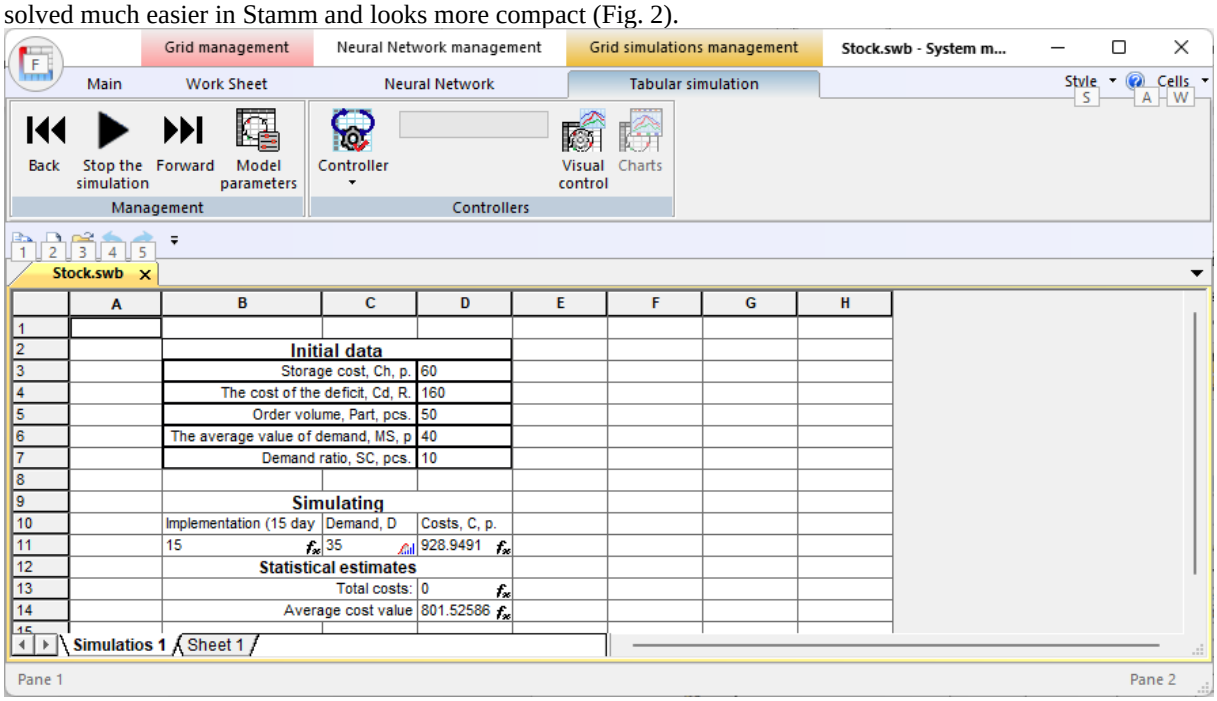


Initial data	
Storage cost, Ch, rub	60
The cost of the deficit, Cd, RUB	160
Initial stock level, N, pcs	5
Production volume, Part, pcs	40
Average demand value, MC, pcs	40
Demand ratio, SC, pcs	5

Modeling			
Period	Demand, D	Stock balance	Costs, C
1	27	18	1080
2	40	18	1080
3	37	21	1260
4	48	13	780
5	50	3	180
6	42	1	60
7	41	0	0
8	37	3	180
9	43	0	0
10	35	5	300
11	47	0	320
12	27	13	780
13	37	16	960
14	32	24	1440
15	38	26	1560
Total costs			9980

Fig. 1. Simulation of a single-period replenishment system. Excel

In case of a need for a multistep Monte Carlo, it is not very convenient to use such a model. The same task is solved much easier in Stamm and looks more compact (Fig. 2).



Initial data	
Storage cost, Ch, p.	60
The cost of the deficit, Cd, R.	160
Order volume, Part, pcs.	50
The average value of demand, MS, p	40
Demand ratio, SC, pcs.	10

Simulating		
Implementation (15 day	Demand, D	Costs, C, p.
15	35	928.9491

Statistical estimates	
Total costs:	0
Average cost value	801.52586

Fig. 2. Simulation of a single-period replenishment system. Stamm 4.3

At the same time, you can observe the system change in a separate window, adding the variables necessary for monitoring there (Fig. 3).

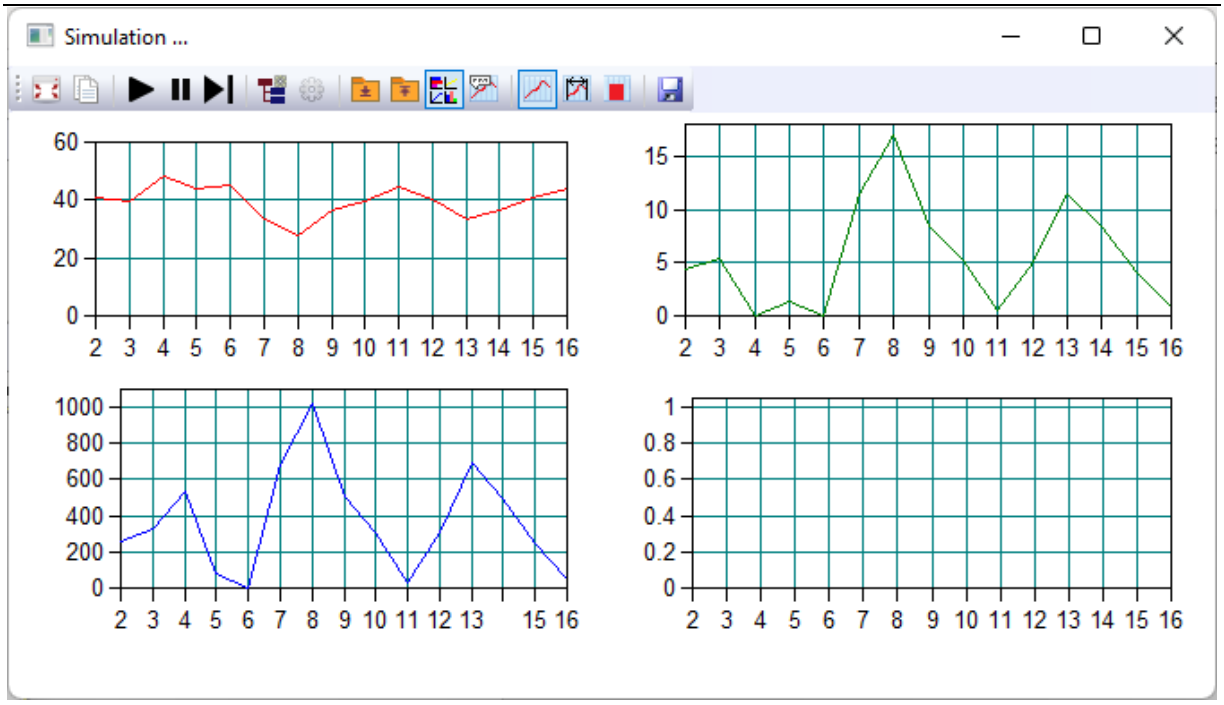


Fig. 3. Parameter control window for tabular simulation. Stamm 4.3

However, it is most convenient to solve optimization problems of logistics using the full potential of the system under consideration. There are a number of diverse tasks for optimizing logistics systems, nevertheless having similar elements.

