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AGRICULTURAL SCIENCES

EFFECT OF CONTROLLED HYDRODYNAMIC CAVITATION IN IRRIGATION WATER ON THE GROWTH ENHANCEMENT OF SCOTS PINE SEEDLINGS

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Abstract

The purpose of the research was to study the effect of structured water on the growth of Scots pine seedlings. The article discusses the results of experimental irrigation with structured water of seedlings of scots pine. Biological and physical research methods were used, such as fixation of root system development and in-depth analysis of irrigation water. Some features of the intensification of the growth of seedlings associated with changes in the structural characteristics of irrigation water, based on the results of mass spectrometry and other analyses, have been identified. In particular, it is shown how, under the influence of hydrodynamic cavitation, an increase in the concentration of ions of various chemical elements appears in irrigation water, which can be considered as a fertilizer chelate. The effect of hydrodynamic cavitation on irrigation water leads to an intensification of the growth of seedlings of scots pine, an increase and proliferation of the root system. The development of the root system was recorded in dynamics and the fact of intensification of growth under the influence of cavitation was established. It should be noted that there is quite little data in the literature on the effect of cavitation on the structure of water, so this material will be a definite contribution to the development of this direction.

Keywords: Hydrodynamic cavitation, intensification of the growth, mass spectrometry, *Pinus sylvestris*, Chelated fertilizers, Structured water.

Aims.

The issues of drinking water quality, agricultural irrigation and irrigation are becoming more and more acute. The relevance and relevance of practical applications in the field of water preparation and treatment is beyond doubt. The boom in demand for nanotechnology, new technologies in various ways of structuring water, other liquids and solutions is growing exponentially.

The data from the materials of the International Committee on Water Resources at the UN, WHO and other generally recognized and specialized international expert organizations are well known that fresh and, especially, drinking water will become a strategic resource by 2025. Over the past decades, the increasing use of various types of mineral and organic fertilizers has led to an impressive increase in yields. The main emphasis in them was placed on the use of macronutrients - nitrogen, phosphorus and potash fertilizers. There is a large amount of fertilizers on the market. And every year their list is updated. Among this wide variety of fertilizers, it is proposed to choose highly environmentally friendly, produced on the basis of safe technologies, easily soluble and universal. Chelated forms of fertilizers differ favorably from fertilizers of the last generation, for example, inorganic metal salts in that they have a «milder» effect on plants and are immediately absorbed by them, and do not turn into insoluble compounds in the soil. Mineral salts, on the contrary, can be toxic to plants and are absorbed only by 20-30%. The remaining 70-80% are lost, and we are to have to

apply more than the required amount of fertilizers, thereby harming the environment and your health.

The fact of the influence of hydrodynamic cavitation in the form of a thermodynamic effect is known [1], as well as changes in the structure of water when exposed to ultrasonic cavitation [2, 5]. It should be noted that there is quite little data in the literature on the effect of cavitation on the structure of water and other manifested properties that were studied in [3, 4]. The change in the properties of water when exposed to cavitation was also discussed in works. [5, 6, 7]. Work [8] is devoted to changing the structure of water and other solutions, in work [9] ultrasonic resonator arrays for implantation devices are proposed. It is also shown that the instantaneous collapse of cavitation cavities leads to the appearance of ultrasonic vibrations [10, 11]. The work [12] was devoted to a computational study on the change in the properties of water under the influence of cavitation. Cavitation leads to a change in the physico-chemical properties of water, its partial ionization, since cavitation processes are accompanied by sonoluminescence during the formation and instant collapse of microbubbles. It was found that there are practically no or very few studies devoted to the effect of cavitation on irrigation water in order to intensify plant growth.

Methods.

The authors have been studying the effect of both ultrasonic cavitation [2] for the intensification of to-

mato growth and hydrodynamic cavitation for seedlings of scots pine for a long period. For irrigation and creating conditions for structuring irrigation water, a cavitation device was created [13], which made it possible to create controlled cavitation in the flow of irrigation water.

The cavitation device, made according to the type of Venturi tube with parabolic walls, at the exit from the confusor section of which profile twisting blades are installed, works as follows (Fig.1). The use of swirling blades having a streamlined profile allows the flow to be hydrodynamically formed, and in such a way that

the vapor-gas phase in the form of microcavities is formed throughout the volume of the diffuser section due to the twist and mixing impulse given to them, which allows the microcavities to collapse (collapse) in the high-pressure region of the Venturi tube, thereby creating an active structuring of the flow and contributing to the effective mixing of the liquid. The parabolic walls of the Laval nozzle allow for better formation of the fluid flow. It should be noted that the flow in the cavitation device was calculated using a 3D model [14].

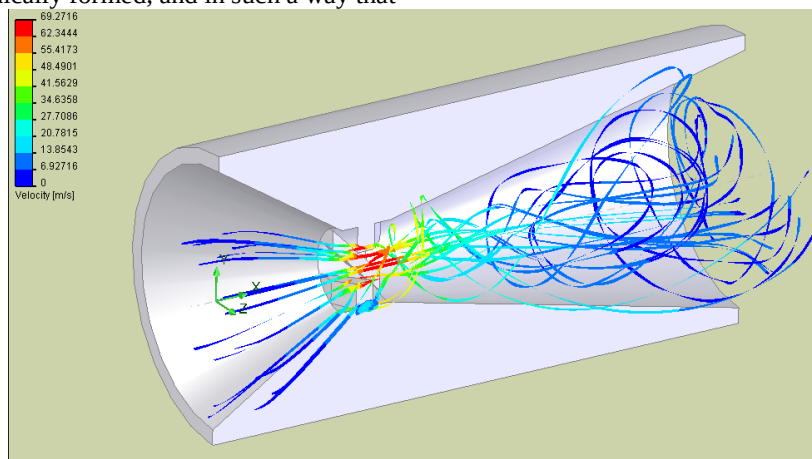


Fig. 1 The design of the cavitation device in a 3D model

An experimental nozzle (sprinkler) for watering pine seedlings, shown in Fig. 2, was made on a 3D

printer, which was installed on a watering system in the open ground.



Fig. 2 The appearance of cavitation nozzles

A series of experiments was carried out on watering with structured and plain water seedlings of scots pine. To measure water samples, a MALVERN mass spectrometer was used, which determines 28 chemical elements, and a slight increase in pH values was recorded with a decrease in the measured electrical conductivity of water. The averaged results of fixing changes in the spectral analysis of water are shown in Fig. 3. It can be seen that the concentration of iron ions increases sharply with an increase in magnesium, boron, and copper ions. A sharp decrease in strontium ions is noticeable. Iron plays an important role in the formation of chlorophyll, being an integral part of en-

zymes involved in the synthesis of green pigment; regulates the processes of oxidation and reduction of complex organic compounds, is part of respiratory enzymes; with a lack of iron, the synthesis of growth substances is delayed. Copper is a part of enzymes, activates carbohydrate and protein metabolism. Signs of copper starvation are chlorosis of leaves, wilting and premature shedding of them. with a large deficit, growth is inhibited and the formation of fruit-bearing organs is disrupted.

Results

Experiments on growing Scots pine (*Pinus sylvestris*) were carried out over several years on the territory of the forest nursery of the Laukar peasant farm.

Examination of seedlings for the presence and damage of pathogenic fungi and pest damage was carried out in the laboratory of the Semipalatinsk zonal forest seed station. In this case, the roots were washed in water, their length was measured, the number of sucking root endings was counted, and the presence of pathogenic microflora was determined.

The forest seedlings were healthy, without signs of mechanical damage, fungal diseases or damage by insect pests.

The results of the study of root systems are shown in Table 1.

Table 1.

Improving the characteristics of the root system.

Name	Root length, mm					
	Order 1		Order II		Order III	
	inspection	experience	inspection	experience	inspection	experience
Forest nursery	108	112	520	532	256	260

The length of the roots of Scots pine seedlings in the experiment increased by 5-12 mm compared to the control.

One of the main requirements when working with planting material is to prevent even slight drying of the root systems and their damage due to self-heating. After digging, normal water exchange in the plant is disrupted, and the root system is deprived of the ability to replenish even the minimum consumption of the required moisture. In addition, during the process of sorting, storage, transportation and planting, water loss by plants increases even more, which leads to the death, first of all, of small suction roots.

During this entire period, the root system of seedlings needs reliable protection from exposure to the sun, wind, high temperatures and other factors that contribute to desiccation. Planting material and its root systems are placed in liquid clay-humus mash, then the seedlings are buried in the snowfield previously prepared in winter before being transported to silvicultural areas. When preparing seedlings for planting, they are sorted and long roots are trimmed in accordance with the requirements of the standards. Before planting, the root systems are again placed in a mash, treated with biostimulants, and, if necessary, with pesticides to protect them from damage by root-gnawing pests.

When planting, the following requirements must be observed: carefully seal the root systems in the soil, avoid intertwining and bending of roots and voids around them, strictly maintain the established planting depth, straightness of the rows, which will ensure the possibility of mechanized soil care in forest crops.

In the spring, there is a mortality rate of pine seedlings caused by infectious lodging, in some years it is

50% or higher. There are known cases of complete death of all seedlings growing in the nursery.

Measures to combat lodging of seedlings consist of a set of preventive, exterminatory and agrotechnical recommendations.

Preventive measures include disinfection of soil, seeds and tires, but chemicals have a detrimental effect on the human respiratory system and are not removed from the soil for up to 10 years.

Seedlings and young pines are very sensitive to diseases caused by various fungi. In most cases, when the disease occurs, the affected plants die. The following diseases are especially dangerous for pine trees: lodging and damping off of seedlings, yellowing of needles, curvature of shoots.

Lodging of seedlings is a disease caused by fungi from the genus *Fusarium*, as well as fungi from the genera *Pythium*, *Botrytis*, *Alternaria*, etc. Pine seedlings up to 1-2 months old are affected by the disease. Externally, the disease manifests itself in the formation of a constriction near the root collar or below the subcotyledon. As a result, the affected seedling falls to the ground and gradually dies, with the seedlings wilting from the root to the top. At the same time, root rot begins. When a diseased seedling is pulled out of the soil, the peripheral part of the root is torn and its central part is exposed. In some cases, the fungus causes the death of seedlings even before they reach the surface. The death of seedlings older than 2 months of age due to lignification of the stem is not accompanied by lodging.

A good effect is achieved by temporarily reducing air and soil humidity, as well as frequently loosening the soil between lines. Experience in soil research using a cavitation system showed positive results (Table 2).

Table 2

Results of phytopathological examination

№	Substrate composition	Alter-naria,%		Fusarium,%		Hormiscium,%		Penicil-lium,%		Botrytis,%		Rhizo-pus,%	
		exp-ce	control	exp-ce	control	exp-ce	control	exp-ce	control	exp-ce	control	exp-ce	control
1	Sandy soil, forest	1	4	0	1	1	5	3	11	2	5	1	7
2	Soil+sand+humus			1	6			2	8	0	4		
3	Sand+peat	0	2			1	4	1	6			0	2
4	Soil+humus			2	6			0	5			2	7
5	Soil+humus+sawdust	3	15	0	4	1	5	4	15	1	6		
6	Soil + humus layer	1	4	0	3	0	1	0	4				
7	Soil+loam	1	4					0	6	0	4		

According to the results of a study of soil samples, it can be concluded that by using cavitation technologies it is possible to avoid lodging of seedlings when growing them in open-ground nurseries.

The research carried out using a nozzle with a cavitation device made it possible to forget about this problem of seedling lodging, as the plants become resistant to diseases.

Laboratory results were obtained before and after the effect of cavitation on irrigation water. In Fig. Figure 3 presents a comparative description of the spectrograms.

Comparative characteristics of water before and after exposure

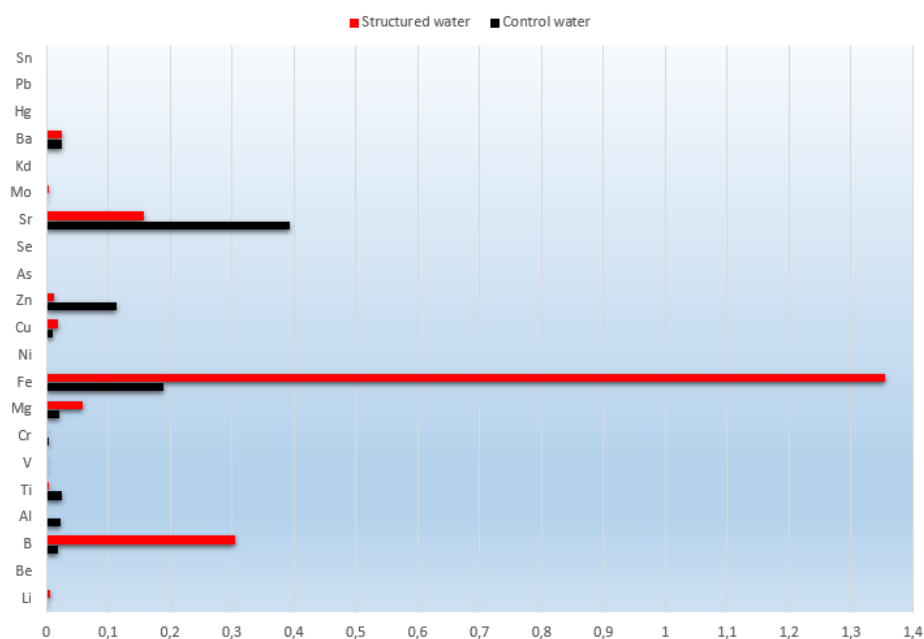


Fig.3 Comparative characteristics of spectrograms

Conclusions

The plant body, extracting substances in the form of microelements, creates their necessary concentration in its tissues, due to which it grows faster, is less susceptible to disease and also includes powerful stimulants for the growth of the root system - heteroauxins, which contributes to accelerated root formation.

In connection with the development of forest degradation processes in certain regions of Kazakhstan, the issues of growing healthy Scots pine seedlings to re-

store the Irtysh belt forests have been studied. Hydrodynamic cavitation can be generated via pressure fluctuations induced by varying the flow velocities of a liquid medium. It is achieved either by the passage of liquid through a constriction in a system, such as an orifice or venturi, or by the rotation of an object within liquid. Cavitation can be effectively induced by either ultrasound (acoustic cavitation, AC) or a local pressure drop (hydrodynamic cavitation, HC) Controlled hydrodynamic cavitation in irrigation water, specifically when used with a surfactant, can lead to a transient increase

in leaf water potential in Scots pine seedlings, potentially impacting their growth and water dynamics. Further research on the effects of CHC on the microorganisms, nutrition contents, and safety and the optimizations of CHC devices and processes are needed in future.

Declaration

The authors would like to add that we completely exclude any conflict of interest. The research was carried out entirely on the initiative and at the authors' own expense as a great interest in the object of research. As authors, we can confirm once again that all the research was carried out at our own expense and without attracting any investments from outside.

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ARTS

APPLICATION OF THE LAWS OF COMPOSITION IN GRAPHIC DESIGN

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ЗАСТОСУВАННЯ ЗАКОНІВ КОМПОЗИЦІЇ У ГРАФІЧНОМУ ДИЗАЙНІ

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Abstract

The article deals with the basic laws of composition and their application in creating graphic design objects. The importance of adherence to the principles of composition for achieving a harmonious and effective visual perception of design products is determined.

Анотація

У статті розглянуто основні закони композиції та їхнє застосування в створенні об'єктів графічного дизайну. Визначено важливість дотримання принципів композиції для досягнення гармонійного та ефективного візуального сприйняття дизайн-продуктів.

Keywords: composition, laws of composition, graphic design objects, principles of creation.

Ключові слова: композиція, закони композиції, об'єкти графічного дизайну, принципи створення.

Графічний дизайн спрямований на візуальне сприйняття, адже саме через зорові образи відбувається основна комунікація між об'єктом дизайну та глядачем. За допомогою різноманітних поєднання візуальних елементів: форма, колір, композиція, типографіка та графічні символи, створюють емоційне враження, передають інформацію та формують асоціації. Завдяки цьому об'єкти графічного дизайну не лише інформують, а й впливають на сприйняття, поведінку та рішення людини, роблячи образи впізнаваними, а повідомлення – зрозумілими й ефективними.

Створення об'єктів графічного дизайну базується доцільному застосуванні зображувальних елементів, сформованих за допомогою композиції. У мистецтві та дизайні, графічному зокрема, композиція є одним із найважливіших компонентів, оскільки саме вона забезпечує цілісність, гармонійність та логічну структуру візуального образу. Грамотно побудована композиція сприяє ефективній візуальній комунікації, викликає емоційний відгук і посилює естетичну привабливість дизайн-продукту.

Для досягнення естетичної привабливості, змістовного наповнення та емоційно насиченого дизайн-об'єкту, композицію підпорядковують законам створення, які визначають структуру, гармонію та логіку візуальної побудови. До композиційних законів належать ідейний задум, наявність композиційного центру, співрозмірність та цілісність.

1. Закон ідейного задуму зобов'язує дизайнера до того, щоб композиція в усіх своїх деталях підпорядковувалась основній концепції, розкривала змістовне наповнення об'єкта та відображала ставлення автора до зображуваного [3, с. 114]. Цей принцип передбачає єдність художнього образу, де кожен елемент виконує функцію підтримки головної ідеї, передає емоційне наповнення, посилює враження та занурює глядача в авторський задум. У графічному дизайні це особливо важливо, адже через різноманітні композиційні засоби дизайнер має донести суть повідомлення, сформувати образ, що викликає асоціації та залишає емоційний слід.

Наприклад, у логотипі ідейний задум має бути максимально стислим, але змістовним. Наприклад, якщо бренд позиціонує себе як екологічно відповідальний, дизайнер підбирає органічні форми, м'які лінії, природну колористику (зелені, блакитні відтінки), щоб передати цінності бренду. Усі елементи логотипу мають відповідати цій концепції – форма листка, плавна геометрія, шрифт без агресії (Рис.1).

У дизайні упаковки, скажімо, органічного чаю, ідейний задум – натуральність, користь, гармонія з природою. Це може візуалізуватись через зображення трав, витончені ботанічні ілюстрації, мінімалістичний дизайн, теплі відтінки. Композиція будується так, щоб не перевантажувати споживача, а навпаки викликати довіру й відчуття природності (Рис.2).



Рис.1. Логотип українського бренду косметики



Рис.2. Упаковка органічного чаю

У плакаті на екологічну тематику ідейний задум може полягати в заклик до дії – збереження природи, зменшення пластику тощо. Тут важливо, аби композиція, колір, шрифт, образність були спрямовані на підсилення цього послання: контрастні кольори – для акценту, сильна візуальна метафора – для емоційного впливу.

2. Необхідною складовою повноцінної композиції є композиційний центр – ключовий елемент, що концентрує увагу глядача та містить головні візуальні акценти, покликані розкрити ідею твору. Саме навколо нього вибудовується загальна композиційна структура, що забезпечує логіку сприйняття та художню цілісність [1, с. 94].

Серед основних прийомів акцентування композиційного центру варто виділити оперування формами, лініями, кольором, світлотінню, масштабом та розміщенням у просторі. Ці засоби дозволяють не лише виділити головний елемент, але й створити динаміку та глибину зображення. Композиційний центр притягує погляд, викликає емоційний відгук, фокусує увагу на головному змістовому посилю. У графічному дизайні надзвичайно важливо наявність сюжетно-композиційного

центру, якому підпорядковуються всі інші візуальні елементи. Відсутність чіткого центру або наявність кількох рівнозначних композиційних домінант може порушити цілісність сприйняття, створити візуальну плутанину та знизити ефективність комунікації. Це суперечить як естетичним засадам, так і психології зорового сприйняття, яка потребує чіткого орієнтира та візуальної ієрархії.

Наприклад, у логотипі Інтернет-магазину ROZETKA чітким композиційним центром є зображення смайлика, що сміється і підморгує. Простота форми, виразний силует і розміщення в центрі на нейтральному фоні миттєво фокусують погляд. Саме смайлик не тільки приваблює увагу, а й несе ідею – відчуття позитиву і довіри (Рис.3).

У постері до фільму «Joker» композиційний центр зосереджений на обличчі головного героя, яке розміщене у верхній частині кадру, виділене контрастним світлом і кольором. Його емоція – це не просто візуальний акцент, а центр змістового наповнення: вона несе весь психологічний настрій і концепцію фільму (Рис.4).



Рис.3. Логотип Інтернет-магазину ROZETKA



Рис.4. Постер до фільму «Joker»

На багатьох преміальних винних етикетках з рослинною стилізацією центральним елементом виступає стилізований малюнок лози або квітки, який об'єднує назву, тип вина та декоративні елементи. Композиційний центр тут виконує одразу кілька функцій: естетичну, інформаційну та ідентифікаційну.

3. Закон співрозмірності всіх частин композиції є ключовим для забезпечення гармонійності та цілісності твору. Він вимагає правильного визначення співвідношення сюжетно-композиційного центру до загальної структури та пропорцій зображення. Це співвідношення має бути збалансованим

і взаємопідкріплювати всі елементи, щоб композиція виглядала органічно [2, с. 47].

У графічному дизайні цей принцип включає в себе врахування наступних аспектів:

- об'єми: важливо, щоб розміри елементів були узгоджені між собою, щоб зображення не виглядало перевантаженим або занадто простим;
- кольори: кожен колір повинен гармоніювати з іншими, зберігаючи баланс і візуальний комфорт;
- світло та тон: правильне співвідношення світла і тіні дозволяє створити глибину і структуру композиції;

- форма: форми повинні доповнювати одна одну, зберігаючи єдину стилістичну концепцію;
- ритм і пластика: взаємодія між елементами, ритм (повторення чи варіація елементів) повинні органічно поєднуватися, створюючи єдину концепцію;

- статика чи динаміка: рух чи спокій у композиції впливають на емоційний настрій і залежать від того, як співвідносяться елементи між собою.

Завдяки цьому балансуванню, композиція набуває відчуття єдиного цілого, що не порушує загального враження. Принцип співрозмірності дозволяє дизайнерам створювати зображення, що не лише відповідають технічним вимогам, але й передають ідею, викликають емоційний відгук та гармонійно сприймаються.

Наприклад, у логотипі, де важлива чіткість і максимальна виразність при мінімалістичному використанні елементів, співрозмірність має вирішальне значення. Наприклад, у логотипі Nike класичний «підйом» символу «swoosh» відповідає загальній динаміці бренду, який асоціюється з рухом і спортивним прагненням. Розміри та пропорції елементів дозволяють логотипу бути чітким і впізнаваним навіть у малих масштабах, що важливо для різних форматів використання.

У плакатах для концертів або фестивалів важлива не тільки чіткість основного акценту, а й правильне співвідношення тексту і зображення. Якщо шрифт або інші елементи композиції надто великі чи малі щодо зображення, глядач може не помітити ключову інформацію або відчувати дисгармонію. Наприклад, у рекламних матеріалах для музичних фестивалів важливо, щоб назва гурту або дата були чіткими та легкими для сприйняття, але при цьому не закривали образну частину – фотозображення артистів або тематичний малюнок.

4. Закон цілісності композиції є одним з основних у графічному дизайні, оскільки він гарантує, що весь твір сприймається як єдине, неподільне ціле. Уся композиція повинна органічно поєднувати свої елементи так, щоб кожен з них доповнював основну ідею, підкріплював зміст і не розривав загальну структуру. Це забезпечує гармонію та ефективну передачу задуму через правильну взаємодію всіх частин твору [2, с. 65].

Основними аспектами закону цілісності є:

- неподільність композиції. Цілісність досягається через конструктивно-художню ідею, яка об'єднує всі елементи в одне ціле. Це означає, що кожен елемент (форми, кольори, текстури) не є окремо, а є частиною більшого контексту. Як тільки одна деталь відрізняється за стилем чи напрямком, композиція втрачає єдність;

- зв'язок і узгодженість елементів. Всі компоненти повинні бути між собою гармонійно

пов'язані. Залежно від задуму автора, елементи можуть бути спрощеними або деталізованими, але обов'язково кожен із них повинен служити загальною метою. Зазначена узгодженість дозволяє твору бути зрозумілим і легким для сприйняття;

- головний та другорядні елементи. Згідно з законом цілісності, всі частини композиції повинні підкорятися головному задуму. У кожній композиції є сюжетно-композиційний центр, навколо якого об'єднуються всі другорядні деталі. Цей центр повинно бути визначено ще на етапі планування композиції;

- плями і геометричні форми. Композиція починається з узагальненого визначення положення основних елементів за допомогою плям, що мають певну форму. Ці форми можуть нагадувати геометричні фігури, котрі потім розвиваються в більш детальну структуру.

Закон цілісності у графічному дизайні забезпечує, щоб всі елементи твору були об'єднані в єдину цілісну структуру. Кожна деталь відіграє свою роль у підкріпленні основного змісту і повідомлення, допомагаючи твору виглядати завершеним і збалансованим. Зокрема, важливим є правильне визначення головного композиційного центру і узгоджене розміщення кожного елемента відповідно до основної ідеї, що дозволяє досягти максимального емоційного ефекту.

Отже, закони композиції є вагомими чинниками у створенні об'єктів графічного дизайну

Отже, закони композиції є вагомими чинниками у створенні об'єктів графічного дизайну, оскільки вони визначають структуру та організацію всіх складових елементів. Завдяки їм досягається не тільки естетична привабливість, але й ефективна комунікація з глядачем. Правильне застосування композиційних законів дозволяє забезпечити гармонійне поєднання форм, кольорів, текстур та простору, що створює цілісне і зрозуміле повідомлення. Закони композиції, такі як ідейний задум, композиційний центр, співрозмірність та цілісність, допомагають створювати дизайн-об'єкти, які не лише привертають увагу, але й ефективно передають основний зміст та емоційне послання. Вони дозволяють дизайнеру організувати інформацію таким чином, щоб вона була сприйнята правильно і легко.

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BIOLOGICAL SCIENCES

THE MONOTYPIC GENERA OF THE *BRASSICACEAE* BURNETT. FAMILY IN THE FLORA OF THE NAKHCHIVAN AUTONOMOUS REPUBLIC

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МОНОТИПНЫЕ РОДЫ СЕМЕЙСТВА *BRASSICACEAE* BURNETT. В ФЛОРЕ НАХИЧЕВАНСКОЙ АВТОНОМНОЙ РЕСПУБЛИКИ

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Abstract

The article discusses the monotypic genera of the Brassicaceae Burnett family in the flora of the Nakhchivan Autonomous Republic. It highlights the position of monotypic genera in the flora and the importance of their conservation. A systematic review of these genera is provided, along with information on their biological, morphological, and ecological characteristics. The article also includes data on the elevation belts, ecological environment, phenophases, and life forms of the plants in question. Since most of the monotypic genera belong to the annual life form, characteristics specific to annual plants are also included here.

Аннотация

Статья посвящена монотипным родам семейства Brassicaceae Burnett в флоре Нахичеванской Автономной Республики. В ней рассматривается положение монотипных родов во флоре и важность их сохранения. Представлен систематический обзор этих родов, а также информация о их биологических, морфологических и экологических характеристиках. В статье приведены данные о высотных поясах, экологической среде, фенофазах и жизненных формах рассматриваемых растений. Поскольку большинство монотипных родов принадлежат к однолетним растениям, здесь также приведены характеристики, специфичные для однолетних растений.

Keywords: *Brassicaceae* Burnett., flora, monotypic genera, species, plant.

Ключевые слова: *Brassicaceae* Burnett., флора, монотипные роды, виды, растения.