The enlarged simulation algorithm using cells in the table provides the following actions (Fig. 4). Initialization of virtual model time variables – initial value (T_0), final value (Tmax) and modeling step (ΔT).

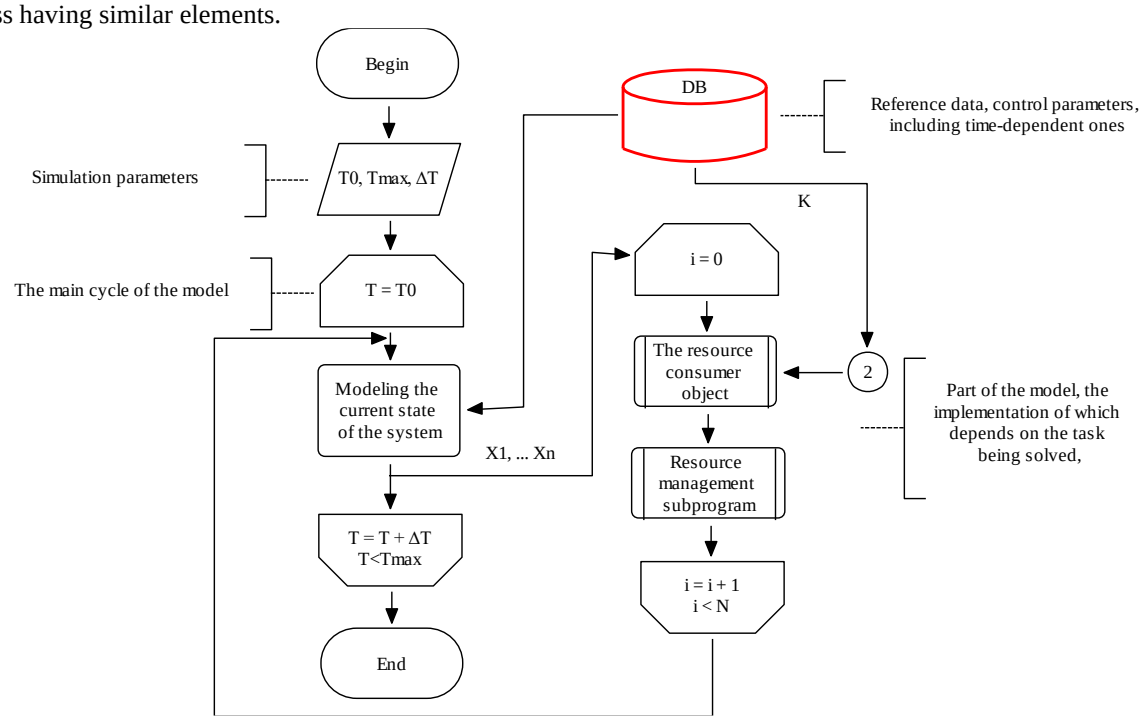


Рис. 4. Основной алгоритм табличной имитации. Stamm 4.3

Before the expiration of the model time, a cycle is performed, at each step of which the current state of the system is determined, including, if necessary, a nested cycle inside the main cycle of the model that processes the state of a finite number of similar virtual objects. Such objects, in accordance with the principles of object-oriented modeling, have the same structure, a set of variable parameters, and connections with other components of the model.

In the case of solving a large range of tasks in the field of logistics in transport, it is possible to allocate objects of the "Resource Consumer" class. Instances of this class can be, for example, cars that consume fuel, tires, etc. during operation. This consumption Y is a function of external and other factors (X1, X2, ... Xn) and time. In turn, this class has two fundamentally different derived classes that continuously consume a re-

source over time and consume it discretely. The peculiarities of the latter include a change in its state in the process of resource consumption. Examples of the second subclass are cars that periodically undergo scheduled maintenance and need to replace some parts, oil, etc. Figure 5 shows an algorithm for processing objects of this class in a tabular simulation. This algorithm, like the class itself, is abstract. Its specific implementation will depend on the characteristics of the object being modeled.

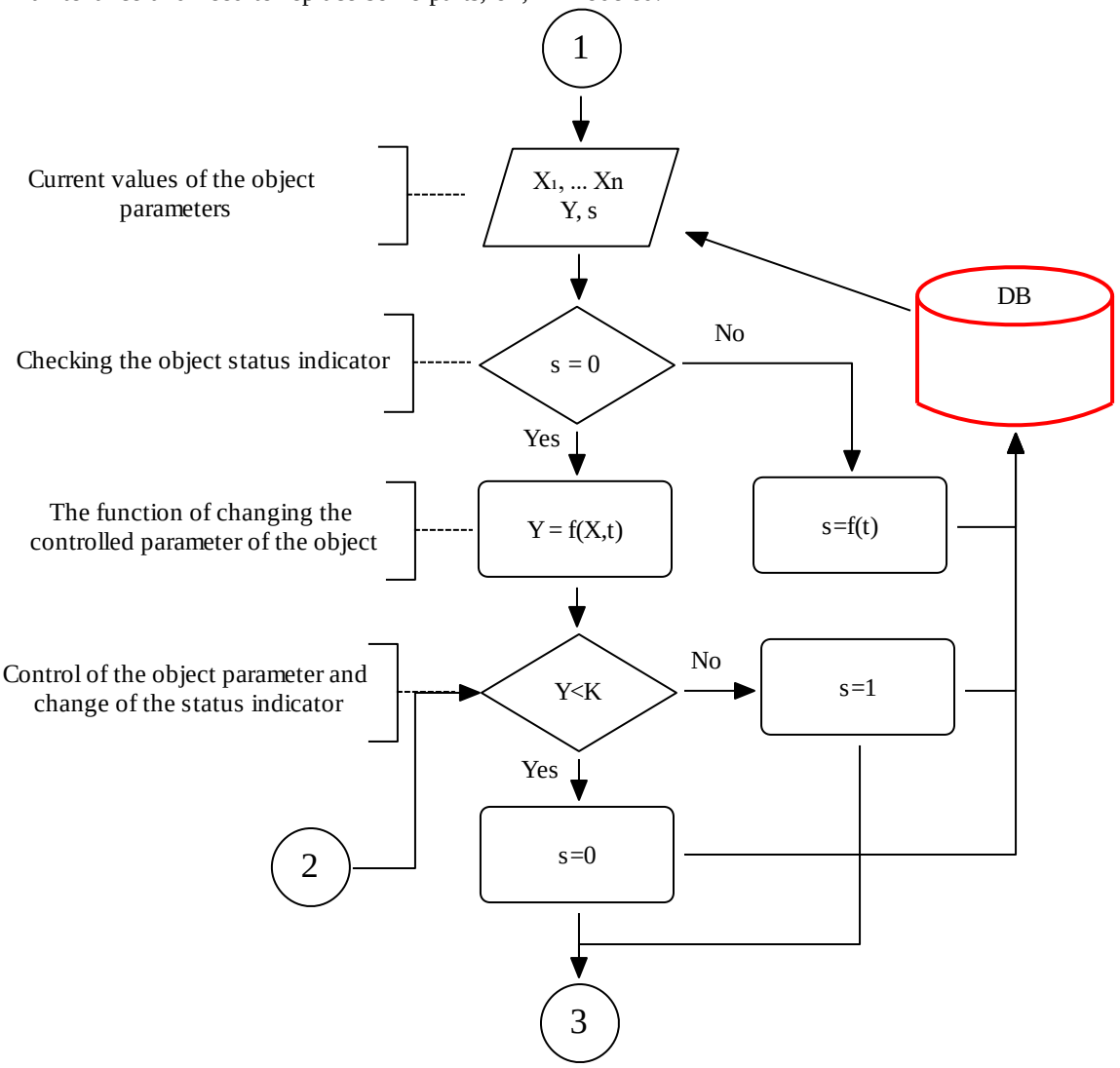


Fig. 5. Template of the algorithm "Resource consumer object" in the Stamm 4.3 program

Results

In the process of simulation of logistical tasks involving a large number of similar objects as components of the model, such as cars, in order to save PC memory, it is impractical to use copies of each of them during the entire life of the model. The spreadsheet-based simulation model considered in this paper provides for processing all objects at each step of the simulation with reading the current state from the database and further saving changes (Fig. 4, 5).

Using the considered approaches, several simulation models have been developed in the Stamm system. For example, a model for optimizing the stocks of pneumatic cylinders of buses (Fig. 6).

Simulation of air suspension buses failures.swb

	A	B	C	D	E	F	G	H	I	J
1	Current	day	1	Temperature	-13.67		Intensity	On the line	Error!	
2		month	1	Precipitation	0.86		0.0185239	Reserve	1	
3	Days from the beginning		6							
4	Number of buses	98		Pneumoballons						
5	Bus number	Initial status	Mileage	1	2	3	4			
6	7	0	200.92879	0.999205064	0.8889829	0.0044407	0.0030372	80775.306		
7				75357.94591	69629.042	704.34176	66403.803			
8				0.013284488	0.0078160	0.0091708	0.8762813	Repair	Status after the ru	Waiting
9				6	70555.982	76518.259	70301.087	0	0	0
10	Expenses			Current			Refusals			
11	Simple 1 bus per day	9600	Under repair	60	180000	In stock	200		Maximum level	200
12	The cost of a pneumatic	15000	Waiting	0	0	Order	0	0	Minimum level	180
13	Replacement	3000		For storage	2883673.4				Term of execution	90
14	Storage of 1 pneumatic c	150		Order	0				Ordered	0
15	Ordering 1 cylinder	1000		Total	3063673.4					

Stock optimisation | Graphs data | Weather | Failure | Buses

Fig. 6. The model for optimizing the stocks of pneumatic cylinders in the Stamm 4.3 program

The state of the air suspension of buses is reproduced in cells A6..J9. Data on the current state of the bus is modeled using special controller cells (Fig. 7).

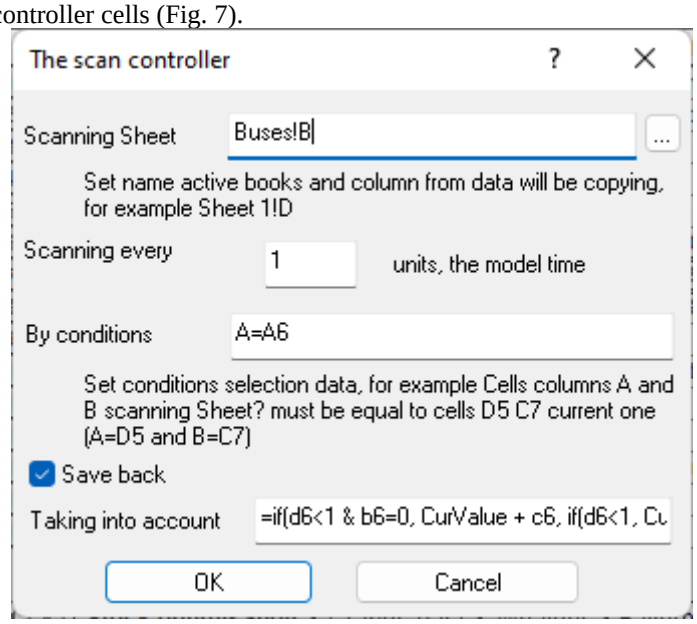


Fig. 7. Controller cell for data exchange with the "Buses" table

The contents of the "Buses" table change for each bus when the model time changes (Fig. 8). Factors affecting the resource consumption of pneumatic cylinders are contained in cells E1, E2, G2 of the table containing the simulation model "Stock optimisation" (Fig. 6), they in turn depend on the ambient temperature and others the operating conditions presented in tabular form, the "Weather" sheet (Fig.9).

Simulation of air suspension buses failures.swb

	A	B	C	D	E	F	G	H	I	J
1	1	6493.292485	4617.904036	1863.267245	74494.65368	10465.26851	68360.03010	75832.60721	2100.58857	0.097417788
2	2	76475.25484	76003.35519	73692.32567	3451.349192	9229.160652	8283.493186	4145.04208	67661.84854	0.966755262
3	3	5112.429271	3064.428494	77391.25716	69586.15618	4192.627909	76477.99637	6026.281955	76477.99637	0.071115785
4	4	73675.53813	231.019163	666.78761	72961.34955	70883.69322	5684.270259	67677.50717	0	0.938405406
5	5	8073.341745	75211.23464	75669.46655	73558.38972	1866.477539	76127.10105	73325.07715	78703.99250	0.121457335
6	6	77084.87629	5051.135174	1582.475005	2255.023158	1365.890057	5758.637037	2255.023158	77084.87629	0.972767826
7	7	75357.94591	69629.04215	704.341766	66403.80351	73509.12930	70555.98212	76769.75173	75357.94591	0.972049520
8	8	75346.72145	73960.90578	2944.143825	77011.30397	68183.14438	6157.344532	76518.25982	8685.074754	0.973155264
9	9	6650.155863	3028.96286	1412.195131	3486.46304	75157.43328	8282.865919	923.709738	70301.08737	0.098361363
10	10	75034.45921	1168.400369	74356.29856	3641.686899	5531.219582	8126.206053	69279.42397	75486.41915	0.999205064