The *Brassicaceae* Burnett. family is of great ecological and economic importance. This family, which has a wide global distribution, plays a significant role in food, medicine, and industry. The *Brassicaceae* Burnett. family includes over 3,000 species and more than 370 genera. The Nakhchivan Autonomous Republic is known for its rich flora, and various representatives of the *Brassicaceae* Burnett family are found here. Plants of the *Brassicaceae* Burnett. family can thrive in various climates, but the unique climate of the Nakhchivan Autonomous Republic makes the distribution of these plants even more interesting. Although various species and genera of the *Brassicaceae* Burnett. family are present in the Nakhchivan Autonomous Republic, monotypic genera are of particular interest. A monotypic genus is a genus that contains only one species, and this species is found endemically in a specific region. Such genera play a unique and distinct role in the ecosystem and are also of great importance in the conservation of biological diversity. In the Nakhchivan Autonomous Republic, there are several notable examples among the monotypic genera of the family. These genera help maintain a specific ecosystem balance in certain environments with their species. The conservation of monotypic genera of the *Brassicaceae* Burnett. family in the Nakhchivan Autonomous Republic is crucial. These genera, represented by only one species, may face a

rapid risk of extinction due to natural disasters and human activities. Therefore, local flora conservation policies should focus on the protection of these genera. The management of both underground and surface resources, the preservation of the plants' natural habitats, and continued research on these genera can ensure their future. At the same time, research on these plants could help increase their use in modern industrial and medical fields. These genera are adapted to local conditions and are represented by a single species in certain geographical areas. The *Brassicaceae* (*Cruciferae* or mustard family) is a large plant family with approximately 338 genera and 3709 species distributed worldwide, most are distributed in the temperate areas of the Northern Hemisphere (Kawther Younes, et al. 2015). Numerous studies (e.g. Al-Shehbaz 1984, Price et al. 1994, Appel and Al-Shehbaz 2003, Koch et al. 2003a, Mitchell-Olds et al. 2005) have amply demonstrated that morphological characters in the *Brassicaceae* are highly homoplasious, making it virtually impossible to utilize them alone in establishing phylogenetic relationships on a family-wide basis or sometimes even within genera (Al-Shehbaz, I.A. et al. 2006). A distinctive and relatively rare feature of the *Brassicaceae* family is heterocarpy, which often develops simultaneously with heterospermy (Dorofeev, V.I. 2003). The *Brassicaceae* Burnett. is one of the leading families in the flora of the limestone formations in the southern Primorsk region,

the flora of the left bank of the Katun River, and the flora of the northern foothills of the Altai Mountains (Dudkin, R. V. 2004, Achimova, A. A. 2004, Zhikharova, O. N. 2004).

The *Brassicaceae* Burnett. family is represented by 67 genera in the flora of the Nakhchivan Autonomous Republic. Of these, 10 genera (14.92%) are monotypic:

Phylum: *Magnoliophyta*

Classis: *Angiospermae*

Subclassis: *Magnoliidae*

Superordo: *Myrtales*

Ordo: *Brassicales* Bromhead

Familia: *Brassicaceae* Burnett, nom. cons.

(= *Cruciferae* Juss., nom. cons.)

Genus: *Asperuginoides* Rauschert (*Buchingera* Boiss. & Hohen.)

Asperuginoides Rauschert (*Buchingera* Boiss. & Hohen.)

Genus: *Calepina* Adans.

Calepina irregularis (Asso) Thell.

Genus: *Coluteocarpus* Boiss.

Coluteocarpus vesicaria (L.) Holmboe

Genus: *Diptychocarpus* Trautv.

Diptychocarpus strictus (Fisch. ex Bieb.) Trautv.

Genus: *Euclidium* R.Br.

Euclidium syriacum (L.) R. Br.

Genus: *Leptaleum* DC.

Leptaleum filifolium (Willd.) DC.

Genus: *Litwinowia* Woronow

Litwinowia tenuissima (Pall.) Woronow ex Pavl.

Genus: *Myagrum* L.

Myagrum perfoliatum L.

Genus: *Nasturtium* R.Br.

Nasturtium officinale R. Br.

Genus: *Turritis* L.

Turritis glabra L. [*Arabis glabra* (L.) Brnh.]

***Asperuginoides* Rauschert (*Buchingera* Boiss. & Hohen.) (1849).** Plant annual, stem simple or branched from base, subflaccid, minute stellate hairy (Barish, B. and Nezaket, A. 2006). The cauline leaves are not pouch-shaped. The petals are undivided and white. The filaments of the stamens are simple. Short stamens have a small nectar gland on each side, and there is no middle stamen. The ovary is sessile, with a blunt, short, two-lobed style. The fruit is a round capsule that is flattened on the back, with branching veins and densely covered with hook-like hairs. The septum is weak, and the epidermal cells have walls with parallel divisions. The locules are one-seeded, but sometimes one locule does not develop, in which case the fruit becomes one-seeded. The seeds are of a simple shape with leathery wings. It is an annual plant with branched, hook-like hairs, and flowers are found at the axils (at the point where the leaf attaches to the stem) and are bent. It is an annual, xerophytic plant belonging to the Iran-Turan geographic element (Movsumova, F.G. 2005). It is spread in the broadleaf forests, dry, saline, rocky, and clayey areas of the middle mountain belt of the Nakhchivan Autonomous Republic:

Asperuginoides axillaris (Boiss. & Hohen.) Rauschert (*Buchingera axillaris* Boiss. & Hohen.)

***Calepina* Adans. (1763).** The stem branches from the base. The leaves are entire, serrated, with the lower leaves being lyrate or lyrate-pinnate, arranged in a rosette on long petioles. The stem leaves are elongated or elongated-lanceolate, sessile, with similar-shaped sharp auricles at their bases. The flower stalk is 6-16 mm long, spreading and becoming erect during fruiting. The sepals are separate, not pouch-shaped. The stamens are simple and free. The short stamen filaments have a serrated shape on the inner side, while the outer side has several concave nectar glands. In front of each long stamen pair, there is an elongated nectar gland. The ovary is sessile, and the style is very short. The small, reverse-ovate petals are white (Zeki, A., et al. 2020). Its fruit is small, ovate, leathery, indehiscent, with blunt, quadrangular ends, a net-veined husk, and the upper part narrows to a short tip. It is an annual plant with entire leaves and is hairless. It is an annual, mesophytic plant and belongs to the Eurasian geographic element. The genus is represented with *C. irregularis* (Asso) Thell. in Turkey, and we have not yet encountered any local usage or economic value of the species (Donmez, A.A. et al. 2020). It is spread in the grassy, low-moisture areas of the plains and foothill regions of the Nakhchivan Autonomous Republic:

Calepina irregularis (Asso) Thell.

***Coluteocarpus* Boiss. (1842).** The sepals are flat. The petals are white or pink. The stamens are simple and free. The style is capitate. The fruit is swollen, thick, ellipsoidal or ovate, and is a capsule that opens at the apex. The husks are veined. The locules are 8-seeded, and the seeds are wingless. It is a perennial herb covered with simple hairs. It is a perennial, xerophytic plant and belongs to the geographic element of Anatolia. It is found in the dry and rocky slopes of the middle to high mountain ranges of the Nakhchivan Autonomous Republic:

Coluteocarpus vesicaria (L.) Holmboe

***Diptychocarpus* Trautv. (1860).** The sepals are not net-shaped. The petal veins are purple. The ovary is sessile, with a short style and closely placed tubular parts. Short stamens have nectar glands on both sides. The capsule has two forms: the upper part opens, with compressed, wide-winged seeds, while the lower part is unopened, cylindrical, with narrow-winged seeds, and is divided into sections. The seeds are slightly compressed. These are branched, hairy, annual plants with elongated, veined leaves. It is an annual, xerophytic plant and belongs to the Iran-Turan geographic element (Kravchenko, A.V. 2007). It is found in the clayey, weakly saline slopes and grassy areas of the lower mountain belt of the Nakhchivan Autonomous Republic:

Diptychocarpus strictus (Fisch. ex Bieb.) Trautv.

***Euclidium* R.Br. (1812).** The sepals are spaced apart and are not net-shaped. The white petals narrow toward the base. The stamens are free and unifid. Each short stamen has small, triangular nectar glands on both sides. The ovary is sessile, with a long, conical style. The fruit is ovate or ellipsoid, swollen, with two locules, an indeterminate covering, and numerous parallel walls. It is an indehiscent capsule. The beak is intersected, hook-shaped, and curved, with a single hanging

seed in each locule. These are annual, branched plants covered with simple hairs. It is an annual, xerophytic plant and belongs to the Eastern Mediterranean and Iran-Turan geographic elements. It is found in the semi-desert areas, along roadsides as a weed, and in fields up to the middle mountain belt of the Nakhchivan Autonomous Republic:

Euclidium syriacum (L.) R. Br.

Leptaleum DC. (1821). The sepals are linear and flat. It has numerous small, whitish or whitish-purple petals. The long stamens pair up toward the apex. Each small stamen has one nectar gland on each side. The ovary is sessile, with a short style, and the stigma is a two-lobed, fused capitate structure. The fruit is linear, laterally compressed, difficult to open, leathery, with thick wings, a central vein, and small, reticulate lateral veins. The septum is spongy, with numerous epidermal cells having parallel walls. The seeds are elongated, small, and compressed, arranged in two rows. It is a dwarf annual herb with simple or pinnate leaves (Murat, Ü., Fevzi, Ö. 2007). It is a monotypic genus found in the Caucasus and Central Asia. It is an annual, xerophytic plant and belongs to the Iran-Turan geographic element. It is found in the dry, sandy, rocky slopes and clayey semi-deserts of the plains and foothill areas of the Nakhchivan Autonomous Republic:

Leptaleum filifolium (Willd.) DC.

The species is listed as endangered in the flora of the Lower Volga Valley (Laktionov, A. P. 2004).

Litwinowia Woronow (1931). The sepals are flat, slightly pouch-shaped at the base. The petals are purple or whitish. The globe-ovate, indehiscent, glabrous capsule is 2-loculed, with two seeds, and easily disperses. The style is twice as long as the capsule. It is an annual plant covered with simple hairs. It belongs to a genus typical of open areas. It is an annual, xerophytic plant and belongs to the Turan geographic element (Ebel, A.L. et al. 2014). It is found in the dry slopes and grassy areas of the lower mountain range (often extending to the middle mountain range) of the Nakhchivan Autonomous Republic:

Litwinowia tenuissima (Pall.) Woronow ex Pavl.

Myagrurum L. (1753). The stem is branched. The sepals are approximately 3 mm long, flat, with the sides slightly pouch-shaped at the base. The elongated petals, about 4 mm long, are yellow or pale yellow. The leaves

are entire, gray-green, with the lower ones being elongated, extending toward the flower stalk, usually fragmented and cut, blunt, triangular, while the upper ones are long, lanceolate, with a petiole surrounding the base, and have a pointed tip. The stamen filaments are unbranched. The ovary is sessile, with a triangular short style. The capsule is indehiscent, inverted pear-shaped, leathery, with two swollen, empty locules at the top, and a one-seeded, fruit-bearing locule at the bottom. The style is short and swollen. It is a hairless, annual plant. It is an annual, mesophytic plant and belongs to the European-Southwestern Asia geographic element. It is found in the cultivated areas and mainly in weedy places from the plains to the middle mountain range of the Nakhchivan Autonomous Republic:

Myagrurum perfoliatum L.

Nasturtium R.Br. (1812). The sepals are identical, spaced, and bent. The elongated, inversely oval, petiolate petals are white in color (Zeki A. et al. 2020). The stamens are unbranched. Each short stamen has one large, outward-facing nectar gland, and there are no median glands. The ovary is sessile, and the style is visible. The fruit is short, cylindrical, swollen, and has a thick, smooth, leathery capsule with no veins. The septum is thin, and the epidermal cells are irregularly polygonal, slightly elongated, and have thin walls. The seeds are arranged in two rows in each locule. The seed capsules are flat, and it is a perennial aquatic plant. *Nasturtium officinale* a glabrous species or has a small hairs, unbranched unicellular, smooth sharp apex. (Post, 1933; Jafari and Hassand, 2012). Also the study Cumbus and Robinson (1977) confirmed that species *Nasturtium officinale* has two types of roots depending on environmental conditions. When there is a large amount of phosphorus in the water, the roots are adventitious, while the lack of phosphorus in the water, the roots are mainly Tap root. Formation of roots in water-cress helped it to widely spread in addition to the direct growth of the seed. (Sura S. A. et al. 2017). The genus includes only one species, which is distributed across almost all regions of the world. It is a cosmopolitan genus. It is a perennial, hydrophytic plant and belongs to the European geographic element. It is found in the wetlands and riverbanks of the Nakhchivan Autonomous Republic, extending to the middle mountain range:

Nasturtium officinale R. Br.

The lenticular range of the species *Nasturtium officinale* R. Br. (Chalxanqala area, 17.05.2023).

***Turritis* L. (1753)** . *Turritis* was established in 1753 by Linnaeus, but most authors unite it with *Arabis*. (Al-Shehbaz, I.A., 2005; Mutlu, B. and Erik, S., 2015). Among the species that define the characteristics of the Volgograd-Stupinsk floristic region is *Turritis glabra* (Laktionov, A. P. 2004). The sepals are pouch-shaped at the base and stand upright. The elongated, linear petals are yellowish-white and have long petioles. The nectar glands are ring-shaped at the base of the short stamens, with the inner side slightly concave, and are connected to the wide median stamens. The sessile pistil has a very short style, and the stigma is capitate. The fruit is a linear capsule with clear central veins, with paired, flat, and membranous walls. The septum walls are thin, or thickened in the middle, and the epidermal cells are elongated with thickened walls.

The seeds are arranged in two rows in the locules. It is a branched, hairy biennial plant. It is a monotypic genus native to Europe, the Caucasus, Siberia, and Central Asia. The genus includes only one species, which is found in North America, Australia, Europe, and Asia. Its origin is believed to be Central Asia, but it has spread beyond its original range as a weed in agricultural fields. It is a biennial, xerophytic plant and belongs to the Palearctic geographic element (Kravchenko, A.V. 2007). The genus is found in the meadows, shrub edges, and roadsides of the Nakhchivan Autonomous Republic, extending to the middle mountain range:

Turritis glabra L. [*Arabis glabra* (L.) Brnh.]

The species is listed as endangered in the flora of the Lower Volga Valley (Laktionov, A. P. 2004).

Research shows that the monotypic genera of the Brassicaceae Burnett family are represented by 7 annual, 2 perennial, and 1 biennial life forms. Among these plants, annual plants (7 species - 70%) are predominant. The fact that most of the monotypic genera are annuals can be explained by their short vegetative period. Annual plants can grow in various environments, including fields, gardens, and other ecosystems, because they possess characteristics that allow rapid reproduction and growth. Due to their very short life cycle, they have the ability to make genetic changes for the next generation. For example, species resistant to drought or cold can develop. Such plants respond specifically to arid climate conditions, which results in earlier flowering and fruiting phases. In the regional flora, the necessity for protecting annual plants arises due to the arid climate type of the area.

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THE INFLUENCE OF CLIMATE ON THE NUMBER OF ARBOREAL HEMIPTERA IN SOUTH-EASTERN KAZAKHSTAN**Korganbek Kh.***Doctoral student of the Department of Biology, Ecology and Chemistry,
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Almaty, Kazakhstan*<https://doi.org/10.5281/zenodo.15220735>**Abstract**

This article is devoted to the study of the influence of climatic factors on the population dynamics of the main species of arboreal Hemiptera inhabiting various forest formations of South-Eastern Kazakhstan. During long-term observations in the foothill plains, midlands and highlands, dominant species of phytophages on deciduous, coniferous and fruit tree species were identified. A statistical analysis of the correlations between the population size of Hemiptera and such climatic parameters as air temperature, precipitation and humidity was carried out. The results showed that spring-summer temperature has a predominantly positive effect on the number of many Hemiptera species, while extreme temperatures and droughts can have a negative effect. Low winter temperatures were identified as a potential limiting factor for the survival of wintering stages of some species. Specific climatic factors that most significantly affect the population dynamics of individual pest species were identified. The potential impact of predicted climate change on the abundance and distribution of arboreal Hemiptera in the region is discussed, highlighting the need for further monitoring and development of adaptive forest protection measures.

Keywords: arboreal Hemiptera, climate, abundance, South-Eastern Kazakhstan, temperature, precipitation, humidity, climate impact, forest ecosystems.

Introduction

South-Eastern Kazakhstan is a unique region with diverse landscapes, including mountain ranges, foothill plains and desert areas. The vegetation cover of the region is characterized by high biodiversity, where a significant role is played by tree species, forming forests and individual tree-shrub communities. Arboreal Hemiptera are an important component of these ecosystems, playing a significant role in trophic chains and influencing the physiological state of plants.

Hemiptera, in particular some of their species, are phytophages feeding on plant juices. Their mass reproduction can lead to weakening of trees, a decrease in their growth, deformation of shoots and leaves, and in some cases - to death. In this regard, the study of factors influencing the number of arboreal Hemiptera is of great practical importance for forestry and the conservation of biodiversity in the region.

Climate is one of the key abiotic factors that significantly influences the dynamics of insect populations, including Hemiptera. Temperature, humidity, precipitation and other climatic parameters can directly or indirectly affect the survival, development, reproduction and distribution of these phytophages. Climate change observed in recent decades can lead to changes in the phenology of plants and insects, changes in the distribution ranges of pests and an increase in the frequency and intensity of outbreaks.

South-Eastern Kazakhstan is characterized by a continental climate with hot, dry summers and cold winters. Mountainous areas have a cooler and more humid climate than flat areas. Such climatic heterogeneity creates diverse living conditions for various species of arboreal hemiptera.

Despite the importance of arboreal hemipterans in the forest ecosystems of South-Eastern Kazakhstan, the influence of climatic factors on their numbers has not been sufficiently studied. Research in this area will help identify key climatic parameters that limit or stimulate the development of populations of these insects, which is necessary for developing effective strategies for monitoring and forecasting their numbers in a changing climate.

The aim of this study is to investigate the influence of climatic factors on the number of the main species of arboreal hemiptera living in various forest formations of South-Eastern Kazakhstan.

Materials and methods**Research areas:**

The research was conducted in various forest areas of South-Eastern Kazakhstan, representing the main types of forest vegetation in the region. Key areas were selected in the following altitudinal zones and forest formations:

Foothill plains and lowlands (up to 1000 m above sea level): Areas dominated by deciduous species such as poplar (*Populus* spp.), willow (*Salix* spp.), elm (*Ulmus* spp.), as well as fruit crops (*Malus* spp., *Armeniaca* spp.).

Middle mountains (1000-2000 m above sea level): Areas with coniferous forests formed by Tien Shan spruce (*Picea schrenkiana*), Scots pine (*Pinus sylvestris*) and Siberian larch (*Larix sibirica*), as well as mixed forests with birch (*Betula* spp.) and aspen (*Populus tremula*).

Upper mountains (above 2000 m above sea level): Areas with sparse coniferous forests and juniper forests (*Juniperus* spp.).

Collection of materials:

The collection of arboreal hemipterans was carried out over several growing seasons (from spring to autumn) in the period from 2023 to 2024. Permanent trial plots were established at each site, where insect numbers were regularly counted.

The following methods were used to account for the population:

Visual inspection: Inspection of tree branches, leaves and trunks for colonies of Hemiptera. Counting the number of colonies or individuals per unit area (e.g. per 10 cm of branch or per leaf).

Shaking: Shaking branches onto a litter cloth or entomological umbrella and then counting the insects collected.

Sticky traps: Using sticky traps to catch winged forms of Hemiptera.

Washing: Washing insects off leaves and branches and then analyzing them microscopically.

The collected samples were fixed in 70% ethyl alcohol and delivered to the laboratory for species identification using identification guides and morphological keys.

Climate data collection:

For each study area, data on average daily air temperature, precipitation amount and relative air humidity were collected for the observation period. Data from the nearest weather stations were used, and, if necessary, autonomous weather stations were installed in the study areas.

Statistical analysis:

Correlation and regression analysis methods were used to identify relationships between the abundance of arboreal Hemiptera and climatic factors. Time series of insect abundance and climatic parameters were analyzed. The influence of average annual and seasonal values of temperature, precipitation, and humidity on the population dynamics of various Hemiptera species was assessed.

Multivariate regression analysis was used to determine the most significant climatic factors affecting the abundance of individual species. An analysis of delays in the influence of climatic factors was also conducted (for example, the influence of winter temperatures on abundance in spring).

Results

During the research conducted in the territory of South-Eastern Kazakhstan, the following main species of arboreal hemiptera were identified, dominating on various tree species:

On deciduous species (poplar, willow, elm): *Elatophilus stigmatellus*, *Empicoris vagabundus*.

On coniferous trees (spruce, pine, larch, juniper): *Phytocoris ulmi*, *Orthotylus marginalis*.

On fruit crops (apple, apricot): *Zicrona caerulea*.

The analysis of the population dynamics showed that the populations of various species of Hemiptera demonstrated significant fluctuations during the study period. Both periods of high numbers (outbreaks) and periods of depression were noted.

The statistical analysis revealed the following main correlations between the numbers of arboreal Hemiptera and climatic factors:

Temperature:

For many species of Hemiptera, a positive correlation was observed between the average temperature of the spring-summer period and abundance. Warmer springs contributed to an earlier onset of development and an increase in the number of generations per season.

Too high summer temperatures combined with low humidity had a negative effect on some species, leading to a decrease in their abundance.

Low winter temperatures can be a limiting factor for the survival of overwintering stages of some species of Hemiptera. A negative correlation was found between minimum winter temperatures and subsequent spring abundance.

Precipitation:

Moderate amounts of precipitation in the spring and summer period, as a rule, contributed to the development of host plants and indirectly favored the development of some species of Hemiptera.

Long rains could have a mechanical effect on populations, washing insects off plants, especially at early stages of development.

Dry periods often led to an increase in the number of sucking pests due to the weakening of plant turgor and an increase in the concentration of nutrients in the sap.

Air humidity:

High air humidity combined with moderate temperatures contributed to the development of fungal diseases that could regulate the numbers of some species of Hemiptera.

Low air humidity during hot periods could lead to dehydration and death of larvae and nymphs.

The results of multivariate regression analysis allowed us to identify the most significant climatic factors for each studied species of Hemiptera. For example, for *Zicrona caerulea*, the key factors were the average temperature in May and the amount of precipitation in June.

A delay analysis showed that the climatic conditions of the previous year (for example, a warm autumn) could influence the survival of overwintering stages and, accordingly, the numbers in the spring of the following year.

Discussion

The obtained results confirm the significant influence of climatic factors on the dynamics of the number of arboreal hemiptera in South-Eastern Kazakhstan. Differences in the reactions of different species to the same climatic parameters are due to their specific biological characteristics, developmental phenology and trophic links with host plants.

The positive correlation between spring-summer temperature and the abundance of many species of Hemiptera may be due to the acceleration of their metabolism, reduction in the development time of generations, and increase in reproductive potential in warmer

years. However, exceeding optimal temperature thresholds may have a depressing effect.

The impact of precipitation is more complex. Moderate moisture promotes the growth and development of host plants, providing a better food base for phytophages. At the same time, excessive precipitation can directly reduce the number of insects, and droughts can lead to physiological stress of plants and changes in their chemical composition, which can either favor or hinder the development of various species of Hemiptera.

The influence of air humidity is also related to the physiology of insects and the development of their natural enemies and diseases. High humidity can promote the development of entomopathogenic fungi that regulate the number of pests, but can also create favorable conditions for the development of some species of Hemiptera.

Projected climate changes in the region, including higher average temperatures, more frequent droughts, and more extreme weather events, may lead to significant changes in the abundance and distribution of arboreal hemipterans. Warming may facilitate the expansion of the ranges of some heat-loving species to the north and higher mountain zones, as well as an increase in the number of generations per season. Increased drought frequency may weaken woody plants and increase their susceptibility to pest damage.

The obtained data are important for the development of systems for monitoring and forecasting the number of arboreal hemiptera in forest ecosystems of South-Eastern Kazakhstan in the conditions of a changing climate. Understanding the key climatic factors influencing the dynamics of pest populations will allow for more effective planning of forest protection measures and taking measures to preserve the sustainability of forest plantations.

Conclusions

During the research in various forest formations of South-Eastern Kazakhstan, a wide range of species of arboreal Hemiptera, dominant on the main forest-forming and fruit trees, was identified.

The dynamics of the population of the studied Hemiptera species was characterized by significant inter-annual fluctuations, which indicates the influence of external factors, including climatic ones.

Statistical analysis revealed significant correlations between the number of various species of arboreal Hemiptera and such climatic factors as air temperature,

precipitation and air humidity. The nature of these relationships varied depending on the insect species and the phenological phase of its development.

For many Hemiptera species, a positive correlation was observed between spring-summer temperature and population, and extreme temperatures and droughts had a negative effect on some species. Low winter temperatures can limit the survival of overwintering stages.

Projected climate changes in South-Eastern Kazakhstan may lead to significant changes in the abundance and distribution of arboreal hemipterans, which requires further monitoring and development of adaptive forest protection strategies.

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CHEMICAL SCIENCES

INFLUENCE OF EXPANDED CLAY WASTE ON CONCRETE PROPERTIES

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Abstract

The chemical composition of expanded clay, its physicochemical properties and granulometric composition were studied. The effect of expanded clay dust additive – waste from expanded clay production (Azerbaijan) on the compressive and flexural strength of concrete was investigated. It was found that the introduction of expanded clay additive in the amount of 2-10% slightly reduces the compressive strength from 46.2 to 44.5 MPa, and the compressive strength from 29.8 to 28.3 MPa passing through a maximum at 4% expanded clay to 30 MPa, respectively. An increase in the expanded clay content above 10% is accompanied by a decrease in the strength of concrete.

Keywords: solid production waste, expanded clay, strength, cement, concrete.

Introduction

Cement production is one of the largest-scale industries both globally and in Azerbaijan. Over the past 20 years, due to the growth in construction of residential and industrial buildings, cement production has increased significantly.

The clinker manufacturing process is energy-intensive and associated with significant emissions of carbon dioxide into the atmosphere, negatively impacting the planet's ecology and contributing to the greenhouse effect. Therefore, research aimed at reducing natural raw material usage by incorporating various additives industrial wastes (such as ash, slag, expanded clay, microsilica, etc.) is promising both economically and ecologically [1-8].

Among industries capable of consuming industrial (technogenic) waste, the construction materials sector is the most significant. Production waste or industrial by-products serve as secondary material resources. Many wastes have compositions and properties similar to natural raw materials. It has been established that using industrial waste can cover up to 40% of construction material needs. Utilizing industrial waste reduces costs for manufacturing construction materials by 10–30% compared to production from natural raw materials, enables the creation of new construction materials with superior technical and economic characteristics, and also decreases environmental pollution [7-9].

In expanded clay production plants, large amounts of dust particles wastes with varying dispersity and chemical composition similar to the main production product are generated as by-products.

In the production of expanded clay gravel, the disposal of expanded clay dust, collected in dust collection systems such as settling chambers, cyclones, and filters, poses a significant challenge. Major expanded clay

plants can generate up to 7–8 tons of expanded clay dust daily.

Despite the effectiveness of dust-collecting devices, expanded clay-containing wastes infiltrate all gaps in non-hermetic equipment, polluting the environment. During inspections of one expanded clay plant, four types of expanded clay dust waste were identified, with total daily emissions exceeding one hundred cubic meters. The harmful environmental impact of aluminosilicate wastes, which include expanded clay dust, is associated with the content of aluminum, silicon, iron, and their compounds, and sulfates.

The utilization of ultrafine ceramic brick production wastes as active micro-fillers for concrete is one of the most effective solutions to critical issues in the construction industry. This approach helps obtain high-strength, particularly dense, and durable concretes and reinforced concrete structures, reduces the energy intensity of concrete production, and, when necessary, saves cement.

Despite the variety of cement additives available, their selection is not always justified. Insufficient research has been conducted into the optimal ratios and dispersity of additives relative to cement [5-8].

Currently, there are individual studies on concrete properties using expanded clay dust from various enterprises. However, systematic comprehensive studies on the type, composition, dispersity, and content of expanded clay dust additives on cement and concrete properties and related composite materials have not been performed.

Experimental

The purpose of this study is to investigate the physicochemical properties of cement concrete with expanded clay dust additives collected from cyclones

and filters at the AZKERAMZIT plant in Sumgait, Azerbaijan.

Standard methods were employed to study the properties and structure of raw components, including determining hydraulic activity, grinding fineness, setting time of binders, strength indicators, softening coefficients, etc.

Compression tests were conducted on a computerized flexural-compression testing machine, YAW-300D, with maximum flexural and compressive forces of 300 and 10 kN, respectively. Concrete specimens for compression tests were prepared in special molds

measuring 40×40×40 mm. After molding and special thermal treatment, samples were conditioned according to standards at room temperature for 24 hours. Compressive strength was calculated using the formula:

$$\sigma = F / A$$

where σ is compressive strength in MPa; A is the cross-sectional area of the sample in mm²; and F is the maximum compressive force in N.

Results and discussion

As a result of the conducted studies, the chemical composition and physicochemical properties of expanded clay dust were determined (Tables 1, 2).