Stock optimisation | Graphs data | Weather | Failure | Buses

Fig. 8. A sheet with up-to-date data on the status of buses

Simulation of air suspension buses failures.swb

	A	B	C	D	E
1	1	-18.02	0.98	1.01	
2	2	-23.3	0.7	2.01	
3	3	-27.14	0.86	3.01	
4	4	-21.63	0.37	4.01	
5	5	-20.26	0.74	5.01	
6	6	-13.67	0.33	6.01	
7	7	-26.57	0.43	7.01	
8	8	-24.68	0.32	8.01	
9	9	-27.94	0.06	9.01	
10	10	-29.11	0.89	10.01	

Stock optimisation | Graphs data | Weather | Failure | Buses

Fig. 9. A sheet with forecast data on the weather and the intensity of operation of "Weather"

Using similar algorithms, logistics management models have also been developed for the repair and maintenance of the Utair helicopter fleet in the North of the Tyumen Region (Fig. 10) and a number of others.

Helicopters.swb

	A	B	C	D	E	F	G	H	I
1	Initial	01//01//2017	152.3030303	Flight experience			Flight experience norms		
2	Final	01//12//2021	Surgut	50	52		Engine TV2-117	Gearbox VR-8	Main rotor bushing
3	Current	02//06//2017	Noyabrsk	45	48		1500	1500	2000
4	Month	1	Tazovsky	85	69				
5			Novy Urengoy	100	100		The probability of exten		0.957477
6	Number of aircraft	11							
7				Units					
8	№ aircraft	Basing	Total flying time	Engine TV2-117	Gearbox VR-8	Main rotor bu	Status		
9	3	Surgut	19787	0	970	1381	9		
10				2000	1500				
11			Replace						
12		Engine TV2-117	Gearbox VR-8	Main rotor bushing			Engine TV2-117	Gearbox VR-8	Main rotor bushing
13	Surgut	1	0	0		Surgut	1	-	1
14	Noyabrsk	0	0	1		Noyabrsk	-	-	-
15	Tazovsky	0	0	0		Tazovsky	-	-	-
16	Novy Urengoy	0	0	1		Novy Urengo	-	-	-
17	Total	0	2	1		Total	-	Idle 1 aircraft per day	9600

Optimisation store | Flight time | Replacement | Aircraft

Fig. 10. Tabular simulation model "Logistics management of the main units to the helicopter bases"

Conclusions

The proposed methods of organizing tabular simulation models will reduce the time for their development, as well as use the database of the current state of objects during the simulation experiment for additional analysis and decision-making, both during the simulation and at its completion. The results can be easily transferred from Stamm worksheets to other applications, such as Excel.

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ATTACHING TO WALL SIGNS WITH AN INVERTED ANGULAR SERIF

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ПРИВ'ЯЗКА ДО СТІННИХ ЗНАКІВ ОБЕРНЕНОЮ КУТОВОЮ ЗАСІЧКОЮ

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Abstract

The work presents the method of tying the points of the geodetic network to the wall signs with an inverted angular serif. The calculation of point coordinates is shown on an example.

Анотація

В роботі приведена методика прив'язки пунктів геодезичної мережі до стінних знаків оберненою кутовою засічкою. Обчислення координат пунктів показано на прикладі.

Keywords: geodetic network, inverted angular serif, wall signs, coordinates of points.
Ключові слова: *геодезична мережа, обернена кутова засічка, стінні знаки, координати пунктів.*

Вступ

Пряму і обернену кутові засічки застосовують для згущення геодезичних мереж, відновлення втрачених межових пунктів, передачі координат на стінні знаки, прив'язки до стінних знаків і т. п. На забудованих територіях пункти полігонометрії мають бути закріплені групою з двох стінних знаків [1, 3.17]. В способах прямої і оберненої кутових засічок на пунктах А і В вимірюють горизонтальні кути β_i на стінні знаки 1 і 2 (рис. 1).

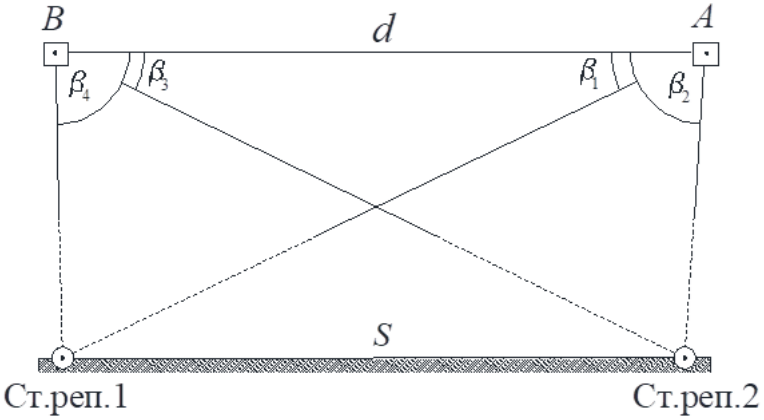

Рис. 1. Схема прив'язки до стінних знаків

За виміряними кутами визначають прямокутні координати стінних знаків 1 і 2 або пунктів А і В. В прямій кутовій засічці спочатку визначають поправки до виміряних кутів, а потім за виправленими кутами обчислюють координати стінних знаків [2, с.108]. Для оберненої кутової засічки розроблено формули для обчислення координат пунктів без введення поправок у вимірянні кути.

Основний текст

Для прив'язки пунктів полігонометрії до стінних знаків вимірюють кути β_i і відстань d між пунктами. Координати стінних знаків X_1, Y_1; X_2, Y_2 і відстань між ними S відомі величини. Координати пунктів обчислюють за формулами:

$X_A=X_1-k_1\Delta X-k_2\Delta Y$; $Y_A=Y_1-k_1\Delta Y+k_2\Delta X$;
$X_B=X_A+\Delta X$; $Y_B=Y_A+\Delta Y$,
де $\Delta X=[c(X_2-X_1)+b(Y_2-Y_1)]/(c^2+b^2)$; $\Delta Y=[b(X_2-X_1)-c(Y_2-Y_1)]/(c^2+b^2)$;
$c=k_3-k_1$; $b=k_4-k_2$;

$$k_1=\frac{ctg\beta_1}{ctg\beta_1+ctg\beta_4};\ k_2=\frac{1}{ctg\beta_1+ctg\beta_4};$$

$$k_3=\frac{ctg\beta_2}{ctg\beta_2+ctg\beta_3};\ k_4=\frac{1}{ctg\beta_2+ctg\beta_3}.$$

Середні квадратичні похибки M в положенні пунктів A і B можна обчислити за наближеними формулами [3, с.147]:

$$M_A=\frac{Sm_\beta}{\rho\sin^2\gamma_1}\sqrt{\sin^2\beta_1+\sin^2\beta_4};$$

$$M_B=\frac{Sm_\beta}{\rho\sin^2\gamma_2}\sqrt{\sin^2\beta_2+\sin^2\beta_3},$$

де m_β – середня квадратична похибка вимірювання кутів; γ – кут засічки ($\gamma_1=\beta_2-\beta_1$; $\gamma_2=\beta_4-\beta_3$).

Приклад.

На пунктах A і B виміряні кути β_i і відстань d:
β_1=38°50′12"; β_2=75°56′21"; β_3=39°04′26"; β_4=74°27′22"; d =61,207м.
Координати стінних знаків і відстань між ними дорівнюють:
X_1=2045,326м; Y_1=2023,501м; X_2=2036,127м; Y_2=2062,099м; S=39,679м.
Вихідні дані взяті з [2, с.108].

Розв'язок:

Величини k_i, c і b будуть дорівнювати:
k_1=ctg38°50′12"/(ctg38°50′12"+ctg74°27′22")=0,817039;
k_2=1/(ctg38°50′12"+ctg74°27′22")=0,657779;
k_3=ctg75°56′21"/(ctg75°56′21"+ctg39°04′26")=0,168987;
k_4=1/(ctg75°56′21"+ctg39°04′26")=0,674717;
c=0,168987-0,817039=-0,648052; b= 0,674717-0,657779=0,016938.
Прирости координат:
ΔX= [(-0,648052)(-9,199)+ 0,016938·38,598]/0,420258= 12,630м;
ΔY = [0,016938(-9,199)-(-0,648052)38,598]/0,420258= -59,890м.
Координати пунктів:
X_A=2045,326-0,817034·12,630-0,657779(-59,890) =2074,401м;
Y_A=2023,501-0,817034(-59,890)+0,657779·12,630 =2080,741м;
X_B=2074,401+12,630 =2087,031м; Y_B=2080,741-59,890 =2020,851м.
Контроль обчислень:

$$d_{A-B}=\sqrt{(2087,031-2074,401)^2+(2020,851-2080,741)^2}=61,207\text{м}.$$

Оцінка точності:

$$M_A=\frac{39679\circ 5''}{206265''\sin^2 66°43'}\sqrt{\sin^2 38°50'+\sin^2 74°27'}=1,3\text{мм};$$

$$M_B=\frac{39679\circ 5''}{206265''\sin^2 64°59'}\sqrt{\sin^2 39°05'+\sin^2 75°56'}=1,4\text{мм}.$$

Висновки: одержані формули для визначення координат пунктів прості для обчислень на калькуляторі і програмування; оцінка точності підтвердила достатню точність визначення координат пунктів.

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HOLE LİFETİME İN SİLİCON DİODES BASED ON N

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ВРЕМЯ ЖИЗНИ ДЫРОК В КРЕМНИЕВЫХ ДИОДАХ НА ОСНОВЕ N

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Abstract

The study of the parameters of the recombination centers created by various additives attracts the attention of research scientists. Transition elements such as nickel, tungsten, titanium, etc. are used in their manufacturing technology to improve the parameters of silicon devices and increase the percentage of availability.

When the p-n junction is obtained, as a result of high-temperature operation, thermoacceptors are formed in the volume of silicon, and additives that create deep levels within it diffuse, as a result of which the lifetime is significantly reduced. Lifetime varies between 10-9÷10-5 seconds in p-n junction devices. The lifetime of non-main carriers in thermally treated silicon can be increased by nickel. Therefore, nickel is widely used in the preparation of silicon p-n junctions. However, the mechanism of action of nickel has not been fully clarified and its recombination properties have been partially studied at temperatures above the operating limit of silicon devices (T=4900 K) in nickel-doped samples, recombination again occurs in the centers located in the middle of the band gap (ΔEt=0.54ev).

Аннотация

Изучение параметров центров рекомбинации, создаваемых различными добавками, привлекает внимание ученых-исследователей. В технологии их изготовления используются переходные элементы, такие как никель, вольфрам, титан и др., для улучшения параметров кремниевых устройств и повышения процента их готовности.

При получении p-n перехода в результате высокотемпературной эксплуатации в объеме кремния образуются термоакцепторы, а добавки, создающие глубокие уровни внутри него, диффундируют, в результате чего срок службы существенно снижается. Срок службы в устройствах с p-n переходом варьируется в пределах 10-9÷10-5 секунд. Время жизни неосновных носителей в термически обработанном кремнии можно увеличить с помощью никеля.Поэтому никель широко используется при изготовлении кремниевых p-n-переходов.Однако механизм действия никеля до конца не выяснен и его рекомбинационные свойства изучены. частично исследовано при температурах выше предела эксплуатации кремниевых приборов (T=4900 K) в легированных никелем образцах рекомбинация вновь происходит в центрах, расположенных в середине запрещенной зоны (ΔEt=0,54эВ).

Keywords: semiconductor, metal, electron, diode, recombination, activation energy, forbidden zone.

Ключевые слова: полупроводник, металл, электрон, диод, рекомбинация, энергия активации, запрещенная зона.

Изучение параметров центров рекомбинации, создаваемых различными добавками, привлекает внимание ученых-исследователей. Для улучшения параметров кремниевых устройств и повышения процента готовности в их технологии изготовления используются переходные элементы, такие как никель, вольфрам, титан и др. Однако вопросы рекомбинации этих элементов в кремнии малоизучены.

При получении p-n перехода в результате высокотемпературной эксплуатации в объеме кремния образуются термоакцепторы, а добавки, создающие глубокие уровни внутри него, диффундируют, в результате чего срок службы существенно снижается. Срок службы в устройствах с p-n переходом варьируется в пределах 10-9÷10-5 секунд. Время жизни неосновных носителей в термически обработанном кремнии можно увеличить с помощью никеля.Поэтому никель широко используется при изготовлении кремниевых p-n-переходов.Однако механизм действия никеля до конца не выяснен и его рекомбинационные свойства изучены. частично изучено.

Время жизни дырок в базе кремниевых диодов, полученных методом диффузии, измерялось по характеристикам изменения импульса при малых значениях инжекции [1].Измерения проводились в вариантах Лакса и Ледехендлера.Зависимость времени жизни от уровня инжекции при различных температурах исследовалось методом Лакса.Измеренные значения времени жизни представляли собой рекомбинационные и диффузионные токи на переходе, использованные для расчета

На рисунке 1 представлена температурная зависимость времени жизни отверстий в базе диода, изготовленного на основе кремния n-типа (ρ=20 Ом•см) при малых значениях инжекции.