Table 1

Chemical composition of expanded clay dust Content in % on a dry weight basis

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	CaO	K ₂ O	Na ₂ O	TiO ₂	MnO	P ₂ O ₅	SO ₃
62,2	17,1	8,1	4,0	2,8	2,5	0,7	1,2	0,3	0,1	0,7

Table 2

Physical and mechanical properties of expanded clay dust

№	Indicator name	Numerical value
1	Mass density, kg/m ³	750-770
2	Grinding fineness (passing through sieve h/c 0.14%)	65÷70
3	Fire resistance, °C	1240-1250

Tables 3 and 4 provide data on the determination of the granulometric composition of the types of ex-

panded clay dust selected for the studies and the hydraulic activity based on lime absorption of expanded clay dust with different grinding fineness.

Table 3

Granulometric composition of expanded clay dust (ECW)

№	Samples	Passing through sieve, %			
		1 mm	0,5 mm	0,2 mm	0,1 mm
1	2	3	5	6	7
1	ECW-1	32	32	29	9
2	ECW-2	9	8	8	67

The feasibility of grinding active mineral additives to 500-600 m²/kg, introduced into slag-alkaline binders, is also discussed in the work [9-11].

Table 4.

Hydraulic activity for CaO absorption of expanded clay dust with different grinding fineness

Expanded clay waste	Grinding fineness, m ² /kg	Activity, mg/g
Clay waste	250	330
	500	459
	800	464

Analysis of research results (presented in Table 4) shows that grinding expanded clay dust to a specific surface area of 500 m²/kg increases its hydraulic activity. Further grinding to 800 m²/kg results in only slight increases, likely due to flocculation of finely ground particles.

Analyzing the composition and temperature range of expanded clay dust formation (normal to approximately 800°C) indicates it should be viewed not as a ceramic material but as thermally activated clay.

The results of the study on the dependence of concrete strength in compression and bending with the addition of expanded clay waste from 2% to 10% are shown in fig. 1, 2.

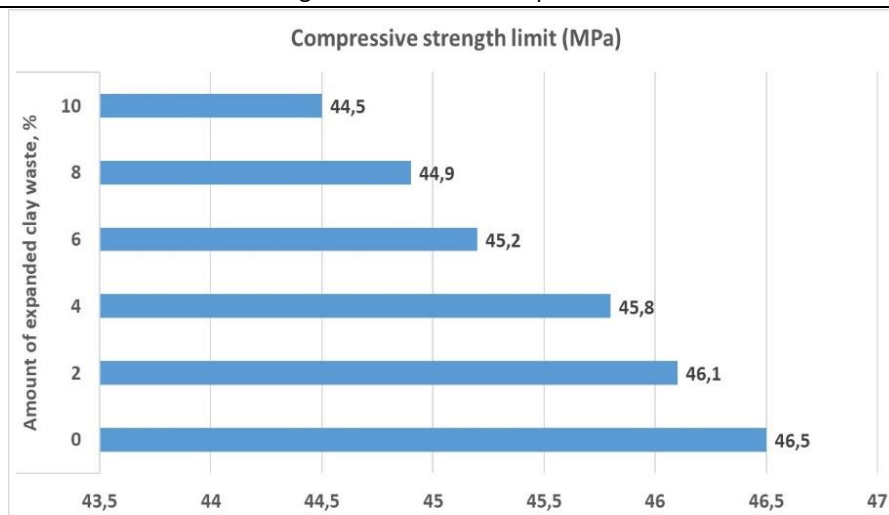


Fig 1. Dependence of concrete compressive strength on the amount of clay filler

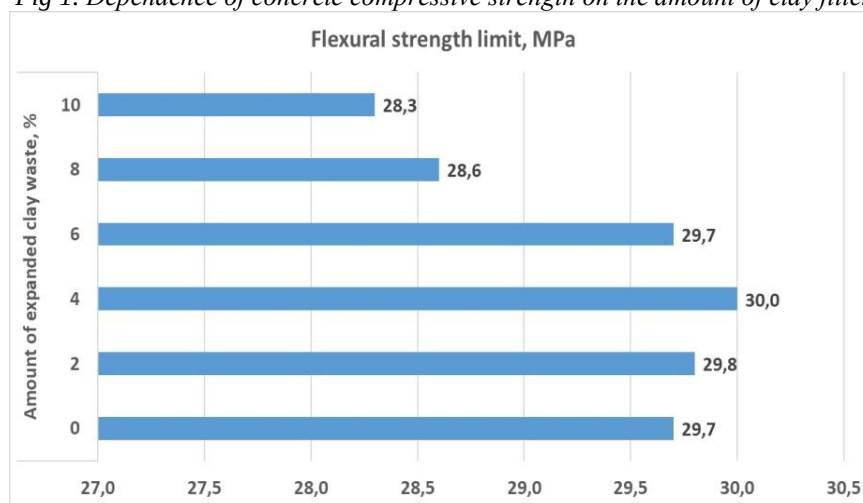


Fig. 2. Dependence of concrete flexural strength on the amount of clay filler

Conclusion

The hydraulic activity of expanded clay powder with different grinding fineness for CaO absorption has been determined. As the grinding fineness value increases, the hydraulic activity increases. Accordingly, when the fineness is 250, 500, 800, the hydraulic activity is 330, 459, 464.

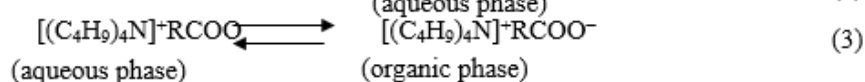
The study of the compressive and bending strength of concrete with the addition of expanded clay dust in an amount of 2 to 10% showed a slight decrease from 46.2 to 44.5 MPa and 29.8 to 28.3 MPa, respectively (fig.1,2)/ Considering the importance of the task of implementing the waste and the environmental factor, such a slight decrease in the strength of concrete does not detract from the relevance of the study and the possibility of using modified concrete.

Environmental and economic importance – The cement production process results in high energy consumption and CO₂ emissions. In addition, the use of industrial waste (ash, slag, ceramic powder, ceramic dust generated in ceramic production, etc.) is efficient. In addition to improving the mechanical and thermal properties of concrete, it reduces the environmental impact of industrial waste.

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The physicochemical properties of some of the raw materials used in the present study are provided below:

Table 1.

Physicochemical Properties of the Raw Materials

Physicochemical Properties of the Raw Materials	Petroleum acid	1,2 – dibromopropane	Catalyst Tetrabutylammonium Bromide (TBAB)
Density, at 20°C, g/cm ³	0.9544	1.98	1.039
Boiling point, °C	120 – 190/6.65 MPa	141	102
Melting point, °C	–	~ -70	102 – 106
Molecular weight, g/mol	206	201.98	322.37
Acid value	272.53	–	–
Refractive index, n_{20}^D	1.4592	1.527 – 1.530	1.422

The synthesis of complex esters of naphthenic acids was carried out in the laboratory in two main stages. In the first stage, naphthenic acid reacted with sodium hydroxide to form the corresponding sodium salt. In the second stage, the obtained sodium naphthenate reacted with dibromopropane, resulting in the synthesis of the ester compound.

Initially, 50 mL of distilled water was added to a 100 mL three-necked flask. Then, 1.7 g of naphthenic acid was added, and under stirring, a 0.4 g solution of sodium hydroxide was gradually added dropwise. The mixture was stirred until completely dissolved and allowed to react for 10–15 minutes to ensure completion of the reaction. The progress of the reaction was monitored by pH measurements and adjusted until a neutral pH was achieved. The resulting sodium naphthenate was then separated from the aqueous phase and dried.

In the next stage, 2.81 g of sodium naphthenate was added to a 100 mL three-necked flask. Then, 2.02 g of dibromopropane and 0.16 g of the phase-transfer catalyst, tetrabutylammonium bromide (TBAB), were added. The reaction mixture was then supplemented with 30 mL of diethyl ether or 0.05 g of toluene as a solvent and stirred at 70–80°C for 4–6 hours.

After the reaction was complete, the mixture was cooled and separated into aqueous and organic phases using a separatory funnel. The organic phase was dried

with Na₂SO₄ and filtered. The solvent was then removed using a rotary evaporator, and the resulting product was analyzed. The purity and structure of the product were confirmed using FT-IR spectroscopy and nuclear magnetic resonance (¹H and ¹³C NMR) methods.

The obtained results showed that the synthesized product was a high-purity naphthenic ester, and the reaction yield ranged from 70–85%. The infrared (IR) and nuclear magnetic resonance (NMR) spectroscopy results of the complex esters obtained in the process are as follows:

IR:1750 cm⁻¹ – C=O (carbonyl)1150 cm⁻¹ – C-O-C (ether)540 cm⁻¹ – C-Br**NMR:**¹H-NMR (δ, ppm)4.1–4.3 – Ether CH₂0.9 – CH₃

11.5 – Carboxyl proton (residual)

¹³C-NMR (δ, ppm)

173 – Carbonyl C

64–66 – OCH₂

This method is highly efficient and optimal for the synthesis of complex esters. After the completion of the process, the yield of the complex ester was 87%.

Table 2.

Physicochemical Properties of the Obtained Complex Ester

Sample	Density (g/cm ³)	T _{gav.} , °C	T _{freez.} , °C	T _{flash} , °C	Mr
RCOOCH ₂ CHBrCH ₃	0.960	185 – 195/ 0.4 – 0.5 kPa	-23	250	458

TBAB is an appropriate catalyst for increasing interphase contact. It accelerates the reaction rate by 2–3 times and ensures a high yield under milder conditions.

The surface-active properties of the obtained ester were investigated, and it was found that it significantly

reduces the surface tension. Specifically, at a concentration of 1.0% by mass in water, the surface tension decreases from 72.2 to 29.5 dyn/cm.

The surface tension values of the obtained ester at the air-water interface are presented in the following table.

Table 3.

Surface-active Properties of the Obtained Ester at the Water-Air Interface, at 20°C

Ester concentration in water, mass %	Surface tension value, dyn/cm
0.1	56.3
0.25	46.7
0.5	38.5
1.0	29.5

Conclusion

An effective method has been developed for the synthesis of halogen atom-containing saturated esters of naphthenic acids derived from petroleum. This method is based on the interaction of sodium salts of the aforementioned naphthenic acids with halogen-containing saturated and unsaturated C₃ hydrocarbons in the presence of a phase-transfer catalyst, tetrabutylammonium bromide.

Optimal conditions for the synthesis of mono-esters with high yields through the interaction of sodium naphthenate with 1,2-dibromopropane in two-phase systems have been determined. The obtained mono-ester has been proposed as a surfactant.

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EARTH SCIENCES

CORRELATION-REGRESSIVE ANALYSIS OF GRAVIMETRIC AND SEISMIC DATA

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Abstract

The article is devoted to the issue of correlation and regression analysis of gravimetric and seismic data. Analysis of geophysical data shows that there is a correlation relationship between geological and geophysical data. This relationship can be studied using methods of probability theory and mathematical statistics. In a particular case, such a relationship can be between geophysical and geological parameters, for example, between gravity exploration data and seismic exploration data on the depth of the geological boundary under study. Such correlation analysis is initially carried out on standard seismic-gravimetric profiles with known values of gravimetric and seismic-geological data. The correlation relationships established on the standard are used to predict geological characteristics based on gravimetric data within the studied (forecast) territory. The Geophysics department of the ASOIU has developed software for correlation and regression analysis of gravity and seismic data MRA-COMSCOM, which allows predicting seismic-geological boundaries in a profile and area version for complexly constructed areas. At the same time, the MS Excel program is currently widely used for correlation-regression analysis of data. The article describes the results of correlation-regression analysis of a seismic-gravimetric profile model using the capabilities of the Excel office program.

Keywords: correlation, regression, forecasting, correlation coefficient, regression, linear relationship.

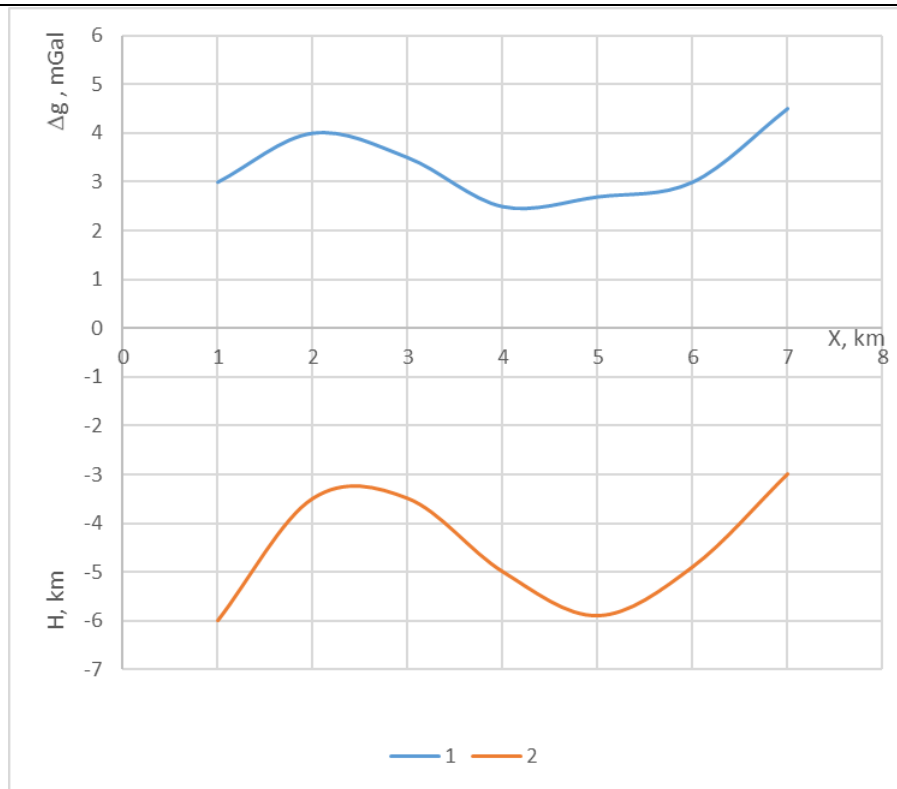
Introduction

Complex interpretation of gravity and seismic data using statistical methods of mathematics is widely used to solve geological problems [1,3,10,11]. Construction of structural schemes for a set of geological and geophysical information using static methods is used mainly in the modification of multivariate regression analysis (MRA) and correlation methods of field transformation (CMFT). In the case of MRA, a statistical relationship is established between the depths of various geological boundaries according to seismic exploration (or drilling) data and the observed values of gravity and its transformants. In the case of reliability, these relationships are extrapolated to areas not studied by seismic exploration or drilling. Since in the complexly structured regions of Azerbaijan and in particular in the Middle Kura Depression, due to complex seismological conditions, it is not possible to obtain unambiguous reference seismic data on the structure of the lower Mesozoic stage, MRA is used using only conventional seismic horizons and data from detailed and high-precision gravity exploration, which correlate well with the curve of the local gravity anomaly [4-6]. At present, the MS Excel program is widely used for correlation and regression analysis of data [2,7-9,12-13]. The purpose of this article is to apply the capabilities of the correlation

and regression analysis of the MS Excel office program using the example of a model seismic-gravimetric profile.

Tools and methods

To perform correlation-regression analysis using the Excel office program, a seismic-gravimetric profile model was initially constructed consisting of one curve of local gravity anomaly and a model seismic boundary (Fig. 1). As can be seen, the gravity curve is characterized by one maximum of gravity (left branch) with an intensity of approximately 2 mGal and a minimum of gravity (right branch) with the same intensity. The minimum of gravity is complicated by a relative maximum of very weak intensity, which does not correspond to the right branch seismogeological boundary. In turn, the seismogeological boundary is dislocated and consists of an anticline and a syncline with an amplitude of 2.5 km. At the beginning, it is necessary to evaluate the quality of the correlation between these curves. In Excel, statistical analysis can be performed in several ways. We used the additional function "data analysis", which must be activated in the Excel properties "options". After activating this function, the "data analysis" button appears on the menu ribbon in the main menu "data". After clicking this button, select the "correlation" option in the drop-down



Legend:

1 is the local gravity anomaly curve (blue); 2 is the seismogeological boundary (red).

Fig. 1. Model of seismic-gravimetric profile

menu. After this, it is necessary to fill in the rows with the original data. This is a column with discrete gravity values taken from the local gravity anomaly

curve and the depth values of the geological boundary model based on seismic exploration or drilling data (Fig. 2). Then we click the

H, km	Δg, mGal
-6	3
-3.5	4
-3.5	3.5
-5	2.5
-5.9	2.7
-4.9	3
-3	4.5

Fig. 2. Table of gravity and seismogeological boundary values

OK button and receive the following characteristics of the correlation relationship on a new sheet (Fig. 3).

	Column 1	Column 2
Column 1	1	
Column 2	0.854841	1

Fig. 3. Results of correlation analysis of seismic-gravimetric data

As can be seen from the figure, the correlation coefficient of the linear dependence is 0.854841. This

means that the relationship between seismic and gravimetric data is good and positive since the correlation coefficient has a positive sign.

Next, it is necessary to perform a regression analysis of the model seismic-gravimetric profile data. To do this, select the regression function in the "data anal-

ysis" menu and fill in the rows with the initial data. After performing this function, we obtain the following results (Fig. 4).

H1												
	A	B	C	D	E	F	G	H	I	J	K	L
1	SUMMARY OUTPUT											
2												
3	Regression Statistics											
4	Multiple R	0.854841										
5	R Square	0.730753										
6	Adjusted R Square	0.676904										
7	Standard Error	0.690616										
8	Observations	7										
9												
10	ANOVA											
11		df	SS	MS	F	Significance F						
12	Regression	1	6.472388	6.472388	13.57034	0.014237						
13	Residual	5	2.384755	0.476951								
14	Total	6	8.857143									
15												
16												
17												
18												
19												
20												
21												
22	RESIDUAL OUTPUT						PROBABILITY OUTPUT					
23												
24	Observation	Predicted Y	Residuals	Standard Residuals			Percentile	Y				
25	1	-4.99347	-1.00653	-1.59655			7.142857	-6				
26	2	-3.55971	0.05971	0.09471			21.42857	-5.9				
27	3	-4.27659	0.776588	1.231812			35.71429	-5				
28	4	-5.71034	0.710345	1.126738			50	-4.9				
29	5	-5.42359	-0.47641	-0.75567			64.28571	-3.5				
30	6	-4.99347	0.093466	0.148255			78.57143	-3.5				
31	7	-2.84283	-0.15717	-0.2493			92.85714	-3				
32												
33												

Fig. 4. Results of regression analysis of seismic-gravimetric data

As you can see, the results of the regression analysis are displayed here: regression analysis statistics, variance analysis results, and regression analysis coefficients. The statistics of regression analysis include the correlation coefficient value calculated in the previous step, the R Square coefficient equal to 0.730753, which characterizes the quality of the model, the adjusted R-square is a corrected measure of goodness of fit for linear models (model accuracy), the value of which is 0.676904, the standard deviation equal to 0.690616 and finally the number of data equal to 7. The analysis of variance includes the degree of freedom df equal to 1, the variance of deviations SS (the sum of the squares of the deviations of the predicted value from the mean) equal to 6.472388, the standard error MS (the mean value of the sum of squares divided by the degrees of freedom of the regression and residuals) equal to 6.472388, the Fisher coefficient F equal to 13.57034 and the significance F equal to 0.014237. Next, the coefficients of regression analysis are given: coefficients

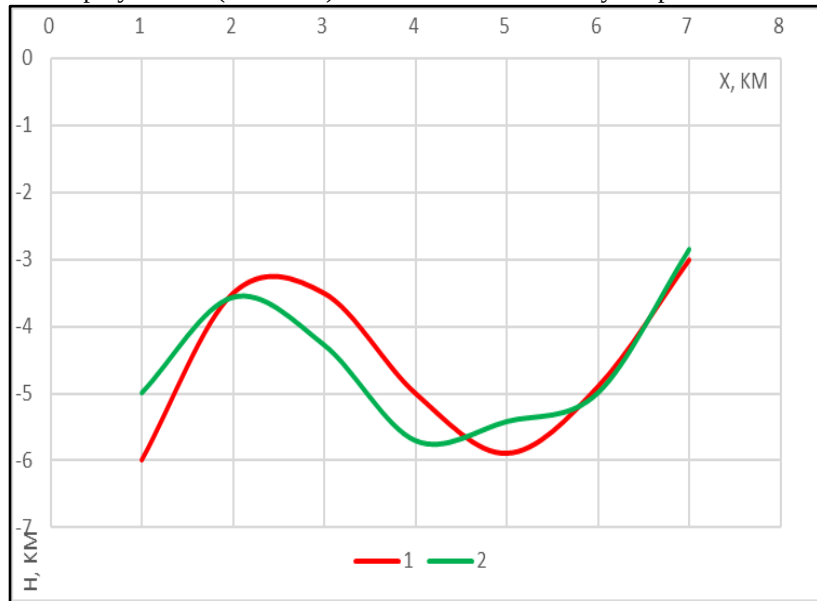
of the regression equation, t-statistics, Pearson's p-coefficient, lower and upper confidence intervals of statistical parameters. At the end, the results of the forecast are given: initial depths, residual deviations and probabilities of the values of the depths of the studied boundary. Thus, we obtained the following regression equation:

$$H = -9.29474 + 1.433757 \Delta g \quad (1)$$

A graphical representation of the results of the seismic boundary prediction on the reference model profile is given below (Fig. 5). As can be seen, good agreement is observed in the interval of 5.8-7 km and at the point of 1.8 km on the observation profile. In other areas, a discrepancy of approximately 0.6 km is observed. It should be noted that the regression analysis was carried out for the linear version of the dependence of the initial data. Let us analyze possible options for the dependence between seismic exploration and gravity exploration data (Fig. 6). The figure shows three options for approximating the curve of the dependence of

the depth of the model boundary on the values of the local gravity anomaly: linear trend analysis, logarithmic trend analysis and polynomial (nonlinear) trend

analysis. In all three cases, we can say that the effect is the same. Thus, the linear option for predicting the model boundary is optimal.



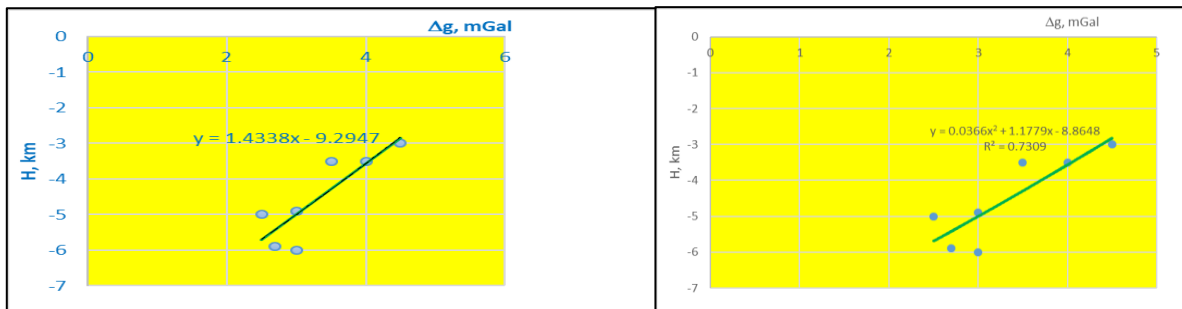
H, km	-5	-3.6	-4.3	-5.7	-5.4	-5	-2.8
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Legend:

1- actual curve of the model seismic boundary (red);

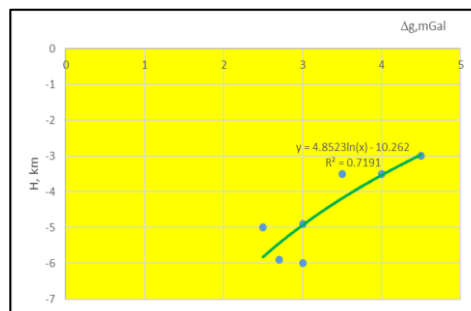
2- predicted curve of the model seismic boundary (green)

Fig. 5. Results of the seismic boundary prediction on the reference



Linear trend

Polynomial



Logarithmic trend

Fig. 6. Results of trend analysis of seismic-gravimetric data

Conclusions:

1. The statistical foundations of correlation methods for interpreting geophysical data and methods for establishing correlations between geological and geophysical data are considered. The possibilities of correlation-regression analysis of data in the MS Excel office program are studied for using these capabilities in the complex interpretation of geological and geophysical data by correlation methods.

2. A model of a seismic-gravimetric profile is compiled, which consists of a curve of a local gravity anomaly and a seismic-geological boundary based on seismic exploration data. The curve of a local gravity anomaly has one maximum and minimum of gravity and approximately displays a dislocated geological boundary obtained from seismic exploration data.

3. Correlation and regression analysis is performed between the model data of gravity exploration and seismic exploration using the capabilities of the MS Excel office program. A correlation relationship between these data is established and statistical characteristics of these relationships are given. Based on regression and trend analysis, a regression equation was compiled, with the help of which an optimal forecast of the seismic-geological boundary on the reference profile was made.

4. The MS Excel program has good capabilities for statistical analysis of geological and geophysical data and can be very useful at the preliminary stage of complex interpretation of gravimetric and seismic data of complex areas using multidimensional regression analysis methods and correlation methods of separation and transformation of fields.

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ECONOMIC SCIENCES

TRANSNATIONAL TOURIST DESTINATION MANAGEMENT

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Abstract

The specifics of tourism destination management are widely covered in the scientific literature; however, the management of transnational destinations spanning multiple countries' territories has not been extensively studied to date. The practical cooperation of key stakeholders conditions the development of transnational destinations. The conditions for this are primarily created in coastal regions, against the backdrop of intensive development of integration processes. For example, the Baltic Sea region became the first macro-region of the European Union to implement a transnational strategy. Within this framework, tourism was recognized as a priority for the region's development. The key task in this process was to create an effective system for tourism destination management. This paper aims to define the concept of transnational tourism destination management and to provide a critical analysis of it. One of the study's objectives was to determine the nature of the changing determinants of tourism management in the Black Sea region and the relationships between key stakeholders. The author reviewed the existing scientific literature on tourism destination management and conducted a critical analysis of secondary sources, including documents, information materials, and Internet resources. Participant observation was chosen as the research method. The study identified three models of tourism destination management: marketing-oriented, planning-oriented, and management-oriented.

Keywords: Transnational tourism destination, tourism destination management, international cooperation, Black Sea region.

Introduction

At the end of the 20th century, due to geopolitical changes in Europe, the Baltic Sea region became an area of dynamic socio-economic cooperation. Georgia's status as an associate member of the European Union strengthened this cooperation. The next stage of the country's integration was the development of an innovative EU Strategy for the Black Sea Region in 2022.

This article presents a comparative analysis of the current concept and previously studied approaches to tourism destination management in the Black Sea countries. This approach helps to identify the determinants of tourism cooperation in the Black Sea region and contributes to the development of the concept of transnational tourism destination management. Of all the EU macro-regions, the BSR is the most advanced in developing transnational tourism; as a result, it serves as a testing ground from which the experience can be applied in other EU macro-regions. Discussion

There are many definitions of the term "tourist destination" in scientific literature; however, despite the various interpretations, the following main provisions can be identified when characterizing it:

- 1) a territory (commune [1], space, district, region, place [2]) that makes up the destination of tourists [3];
- 2) a set of entities (institutions [4], clusters [5]) that create conditions for tourism in the visited area;
- 3) a set of products consumed by visitors during their stay in this territory [6];
- 4) a set of impressions (sensations) that visitors receive from staying in this area [7].

Different approaches to defining the term "tourist destination" complement each other, which allows us to characterize it more fully [8].