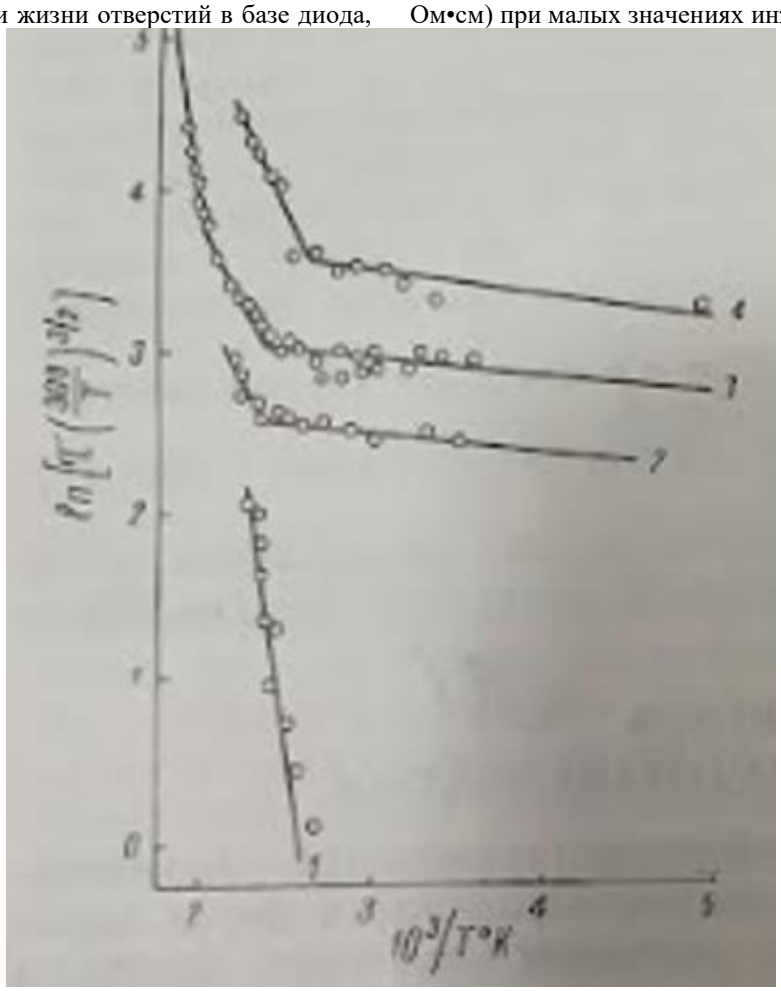

Рис. 1. Температурная зависимость времени жизни дырок в безникелевом (1) и никельсодержащем (2,3,4) кремнии n-типа при малых уровнях инжекции

Кривая 1 относится к цене без никеля, кривые 2, 3 и 4 — к ценам с никелем. Время жизни при 3000 К в ценах без никеля составляет τ р~10-9-10-8 сек. нижний предел используемого метода измерения — 10-6. Измерить температурную зависимость срока службы τ р в безникелевых центры, а эти уровни являются очень эффективными центрами рекомбинации.Включение никеля значительно увеличивает время жизни. Время жизни дырок в образцах, легированных никелем, при комнатной температуре составляет ~10-6÷10-5 секунд.При низких температурах (Т< 4000К) энергия активации рекомбинации формируется в центрах с 0,04÷0,06 эв. Освещение образца Белый свет не влияет на цену срока.

При высоких температурах энергия активации рекомбинации находится на уровнях ΔEt=0,22+0,02 эв.значениях при низких температурах (103/Т>3) невозможно. Для определения параметров рекомбинационных центров, активированных никелем в кремнии n-типа, была измерена зависимость времени жизни τр от прямого тока при различных температурах.Во всех образцах время жизни дырок (τр) уменьшается с увеличением прямой ток.Зависимость периода времени от плотности тока и (на рисунке 3) от уровня инжекции (р/(no+po)), где р/(no+po) - отношение концентрации инжектированных носителей к концентрации сбалансированных основных и неосновных перевозчиков

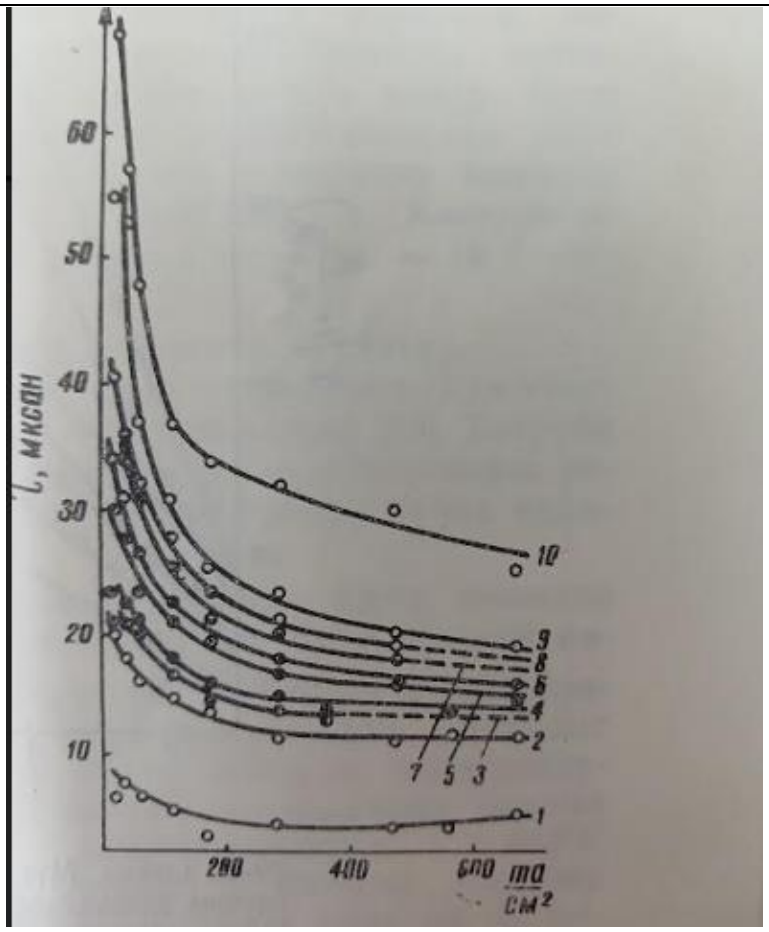

Рис. 2. Зависимость плотности тока от порядка времени жизни дырок в n-кремнии при различных температурах.