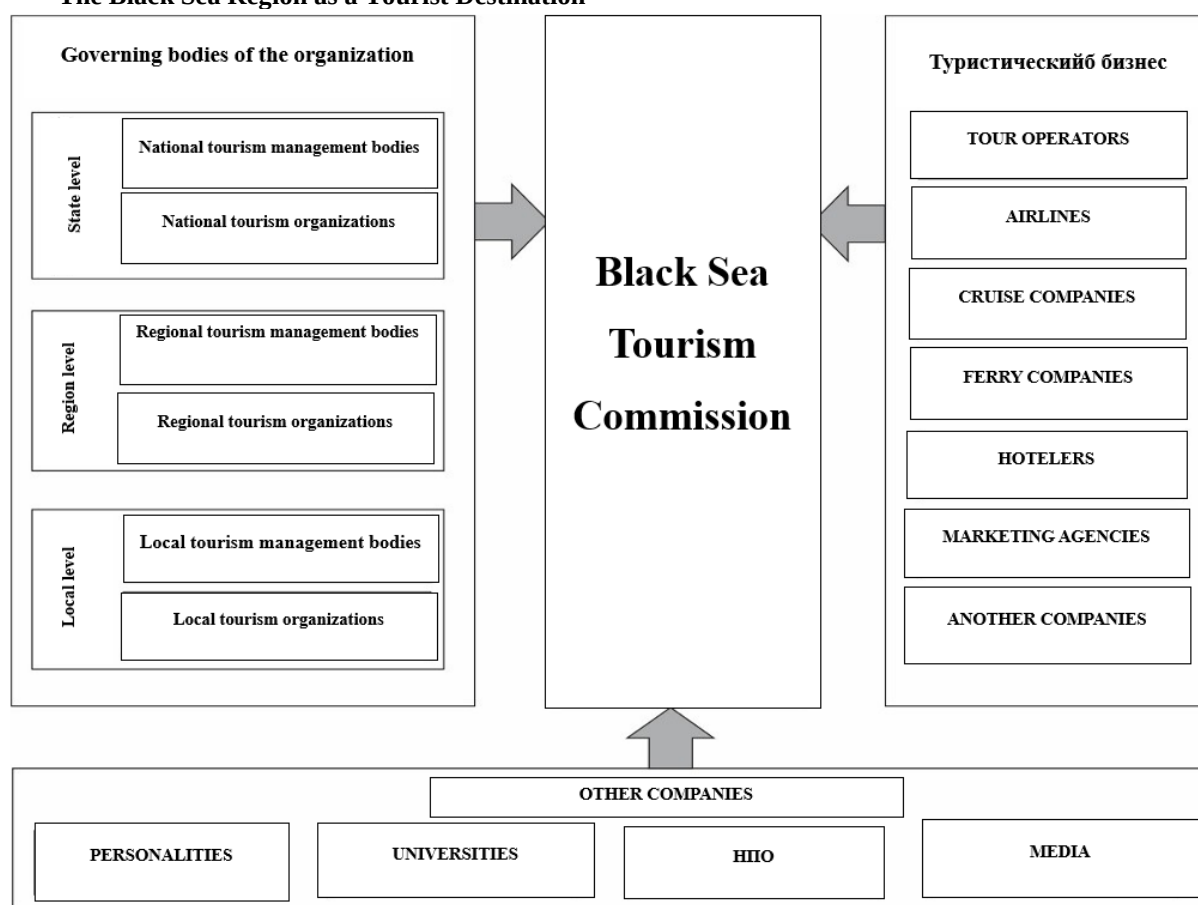
According to the definition given by the World Tourism Organization (UNWTO), a tourist destination is "a physical space in which a visitor spends time with at least one overnight stay. It encompasses tourism products, including services, attractions, and resources, all within a single day of travel. This space has physical and administrative boundaries that determine the way it is managed, images and perceptions that create its market competitiveness." In turn, in the Guidelines of the European Commission on the Management of Sustainable Tourism Areas, a destination is characterized as:

1. a geographical area currently or potentially attractive to visitors/tourists;
2. a place or area that is clearly defined as a visitor destination and has a range of facilities and products that can be used for tourism purposes;
3. a place or area that is promoted as a destination for a tourist or consumer of tourism services;
4. a place or area where the visitor management process typically involves a range of public and private sector stakeholders, including the host community;
5. a place or area in which the supply of and demand for tourism services, i.e., the visitor economy, can be determined.

Numerous scientific studies demonstrate that tourist destinations are pivotal points for tourism development [9] and, consequently, for the study of tourism. At the same time, the difficulties of destination management stem from its complex nature [10], precisely the fact that destination management is carried out through a wide range of tools [11]. Destination management is often carried out by specialized professional institutions, known as destination management organizations [12]. Another standard solution is joint destination management, which

involves government bodies and organizations collaborating on specific types of work [13]. These tasks primarily concern marketing [14]; therefore, such organizations are referred to as “destination marketing organizations” [15]. In the case of international destinations, implementing management is significantly more complex, which is caused, among other factors, by different administrative structures, legal frameworks, and incompatibilities in tourism management systems. This is why researchers and practitioners are seeking new organizational, legal, and economic solutions to support the development of transnational tourism [16]. To manage tourist destinations, solutions developed within the framework of the theory of multilevel management [17] are utilized and adapted. They involve the inclusion of key stakeholders from the destination in the management process. In this way, the costs of developing tourism in the destination are shared among stakeholders.

The Black Sea Region as a Tourist Destination



The promotion of the Black Sea region as a transnational tourism destination began with the collapse of the USSR and the independence of the post-Soviet and Eastern European countries. In Europe, cross-border cooperation has been developing dynamically, encompassing not only countries but also regions and cities. The foundation for the sustainable development of the destination was the idea of leveraging the region's attractive historical and natural heritage, numerous connections between the states located on the Black Sea, and the willingness to cooperate, as highlighted by the enthusiasm expressed by the main stakeholders for tourism purposes. Since then, various destination management solutions have been implemented, categorized

The lack of a unified approach to understanding the boundaries and composition of the Black Sea region means that the issue of delimiting destinations in this region remains unresolved. There are many definitions of the term "Black Sea region" [18]. Undoubtedly, this region includes countries that have access to the Black Sea, but in some cases Belarus and Armenia, which do not have such access to the Black Sea, are also considered part of the region; these countries are located in the Black Sea basin and are functionally connected with the rest of the countries in the region.

For this study, it is permissible to assume that the Black Sea region covers the territories of Russia, Ukraine, Romania, Bulgaria, Turkey, Georgia, three of which (Romania, Bulgaria, and Turkey) are NATO member states, and two (Ukraine and Georgia) are partner countries. The EU member states are Ukraine, Romania, Bulgaria, and Türkiye.

into three models: marketing and planning. The Black Sea Tourism Commission is a marketing-oriented destination management body that needs to be established. This commission would serve as an institution coordinating the marketing activities of key structures within the tourism system of the Black Sea region. It would be registered in a neutral European country, such as Switzerland, as an international non-governmental organization. The idea for its creation emerged during the Black Sea Scientific and Practical Tourism Conference in Istanbul, Turkey, in 2022. The initiators of this organization should include representatives from the tourism industry, including tour operators, air carriers, sea carriers, and hoteliers. Additionally, government

bodies, local governments, tourism organizations at the national, regional, and local levels, and representatives

from the social sector should contribute. Additionally, consider becoming a member of the BTC (Fig. 2).

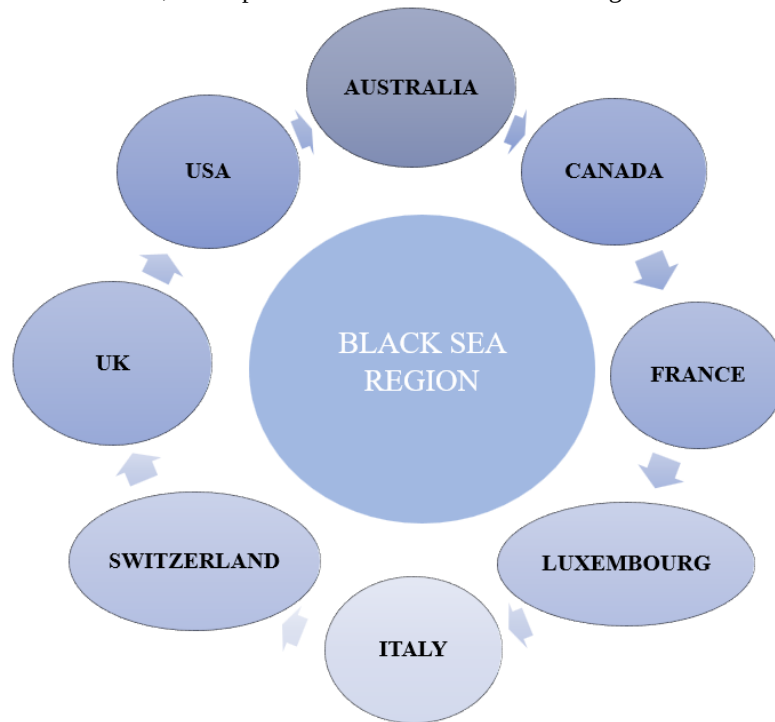


Fig. 2. Tourist sending countries that are members of the Black Sea Tourism Commission

It is worth noting that the Baltic Commission, for instance, included not only representatives of the relevant destinations but also organizations, primarily tour opera-

tors, from countries that send tourists (Fig. 3). This structure was instrumental in promoting tourism products in target markets, including foreign ones.

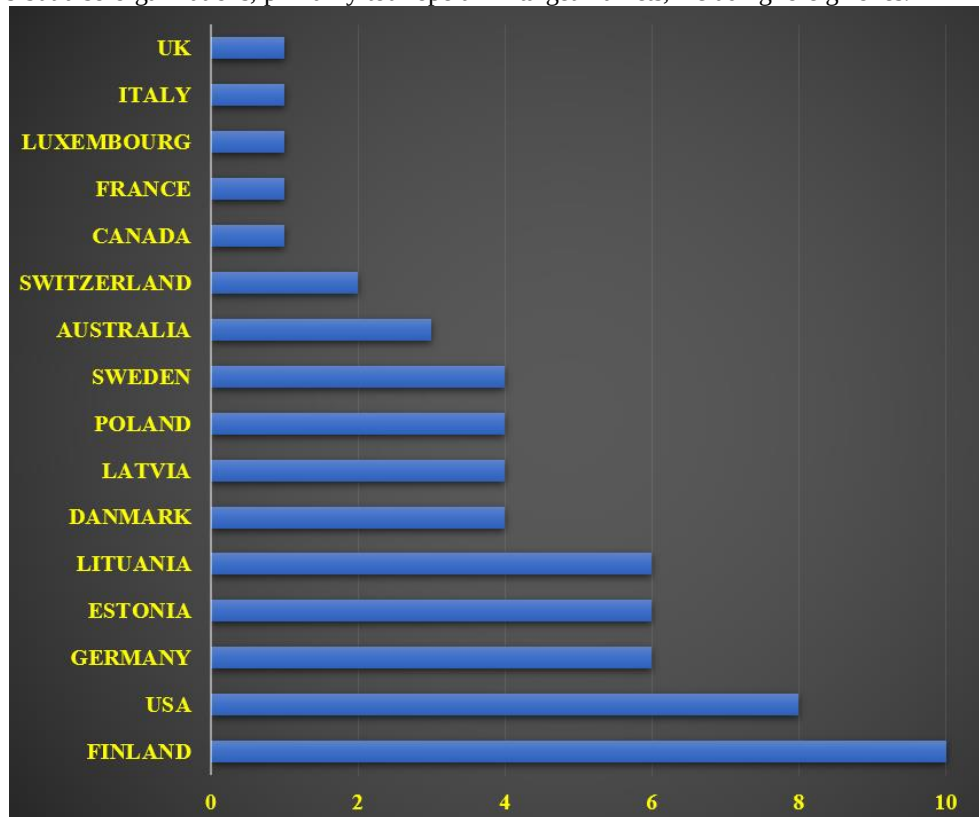


Fig. 4. Number of participants of the Black Sea Tourism Commission from different countries

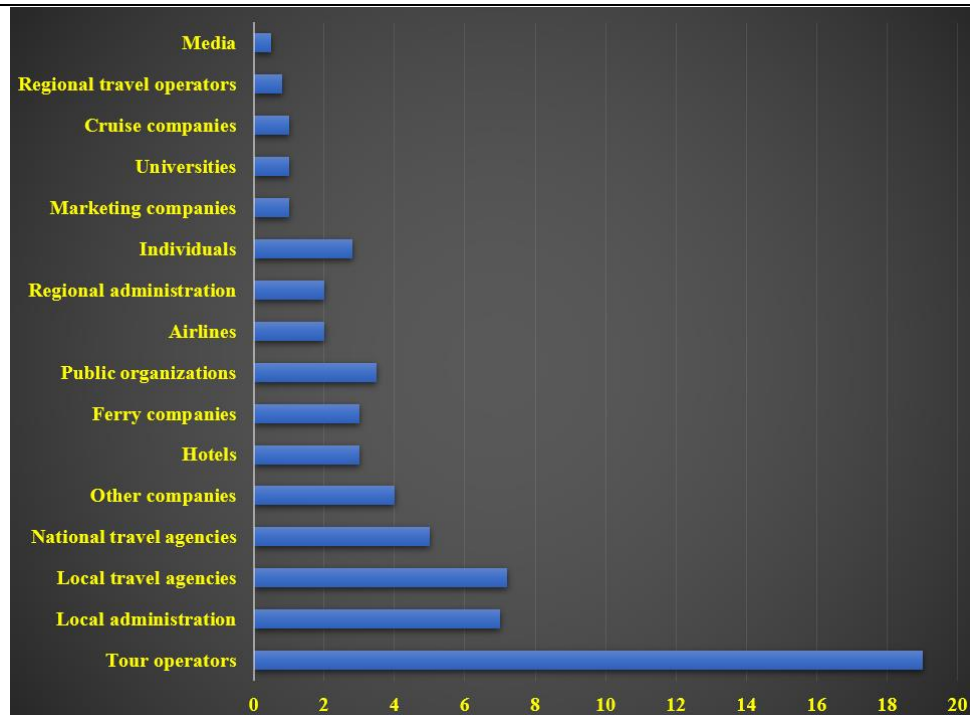


Fig. 5. Number of participants of the Black Sea Tourism Commission representing different categories

To enhance the coordination of its activities, the Black Sea Tourism Commission should establish branches in several countries within the Black Sea region. Its representative office should be located in Georgia, which is determined by the following circumstances: as noted, (i) Georgia is a link between European and Asian countries (in this case, between Turkey and the countries of Eastern Europe); (ii) in addition, by the countries of the Black Sea destination we also mean Belarus, Azerbaijan, Moldova and Armenia, which can use the ports of Georgia for direct water communication with the countries of Europe. Thus, although indirect, the connection with the countries of the Black Sea will strengthen economic, cultural, and political ties in the region.

Network for Sustainable Tourism Development in the Black Sea Region: Planning-oriented Destination Management

The Network Sustainable Tourism Development in the Baltic Sea Region (NSTDBSR) platform was established by academic institutions and environmental organizations in the BSR as a bottom-up initiative. The organizers aimed to ensure sustainable tourism development in line with the guiding principles outlined in Agenda 21, developed at the Earth Summit in Rio de Janeiro in 1992.

The Black Sea Tourism Centre: Management-oriented Destination Management. The Black Sea Tourism Centre will be an innovative tool for managing a

multi-level tourism destination. Its creation will be the result of long-term, synergistic cooperation in the Black Sea region, with a focus on tourism.

The European Commission adopted the EU Strategy for the Black Sea Region in June 2009. The pilot program was developed for the Baltic countries – former Soviet Union members – Estonia, Latvia, and Lithuania. The strategy implemented intergovernmental (e.g., VASAB or HELCOM projects) and transnational (bottom-up) cooperation in these countries and harmonised them within the EU cohesion policy. The strategy therefore does not replace existing networks and relationships [23], but instead leverages them [24]. The plan comprises four horizontal actions, three objectives, and 13 priority areas. Tourism policy is one of the 13 current common policy areas, the implementation of which focuses on the thematic areas of action carried out within the integrative framework – the EU Strategy for the Black Sea Region – and aimed at addressing the current and future challenges of the Black Sea region. Figure 6 provides an overview of the Action Plan of the Strategy, which defines its common objectives, policy areas, and horizontal actions. Tourism was assigned to the objective ‘Increasing prosperity’, mainly due to the estimated economic potential of the region.

Establishing an institution responsible for managing tourism destinations will take several years to accomplish. This topic was discussed at the Black Sea Tourism Forum.

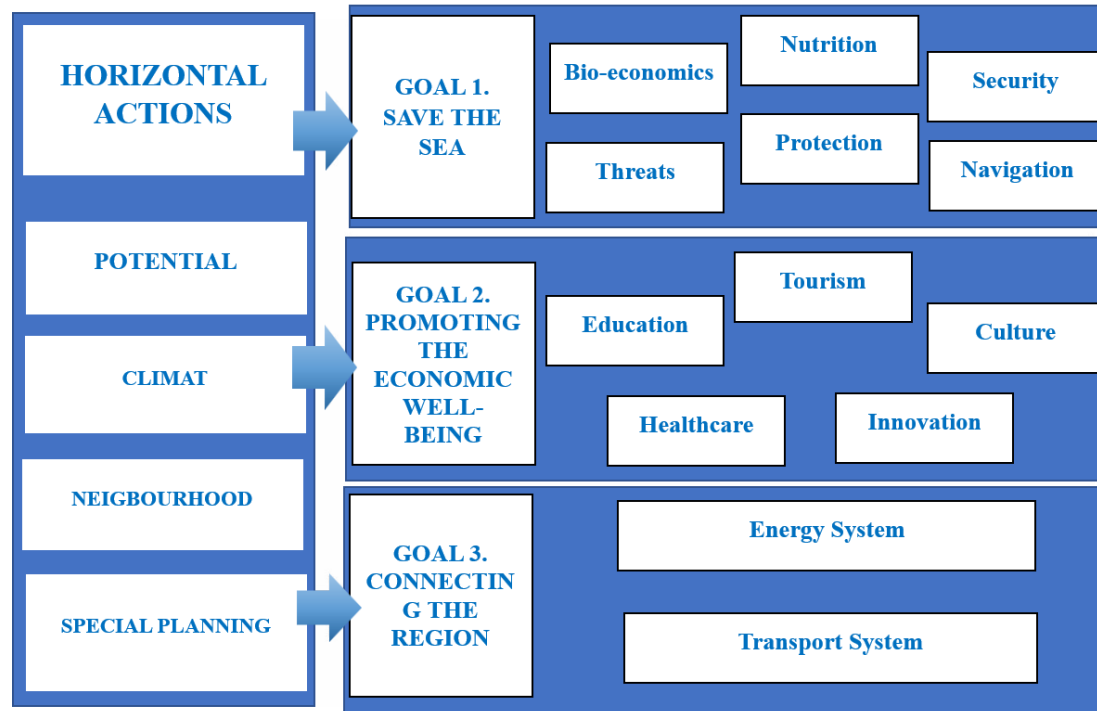


Fig. 6. Model of the EU Strategy for the Black Sea Region

The Black Sea Tourism Centre should be coordinated by the Ministry of Economy, Employment and Labour of Georgia. Organisations from the Black Sea countries should be involved in the development process. The institution aims to become a leading Centre of expertise, advocating for tourism development in the Black Sea region, fostering partnerships, and disseminating ideas and knowledge. We have identified the following tasks as the most important:

- pooling resources, sharing new knowledge to ensure readiness to respond to relevant trends;
- sharing experiences to solve common problems;
- providing information and enabling comparative analysis;
- obtaining information on participants, projects, and initiatives through coordination and strategic use of project results;
- supporting training and product development in the sectoral areas;
- increasing the importance of the territories, countries, and the entire Black Sea region as a tourist destination.

The management model of the Black Sea Tourism Centre, developed in 2018, is based on the concept of multi-level management. [26; 27]

It should be emphasized that the COVID-19 pandemic in 2020 halted all work at the Baltic Sea Tourism Centre and the study of creating a similar Centre for Black Sea countries, with headquarters in Georgia. The current situation is a serious threat to the development of tourist destinations. Numerous studies confirm that the European Territorial Cooperation funds play a key role in the development of tourism in border areas [29]. Meanwhile, the EU project to finance the Black Sea Tourism Centre has recently been completed, and alternative means of ensuring the continued existence of the management structure have yet to be identified.

Conclusion

The Black Sea region can be considered a transnational destination. It is distinguished by its high tourism potential, including transnational attractions, shared history, and fruitful long-term cooperation. However, the definition of the boundaries of the BSR is controversial, and therefore, the definition of the destination's boundaries is problematic. A reasonable definition of the boundaries suggests that the Region encompasses the Black Sea countries, Armenia, and Azerbaijan, among others. Additionally, Belarus, which is not part of the Black Sea region, occasionally participates in tourism cooperation. Organizations that co-manage tourism destinations typically include representatives from central and local administrative units, national and regional tourism organizations, as well as local entrepreneurs. Public organizations and educational institutions have limited participation. Numerous attempts have been made to coordinate tourism cooperation, and various tourism management structures have been established. To date, three concepts of tourism destination management have been implemented: marketing-oriented, planning-oriented, and multi-level management-oriented. The primary stakeholders involved in this process are large enterprises, including airlines, ferry companies, and hotel chains, which typically benefit significantly from membership in the Black Sea Tourism Commission and are therefore willing to finance the organization's activities.

The second concept is planning oriented towards tourism development based on the principles of sustainable development. The network for sustainable tourism development was created mainly by educational institutions, as well as environmental and public organizations. Valuable theoretical solutions were developed, but not the tools for their practical application. Unfortunately, this cooperation was financed by EU funds,

and with the completion of the relevant projects, funding for continuation of the work was not possible. The concept of multi-level tourism destination management is exciting due to the synergy between the Black Sea Tourism Center, the Black Sea Tourism Forum, and the EU Tourism Development Strategy at its core.

An analysis of the evolution of tourism destination management shows that maintaining the stability of the management structure requires significant financial participation of stakeholders. EU funds should only be used to establish management structures, but they cannot serve as the basis for their ongoing activities. Currently, the economic sector's role in the multi-level tourism management system in the BSR is limited. Public stakeholders are moderately involved in the development of transnational destinations, as they probably do not see sufficient benefits in cooperation.

One way to develop the destination is to use the opportunities provided by the constantly evolving EU Strategy for the Development of the Black Sea Region. This is a tool worth using, which will enable further activities related to the development and promotion of the BSR as an attractive, sustainable, and accessible transnational tourism destination.

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STRATEGIES FOR ENTERING INTERNATIONAL MARKETS IN THE PACKAGING INDUSTRY: RISK AND OPPORTUNITY ANALYSIS FOR SUSTAINABLE GROWTH

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Abstract

This article analyzes strategies for entering international markets in the packaging industry with a focus on risks and opportunities for sustainable growth. It examines key challenges such as globalization, technological changes, shifts in consumer preferences, and environmental requirements. Special attention is given to innovative approaches to sustainable packaging production and adaptation to environmental standards, which have become an important aspect of successful international expansion. The description of the most effective methods for risk mitigation and the application of modern technologies in the packaging industry helps companies enhance their competitiveness and ensure long-term sustainability in the global market.

Keywords: international markets, packaging industry, sustainable development, innovations, environmental standards.

Introduction

Globalization of economy and international trade exchange process reforms pose absolutely new opportunities and place very serious tasks in front of different types of companies. Internationalization of packaging industry had taken an active role over the last two years. This includes a wide variety of variables, from a shift in consumer demand, green policies, and import-export restrictions.

Meanwhile, the way in which packaging companies enter international markets is fraught with such risks as political instability, currency fluctuations, and economic crises, not to mention many regulatory challenges. Within the last few decades, the ecological requirements for packaging—for instance, reducing the usage of plastic and switching to biodegradable materials—have turned into a serious factor of choice for the strategy of entering international markets. These factors

have influenced not only the financial costs of companies but also their capability for adaptation to global trends in sustainable development. Therefore, research is needed regarding international market entry strategies in the packaging industry, through which recommendations can be developed on the best paths to achieve sustainable growth and successful adaptation to changing global economic and market conditions.

Main part. Global packaging market: current status and trends

The global packaging market is continuously showing its robust growth as part of international trade and economic processes. In 2023, the value of the global packaging market reached over \$1,1 trillion and is expected to grow at a CAGR (Compound Annual Growth Rate) of 4-5% by 2028, reflecting the consistently high demand for packaging materials worldwide (fig. 1).

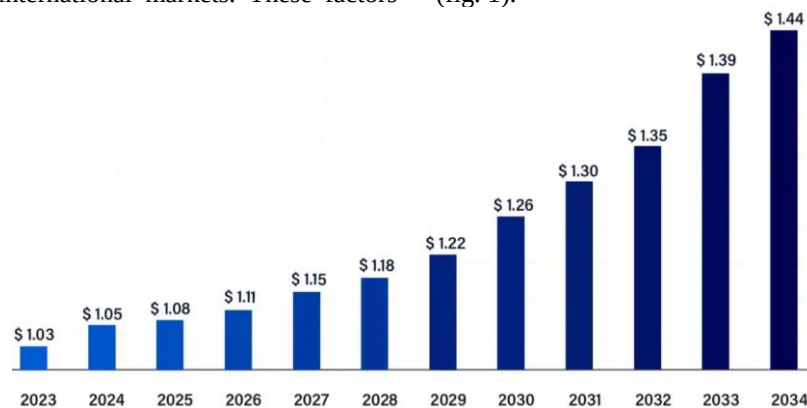


Figure 1. Packaging material market size 2023 to 2034, trillion dollars [1]

Some of the drivers include increasing consumer demand, e-commerce expansion, and an escalating demand for sustainable solutions. Sustainable packaging solutions are one of the trends that can easily be witnessed in the international packaging market. By pressure group lobbying and even by legislation, organizations are compelled to reduce their use of plastic and thus continuously try to produce packs that have minimal negative impacts on the environment. Biodegradable and compostable material development, for example, or developing packaging that contains recyclable content, is all in this category.

Besides, digitization of the packaging industry plays a significant role. Inclusions of the Internet of

Things, digital printing, and attachment to tracking systems are already integral components of the packaging process. These will allow companies to further enhance supply chain transparency, quality of a product, and tracing status of packaging in real time. It opens new opportunities for logistics process improvements with high levels of customer service.

Further, the global packaging market is shifting towards smart packaging, embedding sensors to monitor the quality and safety of products. Smart packaging has turned into a very significant constituent for industries such as food, pharmaceuticals, and cosmetics, in which shelf-life control and/or storage conditions are important [2].

Important changes in the global packaging market, therefore, are focusing on sustainable development, technological innovation, and increases in the efficiency of production. Most importantly, these changes affect international competition and the entry strategy companies utilize in foreign markets. Consequently, with a view to successful expansion in the international arena, packaging companies need to take into account both the macroeconomic factors and technological trends, not only to meet the demands of consumers but also to minimize their environmental footprint.

Macroeconomic factors and their impact on exit strategies

Macroeconomic factors determine the international market entry strategies of packaging companies. Such changes in the economic environment may strongly influence the financial stability of companies and their possibilities for international expansion due to global financial crises, inflation, exchange rate fluctuations, and trade barriers. **Changes in currency rates**, in particular, directly affect production and transportation costs, which, in turn, modify the attractiveness of export strategies for companies specializing in packaging.

Moreover, **economic crises** are a strong force behind the supply and demand of international markets. During a crisis, companies try to reduce their costs, which has a tendency to cut down demand for packaging, especially for expensive or specialty forms of packaging solutions. At the same time, a crisis may increase demand for cheap and high-efficiency packaging solutions, opening up new opportunities for companies targeting the economy segment.

The other significant consideration in the design of the international market entry strategy is customs

tariffs and trade barriers. The imposition of new tariffs, quotas, or other bans will double the price of supplies and make the market less attractive to exporters. Particular emphasis was given to the need to change strategic priorities, especially after the imposition of tariffs between the USA and China in 2018, which forced various organizations to reallocate production capacity from country to country and region to region for cost expense reduction purposes [3]. With this, it becomes especially crucial to choose an optimum mode of entry—from direct investment to joint ventures with local partners, which avoids tariff risk and political risk.

Another important **macroeconomic factor** that affects the businesses in the global market is the process of economic globalization and the signing of international trade agreements. Trade agreements, such as free trade agreements, create ease of entry into new markets because there are fewer administrative and trade barriers. Packaging businesses can use such agreements in an attempt to strengthen their positions in the global market because of improved terms for import and export [4].

Regulatory barriers and their role in exit strategies

Regulatory barriers play an important role in packaging firms' internationalization and exert a substantial influence on the strategy of expansion and product adaptation decision. They include quality standards, environmental law, safety and packaging law, and consumer protection law. A awareness and respect of these regulations are key to minimizing the risk of local legislation violation and penalties (table 1).

Table 1.

Regulatory barriers and their impact on market entry strategies in the packaging industry

Regulatory barrier	Description	Impact on market entry strategies	Example
Environmental requirements for recycling and waste disposal	Legislation regulating packaging recycling, restrictions on certain materials.	Requires adaptation of packaging to meet environmental standards, transition to recycled materials.	European Commission: «European Green Deal».
Packaging labeling and safety standards	Safety and quality standards for packaging, such as FDA requirements in the USA	Companies must comply with local standards, impacting packaging material selection and production methods.	FDA standards for food packaging in the USA
Customs tariffs and quotas on packaging materials imports	Regulation of trade tariffs and restrictions on packaging imports, increasing customs duties.	Encourages creation of local production facilities and joint ventures to minimize costs.	High tariffs on plastic packaging in South America.
Legislative restrictions on plastic use	Laws restricting or banning the use of plastics in packaging, requirements for biodegradable materials.	Requires change in packaging composition and transition to eco-friendly alternatives.	Ban on single-use plastics in the EU.
Regulation of chemical additives in packaging	Restrictions on the use of certain chemicals in packaging materials.	Necessitates compliance with chemical composition regulations, affecting production technology.	Strict regulations on chemical additives in packaging in India.

Another of the key regulatory drivers will have to be environmental policy, especially in the face of increasing calls to reduce plastic usage and replace with

more eco-friendly materials. Within the European Union alone, strict regulation is placed on recycling and disposal methods related to packaging and recycling

material use requirements. The European Green Deal strategy was adopted by the European Commission in 2021 with a carbon emission and making packaging more sustainable target. Its implementation is a serious investment in technological change and product modification, which will be necessary for any packaging company intending to enter the EU market. For instance, packaging companies in Europe must comply with the Packaging and Packaging Waste Directive, (94/62/EC), that has created standards for packaging design that should be recyclable or reusable [5].

Apart from the above requirements, regional product safety and quality requirements differ, thereby necessitating compliance with national laws by companies. For example, in the USA, food packaging has to comply with FDA (Food and Drug Administration) requirements, while in Asian countries, there are other regulations on the safety of packaging, especially food-contact packaging. Some countries have strict rules even for packaging labelling, e.g., listing the ingredients, shelf life, as well as the use of chemical additives. Failure to follow these rules can lead to extremely heavy fines or the banning of the sale of the products.

Another big regulatory barrier includes customs duties and quotas, which can significantly increase the export cost of packaging products. Some countries do not allow or have restricted importation of packaging materials; therefore, companies are obliged to seek ways of overcoming such obstacles. South American countries have very high customs duties for importing plastic packaging, and companies would be obliged to either find local partners or invest in local production. It is also encouraging in the selection of strategies like joint ventures or localization of production, which decrease dependency on international trade barriers [6].

Therefore, regulatory barriers are one of the most influential factors in the choice of strategy to enter international markets. Companies should take these into consideration while devising their strategies, keeping in view the local laws and standards to avoid legal risks and maximize their possibilities for successful expansion.

Strategies for adaptation to macroeconomic and regulatory challenges

Adaptation to macroeconomic and regulatory concerns is among the most crucial elements of a successful strategy for packaging companies to grow in international markets. These concerns require flexibility and the ability for swift response to changes in the external environment with the aim of mitigating risks and maximizing the opportunities that arise in a dynamic context [7].

One of the most effective ways is **production localization**. As exchange rates fluctuate unpredictably, customs tariffs rise, or trade barriers exist, the relocation of production facilities close to target markets reduces logistics costs and enables greater responsiveness to changes in demand. For example, Amcor, a packaging giant, has invested in local production capacities in high-duty countries such as India and China in order to lower costs and make its products more competitive [8]. Localization also allows for easier compliance

with local regulatory requirements, such as environmental and safety standards.

Another approach is to collaborate with **domestic firms**. Under a situation of stringent regulatory constraints and product standards, joint ventures or collaborations with local firms can assist in resolving compliance issues efficiently. This enables the firm to utilize local market intelligence and existing relationships, which ensures quick entry into the market and minimizes the time taken to conform to local conditions.

Also, new solutions for sustainability are arising as a major factor in adapting to macroeconomic and regulatory issues. A shift towards greener materials and producing packages with tight recycling requirements is now a necessity not only to remain within the pages of local legislation, but to improve company reputation.

The **diversification** of a **product portfolio** is another significant adaptation strategy. Many packaging companies targeting international markets often face the need to provide solutions that are demanded by particular country and industry needs. Development of multi-functional packaging solutions, adaptable under varying conditions of storage and transportation, will facilitate effective work in various parts of the world, with considerably varied economic and regulative conditions.

Thus, the successful companies operating in international packaging markets have to be ready to change their strategy in response to macroeconomic and regulatory challenges. Localization of production, partnership with local companies, implementation of innovations, and diversification of the product portfolio are becoming the main tools for ensuring sustainable growth and minimizing risks in a changing external environment.

Conclusion

All strategies regarding entry into international packaging markets would need to incorporate all aspects: comprehensive-considering the current macroeconomic, regulatory challenges coupled with the modern trend of sustainable development and technological innovation. Indeed, flexibility to adapt to global fluctuations in the economic world, localization of production that is effective, strategic partnerships along with innovative solutions-minimize risks for growth and will maximize opportunities thereof. The transition to environmentally friendly and multifunctional packaging solutions is turning from just a response to market demands into an important component of a company's reputation in the context of growing attention to sustainability issues. Only those packaging companies that will manage to integrate these approaches will be capable not only of succeeding in a globally competitive environment but also of ensuring long-term sustainability and growth in the international arena.

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FEATURES OF ORGANIZATION AND CARRYING OUT OF INTERNAL AUDIT

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Internal audit plays a key role in the management system of the company, providing an objective assessment of the effectiveness of work processes. The article deals with the theoretical basis of internal audit, its organizational aspects, methods and tools of conducting an audit in the company.

Keywords: Internal audit, control, risks, efficiency, standards, methods, international auditing standards, regulatory and legal requirements.

In today's world with the rapid development of business structures in various industries, accounting remains an invariably important activity of the company, while ensuring transparency and efficiency of their activities. Accounting is a system of collecting, processing and interpreting financial information necessary for making informed management decisions. With the development of technology, globalization and digitalization, the importance of accounting in company management is increasing, making it the most important foundation for sustainable economic development.

A requirement for the effective management of organizations is internal auditing, which is becoming increasingly strategic. One of the key aspects of strengthening economic stability is, properly designed, an internal control system that provides an independent and objective assessment of the financial condition of the company.

This process is not limited solely to the control function, but represents a key element of the threat management system, ensuring compliance with regulatory requirements and improving the company's internal mechanisms. Competently organized and conducted internal audit contributes to building confidence on the part of management structures, business owners and other stakeholders, which, in turn, contributes to increased transparency, efficiency and effectiveness of the organization's functioning.

The relevance of the study of internal audit is due to its significant role in both commercial organizations and public institutions, where special attention is paid to the rational use of resources and ensuring a high level of internal audit. Internal audit performs a key role in identifying and analyzing risks, forming reasonable proposals for improving organizational processes and providing an independent expert assessment of the effectiveness of the management system.

The purpose of the study is a comprehensive analysis of the organization and control of internal audit, detection of factors determining its effectiveness and development of recommendations for its improvement.

Today, in the conditions of market economy development and increase in business structures audit is

an important area that performs a key function in the company's management system, providing an independent assessment of the financial condition, efficiency and reliability of the company's internal processes.

In this way, the internal control system serves as the organization's "first line of defense," providing not only control over operations but also enhancing the company's reputation. Financial reporting is the foundation, the face of the company to shareholders, creditors and regulators, and the accuracy of this reporting is directly dependent on internal controls.

Audit - an audit for the purpose of expressing an independent opinion on the financial statements and other information related to the financial statements, in accordance with the legislation of the Republic of Kazakhstan. [2]

Audit performs a key function in ensuring stable, productive and effective functioning of the company's activities, as in changing economic conditions and international political interactions increase the likelihood of financial and operational risks that can provoke to crisis situations. In this aspect, audit activity contributes to the timely identification of problem areas in the company's activities, providing an objective assessment of its financial condition, the effectiveness of internal processes and compliance with regulatory requirements, which in turn allows to minimize the level of risks and increase the sustainability of business strategy.

Auditor - an individual certified by the Qualification Commission for Attestation of Candidates for Auditors (hereinafter - the Qualification Commission) who has received a qualification certificate for the qualification of "auditor." [2]

Auditors may also provide other services related to auditing, i.e. consulting services in the field of tax and accounting in accordance with the regulatory requirements specified in the legislation of the Republic of Kazakhstan.

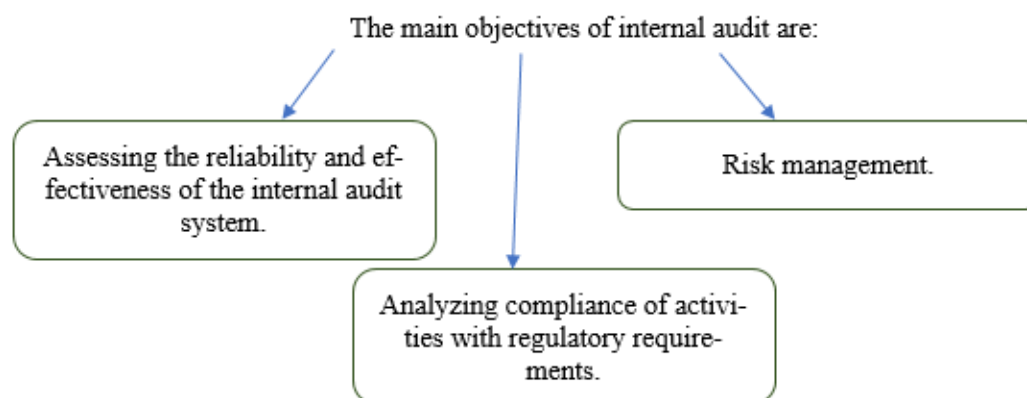
Characterization of the main directions of other audit services.

Table 1.

№	Name of services	Content of the auditor's work
1	Tax audit	Checking the subject's tax declarations for compliance with tax legislation
2	Compliance audit	The analysis of certain financial or business activities of an economic entity to determine whether they comply with prescribed conditions, rules or laws
3	Price audit	Checking the reasonableness of price setting for an order, product, unit or batch of goods or products
4	Performance audit	A systematic analysis of an organization's performance conducted for a specific purpose
5	Special audit	Verification of specific aspects of the economic entity's activities, its compliance with certain procedures and rules, established norms and regulations

Audit activity is the activity of auditing and rendering related services carried out by audit organizations, individual auditors. [3]

The main objectives of internal audit are:



The key document regulating internal audit activities is the International Standards on Internal Auditing.

The internal audit process includes such stages as:

1. Planning-identify the purpose of the audit, develop appropriate audit programs and methods.

2. Conducting the audit-analyze, review documentation, conduct testing with employees (interviewing employees, testing).

3. Formation of the report - the final stage of the audit, control over the elimination of identified problems, recommendations if necessary, elimination of problems to avoid further risks.

Before conducting an audit, the auditor should Determine the method of conducting the audit.

In the process of collecting and interpreting information, professionals use a variety of methods and strategies. The most common ones include the following audit control methods:

Solid method. All source accounting documentation is subjected to comprehensive analysis, which is compared with the indicators of analytical registers. Then the latter are correlated with the movement of funds and balances in synthetic accounting forms. This method of audit is characterized by a high degree of reliability, but requires considerable time and labor costs. Application of this approach for organizations with numerous settlement accounts (for example, credit institutions) is inefficient.

Sampling method. Evaluation of the organization's activity at this approach is carried out not on the basis of the whole documentation, but on its separate sections. The efficiency is largely determined by the representativeness of the surveyed sample. Information for

audit control can be selected using random number generators, at specified intervals (for example, every hundredth document) or by means of mixed technologies.

Mixed method. Includes elements of full and randomized audit trails. The first approach is used in the study of activities associated with increased risks, while the second is used for standard, routine operations, which the company performs regularly and in significant volumes (for example, settlement or cash transactions).

Modern internal audit is being actively transformed by digitalization, automation and changing approaches to risk management. With the growing complexity of business processes, companies are seeking to integrate advanced technologies to improve the efficiency of audit procedures.

The use of specialized software solutions (Audit Management Software, ERP systems, data control systems) can significantly improve the accuracy and speed of analysis. Among the key advantages of digital tools are: Reduced probability of errors due to automated data processing

1. Ability to analyze large volumes of information (Big Data)

2. rapid identification of anomalies and risks using artificial intelligence (AI) and machine learning

3. Facilitate interactions between internal auditors and management through digital platforms

The use of automated systems allows auditors to focus on strategic aspects of controls, minimizing routine operations.

Traditional audits were often focused on retrospective analysis, identifying irregularities after they

occurred. Current trends suggest a shift to risk-based auditing, aimed at preventing potential problems. The main features of this approach include:

1. Focus on critical areas of the business where the probability and potential consequences of risks are most significant
2. Flexibility in planning audits depending on the changing business environment
3. use of predictive models to assess likely threats.

Risk-oriented audit is especially relevant in companies with high dynamics of changes, where traditional methods of audit do not always allow to identify problems in time.

Conclusion

Internal audit plays a key role in the management system, providing an independent and objective assessment of the effectiveness of processes, risk management and internal control systems. In the conditions of dynamic business development, increased competition and digital transformation of companies, internal audit becomes not just a verification tool, but an important element of strategic management.

The study examined the theoretical foundations of internal audit, its organizational aspects and methodological approaches. The analysis showed that internal audit has evolved from traditional document control to a comprehensive system of monitoring and evaluation of business processes, focused on risk prevention and improving operational efficiency.

The article pays special attention to modern trends in the development of internal audit. The introduction of digital technologies, automation of audit procedures, the use of artificial intelligence and Big Data allow to significantly increase the accuracy and speed of analysis, as well as to reduce the influence of the human factor. At the same time, automation does not replace the internal auditor, but only changes his functions, making his work more analytical and strategically significant.

The risk-oriented approach, which is increasingly used in the practice of internal audit, allows not only to identify actual violations, but also to predict potential threats, minimizing their consequences. This is especially important in the context of globalization and rapidly changing market conditions, when traditional audit methods no longer provide an adequate level of protection of the company from financial, operational and strategic risks.

An important element of internal audit is compliance with International Standards on Auditing (ISAs), which ensure uniformity of approach, transparency and reliability of audit procedures. In particular, the key standards applicable to internal audit are:

ISA 315 "Identification and Assessment of Risks of Material Misstatement" - defines methods and procedures for assessing risks and their impact on the financial statements.

ISA 330 "Audit Procedures in Response to Assessed Risks" - establishes principles for designing audit procedures based on identified risks.

ISA 500 "Audit Evidence" - regulates the process of gathering and evaluating audit evidence to form reasonable conclusions.

ISA 610 "Use of Internal Auditors' Work" - defines criteria for interaction between external and internal auditors, ensuring more effective use of internal audit results.

ISA 620 "Use of Auditor's Experts" regulates the use of experts to assess complex and specialized aspects of the audit.

Thus, internal audit remains an essential element of effective enterprise management. Its role will only increase in the future, especially in the digital economy. Companies that manage to adapt internal audit to modern requirements and integrate it into strategic management will gain a significant competitive advantage by increasing the transparency, manageability and sustainability of their business.

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GLOBAL IMPACT OF TRADE UNIONS ON HUMAN RESOURCE MANAGEMENT: AN ANALYTICAL APPROACH

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Abstract

Trade unions have long been recognized as pivotal institutions in shaping labor relations, advocating for workers' rights, and influencing organizational policies. This dissertation examines the global impact of trade unions on human resource management (HRM), focusing on their role in shaping practices such as recruitment, compensation, training, and conflict resolution. By adopting an analytical approach, the study explores the dynamic interplay between trade unions and HRM across diverse cultural and economic contexts.

The research highlights regional variations in the influence of trade unions, contrasting strong union environments, such as in Europe, with weaker unionized frameworks in emerging economies and the gig economy. It also delves into the challenges faced by HR practitioners in unionized settings, including navigating collective bargaining processes, managing organizational objectives, and aligning workforce strategies with union demands. The study addresses critical questions regarding the future of trade unions in a globalized, technology-driven labor market and their implications for HRM policies.

The findings suggest that while trade unions have historically driven significant improvements in working conditions and employee benefits, they also pose unique challenges to HR managers striving for organizational efficiency. The dissertation concludes by offering strategic recommendations for fostering collaboration between HR managers and trade unions, ensuring sustainable labor relations that balance employee advocacy with organizational goals.

This research contributes to the academic discourse on HRM and labor relations, providing insights for practitioners and policymakers on navigating the complexities of unionized and non-unionized work environments in an evolving global economy.

Keywords: Trade Unions, Human Resource Management (HRM), Labor Relations, Collective Bargaining, Global Workforce Dynamics.

Introduction

In the ever-evolving global business environment, the role of human resource management (HRM) has become central to fostering organizational success and sustainability. At the same time, trade unions—organized groups that advocate for the rights and interests of workers—have had a profound influence on shaping labor practices across industries. The interplay between HRM and trade unions represents a dynamic relationship, marked by collaboration, negotiation, and at times, conflict. This dissertation explores the global impact of trade unions on HRM through an analytical approach, shedding light on how these organizations shape HR strategies, policies, and practices in diverse cultural and economic contexts.

Trade unions have historically played a pivotal role in advocating for better wages, working conditions, and social protections, making them a cornerstone of labor relations. With globalization and technological advancements redefining the workplace, their influence extends beyond traditional industries to include emerging sectors and gig economies. Simultaneously, HRM as a discipline has evolved, transitioning from administrative functions to strategic initiatives aimed at maximizing employee engagement, productivity, and well-being. The intersection of these forces

presents both opportunities and challenges for organizations worldwide.

This dissertation aims to answer key questions: How do trade unions influence HRM practices such as recruitment, compensation, training, and conflict resolution on a global scale? What are the regional variations in this influence, and how do organizations navigate the complexities of unionized and non-unionized workforces? By addressing these questions, this research seeks to provide a comprehensive analysis of the symbiotic and, at times, adversarial relationship between trade unions and HRM. The significance of this study lies in its relevance to modern workplaces, where HR managers must adapt to increasingly complex labor environments. Understanding the global impact of trade unions is essential for HR practitioners seeking to balance organizational objectives with employee advocacy, especially in a world shaped by economic uncertainty, social justice movements, and rapid technological change.

The structure of this dissertation is as follows: The literature review delves into historical and theoretical perspectives on trade unions and their influence on HRM. The research methodology outlines the analytical approach employed in this study, followed by an examination of the global impact of trade unions on HR practices. Finally, the dissertation discusses future

trends, challenges, and recommendations for navigating the evolving landscape of labor relations and HRM. This introduction sets the stage for an in-depth exploration of the global impact of trade unions on HRM, offering insights into how these forces interact to shape the modern workplace. Trade unions play an integral role in shaping labor relations and influencing organizational strategies worldwide. Their presence and influence extend to virtually all aspects of Human Resource Management (HRM), from recruitment and compensation to employee engagement and organizational culture. This article delves into the global impact of trade unions on HRM through an analytical lens, exploring their historical significance, current dynamics, and future trajectories. Trade unions, also known as labor unions, emerged in response to industrialization and the rise of employer-employee power imbalances during the 19th century. Their primary goal was to protect workers' rights, improve wages, and ensure safe working conditions. Over time, they have grown into a global force, shaping labor policies and influencing workplace practices. In countries like the United Kingdom and Germany, trade unions played a pivotal role in the development of labor laws, including minimum wage regulations and working-hour limits.

Trade unions perform several essential functions that impact HRM, including:

Collective Bargaining: Negotiating wages, benefits, and working conditions on behalf of their members.

Conflict Resolution: Mediating disputes between employees and employers.

Workplace Representation: Acting as a voice for employees, ensuring fair treatment and addressing grievances.

Advocacy: Lobbying for labor-friendly policies and legislation at national and international levels.

Trade unions significantly influence how HRM functions within organizations. Their involvement affects several key HR areas: **Recruitment and Employment Contracts:**

Trade unions often negotiate terms of employment, including job roles, working hours, and contractual obligations. HR departments in unionized workplaces must align their recruitment strategies with these agreements, ensuring transparency and compliance with collective bargaining outcomes. **Compensation and Benefits:** One of the most visible impacts of trade unions is on wages and employee benefits. Collective bargaining agreements (CBAs) often set industry standards for salaries, bonuses, health benefits, and retirement plans. HR managers must structure compensation frameworks that comply with these agreements while balancing organizational budgets. **Training and Development:** Trade unions advocate for employee skill development to ensure job security and adaptability in changing work environments. HR departments collaborate with unions to design and implement training programs that align with both organizational goals and employee career growth. **Workplace Policies and Compliance:**

Unions influence the formulation of workplace policies related to diversity, inclusion, harassment prevention, and workplace safety. HR practitioners must ensure these policies comply with union guidelines, creating a harmonious and equitable work environment. **Conflict Resolution and Grievance Handling:** Trade unions act as mediators in resolving disputes between employees and management. HR departments in unionized settings often work closely with union representatives to address grievances effectively and foster a culture of mutual respect. **Importance of Understanding the Impact of Trade Unions in the Context of Globalization, Workforce Dynamics, and HRM Strategies:**

Trade unions play a significant role in shaping labor relations, workplace policies, and overall organizational dynamics. Their influence, particularly in the context of globalization, workforce changes, and evolving HRM strategies, underscores the need for a deep understanding of their impact.

In the Context of Globalization

Standardization of Labor Rights: Globalization has indeed brought markets closer together, creating a demand for standardized labor practices that transcend national boundaries. Standardization of labor rights ensures consistency in how workers are treated, regardless of where a multinational corporation operates. This is critical for addressing disparities in wages, working conditions, and employee rights across different countries.

Trade unions play a pivotal role in this effort by advocating for global labor standards. Their work involves pushing for policies that uphold fair treatment for workers, such as equal pay for equal work, safe working environments, and the prohibition of exploitative practices like child labor and forced labor. These standards not only protect workers but also foster ethical business practices, enhance corporate accountability, and create a level playing field for businesses.

Such global labor standards often involve partnerships between governments, international organizations like the International Labour Organization (ILO), and civil society groups. These collaborations are essential in monitoring compliance and ensuring that multinational corporations are held accountable for their labor practices in every country where they operate.

Cross-border Union Collaboration: Cross-border union collaboration has become a crucial strategy in addressing the challenges posed by global trade and the international operations of multinational corporations. As businesses increasingly operate across multiple countries, unions have recognized the need to unite beyond national boundaries to amplify their collective bargaining power and advocate for workers' rights on a global scale. Such collaborations often take the form of joint campaigns, shared resources, and coordinated actions aimed at influencing corporate practices and government policies. By working together, unions can highlight issues like unfair labor practices, wage disparities, and unsafe working conditions that might otherwise go unnoticed in individual countries. One promi-

nent example of cross-border collaboration is the establishment of global framework agreements (GFAs). These agreements, negotiated between multinational corporations and international union federations, set standards for labor practices that apply to all operations of the company worldwide. They ensure compliance with basic labor rights, such as freedom of association and collective bargaining, and often extend protections beyond local legal requirements. This unified approach enables unions to hold corporations accountable for their actions in every region they operate. It also helps mitigate the "race to the bottom" effect, where companies exploit weaker labor laws in certain countries to cut costs. By fostering solidarity and shared strategies across borders, unions play a vital role in shaping a fairer global labor market.

Corporate Accountability: In the context of globalization, corporate accountability has become a cornerstone of ensuring ethical labor practices, especially in low-cost labor markets where exploitation risks are higher. Trade unions serve as a critical watchdog, holding corporations responsible for upholding ethical standards in their global operations. Unions actively address pressing issues such as exploitation, child labor, and unsafe working conditions, often prevalent in developing countries where labor laws may be weak or poorly enforced. Through collective action, unions shine a spotlight on these practices, pressuring corporations to adhere to international labor standards and ethical codes of conduct. One effective strategy unions employ is collaborating with international organizations, such as the International Labour Organization (ILO), to advocate for stronger global labor regulations. Additionally, unions often partner with NGOs and activist groups to launch awareness campaigns, highlighting unethical practices and mobilizing public opinion against corporations that violate labor rights. By negotiating global framework agreements (GFAs), unions establish binding commitments from multinational corporations to ensure fair wages, safe workplaces, and the elimination of exploitative practices across their supply chains. They also promote transparency, urging companies to disclose information about their labor practices and supply chains. Ultimately, union efforts not only improve conditions for workers but also encourage corporations to adopt sustainable and socially responsible business models, fostering long-term benefits for employees, communities, and stakeholders worldwide.

Human Resources Management Strategies

Collective Bargaining: Collective bargaining is a fundamental process through which unions negotiate with employers to establish agreements on wages, benefits, work conditions, and other employment terms. This process significantly shapes Human Resource Management (HRM) strategies, as it creates a structured dialogue between employees and organizations to align mutual interests. For HR professionals, understanding the dynamics of collective bargaining is crucial. It provides insights into employee priorities and enables the development of HR strategies that balance workforce satisfaction with organizational objectives.

Unions directly influence HRM strategies through collective bargaining, impacting wage structures, benefits, and work conditions. Understanding this relationship helps HR professionals design strategies that align with both employee and organizational goals.

Conflict Resolution: Conflict resolution is an essential component of maintaining harmonious workplace relations, particularly in unionized environments. Understanding union dynamics—including their operations, objectives, and negotiation strategies—empowers HR teams to mediate disputes with greater effectiveness and fairness. This understanding fosters trust and strengthens relationships between employers and employees.

Policy Formulation: Crafting effective HR policies requires a balanced approach that incorporates compliance with labor laws and aligns with union agreements. This ensures that workplace practices meet legal, ethical, and organizational standards while fostering positive relationships with employees and their representatives.

Retention and Engagement: Unionized workplaces often excel in fostering higher levels of employee retention and engagement. These outcomes result from the structured communication channels and enhanced employee satisfaction that unions help establish—factors that are critical to the success of Human Resource Management (HRM).

Improvement in Employee Wages, Benefits, and Working Conditions

Wage Negotiations: Trade unions have long been pivotal in advocating for fair and equitable wages for employees across industries. Through the process of collective bargaining, unions work to secure better pay and reduce wage inequalities, ensuring a fair share of economic benefits for the workforce. Unions negotiate on behalf of employees to ensure wages reflect the value of their work, aligning compensation with industry standards and economic conditions. They minimize wage disparities by advocating for standardized pay scales, promoting fairness across roles, genders, and regions within organizations. In addition, unions often push for wage increases tied to inflation rates, ensuring that employees maintain their purchasing power despite economic fluctuations. They also fight for living wages that go beyond minimum requirements, enabling employees to meet their basic needs and improve their quality of life. Successful union negotiations often set industry benchmarks, influencing broader industry practices and benefiting even non-unionized workers. By consolidating employee voices, unions allow workers to negotiate with employers from a position of collective strength, enhancing their bargaining power. Through effective wage negotiations, trade unions not only enhance employee satisfaction and financial security but also contribute to overall economic stability by boosting consumer spending and reducing income inequality. Their efforts underscore the importance of equitable compensation in creating a motivated and productive workforce.

Enhanced Benefits: Unions have played a crucial role in driving improvements in employee benefits, significantly enhancing workers' quality of life. Through collective bargaining, unions have secured better healthcare coverage, retirement plans, paid leave, and family-friendly policies, ensuring that employees are supported both during their careers and in retirement. Unions have pushed for comprehensive healthcare plans that provide workers with access to affordable medical services, often expanding coverage to include dental, vision, and mental health benefits. In addition, they have negotiated for robust retirement plans, ensuring employees can save for their future and retire with financial security. Unions have also been instrumental in securing paid leave benefits, including sick leave, vacation days, and maternity/paternity leave, which allow employees to take necessary time off without the fear of losing income. Family-friendly policies, such as flexible work arrangements and parental leave, have also been a significant focus of union negotiations, ensuring that workers can balance work and family responsibilities. These enhancements not only improve workers' well-being but also contribute to greater job satisfaction, loyalty, and productivity. By securing better benefits, trade unions help foster a healthier, more secure, and more motivated workforce, benefiting both employees and employers in the long term.

Better Working Conditions: Trade unions have been at the forefront of advocating for improved working conditions, significantly influencing workplace safety and ergonomics. Through collective bargaining and activism, unions have pushed for adherence to occupational safety standards, ensuring that employers prioritize the health and well-being of their workers. Unions have secured the provision of protective equipment such as helmets, gloves, and safety goggles, which are crucial in safeguarding employees from workplace hazards. Additionally, unions have fought for the reduction of hazardous work environments, advocating for proper training, better ventilation, and measures to eliminate dangerous conditions, such as exposure to toxic chemicals or unsafe machinery. They have also been instrumental in promoting ergonomic improvements, such as adjustable workstations, better seating, and reduced repetitive strain, particularly in office or manufacturing settings. These efforts have not only improved the physical safety of workers but also contributed to their mental and emotional well-being by creating healthier, more supportive work environments. The push for better working conditions has led to increased employee satisfaction, reduced injury rates, and higher productivity, ultimately benefiting both workers and employers. Through these advancements, trade unions continue to play a vital role in ensuring that workplaces are safe, equitable, and conducive to long-term worker health.