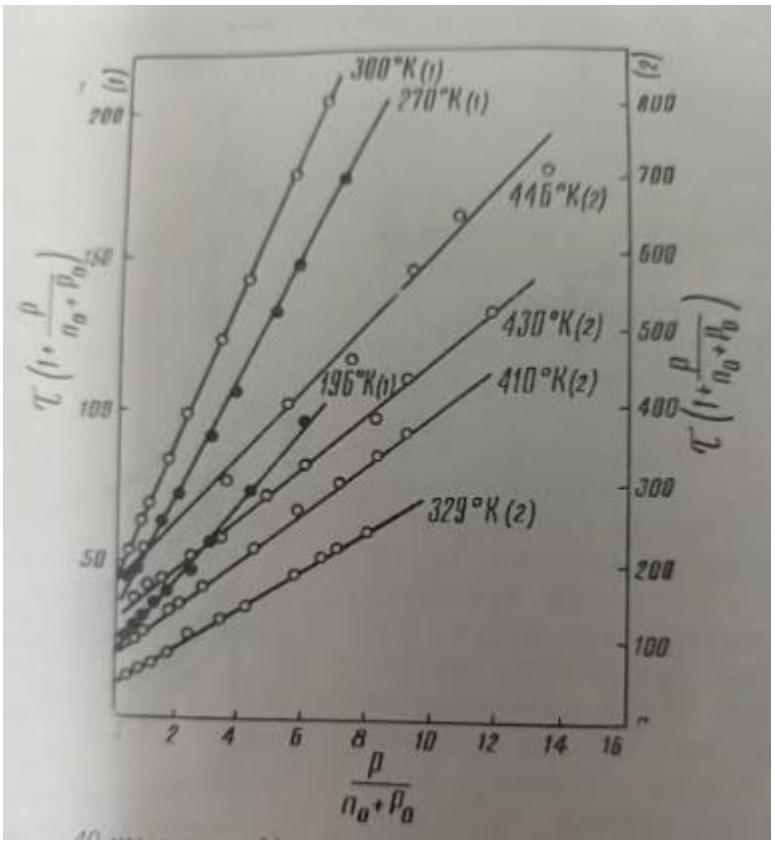

Рис. 3. Зависимость уровня инжекции от времени жизни дырок в кремнии n-типа при различных температурах

Согласно теории Шокли-Рида последней зависимостью является линия, пересечение которой с осью ординат дает время жизни дырок на бесконечно малом уровне инжекции (p→0), а наклон кривой при бесконечно большой уровень впрыска (p→∞). Сравнивая экспериментально найденные значения времен жизни при различных температурах и уровнях инжекции (τ0 и τ = τpo+τno) с формулами теории Шокли-Рида, установлено, что рекомбинация дырок в никелированном n-кремнии происходит при уровень акцепторного типа (σp/σn~10), расположенный выше запрещенной зоны, как и σp~10-15 см2. Отсюда можно сделать вывод, что при введении никеля в кремний теряется влияние более эффективных глубоких (ΔEt=0,55эВ) центров рекомбинации.Увеличение времени жизни дырок никеля объясняется диффузией его атомов в кремний и экранирование других легирующих или дислокационных центров.Эффективную нейтрализацию центров можно объяснить следующим образом: в результате клонационного взаимодействия двух ионных центров изменяются параметры уровней рекомбинации - как эффективное сечение захвата, так и энергия активации - изменение.При электростатической нейтрализации может быть два случая: центр рекомбинации полностью нейтрализуется или его действие несколько ослабляется.[3] Вероятно, акцепторный уровень (Nt) никеля, расположенный на глубине Ec-0,35 эв, частично нейтрализует центр глубокой рекомбинации (ΔEt=0,55 эв) и приводит к наблюдаемому изменению энергии активации со временем жизни 0,2±0,02 эв. При температурах выше предела эксплуатации кремниевых приборов (T=4900 K) в легированных никелем образцах вновь происходит рекомбинация в центрах, расположенных в середине запрещенной зоны (ΔEt=0,54эВ), что показано на втором рисунке. (3-я кривая) Отсюда видно, что эффективные центры рекомбинации глубоких уровней расположены внутри кремния, в это время они экранированы диффузионными атомами никеля.

Интересно изучить влияние переходных элементов титана, тантала и вольфрама на время жизни неосновных носителей заряда.При низких температурах рекомбинация происходит на уровнях с энергией активации ~0,08эВ.При средних температурах, когда T>4430K , рекомбинация происходит вблизи середины запрещенной зоны: 0,41 эв (Ta), 0,45 эв (W) и 0,48 эв (Ti). Время жизни неосновных носителей заряда в указанной легированной n-базе составляет ~10-6 секунд.

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VETERINARY SCIENCES

PROBLEM PROTOZOA OF PIGLETS, MEANS OF THEIR CHEMOTHERAPY AND PREVENTION

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Abstract
The article presents data on the spread of isosporosis, cryptosporidiosis, eimeriosis, and balantidiosis, which are problematic when growing suckling piglets and their pathogenic effect on the body. The results of the use of a complex treatment agent for the mixed course of isosporosis-cryptosporidiosis and eymeriosis-balantidiosis infestation of piglets are provided.

Keywords: isosporosis, cryptosporidiosis, eimeriosis, balanitidiosis, piglets

Pig farming, due to its economic importance, occupies an important place among other branches of animal husbandry, and in crisis situations, pork breeding is one of the main sources of rapid increase in meat production [1]. Therefore, the development of this branch of the agricultural sector is extremely important and promising [2].

Intestinal protozoa are parasites that threaten the health and welfare of pigs and impair the sustainability of pig farms, resulting in monetary losses. Protozoa are major biological barriers to efficient pig production, but are often overlooked because clinical symptoms are rarely detected. [3].

The impact of endoparasites depends on the parasite load and the individual resistance of the animal, which can be influenced by environmental and nutritional factors. Endoparasitism can occur both with and without clinical symptoms. The disease with clinical manifestation can lead to death, especially in the initial phase of animal growth. The absence of clinical symptoms is important for production, because if it remains undetected, it can lead to economic losses due to reduced pig productivity [4].

Parasitocenosis in the intestines is the most abundant and diverse. Various types of bacteria, pathogenic fungi, protozoa and helminths are localized in it. All these organisms are in certain relationships not only with the host, but also with each other. Existing relationships can be both antagonistic and synergistic [5].

K.I. Skryabin (1950) wrote that the life of a parasite is connected not only with the chemistry of the tissues of its definitive hosts and the presence of a particular parasite in a certain area, but also depends on a more complex set of factors, including economic ones.

The relationship between the parasite and the host, in some cases, leads to the formation of immunopathological reactions. At the same time, their importance in the pathogenesis of certain invasions may exaggerate the direct effect of the parasites themselves. It is known that the causative agents of invasive diseases affect the functional activity of the immune system, causing a state of secondary immunodeficiency, therefore its imbalance becomes a decisive factor that determines the occurrence and course of the invasive process. A decrease in the immunological reactivity of the body with protozoa reduces the effectiveness of deworming and at the same time increases the susceptibility of the body to re-infection with parasites [6].