Future Trends: Potential Scenarios for Trade Unions and HRM

The landscape of labor relations and human resource management is rapidly evolving, shaped by technological advancements, the rise of remote work, and increasing calls for global labor standards. Understanding these future trends is essential for predicting

the role of trade unions and their impact on the global workforce.

Automation and AI Integration: The integration of automation and artificial intelligence (AI) into the workforce is reshaping industries and transforming job roles. Many routine and manual tasks are becoming obsolete or are being redefined by technological advancements. This shift presents both challenges and opportunities for workers, employers, and trade unions. In this evolving landscape, unions have a critical role to play in advocating for policies that ensure workers are prepared for the jobs of the future. Trade unions are in a unique position to advocate for reskilling and upskilling programs. These initiatives can help workers transition into new roles that are less susceptible to automation. Unions can negotiate with employers to invest in training programs that provide workers with the skills needed for emerging fields, such as data analysis, AI management, and cybersecurity. By ensuring that workers have access to continuous learning opportunities, unions help mitigate the negative impact of technological displacement on employees. As automation and AI continue to replace certain job functions, trade unions are essential in preparing workers for future roles. Additionally, unions can play a key role in negotiating transition benefits for displaced workers, including severance packages, relocation assistance, and career transition services. This ensures that workers who lose their jobs due to automation are supported during their career shifts. Furthermore, unions can advocate for job guarantees or retraining opportunities that enable workers to remain in the workforce in other capacities. Trade unions also have a role in shaping the ethical implementation of AI and automation technologies in the workplace. As automation systems become more integrated into business processes, unions can advocate for ethical standards that protect workers' rights, ensuring that AI does not lead to unfair surveillance, biased decision-making, or exploitation. Unions can collaborate with policymakers and companies to ensure that automation technologies are deployed in ways that benefit workers, enhancing productivity without sacrificing job security or workers' well-being. Unions can also advocate for a fairer distribution of the economic benefits generated by automation. As AI and automation increase productivity and reduce costs, the profits generated may disproportionately benefit employers and shareholders. Trade unions can work to ensure that workers receive a fair share of these gains, through higher wages, improved benefits, or reinvestment in worker welfare programs. This focus on equity will help ensure that the benefits of automation are not concentrated solely in the hands of a few, but are shared with the workers who make it possible. As automation and AI technologies continue to reshape the labor market, trade unions will be essential in advocating for workers' rights, ensuring that they are equipped with the skills needed for future job roles, and negotiating fair policies to protect displaced workers. Through active engagement in reskilling, transition benefits, and shaping ethical standards, unions can help mitigate the

challenges posed by automation and AI, while also ensuring that workers benefit from the opportunities these technologies create.

Digital Platforms for Unionization: The advent of digital tools and platforms has revolutionized many sectors, and trade unions are no exception. Digital platforms are becoming increasingly important in modern unionization efforts, allowing unions to engage with members, conduct votes, and facilitate negotiations in new, more efficient ways. This digital transformation is particularly significant for gig and informal workers, who have historically been difficult to organize due to the nature of their work and the lack of traditional workplace structures. Digital unionization can overcome these challenges by providing these workers with an accessible and streamlined way to join unions and advocate for their rights. By utilizing digital platforms, unions can enhance member engagement, making it easier for workers to access resources, participate in discussions, and stay informed about ongoing union activities. Online platforms allow workers to engage with union representatives, access educational content, and contribute to decision-making processes from any location, fostering a more inclusive and participatory environment. This level of accessibility is especially beneficial for gig economy workers, who may be geographically dispersed and have non-traditional work hours that make in-person meetings difficult. Moreover, digital tools enable unions to conduct virtual voting processes, streamlining decision-making and ensuring that members' voices are heard, regardless of their location. Virtual voting can help overcome logistical barriers such as long-distance travel or time conflicts, increasing participation and ensuring that union decisions reflect the will of the membership. Digital platforms also provide an avenue for unions to organize workers in sectors that have traditionally been challenging to unionize. Gig economy workers—such as drivers, freelancers, and platform-based workers—are often excluded from traditional labor protections due to their employment status. By leveraging digital tools, unions can provide these workers with the organizational structure and support they need to advocate for better working conditions, wages, and benefits. Furthermore, online platforms enable unions to gather data and conduct research, enhancing their bargaining power and allowing them to advocate more effectively on behalf of workers. In addition to organizing gig and informal workers, digital unionization offers benefits for traditional sectors as well. The ability to quickly disseminate information, coordinate collective actions, and engage in real-time discussions helps unions remain responsive to the needs of workers in an ever-changing labor landscape. By harnessing the power of digital tools, unions can continue to strengthen their role as advocates for workers' rights in a globalized and increasingly digital world.

Monitoring and Data Privacy: The rise of employee monitoring systems and workplace analytics is a double-edged sword, offering employers valuable insights into productivity and performance, while simultaneously raising significant concerns about privacy, ethics, and worker rights. As companies increasingly

implement advanced technologies such as surveillance software, tracking systems, and data analytics to monitor employee behavior, unions are likely to play a crucial role in shaping regulations that protect workers' rights in the face of these intrusive technologies.

The use of employee monitoring technologies often extends beyond traditional surveillance measures, incorporating sophisticated tools that can track everything from computer usage to location and even personal data. While employers argue that these systems help improve productivity, ensure security, and maintain quality control, they also raise significant ethical and legal questions about workers' privacy. The line between legitimate business interests and invasive surveillance can be difficult to define, particularly when monitoring extends to personal devices or off-hours activities. Unions are essential in advocating for workers' privacy rights and ensuring that employee monitoring practices are transparent, fair, and aligned with ethical standards. Through collective bargaining and lobbying efforts, unions can negotiate clear guidelines and limits on the use of surveillance technologies. This includes advocating for the inclusion of worker consent provisions, ensuring that employees are informed about the types of monitoring being conducted and have the opportunity to opt-out or raise concerns. Furthermore, unions can work to ensure that monitoring is used solely for legitimate business purposes, such as improving workplace safety or optimizing performance, rather than for punitive or overly intrusive purposes.

Data privacy is another critical concern. With the growing collection and analysis of personal data through monitoring systems, the risk of misuse, discrimination, and breaches of confidentiality increases. Unions can push for stronger regulations on data protection, ensuring that personal information gathered through employee monitoring is stored securely, used responsibly, and not exploited for purposes outside of the agreed-upon scope. Unions can also advocate for the right to access and review personal data collected by employers, giving workers greater control over how their information is used.

In addition to advocating for privacy protections, unions play an essential role in raising awareness about the potential risks associated with workplace analytics and surveillance. By educating workers about their rights and providing guidance on how to navigate privacy concerns, unions empower employees to make informed decisions about their participation in monitoring programs. This also involves advocating for the development of ethical standards and policies that balance business needs with workers' fundamental rights to privacy and dignity.

As workplace monitoring systems and data analytics continue to evolve, unions will remain at the forefront of advocating for workers' rights. By addressing the complex issues surrounding surveillance, privacy, and ethics, unions can help shape a future in which technology serves both employers' interests and the well-being of workers.

CONCLUSION

Trade unions have demonstrated their profound influence on the global workforce by championing fair

labor practices, ensuring equity, and driving organizational progress. Their role in improving employee wages, benefits, and working conditions has elevated the standard of living for countless workers. By leveraging collective bargaining power, unions have balanced the scales in labor relations, fostering mutual respect and fairness between employees and employers. Furthermore, their advocacy for diversity, equity, and inclusion has significantly contributed to creating workplaces that reflect modern societal values and encourage collaboration among diverse groups.

In an era of globalization and evolving workforce dynamics, trade unions continue to act as vital stakeholders, ensuring that employees' rights and welfare remain integral to organizational strategies. The positive impacts highlighted above underscore the importance of maintaining strong and cooperative labor relations to build sustainable, equitable, and thriving workplaces worldwide.

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RESEARCH THE STRUCTURE AND IMPROVEMENT OF ACCOUNTING AND AUDITING METHODS BASED ON ANALYZING THE COMPANY'S CONSOLIDATED FINANCIAL STATEMENTS

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Abstract

The goal of this research is to look at how a company's consolidated financial statements are prepared and analyzed, as well as the current state of the accounting and auditing organization and how it might be optimized or improved. An in-depth examination of the definition of consolidated financial statements and their significance in reflecting a company's overall financial position and operating results reveals the various interests involved in the consolidation process, as well as the impact of these relationships on audit quality. The current empirical investigation into the structure of accounting audit institutions examines the existing workflow of audit institutions and its limitations, as well as key factors influencing audit quality, such as personnel quality, technical means, and internal control management. As a result, recommendations are given to systematically optimize the accounting and auditing organization, including rational structural adjustments to improve audit independence, openness, and efficiency. A range of particular measures to increase auditing quality are advocated, including the use of data analytics (DA) technology and artificial intelligence (AI) in the auditing process. According to the report, in a changing market context, it is critical to continuously adapt and optimize audit organizational structures to meet the complex and diversified problems provided by corporate consolidation while also promoting the audit profession's continued growth.

Keywords: consolidated financial statements; organization; audit quality; improvement methods; accounting and auditing

Introduction

(i) Background and significance of the study

Mergers and acquisitions (M&A) are a popular business strategy in today's quickly evolving market economy¹. With the acceleration of globalization and increased industry competition, many businesses employ Consolidated Financial Statements Analysis (CFSA) to optimize resource allocation, improve market competitiveness, and realize economies of scale². Auditing plays a vital part in this process, not only because it provides financial transparency, but also because it has a far-reaching impact on the corporate governance structure following the merger. As a result, the study of consolidated financial statement analysis and its impact on accounting and auditing organizations' efficiency is both theoretically and practically relevant.

(ii) Purpose and content of the study

Corporate mergers are becoming increasingly widespread in today's international economy, highlighting the relationship between consolidated financial statement analysis and audit organization. As a result, the purpose of this study is to investigate the impact of consolidated financial statements on the accounting and auditing organization and how it can be improved, as well as to develop an analytical framework based on the SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goal-setting framework³.

This study first clarifies the specific research objectives, i.e., to reveal the challenges and opportunities faced by consolidated financial statements in the auditing process through exhaustive data analysis, and to

provide theoretical and practical guidance for accounting and auditing organizations in the consolidated business environment. Quantitatively, we will ensure the measurability of the research results and strengthen the interpretation of the results through data collection and statistical analysis methods, such as Quantitative Analysis (QA) and Regression Analysis (RA)⁴.

Concept and significance of consolidated financial statements

(i) Definition of consolidated financial statements

Consolidated Financial Statements (CFS) are uniformly formatted statements that disclose the financial situation and operating results of a holding company (Parent Company) and its subsidiaries (Subsidiaries) over a specific period⁵. The primary purpose of this statement is to present a complete and integrated financial viewpoint that reflects the total economic status of the enterprise group rather than just the financial position of a single firm. The key distinction between consolidated financial statements and ordinary financial statements (Standalone Financial Statements) is that the latter only reflect the financial information of a single enterprise and provide no insight into the interactions of the businesses within the group or their contribution to overall performance⁶.

The value of consolidated financial statements should not be underestimated. Its importance in accounting theory can be attributed to the Accrual Basis Principle⁷. This principle demands businesses to record revenues and expenses as they occur for the consoli-

dated financial statements to accurately reflect the company's financial condition and results of operations. Consolidated financial statements allow stakeholders, including investors, creditors, and regulators, to meet their information requirements while making investment decisions. These people are keen to learn the truth about the company's operations and potential prosperity. As a result, consolidated financial statements allow decision-makers to examine the overall financial status of the organization and so impact investment decisions.

(ii) Functions and roles of the consolidated financial statements

Consolidated financial statements are the overall financial statements prepared by the parent firm and its subsidiaries over a specific period. Its primary goal is to give external stakeholders with an overview of the enterprise group's financial status and operating outcomes, allowing investors, creditors, and other stakeholders to conduct in-depth research and decisions. The primary function of consolidated financial statements is shown in the following features.

1. Giving comprehensive information: integrating the financial data of the main firm and all of its subsidiaries to provide users with a more comprehensive and accurate picture of the enterprise group's financial status. After consolidating their statements, stakeholders will be able to assess the group's assets, liabilities, and owners' equity.

2. Supporting decision-making analysis: Consolidated financial statements offer management a comprehensive view of operations, allowing them to better assess various subsidiaries and their impact on the parent firm when making choices.

3. Enhanced transparency: By consolidating financial accounts, firms can increase data transparency and boost public and investor trust in the company.

4. Resource allocation optimization: Consolidated financial statements can reflect the status of enterprise resource allocation, allowing businesses to manage resources more effectively and increase overall efficiency.

One of the most common mathematical formulas used in analyzing consolidated annual financial statements is the consolidated capital turnover ratio, which can be calculated using consolidated sales revenues and consolidated total assets and reflects the efficiency of a company's capital use over time. The formula is expressed as follows.

$$\text{capital turnover ratio} = \frac{\text{Consolidated sales revenue}}{\text{Consolidated total assets}}$$

This formula calculation enables businesses to delve deeper into the function of the consolidated financial statements as well as their resource use.

Analysis of the current status of the accounting and auditing organization

(i) Composition of the organizational structure

In today's complicated financial world, the makeup of the accounting and auditing organization is not only a critical factor influencing audit quality, but it also has implications for business performance optimization. The organizational structure's hierarchy is good, ensuring that diverse functions are successfully coordinated and resources are sensibly distributed, hence increasing audit efficiency.

The primary components of an accounting and auditing organization typically include three levels: top management, middle management, and executive level. Top management is responsible for developing audit strategy and policy, as well as providing advice and direction to the audit process via the Audit Standards and Risk Assessment frameworks⁸. Middle management is responsible for implementing the audit plan, mobilizing and deploying audit staff resources, and ensuring that the audit activity achieves its objectives. This level is in charge of conducting preliminary analyses of audit results to assist senior decision-making. The executive level is the team that oversees the audit process and completes it using specialized methods such as fieldwork, data collection, and analysis.

(ii) Workflow of existing audit bodies

Table 1

Analysis of the current status of the organization for the audit of the consolidated financial statements

Organizational structure	Audit process	Audit quality	Factor
Vertical management	clear-cut hierarchy	Professional qualities and experience	Identify financial risks
	Clear delineation of responsibilities		Judgement
Flat management	Fast feedback	Innovativeness	Adaptable
	Audit flexibility		Technology Application Outlook
Risk assessment		Data integration	Real-time data acquisition
Data collection			Enhancing audit comprehensiveness
Financial Technology Applications			Big data analytics

In today's changing business climate, the value of consolidated financial statements (CFS), which show an organization's entire economic status and financial health, has grown⁹. However, the real reflection of consolidated financial statements is determined not only by the quality of the statements themselves but also by the

efficacy of the Audit Organizational Structure (AOS)¹⁰. In this article, we will examine the current condition of AOS and its impact on the overall audit quality of consolidated financial statements.

In the field of accounting and auditing in China, it is frequently seen that there are vertical management

and flat management of auditing organizations. The former is easy to build a clear hierarchical audit process, which is conducive to a clear division of responsibilities, but also allows the effective allocation of audit resources. The latter, like the "Big Four," can enhance the speed of information feedback, and promote the flexibility of audit work, and adaptation.

Audit organizations' existing processes are complex, with tasks such as risk assessment, information collecting, and on-site auditing. Effective practices can increase efficiency and dependability. When dealing with consolidated financial accounts, it is vital to obtain a thorough grasp of the subsidiaries' operational conditions as well as analyze the credibility of internal controls and financial data. However, the absence of integration of information systems in some audit firms makes it difficult for auditors to access data in real-time, compromising the comprehensiveness and accuracy of audits.

When assessing the aspects that influence audit quality, the audit team's professionalism and experience should not be overlooked. Experienced auditors in the business can better recognize potential financial hazards and misrepresentations and then make proper decisions. Flexibility and innovation in audit thinking are also essential for enhancing audit performance. The use of big data analytics and cloud computing technology in auditing has become increasingly frequent in recent years, as FinTech has grown in popularity. As a result, auditing organizations must continue to use cut-

ting-edge technology to ensure more efficient and reliable data processing. One example is the use of technology such as data mining to perform more accurate trend analysis and risk prediction on historical financial data.

In this paper, we will conduct a thorough study and discussion of the current condition of the organization of consolidated financial statement audits. It is critical to clarify the relationship between organizational structure and workflow, as well as to focus on improving team quality and foresight in technology application, as these are critical to improving the efficiency and quality of the auditing institution's work. Simultaneously, for current challenges and bottlenecks, make specific proposals for improvement to assist the ongoing development of China's audit sector by providing theoretical support and practical guidance.

(iii) Factors affecting audit quality

When studying audit quality, it is vital to delve deeply into the fundamental aspects influencing its quality across a variety of dimensions. These elements include not only regulatory policies, auditors' professional ability, and the degree of standardization of the audit process, but also the interconnections between the process of creating company consolidated financial statements and the general business environment. In the following sections, we will thoroughly examine the elements influencing audit quality and their interrelationships, drawing on data from our own research and business scenarios.

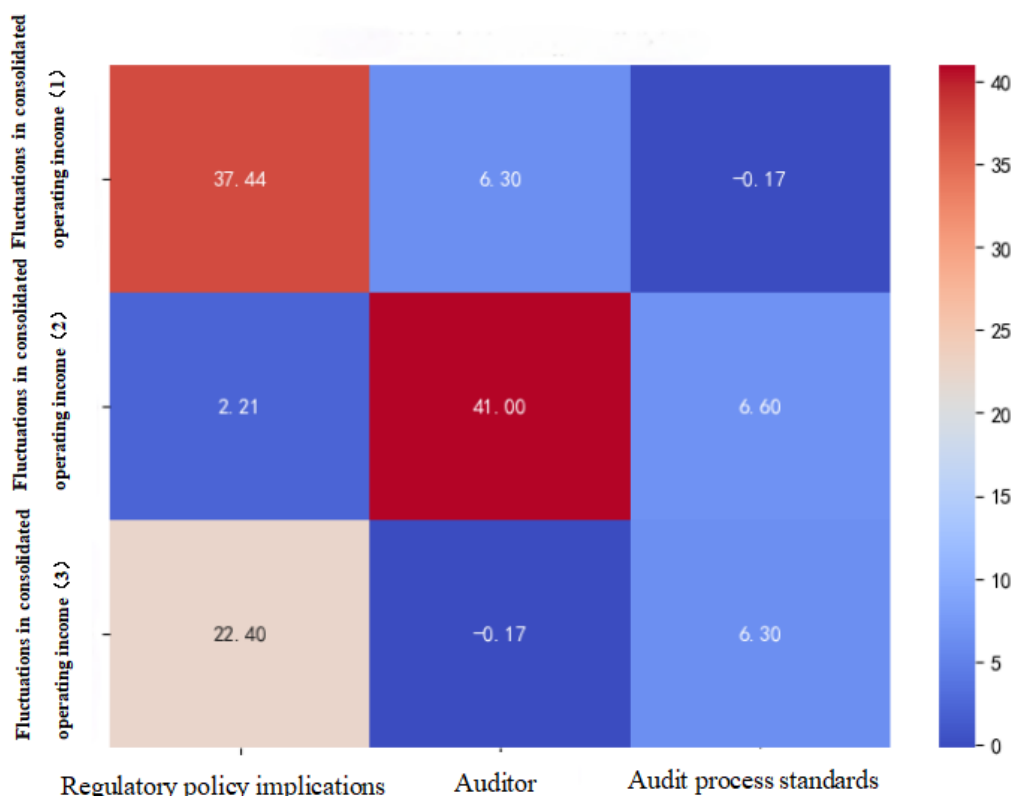


Figure 1. Correlation analysis between regulatory policy and audit quality

Note: Take the listed companies of Shanghai and Shenzhen A shares from 2018 to 2023 as samples

First, the impact of regulatory rules on audit quality is significant. The legislative framework and standards set by regulators have a direct impact on the transparency and authenticity of a company's consolidated

financial statements. By analyzing the data, we discovered that the various fluctuations in the recent year-on-year growth rate of consolidated operating income, such as the difference between 37.44% and 6.3%, more

or less reflect the different coping strategies of companies in the process of consolidated auditing in response to market changes and regulatory policy adjustments. Such variances may reflect disparities in the auditing

organization's ability to adjust in the face of changing rules, as well as potential regulatory compliance issues during audit execution.

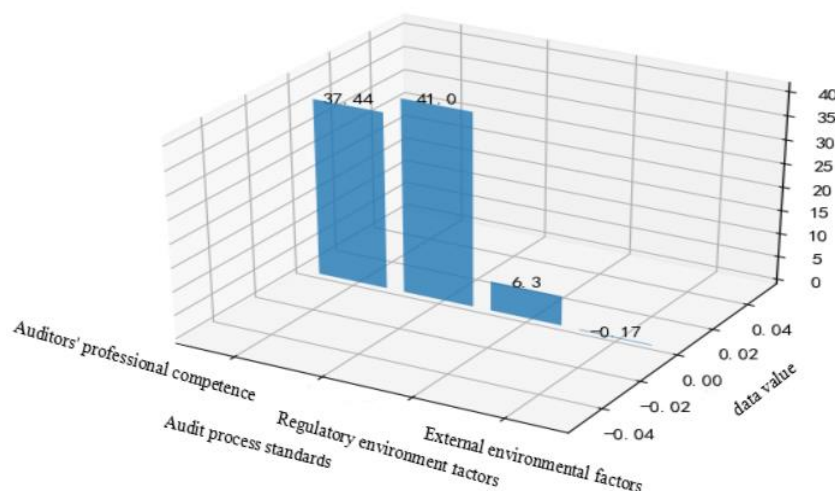


Figure 2. Impact of auditors' professional competence on audit quality

Note: Take the listed companies of Shanghai and Shenzhen A shares from 2018 to 2023 as samples

Second, the professional competence of auditors is an important aspect of establishing audit quality. Auditors must have strong accounting expertise, a comprehension of laws and regulations, and great business insight to succeed in today's ever-changing corporate environment. In our survey data, considerable swings in the year-on-year growth rate of consolidated operating

income, such as outliers of -0.17% and 2.21%, may indicate weaknesses in auditors' risk identification and assessment processes. An audit team that can successfully predict and assess the causes of these changes, and then make sensible decisions, would undoubtedly improve the overall credibility and efficacy of the audit.

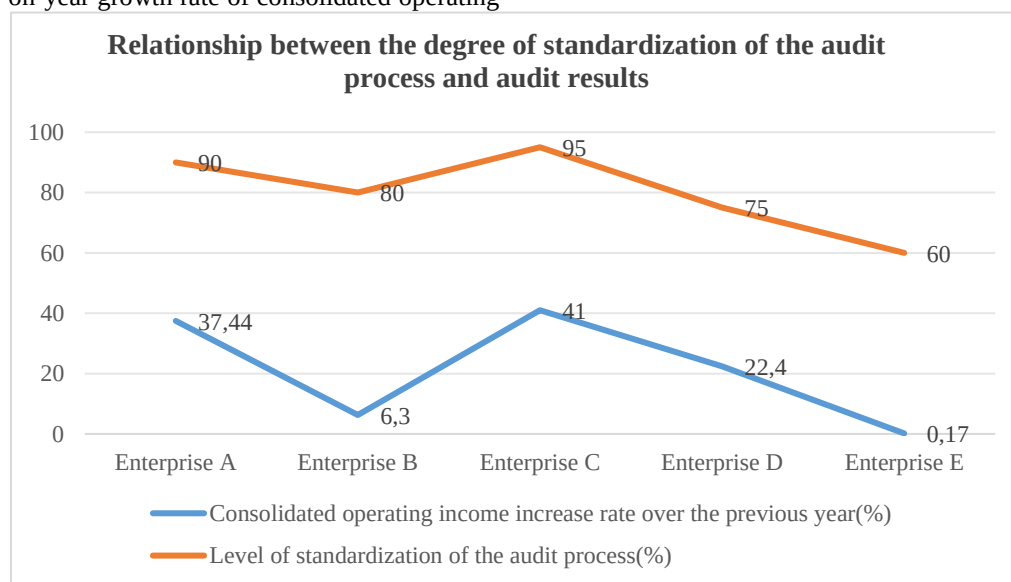


Figure 3. Relationship between the degree of standardization of the audit process and audit results

Note: Take the listed companies of Shanghai and Shenzhen A shares from 2018 to 2023 as samples

Third, the degree of uniformity of the audit process is a key component in determining audit quality. Standard Operating Procedures (SOPs) for auditing consolidated financial statements can reduce human errors while improving data processing uniformity and reliability¹¹. Combined with our data, organizations with a 41% CAGR in consolidated operating revenues

are more likely to standardize and automate their internal audit processes to assure data quality and consistency. Other year-on-year consolidated operational income growth rates, such as 6.6% or 22.4%, may represent the degree and efficacy of standardization used in different firms' audit processes, hence affecting the trustworthiness of audit reports.

An enterprise's internal and external environments can both have a substantial impact on audit quality. For example, increased market rivalry and economic swings may cause adjustments to an enterprise's financial strategy, which may be shown in the consolidated financial statements as irregular variations in revenue growth. By analyzing in-depth audit data from various companies, we can discover that some enterprises have experienced negative growth (e.g., -0.17%) in their consolidated revenue growth during economic downturns or market volatility, and these changes are frequently linked to external market shocks and the timeliness and accuracy of internal decision-making.

The elements influencing audit quality are not restricted to the traditional scope of auditing but must be thoroughly examined in the context of the complex business environment confronting firms' consolidated financial statements. Through extensive data interpretation, we discovered that regulatory policies, auditor professional competency, audit process standardization, and the company's general business environment all interact to influence audit quality. This complete perspective serves as a solid foundation for proposing future improvement approaches and pointing the way forward for optimizing the audit process and improving audit quality.

IV. Improvements to optimize the organization of the accounting and auditing organization

(i) Proposed organizational restructuring Numerous reasons in today's accounting and auditing companies contribute to low audit efficiency and quality, which have a substantial impact on the credibility of the company's consolidated financial statements and decision support. As a result, it is critical to make the necessary changes and improvements to the current structure. In this case, the organizational change model, particularly Cottle's eight-step method of change, must be employed as a theoretical foundation for transformation.

Recognizing the flaws in the current organizational structure is the first step toward optimization. Many audit companies today have unclear duties, poor information communication, and unreasonable resource allocation, making the audit process difficult to perform efficiently and accurately. For example, when confronted with complex cross-border merger audits, certain small audit teams are unable to rely on full competence, limiting the audit's scope and depth. To achieve the best allocation and usage of audit resources, it is recommended to implement a professional team system in the organizational structure, such as separating the audit team into user sector, financial analysis, and compliance audit teams¹².

(ii) Specific measures to improve audit quality

In today's complex economic environment, the quality of financial audits is a critical component of sustainable development. In this regard, the optimization of the accounting and auditing organization is critical, and particular techniques to increase audit quality are the key to achieving this objective. Implementing the PDCA cycle (Plan-Do-Check-Act) management approach has the potential to significantly increase audit quality.

In the "planning" phase, the business must create a clear audit policy and methodology. This procedure entails reviewing all aspects of audit standards and business requirements. Based on this, businesses can use the Risk-Based Audit Approach (RBA) to identify essential business areas and potential risks¹³. This strategy not only focuses on high-risk areas but also guarantees that resources are distributed effectively, improving the audit's professionalism and efficiency.

(iii) Improvement strategies incorporating technological tools

In today's business context, financial audits face increasingly complex issues, prompting companies to examine ways to optimize their accounting and auditing teams through the use of developing technological approaches. The rise of data analytics tools, artificial intelligence (AI), and blockchain technology has aided in the enhancement of audit effectiveness, making the audit process more efficient and accurate.

Data Analytics Tools (DATs) can automate the analysis of large volumes of financial data using powerful algorithms and statistical models¹⁴. This technique helps identify potential financial concerns and enables traditional audits to transition from sample audits to comprehensive audits. Auditors, for example, can use big data analytics to monitor financial activities in real-time. Fraud can be discovered quickly by identifying patterns and abnormalities. The application of such technologies increases audit efficiency, reliability, and scientific decision-making.