Clinical manifestations of parasitocenosis are highly variable and depend on the genotypic and phenotypic heterogeneity of parasites and hosts, the quantitative and qualitative composition of micropopulations, the state of the immune system of the macroorganism, the accompanying non-infectious pathology of the host, the virulence and pathogenicity of the pathogen, etc. The polysymptomatic nature of the clinical picture of parasitocenoses complicates their diagnosis and prevention, which requires the use of the latest technologies along with traditional diagnostic techniques [7].

There is a constant circulation of opportunistic, pathogenic microorganisms, as well as helminths, protozoa and fungi in the piglets' body. In the artificially created conditions of keeping pigs and, in particular, piglets, due to their high concentration in a limited area, permanent parasitocenoses are formed [8-10].

Endoparasitism in pigs indicates the heterogeneity of the involved parasite species and their pathogenicity [11, 12]. In addition, infested pigs are generally more susceptible to infectious and non-infectious diseases that undermine their health and welfare [13].

Gastrointestinal parasites are the main cause of reduced productivity in pigs. They affect performance by directly competing for nutrients required for optimal growth and reproduction. In addition, these parasites can cause tissue damage (lesion) leading to organ culling during meat inspection, poor feed conversion, diarrhea and dehydration, or even animal death [14].

Cystoisospora (syn. *Isospora*) *suis* is the causative agent of coccidiosis in newborn pigs and one of the main causes of diarrhea in suckling piglets worldwide.

Piglets become infected after eating sporulated oocysts from a contaminated environment. The parasite

multiplies in the enterocytes of the small intestine, causing catarrhal enteritis associated with shortening and fusion of intestinal villi, nonhemorrhagic diarrhea, and weight loss. While pigs of all ages can shed oocysts after infection, usually only weanlings develop typical intestinal lesions and signs of disease during the first weeks of life. This is related to the functional immaturity of the immune system of piglets during the first weeks of life [15].

Cryptosporidium is a genus of apicomplexan parasites that is distributed throughout the world and consists of many different species and genotypes. *Cryptosporidium* spp. are parasites with a direct life cycle and pigs become infected when they ingest infectious oocysts from the environment. The infectious dose of *Cryptosporidium* is only ten oocysts, and since such oocysts can survive well in the environment, the probability of spreading to new hosts is high. When ingested, the oocysts are secreted in the pig's small intestine and release sporozoites that penetrate the epithelial cells. Clinical signs in pigs are characterized by diarrhea, anorexia and poor weight gain and depend on the species or genotype [16].

6 species of *Cryptosporidium* were isolated from pigs, namely *C. suis, C. parvum, C. muris, C. andersoni, C. scrofarum* (previously called *Cryptosporidium genotype II*) and *C. tyzzeri* (previously called *Cryptosporidium mouse genotype I*). At the same time, experimental studies showed that pigs were also susceptible to infection with *Cryptosporidium hominis* and *C. meleagridis* [17].

Eimerioses of pigs cause significant economic losses, which are caused by a decrease in the productivity of animals, a delay in growth and development, a decrease in resistance, and a high level of mortality in young animals. The percentage of mortality increases significantly with simultaneous infection of animals with eimeria, bacteria and helminths. *Eimeria* spp. in pigs, it is considered by some authors as an indicator of the hygienic status of the farm - the lower the level of hygiene, the more common *Eimeria* [1, 18].

Eymeriosis is one of the most common causes of diarrhea in piglets. The results of international, mainly Western European studies have shown that Eymeriosis is present on 75-76% of pig farms, and 40-100% of piglets on the farm can be infected regardless of hygienic conditions [19].

In pigs affected by *Eimeria*, in response to the penetration of parasites into the epithelial cells of the intestinal canal, the body reacts with changes in the blood. At the same time, eosinophilia, leukocytosis with a shift of the neutrophil nucleus to the left, the number of erythrocytes and the hemoglobin content decrease [20]. In the blood serum for swine eimeriosis, a decrease in the content of total protein due to albumins and an increase in the content of globulins, mainly due to gamma globulins, is noted [21].

Balantidiosis, caused by *Balantidium coli* (syn. *Neobalantidium coli* or *B. coli*), is a forgotten parasitic infection of zoonotic significance that affects various hosts, including humans. *B. coli* (Malmsten, 1857), a ciliated protozoan belonging to the family Balantidiidae, is considered to be a commensal of the intestines of several mammalian hosts (e.g., pigs, humans, camels, monkeys, and rarely dogs and rats). The reservoir host is domestic and wild pigs, in which the parasite inhabits mainly the villi or lumen of the large intestine. *B. coli* has a direct life cycle with the faecal-oral route of transmission occurring mainly through consumption of food and water contaminated with cysts. High temperature and humidity favor the development and survival of this parasite [22].

Parasite control should focus on eliminating parasites from animals and minimizing the survival and transmission of parasites in the environment. The use of antiparasitic drugs alone is insufficient. Using drugs in small doses or treating pigs at non-strategic moments of time can not only lead to treatment inefficiency, but also to the emergence of resistance.

Treatment of protozoa is most effective in the period of preparation for pregnancy in order to timely interrupt the development of the parasite in the intestine in order to reduce damage to the intestine due to the stages of development and the formation of new oocysts. Studies have shown that the use of the triazinon toltrazuril in the prepatent period reduces diarrhea and oocyst excretion by almost 100% in experimental conditions, and is also effective in field conditions [23].

The most common practice was to treat sows prior to farrowing with fenbendazole administered in feed or water or ivermectin administered subcutaneously or in feed [19].

For the treatment of the mixed course of isosporosis-cryptosporidiosis infestation and eimeria-balantidiosis infestation in piglets, we developed a complex treatment agent, which showed a fairly high efficiency of 96.2% during testing. The basis of the useful model is the agent with an immunostimulating effect "Amprolev", which contains levamisole (Brovalevamisole), by adding amprolium 22%, vikasol and vitamin C (ascorbic acid) [24].

The main requirements for chemotherapy drugs are their effectiveness and safety. In addition, they should be cheap, convenient to use, and easy to use. It is known and proven that long-term use of the same drugs leads to a decrease in their effectiveness, therefore, the pig industry, like no other, needs constant research and development of new chemotherapeutic drugs.

For the prevention of coccidiosis, the physical removal of organic matter is probably more important than the final disinfection step, as sporulated *I. suis* oocysts are resistant to most disinfectants [25].

Successful on-farm control requires a combination of chemotherapy and strict hygiene measures. Thus, proper sanitation, such as steam cleaning and disinfection, is imperative to reduce infestation intensity. Active agents must be used for disinfection, as most disinfectants do not have any effect on removing persistent oocysts from the environment.

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