Artificial intelligence (AI) is rapidly being applied in the auditing profession¹⁴. AI technology may use machine learning to examine previous audit data, generate audit reports automatically, and provide useful insights. For example, AI using Natural Language Processing (NLP) can examine complex contract wording and transaction records to discover potential compliance risks and legal difficulties. This new technique not only significantly saves the time spent on human audits, but it also improves the ability to discover hidden hazards during audits and ensures overall audit quality.

V. Conclusion

In today's rapidly changing market economy, analyzing consolidated financial statements during the company merger and acquisition process is crucial for optimizing resource allocation and increasing competitiveness. Auditing, as a critical component, ensures financial transparency and influences corporate governance structure. Auditors must adapt to the changing auditing environment to improve quality and efficiency. PEST analysis demonstrates how political, economic, social, and technological elements interact to determine consolidated statement analysis and auditing methods. Consolidated statements are critical for satisfying the information needs of stakeholders, and standards such as IFRS must be followed to ensure data veracity. Audit quality is influenced by auditors' professional competence, regulatory policy rigor, and audit process uniformity, making it vital to maximize audit structures and team skills. Based on Cottle's eight-step change process, this study recommends programs to increase efficiency by identifying flaws, facilitating information flow, and creating incentives. Modern technologies like

data analytics, artificial intelligence, and blockchain can improve audit efficiency and accuracy, data processing, risk identification and monitoring, and reliability. Improvement frameworks and targeted recommendations are intended to continuously improve audit quality. Consolidated statement analysis and audit architecture enhancements assist businesses in succeeding in complicated financial contexts, maintaining financial openness and management discipline, and influencing company reputation, investor trust, and stakeholder decision-making. This work addresses a vacuum in the literature, offers theoretical support and methodological direction for academic research and industry practice, and fosters long-term business development.

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INTERNATIONAL EXPERIENCE IN THE DEVELOPMENT OF FRANCHISING IN THE FIELD OF CATERING**Surbaeva M.***Doctoral student DBA**Almaty Management University, Almaty***Rakhimbekova Zh.***Candidate of Economic Sciences, Associate Professor**Almaty Management University, Almaty***МЕЖДУНАРОДНЫЙ ОПЫТ РАЗВИТИЯ ФРАНЧАЙЗИНГА В СФЕРЕ ОБЩЕСТВЕННОГО ПИТАНИЯ****Сурбаева М.И.***Докторант DBA**Алматы Менеджмент Университет, г. Алматы***Рахимбекова Ж.С.***к.э.н., доцент**Алматы Менеджмент Университет, г. Алматы*<https://doi.org/10.5281/zenodo.15220753>**Abstract**

The article examines the international experience of franchising development in the field of catering, the specifics of its adaptation to different countries and the impact of economic and political factors on the growth of franchising networks. The key markets, their prospects and barriers for franchisors are analyzed, as well as the role of the International Franchise Association (IFA) and the International Code of Ethics for Franchising in regulating the industry. Special attention is paid to the American franchise model as a business format that allows effective access to international markets.

Аннотация

В статье рассматривается международный опыт развития франчайзинга в сфере общественного питания, особенности его адаптации к различным странам и влияние экономических и политических факторов на рост франчайзинговых сетей. Анализируются ключевые рынки, их перспективность и барьеры для франчайзеров, а также роль Международной франчайзинговой ассоциации (IFA) и Международного Кодекса по Этике франчайзинга в регулировании отрасли. Особое внимание уделяется американской модели франчайзинга как бизнес-формата, позволяющей эффективно выходить на международные рынки.

Keywords: International Franchise Association, catering, International Code of Ethics for Franchising**Ключевые слова:** Международная франчайзинговая ассоциация, общественное питание, Международный Кодекс по Этике франчайзинга.

С каждым годом индустрия франчайзинга сталкивается с множеством проблем. Пандемия нанесла сильный удар и оставила свой след в деловом мире, потом оказали влияние военные конфликты, колебания мировых цен на нефть, высокий уровень инфляции во всех странах и чрезвычайные ситуации. Не всем франшизам удалось стойко справиться со всеми трудностями, а некоторым удалось даже использовать их в своих интересах. Однако

есть общая тенденция сокращения рынков и покупательской способности во всем мире и франчайзинг позволяет бизнесу выжить даже в самые трудные времена [1].

Больше всего прибыльных вариантов присутствуют практически в каждой франчайзинговой отрасли, однако, самые лучшие возможности сосредоточены вокруг трех рынков (рисунок 1):

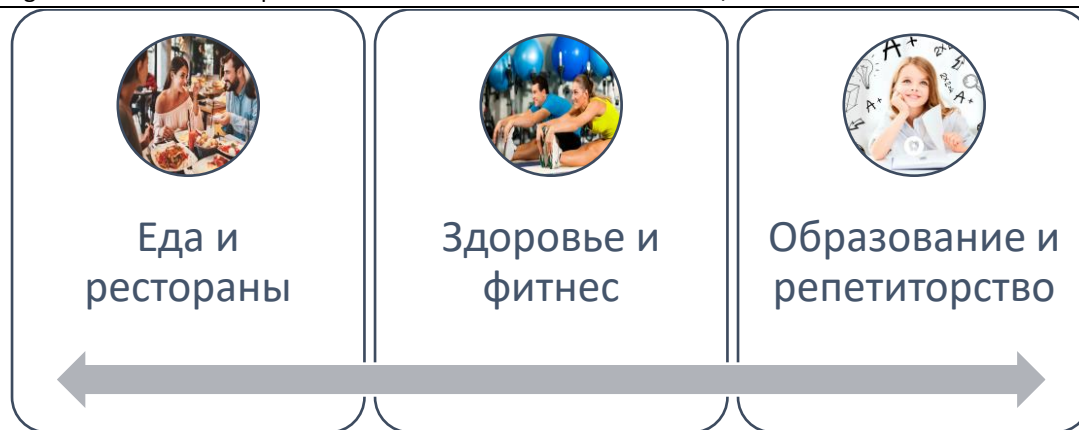


Рисунок 1 – Самые популярные отрасли франчайзинга на международном рынке
Источник: составлено автором

Лидерами и экспертами франчайзинга во всем мире признаны США. Франчайзинг помог США избежать экономический кризис, следовательно, правительство производит государственную поддержку франчайзинга со всех сторон. Страны с богатым опытом в целях развития франчайзинга основали Международную франчайзинговую ассоциацию (МФА-IFA). Торговая группа налаживает связи между правительством и индустрией франчайзинга, защищает интересы и продвигает своих членов. IFA была основана в США, в городе Чикаго в 1961 году. На данный момент членство получили более 1400 компаний.

Документом, регламентирующим работу членов ассоциации является Международный Кодекс

по Этике франчайзинга. Кодекс меняется с целью реагирования на актуальные события в мире в различных отраслях [2].

Причина сохранения лидирующих позиций за компаниями США заключается в модели франчайзинга как бизнес формата. То есть, кроме предоставления своей продукции и торговой марки франчайзер передает готовую бизнес-модель. Модель подразумевает оперативную сервисную поддержку, маркетинговые планы, рекламу и обучение. Франчайзинг один из лучших способов выхода на международный рынок при минимальных вложениях. Американские системы франчайзинга проникают на рынки других государств по 3 схемам (рисунок 2):



Рисунок 2 – Схема выхода франчайзера на международный рынок
Источник: составлено автором

Выбор любого способа выхода на международный рынок определяется экономической и политической обстановкой в стране. Также следует обращать внимание на государственную поддержку франчайзинга, рыночную инфраструктуру, законодательное регулирование, менталитет населения и налоговую систему. Очень часто руководство компании выбирают определенную страну как стартовую площадку развития своего бизнеса в це-

лом ряде стран. К примеру, франшиза в Бельгии отличный вариант для экспорта в соседние страны члены Европейского Союза.

При выборе страны для запуска франчайзинга самые крупные компании обращают внимание на категорию страны и на риски, которые возникают в той или иной стране. Так есть 4 категории стран, в которых разделены государства в зависимости от прогноза развития франчайзинга:

1) Страны, в которых прогнозируется высокий уровень развития франчайзинга:

- Австралия – Существует высокий уровень интереса к развитию новых франшиз.

- Канада – Эта консервативная страна сейчас в значительной степени бизнес вновь развивается. Интерес к франшизе велик для существующих брендов.

- Израиль – эта страна теперь открыта для новых инвестиций.

- Объединенные Арабские Эмираты – наблюдается значительный интерес к инвестициям в новые франчайзинговые бренды и прогнозируется рост еще больше.

2) Страны, в которых прогнозируется умеренный уровень развития новых франшиз:

- Египет - в потребительские центры направляется огромное количество новых инвестиций, и строится новая столица, в которой будут доступны крупные торговые площади.

- Германия – проблемы с цепочкой поставок замедлили работу ее основного производственного двигателя. Однако в последние месяцы мы наблюдаем значительный интерес к новым франчайзинговым брендам.

- Венгрия – В этой стране наблюдается возобновление интереса к новым бизнес-проектам, который по прогнозам экспертов сохранится.

- Ирландия – Небольшой размер страны не способствует созданию большого количества франчайзинговых подразделений для бренда.

- Италия – Итальянские предприятия продолжают восстанавливаться после серьезных остановок, вызванных пандемией, и научились с этим жить. Они открыты для нового бизнеса.

3) Страны, в которых прогнозируется низкий уровень развития новых франчайзинговых услуг:

- Великобритания – Выход из ЕС и серьезный экономический кризис привел страну к достаточно низкой категории. Покупательская способность населения за 2022 год резко сократилась, что влияет на сбыт продукции франшиз.

- Бразилия – По нашим оценкам, 2023 год - это самый ранний период, когда эта страна будет готова к новым инвестициям в франшизу из-за экономических и политических проблем. Резкий рост инфляции влияет на рост цен.

- Китай – Эта страна в настоящее время переживает крупномасштабные экономические, нормативные изменения, отношение потребителей и социологические изменения. Национальные особенности и предпочтения потребителей ограничивают рынок даже на самом густонаселенном рынке.

- Индия – Ведение бизнеса в Индии остается сложной задачей. В стране большой уровень бедности и низкий показатель ВВП на душу населения. Некоторые национальные особенности ограничивают многие компании франчайзинга.

- Пакистан – Есть много запросов из Пакистана и считается, что, появится значительный новый инвестиционный интерес.

- Сингапур – Проблема Сингапура по-прежнему заключается в том, что это насыщенный рынок франчайзинговых брендов с небольшим потенциалом расширения.

- Швеция – Иностранные франчайзинговые бренды имели ограниченный успех в скандинавских странах. Конкретные известные бренды имеют более высокие шансы найти инвесторов.

4) Страны с экономическими и/или политическими проблемами

- Аргентина. Ожидается, что пройдет как минимум 2023 год, прежде чем экономика восстановится до такой степени, что компании будут рассматривать возможность новых инвестиций.

- Чили – политические волнения и написание новой конституции могут замедлить приток новых инвестиций.

- Колумбия – Политические и экономические беспорядки замедляют новые инвестиции местных компаний.

- Мексика – Там правительство не дружелюбно к бизнесу, а терроризм присутствует в нескольких районах.

- Перу – Эта страна обычно радушно принимает иностранные франчайзинговые бренды. Недавние выборы марксистского правительства, которое угрожает национализацией, на некоторое время остановили новые инвестиции в бизнес.

- Турция – Экономический, политический дефицит платежного баланса и беспорядки продолжают негативно сказываться на привлекательности страны для франчайзеров. Землетрясения и высокий уровень инфляции в 2022 году (почти 70%) еще долго будут оказывать влияние на вход новых предприятий на турецкий рынок.

В список крупнейших и популярных американских франчайзеров в отрасли общественного питания можно отнести такие компании как «Burger King», «McDonald's», «Dunkin Donuts», «Pizza Hut», «Kentucky Fried Chicken», «KFC». Все эти компании успешно проникают во многие страны [3].

В МАФ (IFA) существует рейтинг топ -10 самых популярных франшиз в мире. Данные компании достаточно быстро развиваются (таблица 1).

Таблица 1

Рейтинг самых популярных франшиз в мире

Место в рейтинге	Название/ страна франчайзер	Логотип	Отрасль/дата основания
1	KFC/США		Общественное питание/20.03.1930
2	7-Eleven/США		Продовольственные магазины/1927 г.
3	McDonald's/США		Общественное питание/15.05.1940
4	Dunkin'/США		Общественное питание/1950 г.
5	Taco Bell/США		Общественное питание/21.03.1962
6	Pizza Hut/США		Общественное питание/15.06.1958
7	Kumon/Япония		Образование и репетиторство/ 11.07.1958
8	Hampton by Hilton/США		Гостеприимство/ 1984 г.
9	Anytime Fitness/США		Спорт и фитнес/2001 г.
10	Century 21 Real Estate/США		Недвижимость продаж/1971
Примечание: составлено автором			

Как видно из таблицы 1, в топ-10 самых больших сетей франшиз в мире находятся в отрасли общественного питания (5 из 10). Большинство компании основаны в США, что еще раз доказывает лидерство страны по франчайзингу. А даты основания компании показывают, что опыт международных франчайзинговых компании насчитывает более 90 лет.

Многие американские франчайзинговые компании открывались как 1 единица (магазин, ресторан, закусочная, учебный центр и т.д.), затем применяя стратегию развития руководство этих компании приняло решения расширения по всей Америке. Так появились с помощью франчайзинга

сети. После освоения местного рынка в стране, компании начали выходить на международный рынок, понимая возможности огромной прибыли без сильных затрат.

В целом, изучение международного опыта развития франчайзинговых компаний выявило наиболее привлекательные рынки, для франчайзинга с большим потенциалом, опыт международных компании помогает казахстанским компаниям запускать и разрабатывать предложения франчайзинга.

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ENTERPRISE MANAGEMENT AND THEIR FEATURES IN THE SERVICE SECTOR**Baishuakova A.***Doctoral student of Business Administration,
Almaty Management University (Almaty, Kazakhstan)***УПРАВЛЕНИЯ ПРЕДПРИЯТИЯМИ И ИХ ОСОБЕННОСТИ В СФЕРЕ УСЛУГ****Байшуакова А.***Докторант DBA**Алматы Менеджмент Университет,
г. Алматы, Республика Казахстан*<https://doi.org/10.5281/zenodo.15220755>**Abstract**

The article is devoted to analysis of peculiarities of management in service industries. The services sector is currently performing economic, social, and reproductive functions. In Russia, as elsewhere in the world, there has been a dynamic development of this sphere of activity.

The dependence of management in service industries the characteristics of this field of activity, an organizational economic mechanism of enterprise management, the process of its formation, the technology of control. Effective management of service industries suggests the need to consider the feature of service sector activities, namely the specific features that lie in the intangible nature of services, the continuity of consumption and production of services, in the variability of its qualities, the inability to storage and, depending on the contractor's services. For effective management of the enterprises of sphere of services is based on the following factors: high dynamics of the services sector; short production cycle of this sphere of activity; a large number in this field micro and small enterprises; territorial segmentation; personality; high personnel requirements; difficulties in determining the quality of services and their standardization; particular attention to the organization of the service process; the dependence of the growth of demand for services from the real incomes of the population etc. The proposed control mechanism includes the following structural elements: subjects of management; management objectives; management factors; organizational structure of management; resources management; methods of influence upon factors (bearings, tools). The technology of management as a complex of organizational measures on the basis of the formula A-P-SD-O-MI-A, which includes the following interrelated phases: analysis – planning – management decision – organization – motivation – control – analysis. It is concluded that the improvement of the organizational mechanism of enterprise management is a prerequisite for effective activity of enterprises of sphere of services. Development of mechanism of management of the enterprises of sphere of services it requires adaptability, understood as a purposeful change of its parameters, structure and properties of the occurring changes, i.e. the reorientation of the system on the solution of varying problems.

Аннотация

Статья посвящена анализу особенностей управления предприятиями сферы услуг. Сфера услуг в настоящее время выполняет экономические, социальные, воспроизводственные функции. В Казахстане, как и во всем мире, наблюдается динамичное развитие данной сферы деятельности.

Рассмотрена зависимость управления предприятиями сферы услуг от особенностей данной сферы деятельности, предложен организационно-экономический механизм управления предприятием, процесс его формирования, разработана технология управления.

Эффективное управление предприятиями сферы услуг предполагает необходимость учитывать особенность сервисной сферы деятельности, а именно специфических особенностей, которые заключаются в нематериальном характере услуг, неразрывности потребления и производства услуги, в изменчивости ее качеств, неспособности к хранению и зависимости от исполнителя услуги. Для эффективного управления предприятиями сферы услуг необходим учет следующих факторов: высокая динамика сферы услуг; короткий производственный цикл данной сферы деятельности; большое количество в данной сфере микро и малых предприятий; территориальная сегментация; индивидуальность; высокие требования к персоналу; трудности в определении качества услуг и их стандартизации; особое внимание организации процесса обслуживания; зависимость роста спроса на услуги от реальных доходов населения и др.

Предлагаемый механизм управления включает следующие структурные элементы: субъекты управления; цели управления; факторы управления; организационная структура управления; ресурсы управления; методы воздействия на факторы (направления, инструментарий).

Применена технология управления как комплекс организационных мер на основе формулы А-П-УР-ОМ-К-А, которая включает следующие взаимосвязанные этапы: анализ – планирование – управленческое решение – организация – мотивация – контроль – анализ.

Сделан вывод о том, что совершенствование организационного механизма управления предприятием является неременным условием обеспечения эффективной деятельности предприятий сферы услуг. Развитие механизма управления предприятиями сферы услуг требует его адаптивности, что понимается как

целенаправленное изменение его параметров, структуры и свойств на происходящие изменения, т. е. переориентацию системы на решение изменяющихся задач.

Keywords: organizational-economic mechanism of management, object of management, strategic and tactical management of the companies in the services sector, services sector, technology management, management, service, formula control A-P-SD-O-M-I-A (analysis – planning – management decision – organization – motivation – control – analysis).

Ключевые слова: организационно-экономический механизм управления, объект управления, стратегическое и тактическое управление предприятием сферы услуг, сфера услуг, технология управления, управление, услуга, формула управления А-П-УР-О-М-К-А (анализ – планирование – управленческое решение – организация – мотивация – контроль – анализ).

Сфера услуг в настоящее время выполняет экономические, социальные, воспроизводственные функции, многие направления данной сферы имеют решающее значение в развитии научно-технического прогресса.

В настоящее время в Казахстане, как и во всем мире, наблюдается динамичное развитие сферы услуг. По итогам 2024 года объем оказанных в Казахстане услуг составил 78,73 трлн тенге. Таким образом, услуги обеспечили 58,3% от ВВП РК в 2024 году (119,25 трлн тенге), следует из данных Бюро национальной статистики. Для сравнения, в 2023 году показатель занял долю в 56%, а за год до этого – 52,9%. [1]. Темп роста платных услуг в последнее десятилетие имеет положительную динамику.

Следует отметить значение сферы услуг и в решении социальных задач, так как большинство предприятий данной сферы деятельности относится к малым и средним предприятиям, на которых в настоящее время трудится около 65 % занятых в экономике граждан.

Предприятия сферы услуг работают на рынке в условиях жесткой конкуренции. Современный рынок готов предложить покупателю множество услуг. Причем различий между услугами одной категории может быть немного, а производителей – игроков на рынке, огромное количество. Жесткая рыночная конкуренция требует эффективного управления предприятиями сервисной деятельности.

Вопросам управления предприятиями сферы услуг посвящены работы таких авторов, как Г. Л. Азоев [2], А. П. Челенков [2], Е. И. Данилов [3], Н. В. Данилюк [4], А. П. Градов [5], Т. М. Конопляник [6], И. М. Лифиц [7], Е. А. Мазилкина [8], Г. Г. Паничкина [8], Х. А. Фасхиев [9], Р. А. Фатхутдинов [10], и др. При наличии большого числа исследований по данной теме в литературе нет единой точки зрения на организационно-экономический механизм управления предприятием сферы сервиса, на сегодняшний день вопросы управления предприятиями сферы услуг являются дискуссионными. Задачи, связанные с необходимостью эффективного управления данными предприятиями, требуют углубления теоретических положений и дальнейшей разработки практических рекомендаций.

Теоретическую и методическую основу исследования составили труды казахстанских и российских ученых и специалистов по проблемам управления предприятиями услуг, материалы и публикации периодических изданий, монографических

исследований, средств массовых коммуникаций и интернет ресурсов, отчетность предприятий сферы услуг. В ходе изучения данного вопроса использовались монографический метод, сравнительный, логический, системный и ситуационный анализ, методы обобщения полученных результатов, а также метод моделирования.

В статье рассмотрена зависимость управления предприятиями сферы услуг от особенностей данной сферы деятельности, а именно от специфических особенностей услуг как товара. Предложен организационно-экономический механизм управления предприятием, процесс его формирования, использована технология управления, а также определены факторы, влияющие на особенности управления.

Управление – это сознательное целенаправленное воздействие со стороны субъектов, органов на людей и экономические объекты, осуществляемое с целью направить их действия и получить желаемые результаты [11].

Управление предприятием сферы услуг – это сознательное постоянное воздействие субъектов управления на объекты и процессы, а также на участие в них людей, имеющее целью выбора направление деятельности предприятия сферы услуг и получение желаемых результатов. Целями управления являются повышение прибыли и уровня рентабельности деятельности, укрепление конкурентной позиции на рынке, создание конкурентных преимуществ, адаптивность предприятия к изменяющимся внешним условиям, а также реализация интересов собственников, работников и потребителей услуг предприятий.

Эффективное управление предприятиями сферы услуг предполагает необходимость учитывать особенность сервисной сферы деятельности. Особенности связаны с предметом деятельности данных предприятий, а именно оказываемой услугой.

Понятие «услуга» отечественными и зарубежными авторами рассматривается в трех направлениях: с позиции отрасли, где учитывается специализации; с позиции самой услуги, где во внимание принимаются ее свойства, учитывающие специфику конкретной услуги; в качестве альтернативы товару как материальному благу.

Анализ литературы выявил, что большинство авторов выделяют специфические особенности услуг [12, 13], которые заключаются в нематериальном характере услуг, неразрывности потребления и

производства услуги, в изменчивости ее качеств, неспособности к хранению и зависимости от исполнителя услуги.

Услуга в общем смысле является товаром, поскольку имеет свою стоимость и ценность, но в то же время имеет существенные отличия от товара. Производитель товара не создает продукт для конкретного пользователя, даже если это товар премиум класса. Услуга создается под конкретного пользователя, она характеризуется индивидуальностью и личностным характером. Так Р. А. Фатхутдинов отмечает, что товар и услуга имеют незначительные отличия. Саму услугу можно рассматривать как специфичный «товар» [14]. М. Кляйнальтенкамп утверждает, что между товарами и услугами не столь большая разница. Услуга как продукт труда имеет потребительную стоимость, и это определяет ее товарный характер, который выражается в способности быть реализованной потребителями как своеобразный товар [15]. С. П. Бурлаков, И. Е. Ильенкова, А. Е. Скворцов придерживаются другой точки зрения и считают не совсем верным совмещать понятие услуги с понятием продукции [16].

Соответственно, необходимо учитывать следующие факторы, оказывающие существенное влияние на управление предприятиями сферы услуг:

- высокая динамика сферы услуг, связанная не только с увеличением объемов оказываемых услуг

в стоимостном выражении, но и в постоянной изменчивости самих услуг;

- короткий производственный цикл данной сферы деятельности, что делает привлекательным данное направление экономики для бизнеса;

- большое количество в данной сфере микро и малых предприятий (около 70 %);

- локальный характер, территориальная сегментация;

- индивидуальность, отсутствие посредников при оказании услуг;

- изменчивость и нестандартность продукта;

- неопределенность результата;

- высокие требования к персоналу;

- трудности в определении качества услуг и их стандартизации;

- особое внимание организации процесса обслуживания;

- тесная связь с материальным производством, поскольку производственные предприятия в настоящее время не только производят материальный товар, но и оказывают широкий спектр услуг, например, по доставке, наладке, монтажу, сервисному обслуживанию, информационному сопровождению;

- тесная связь маркетинга и процесса оказания услуг;

- зависимость роста спроса на услуги от реальных доходов населения;

- зависимость от места расположения предприятия.



Рисунок 1 - Процесс формирования механизма управления предприятием сферы услуг

Управление предприятием сферы услуг должно предполагать стратегическое и тактическое направление. Стратегическое управление позволяет предприятию вести эффективную деятельность длительное время на рынке за счет обеспечения конкурентных преимуществ. В настоящее время обязательной задачей стратегической направленности является повышение уровня конкурентоспособности предприятия и оказываемых им услуг. Тактическое управление предприятием предполагает детальную разработку и осуществление конкретных мероприятий по осуществлению выбранных стратегий, которое включает в себя решения вопросов, связанных с определением конкретных исполнителей установленной программы действий, сроков исполнения и ответственных.

Следует отметить, что предприятию сервиса стратегическое управление необходимо осуществлять с двух позиций. Во-первых, разработка стратегий должна быть постоянной, регулярной, на основе взаимодействия подсистем управления, анализа и планирования, а также реализации стратегии. Во-вторых, стратегическое управление в реальном времени, с учетом особенностей деятельности конкретного предприятия на конкретном территориальном рынке.

Управление предприятием сферы услуг с учетом перспектив должно осуществляться на основе гибких экстренных решений, так как постоянные изменения во внешней среде требуют незамедлительной адекватной реакции с учетом целей предприятия и имеющихся ресурсов. Чтобы предприятию выжить и вести эффективную деятельность нет иного пути как путь постоянного уточнения стратегий и эффективного использования ограниченных ресурсов в конкретный момент времени.

В основе управления конкурентоспособностью должен лежать стратегический подход, который реализуется через механизм управления. Организационно-экономический механизм управления представляет собой систему взаимосвязанных элементов, обеспечивающих необходимый конечный результат в виде достижения целей управления.

В теории систем управления организационно-экономический механизм включает в себя содержательные и экономические аспекты его строения и функций. Экономическая составляющая создает условия для внедрения программы и формирования экономических отношений между участниками процесса внедрения программы по совершенствованию системы управления на основе экономиче-

ских рычагов и методов. Организационный механизм системы определяет состав классифицированных по характеру и содержанию связей компонентов системы, обусловленных структурой отношений управления. Последовательность упорядоченных связей, скоординированная по отношению к целям системы и структуре процесса принятия решений, определяет организационный механизм управления [17].

Таким образом, экономический элемент в механизме управления отвечает за содержание разрабатываемой программы управления, а организационный – описывает функционирование элементов механизма.

Организационно-экономический механизм управления предприятием сервиса в общем понимании представляет собой организационно-экономические формы взаимоотношений субъектов управления (руководителей, менеджеров, собственников), возникающие при совершенствовании объектов управления (предприятие, подразделения, персонал, услуга), а также экономические методы и инструменты, которые при этом используются.

В экономической литературе не представлено единого подхода к определению механизма управления предприятием сферы услуг. Следует отметить, задача каждого субъекта хозяйствования – создать индивидуальный механизм управления, обеспечивающий конечный результат.

Обязательными элементами любого организационно-экономического механизма являются субъекты управления, организационные формы их взаимоотношений, объекты управления, экономические методы, результаты управления, описание условий управления [18].

Процесс формирования механизма управления предприятием сферы услуг можно представить в виде следующего алгоритма (рисунок 1).

На мой взгляд, механизм управления и реализации стратегии обеспечения конкурентоспособности предприятий сферы услуг должен включать в себя следующие структурные элементы:

- субъекты управления;

- цели управления субъектов управления: под целью понимается желаемый результат деятельности, достигнутый в пределах некоторого интервала времени и полученный;

- факторы управления (элементы объекта управления и их связи, на которые осуществляется воздействие в интересах достижения целей);

- организационная структура управления;

- ресурсы управления (материально-технические, финансовые и другие ресурсы, при использовании которых реализуется избранный метод управления и обеспечивается достижение поставленной цели);

- методы воздействия на факторы (направления, инструментарий) [19].

Организационно-экономический механизм стратегического управления предприятием сферы услуг эффективно реализуется в технологии управления. В данном случае мы рассматриваем технологию в узком смысле как комплекс организационных мер, операций и приемов, направленных на оказание любого вида услуг с номинальным качеством и оптимальными затратами, обусловленных текущим уровнем технологий и особенностей развития рынка конкретных услуг конкретного региона.

Управление предприятием в сложных внешних условиях не статичный процесс, а постоянно изменяющийся, творческий, который требует постоянной координации. Субъект управления предприятием сферы услуг при выборе технологии управления принимает решения о видах и функциях управления в зависимости от целей, имеющихся ресурсов, времени, собственного видения данной проблемы.

В данном случае мы рассматриваем технологию в узком смысле слова как комплекс организационных мер, операций и приемов (таблица 1). На предприятиях сферы услуг наиболее эффективна технология управления на основе формулы А-П-УР-ОМ-К-А, которая включает следующие взаимосвязанные этапы: анализ – планирование – управленческое решение – организация – мотивация – контроль – анализ [20; 21; 22].

Наполнение этапов технологии управления различно по содержанию, но в обязательном порядке должно учитывать особенности территориального рынка, на котором функционирует предприятие, особенности сферы деятельности (оказание конкретного вида услуг) и имеющиеся ресурсы.

Технология на основе формулы АПУРОМКА рациональна и логична, ее использование возможно на малых предприятиях, где все основные функции зачастую сосредоточены в руках одного субъекта управления: руководителя предприятия или собственника.

Технология управления предприятием услуг

Основной этап	Мероприятие	Возможный метод
1. Стратегический анализ ситуации на рынке услуг	1. Анализ внешней среды: анализ макроокружения и микроокружения предприятия 2. Анализ внутренней среды: менеджмент, производство, научные исследования, маркетинг, кадры, финансы, др. 3. Анализ особенностей услуг и развития рынка	Маркетинговые исследования, экспертные методы, PEST-анализ. SWOT-анализ, анализ финансово-хозяйственной деятельности, факторный анализ
2. Определение целей управления предприятием услуг	1. Определение миссии предприятия 2. Разработка иерархической системы целей на уровне предприятия, стратегических единиц бизнеса, функциональных подразделений	Метод «дерева целей», факторный анализ данных экспертной оценки
3. Формирование стратегии управления	1. Оценка альтернативных стратегий управления 2. Выбор оптимальной стратегии развития на уровне предприятия, стратегических единиц бизнеса, функциональных подразделений с учетом перспективных направлений и имеющихся ресурсов	Методы анализа, методы оценки, методы сравнения
4. Выбор методов и средств достижения целей и реализации стратегии	1. Выбор методов с учетом особенностей объекта: предприятие, производственное подразделение, функциональный отдел, коллектив, услуга, отдельный работник 2. Выбор метода по содержанию: организационные, административные, экономические, социально-психологические, самоуправления 3. Выбор методов по организационной форме 4. Определение средств и их сочетание на наиболее перспективных направлениях	Метод сравнительного анализа, интуитивные методы, оценка реальной ситуации,
5. Планирование мероприятий по реализации стратегии	1. Определение направлений управления. 2. Разработка стратегического плана по реализации стратегии (главная стратегия предприятия, стратегии на уровне СЕБ, стратегии на уровне функциональных звеньев), определение средств, способов, сроков, ресурсов, ответственных лиц, исполнителей	Метод сравнения, нормативный метод
6. Организация выполнения мероприятий по реализации стратегии	1. Разработка программы выполнения стратегии: среднесрочные и краткосрочные планы; формирование организационной структуры предприятия, команды, реализующей стратегию; график выполнения стратегии; определение контрольных точек и др. 2. Реализация стратегии: выполнение мероприятий согласно плану	Методы анализа, методы планирования
7. Мотивация персонала	Применение организационно-административных, экономических и социально-психологических методов	Методы анализа, сравнения
8. Контроль и координация выполнения стратегии	1. Контроль реализации стратегии: предварительный, текущий и заключительный 2. Координирование мероприятий	Методы сравнения, анализа
9. Оценка процесса реализации стратегии	1. Экспертная оценка уровня реализации стратегии. 2. Оценка экономической эффективности	Метод расчета интегрального показателя, сравнения, анализа

Используя данную схему управления предприятием, есть возможность решать практические задачи по эффективному управлению деятельностью сервисных организаций.

Следует отметить, что при совершенствовании организационно-экономического механизма управ-

ления предприятиями сферы услуг необходимо решать задачи его адаптивности. Адаптивность организационно-экономического механизма понимается как целенаправленное изменение его параметров, структуры и свойств на происходящие изменения, т. е. переориентацию системы на решение изменяющихся задач. Адаптивный механизм

управления предполагает необходимость быстро и с наименьшими затратами реагировать на изменения внешней среды и внутренних возможностей предприятия. Адаптивность организационно-экономического механизма предприятия предлагается обеспечить за счет постоянного повышения конкурентоспособности оказываемых услуг, технологии управления, совершенствования организационной структуры управления, а также своевременным получением и анализом информации о внешней среде.

Современный рынок услуг предъявляет целый комплекс определенных требований к системе управления предприятием. Основное требование – эффективное функционирование предприятия в условиях активных действий со стороны как внутренней, так и внешней конкурентной окружающей среды. В связи с этим совершенствование организационного механизма управления предприятием является неперенным условием обеспечения эффективной деятельности предприятий сферы услуг.

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HISTORICAL SCIENCES

THE AZERBAIJAN DEMOCRATIC REPUBLIC IN SECRET INTELLIGENCE TELEGRAPHS SENT FROM BAKU TO LONDON

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BAKIDAN LONDONA GÖNDƏRİLƏN MƏXVİ KƏŞFİYYAT TELEQRAFLARINDA AZƏRBAYCAN XALQ CUMHURİYYƏTİNİN FƏALİYYƏTİ (1918)

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Abstract

In the article, the establishment of the Azerbaijan People's Republic, which is considered the first parliamentary republic of Azerbaijan, and the military and political issues that took place during this period were extensively researched. The Azerbaijan Democratic Republic has left deep traces not only in the history of Azerbaijan, but also in the history of the Turkish world with its successful policy and proud steps taken for independence and statehood. As a result of the correct domestic and foreign policy conducted during the period of activity of the Parliament of the Azerbaijan Democratic Republic, it created the basis for the creation of today's independent state of Azerbaijan. In the article, the events that took place during the establishment of the Azerbaijan Democratic Republic were widely covered, the Centrocaspian Dictatorship period was analyzed, and the British plans for Baku were approached from a new angle based on our archival research and the found secret intelligence correspondence between Baku and London.

Müərrəf

Məqalədə Şimali Azərbaycan ilk parlament respublikası sayılan Azərbaycan Xalq Cümhuriyyətinin yaranması, və bu dövrdə baş vermiş hərbi və siyasi məsələlər geniş şəkildə araşdırılmışdır. Azərbaycan Xalq Cümhuriyyəti yürütdüyü uğurlu siyasətlə, müstəqillik və dövlətçilik uğrunda attığı məğrur addımlarla nəinki Azərbaycan tarixində, türk dünyası tarixində də dərin izlər qoymuşdur. Azərbaycan Xalq Cümhuriyyətinin Parlamentinin fəaliyyəti dövründə aparılan düzgün daxili və xarici siyasəti nəticəsində bu gün ki müstəqil Azərbaycan dövlətinin yaranmasına zəmin yaratmışdır. Məqalədə Azərbaycan Xalq Cümhuriyyətinin qurulması zamanı baş verən hadisələr geniş şəkildə ələ alınmış, Sentrokaspi Diktaturası dövrü analiz edilmiş və ingilislərin Bakı üçün qurduğu planlara apardığımız arxiv araşdırmalarına və Bakı ilə London arasında keçən tapılmış gizli kəşfiyyat yazışmalarına əsaslanaraq yeni bir bucaqdan yanaşılmışdır. Bu məqalə Londonda saxlanılan arxiv materiallarının ilk dəfə təqdim olunmasıyla elmə yenilik gətirməsiylə xüsusi əhəmiyyət kəsb edir.

Keywords: Azerbaijan Democratic Republic, Centrocaspian Dictatorship, Azerbaijan National Council, secret archival correspondences.

Açar Sözlər: Azərbaycan Xalq Cümhuriyyəti, Sentrokaspi Diktaturası, Azərbaycan Milli Şurası, İngiltərə Gizli Arxiv Materialları.

Giriş. Müsəlman Şərqində ilk demokratik cümhuriyyətin məhz Azərbaycan torpağında yaranması xalqımızın o dövrdə və o illər ərəfəsində – XIX əsrin sonunda və XX əsrin əvvəllərində milli müstəqillik, azadlıq duyğuları ilə yaşaması ilə bağlıdır. O illərdə xalqımızın qabaqcıl şəxsiyyətləri, mütəfəkkir adamları, ziyalıları xalqımızda milli azadlıq, milli müstəqillik duyğularını gücləndirmiş, milli dirçəliş, milli oyanış əhval-ruhiyyəsi yaymış və bunların hamısı məntiqi olaraq Azərbaycan Xalq Cümhuriyyətinin yaranmasına gətirib çıxarmışdır. (Heydər Əliyev, ümummilli lider) [1].

Bakıda Centro Caspy (Sentro Kaspi) Dövlətinin (Diktaturasının) Qurulması. 1917-ci ilin oktyabr ayında Rusiyada bolşeviklərin hakimiyyətə gəlməsi zamanı baş vermiş böyük əhəmiyyətə malik bu

vəziyyət İngiltərə başda olmaqla, Qərbi Avropa ölkələrinin yeni siyasi yol izləməsinə səbəb oldu. 1917-ci ilin dekabr ayında İngiltərə və Fransa Bolşeviklərin idarəsi altında olan yeni Rusiyanın güclü mövqə əldə etməsinə qarşı durmaq üçün Rusiyanın cənubunu bölməli idilər. Bu planın doğru şəkildə həyata keçməsi üçün İngiltərə və Fransa arasında imzalanan sazişə əsasən İngilislər Qafqaz bölgələrini tabelik altına almalı idilər. İngilislərin Qafqaz bölgələrində tam hakimiyyət əldə etmək yolunda atacaqları ilk addım Bakını tutmaq idi. İngilislər Bakının yerləşdiyi coğrafi ərazilərdəki təbii yeraltı qaynaqların xüsusilə neft yataqlarının müharibədə ciddi təsir edici amil olabiləcəyini bildiklərindən 1918-ci ilin yanvar ayında general-mayor L.Denstervilin başçılıq etdiyi ordu quruldu. Tiflis şəhərində 1918-ci il fevral ayında Zaqafqaziya ölkələri birləşərək Zaqafqaziya

parlamentini elan ettilər. Lakin həmin tarixlərdə həm ölkə daxili, həm də xarici əlaqələrdə gərgin vəziyyət olduğu üçün Zaqafqaziya parlamenti nəzərdə tutulan şəkildə irəliləyə bilmədi. Bu vəziyyət parlamentin strukturuna da öz təsirini göstərərək, parlamentin gürcü nümayəndələrinin parlamentdən ayrılmasına gətirib çıxartdı. Parlamentin Azərbaycan nümayəndiliyi yaranmış gərgin vəziyyətdən çıxış yolu olaraq çox böyük bir qərar qəbul edərək Azərbaycanın idarə edilməsi üçün müvəqqəti Milli Şuranın qurulması qərarını aldı. Şuraya M.Seyidov, H.Ağayev sədr müavini olaraq, M.Ə.Rəsulzadə sədr olaraq fəaliyyətlərinə başladılar. Daha sonra Milli Şuranın daxili strukturu genişləndirilərək 9 nəfərdən ibarət icra edici orqanı quruldu. Milli Şuranın ilk iclasında aparılan müzakirələr nəticəsində Azərbaycanın müstəqil Respublika olaraq öz istiqlalıyyətini elan etməsi ilə əlaqədar orta qərar qəbul edildi və 6 bənddən ibarət istiqlalıyyət bəyannaməsi hazırlandı [2].

Rəsulzadə rəhbərliyində Azərbaycan Xalq Cümhuriyyəti və Milli Şuranın yaradılması. 1918-ci ilin 28 Mayında M.Ə.Rəsulzadənin sədr seçildiyi Azərbaycan Milli Şurasının qəbul etdiyi 6 maddəlik "İstiqlal bəyannaməsi":

1. Bu gündən etibarən Azərbaycan xalqları suveren hüquqlara malikdirlər, Şərqi və Cənubi Zaqafqaziyadan ibarət olan Azərbaycan tam hüquqlu müstəqil dövlətdir.

2. Müstəqil Azərbaycanın siyasi quruluş forması Xalq Cümhuriyyətidir.

3. Azərbaycan Xalq Cümhuriyyəti bütün millətlər, xüsusilə qonşu xalqlar və dövlətlərlə mehriban qonşuluq münasibətləri yaratmağa çalışır.

4. Azərbaycan Xalq Cümhuriyyəti öz sərhədləri daxilində milliyyətindən, dinindən, sosial vəziyyəti və cinsindən asılı olmayaraq, bütün vətəndaşlara vətəndaşlıq və siyasi hüquqlar təmin edir.

5. Azərbaycan Xalq Cümhuriyyəti öz ərazisi daxilində yaşayan bütün millətlərə azad inkişafı üçün geniş imkanlar verir.

6. Müəssislər Məclisi çağırılana qədər bütün Azərbaycanın idarəsi başında xalq seçkiləri ilə seçilmiş Milli Şura və Milli Məclis qarşısında məsuliyyət daşıyan Müvəqqəti Hökumət durur (Sərəncam, 16 may 2017-ci il).

Azərbaycan Xalq Cümhuriyyəti I. Nazirlər Kabineti. İstiqlal bəyannaməsi elan edildikdən sonra Milli Şura F.X.Xoyskiyə hökumətin yaradılmasını tapşırı. Azərbaycanın ilk müvəqqəti hökuməti belə tərkibdə təqdim edildi:

F.X.Xoyski - Nazirlər Şurasının sədri, Daxili işlər naziri; Xosrovpaşa bəy Sultanov - Hərbi nazir;

N.Yusifbəyli - Xalq maarifi və Maliyyə naziri; M.H.Hacinski - Xarici işlər naziri; X.B.Məlikaslanov - poçt, teleqraf və yollar naziri;

Ə.Şeyxülislamov - Əkinçilik və əmək naziri; X.Xasməmmədov - Ədliyyə naziri;

M.Y.Cəfərov - Ticarət və sənaye naziri;

Camo Hacinski Dövlət nəzarəti naziri [3].

Yekun olaraq Tiflis şəhərində qəbul olunmuş müvafiq qərar əsasında Azərbaycan Xalq

Cümhuriyyəti qurulsa da, Azərbaycan Xalq Cümhuriyyəti parlamentinin təşkili reallaşmamışdır.

1918-ci il mart ayında İngilislərin Bakını idarələri altına almaq üçün atdıqları addımlardan biri də Şimali İrandan çəkilən rus kazak dəstələrinin idarəedicisi L.Biçeraxovla hərbi əməkdaşlığın qurulması idi. Bu əməkdaşlığa görə L.Biçeraxov İngilis hərbi komandanlarının əmrlərini yerinə yetirməli və bu icraat zamanı ordunun ehtiyac duyduğu maliyyəni İngilislər təmin etməli idilər. 1918-ci il 16 iyun tarixində Azərbaycan Xalq Cümhuriyyəti Tiflisdən Gəncə şəhərinə köçürülmüşdür. Daha sonra sentyabrın 17-dən 1920-ci il aprel 28-dək Bakıda fəaliyyət göstərmişdir [4].

Bakıda L.Denstervilin rəhbərlik idarəsi. İngilis hökuməti bolşeviklərin daşnaklarla olan birliyinin gələcəkdə onlar üçün gərgin vəziyyətlər yarada biləcəyinə qarşı olaraq general-mayor L.Denstervilin idarəsi ilə ingilis hərbi ordularının şəhərə daxil olması planlaşdırıldı. Fəqət bu gedişatın davam edə bilməsi üçün Xəzər hərbi donanmasının qurulması əhəmiyyət kəsb edirdi. Bunu etmək üçün ingilis hökuməti bolşevik və daşnaklarla tərəfdaşlıq etməli idilər. 1918-ci il iyun ayının 27-sindən iyul ayının 1-inə qədər Qafqaz İslam Ordusu bolşevik-daşnak ordularının Gəncə şəhərinə etdikləri hücumun qarşısını almaqla bərabər, Bakı şəhərinə doğru bir sıra hərbi qalibiyyətlərində qazanılmasına nail oldu. Yaranmış bu vəziyyətdə L.Biçeraxov hərbi qoşunlarını Xəzər dənizi vasitəsi ilə iyul ayının 5-də Ələt şəhərinə doğru yönləndirdi. Bu döyüş zamanı cəbhə xəttində ağır vəziyyətlər yaranmışdı, L.Biçeraxov döyüşdə iştirak etməməyə qərara gəldi. İyul ayının sonlarına qədər L.Biçeraxov öz qoşunlarını cəbhədə ağır vəziyyətlər olmasına rəğmən geri çəkmədi. Lakin iyul ayının sonlarında artıq cəbhədə artan gərginlik L.Biçeraxovu qoşunlarını Şimala doğru yönləndirməyə vadar etdi. İyul ayının 25-i yaranmış bir sıra hərbi və siyasi gərgin vəziyyətlər səbəbi ilə Bakı Sovetinin iclası keçirildi. S.Şaumyan yaranmış ağır vəziyyət haqqında etdiyi məruzəsində ingilis hökuməti ordularının Bakıya göndərilməsi taktikəsinə etirazını bildirdi. Gərgin müzakirələrin nəticəsi olaraq ingilis qüvvələrinin Bakıya dəvət olunması üzrə qərar qəbul edildi. Bolşeviklər mövcud situasiyada hakimiyyətdən çəkildilər və S.Şaumyan istefa verdi [5].

Bakıda 26.Bakı Komissarının İngilislər tərəfindən devrilməsi. S.Şaumyanın istefasından sonra 1918-ci il avqustun 1-də Sentrokaspi Diktaturası və Fəhlə, Əsgər Deputatları Sovetinin Müvəqqəti İcra Komitəsinin birgə hökuməti təşkil edildi. Sentrokaspi Diktaturasının idarəsi zamanı əsas məqsədi İngilislərin Bakıya köçürmək və burada olan qüvvələri gücləndirmək idi. İngilislərin bir digər əsas məqsədi isə türklərin əlaqələr yaratmaq məqsədi ilə Bakıya və eləcə də Şərq ölkələrinə yürüyüşlərinə mane olmaq və bu hədəfin yerinə yetirilməsinə qarşı çıxmaq idi. Türklərə qarşı Bakıya ingilis qoşunları göndərilirdi. Lakin göndərilən orduların sayının az olması səbəbi ilə şəhərin xristian əhalisini təşvişə saldı. Bu məsələ ciddi gərginlik yarada biləcəyindən əhalini sakitləşdirmək üçün həqiqətdə öz əksini tapmayan məlumatlarla böyük orduların Bakıya gələcəyini və Sentrokaspi

Diktaturasının hərbi donanmasını gücləndirəcəyini xəbərini yaydılar. Bu real olmayan böyük orduların Bakıya gələcəyi haqqındakı məlumatların sayı-xarakteri daşdığına, Bakını işğal edən hökumətin hərbi gücü və dəstəyinin az olduğunu anlayan İslam Ordusu Bakını azad etmək üçün hərbi əməliyyatlar aparmağa başladı. Bakı Kommunasının dağılmasından sonra dəstəksiz qalan Sentrokaspi Diktaturasına Moskvadan Bakını İslam Ordusuna qarşı qorumaq üçün hərbi dəstək yardımı təklifi gəldi [6].

Lakin Sentrokaspi Diktataturası İngilislərin onlara bildirdiyi göndəriləcək böyük yardımın olacağına ümid edərək Moskvanın bu təklifini qəbul etmədilər. Nəticədə İngilislər tərəfindən göndərilən hərbi donanma gözlənilən hərbi yardımdan kəskin fərqləndiyi üçün Sentrokaspi Diktaturası çıxılmaz vəziyyətdə qaldı. Sentrokaspiçilər bu ağır vəziyyətdə müdafiə xəttinə təcili olaraq dəstək istədilər, amma bu reallaşmadı. Bunu gören general-mayor L.Denstervil Bakıdan çəkilməyi təklif etdi. Lakin bu təklifə də müsbət cavab verilmədi. Müharibənin eşiğinde olan ingilislərə 1918-ci ilin sentyabr ayının 15-də Azərbaycan-Türkiyə Ordusu tərəfindən son hərbi əməliyyat aparılaraq, general-mayor L.Denstervil Bakıdan çəkilməyə məcbur oldu, çünki əks təqdirdə ingilislər Azərbaycan-Türkiyə Ordusu tərəfindən məğlub ediləcəkdir. Yekun olaraq ingilislərin Qafqaz bölgələrinə o cümlədən Bakıya hakim olmaq üçün qurduğu planlar baş tutmadı və nəticədə son qalan 70 zabıt və 800 əsgəri ilə general-mayor L.Denstervil Bakını tərk etdi [4,6].

Baş vermiş hadisələri, və ingilislərin Bakını ələ keçirmək üçün icra etdiyi planları, apardığımız arxiv araşdırmalarında tapdığımız gizli yazışmalarda da görə bilərik. Aşağıdakı sənədlərin əldə edilməsi üçün Böyük Britaniya Krallığı Milli Hökumət Arxivləri ilə elektron yazışmalar aparılmış və arxivdən təmin olunan bu məxvi materiallar araşdırılaraq tərcümə edilmişdir:

İngilis Məxvi Ordu Bürosunun Bakıdan Londona göndərdiyi, tam məxvi sənədlər. Bu Sənəd Britaniya Hökumətinin müliyyətidir.

TAM MƏXVİDİR

AZƏRBAYCAN HAQQINDA QEYDLƏR

Qeyd– Bu materiallar Türkiyə ilə atəşkəs imzalanmadan əvvəl yazılmışdır. (Şəkil.1.və Şəkil.2).

1. May ayının sonunda Birləşmiş Zaqafqaziya Hökuməti dağıldıqda, tatarlar Bakının işğalından əvvəl Elizavetopolda müvəqqəti paytaxtı olan müstəqil bir respublika elan etdilər. İddia edilən dəqiq ərazi məlum deyil, lakin o, mütləq Yelizavetopol və Bakı əyalətlərini, ehtimal ki, İrəvanın cənub-şərq hissəsini və bəlkə də Dağıstan və Cənubi Azərbaycanı əhatə edirdi. Lakin bu əlavə iddialar Konstantinopoldakı (İstanbuldakı) Tatar nümayəndə heyəti tərəfindən dəstəklənməmiş və tatar olmayan müsəlman (sünni) olan dağıstanlılar Qafqaz dağlarının birliyinə mənsubdurlar və görünür, onların Azərbaycana daxil edilməsi məsələsində bölünürlər. Fars Azərbaycanındakı tatarların yeni dövlətə daxil olmaq istəyinə dair heç bir dəlil yoxdur. Tanınmış Panturan Rəsulzadə, Azərbaycan

Milli Məclisinin sədri və Konstantinopoldakı nümayəndə heyətinin üzvü, görünür, hökumət başçısı Xoyski xanla Yeni Azərbaycan dövlətinin siyasətinin rəhbərliyində əsas təsiri bölüşür. Rəsulzadə Musavat partiyasının (son dərəcə Türk tərəfdarı) qurucusu və lideridir, fars İnqilabı dövründə Tehrandə çalışmış və bu səbəbdən İran demokratları ilə çoxsaylı əlaqələri olduğu düşünüləkdədir.

2. Türklər 1918-ci ilin iyununda Azərbaycana doğru Bakıya doğru irəlilədilər və iyulun sonuna qədər yeni respublika ərazisinin çox hissəsini işğal etdilər. Almaniya o zaman Türkiyənin (Osmanlının) Azərbaycanın faktiki suvereni kimi mövqeyini qəbul etdi, lakin o, heç vaxt onu dövlət kimi tanımadı və bu bərdə heç bir qeydin olmaması və avqustun 27-də Rusiya-Almaniya əlavə müqaviləsində Bakının Rusiyaya təhvil verilməsi Türklərin və Tatarların yüksək etirazlarına səbəb oldu.

3. İyul ayından başlayaraq, Ənvərin qardaşı Nuri bəy (Paşa) Yelizavetopolda (Gəncədə) diktator səlahiyyətləri ilə təyin olundu və gördüyü sərt tədbirlər asayişin qorunmasında uğurlu görünsə də, yerli əhəlinin böyük narazılığına səbəb oldu. O, həmçinin Tatar Korpusunun yaradılması və hazırlanması üçün təzyiq göstərdi. Bu vəziyyəti Nurinin (Paşanın) Bakıya qarşı hərbi əməliyyatları ilə bağlı olmayan bəzi siyasi ambisiyaları ilə bağlı qeyd etmək lazımdır. Sentyabrın 15-də bu sonuncu döyüşün uğurla başa çatması Azərbaycana ən çox arzuladığı mükafatı gətirdi və Azərbaycan hökuməti Yelizavetopoldan dərhal oraya köçdü.

4. Lakin sentyabrın 23-də Almanlar Berlindəki Tatarlardan Türk qoşunlarının Azərbaycandan çıxarılması və Almaniya ilə İran arasındakı əlaqənin dekomunizasiyasından bəhs edən gizli protokol aldılar. Çox güman ki, Talat zərurətdən üstün idi, çünki o, Bolqarıstanın hərbi vəziyyətini və yaxınlaşan çöküşünü tam dərk etmiş, yuxarıda qeyd olunan protokolu imzalamış, bu da Türk siyasətinin Azərbaycanda tam dəyişməsi demək idi. Hazırda dörd diviziyanın İstanbula köçürülməsi bərdə əmr aldığı məlumdur; Digər tərəfdən, Bakını ələ keçirən və Euzelini təmizləmək əmri alan Qoşunların bir hissəsi bu əmrlərə qarşı çıxdı. Yuxarıdakı dörd bölmədən biri, 6-cı. paragrafda göstəriləndiyi kimi, o vaxtdan bəri dayandırma əmri aldı.

5. Digər tərəfdən, Ənvərin Nuriyə göndərdiyi 12 oktyabr teleqramında deyilirdi ki, Türklər Rusları və erməniləri hələ də Azərbaycanda güclü olduqları müddətdə bu ölkədən qovmalıdırlar.* Bu, xüsusilə Lənkəran və Astara rayonlarına aid idi, çünki Türkiyə sərhədinin Azərbaycan sərhədi ilə birləşməsinə mane ola biləcək hər hansı maneələrin aradan qaldırılması lazım idi. Yuxarıda göstərilənlərdən və digər dəlillərdən aydın olur ki, Türklər Azərbaycanda, o cümlədən İran Azərbaycanında möhkəmlənmək və onu saxlamaq niyyətində idilər. Bunu onların Türklərlə məhdudlaşan Yeni Ermənistan sərhədlərindən kənarda müstəqil rabitə xəttinin yaradılması və Qarabağda ermənilərə qarşı əməliyyatlar üçün qoşunların cəlb edilməsi əmri sübut edir.

6. Ənvərin qoşunlarının Azərbaycanda toplaşdığını bilmək və orada xidmət etmək üçün partizan zabitlərinin seçilməsi və Türkiyədən digər zabitlərin

göndərilməsi üçün tədbirlər görmək də vacibdir. Türklərin bu müharibə zamanı Azərbaycanı ilhaq edəcəyini gözləmək mümkün deyil və müntəzəm qoşunlarını boşaltdıqları görünə də, sülhdən əvvəl erməniləri məhv etməyi və xalqların öz müqəddəratını təyinetmə müdafiəsi ilə mövqelərini möhkəmləndirməyi ümid edən bir qrup Ənvər tərəfdarını tutmağı planlaşdırdıqları ehtimalı olmasa da, çətin görünür.

* - Ancaq Bakıda Azərbaycanın Ruslara qarşı mövqeyi barışdırıcı görünür, ermənilərə qarşı şiddətli düşmənçilik var, onlardan 15.000-i şəhəri ələ keçirdikdən sonra öldürüldüyü bildirilir.

Fars vəliəhdinin Təbrizdə imzaladığı bu yaxınlarda iki Azərbaycanın birləşməli olduğu və oktyabrın 17-də Konstantinopola (İstanbul) göndərilən 5-ci Qafqaz diviziyasının Azərbaycanda qalmaq və lazım gələrsə, Azərbaycan hökumətinə tabe olmaq üçün əks əmr alması faktı bu nəzəriyyəyə əlavə rəng verir. təxminən 9000 nəfərlik milli qüvvələrin sentyabr ayının sonunda tam təşkil olunmadığı bildirildi. Nuri Paşa oktyabrın əvvəlində Şimali Qafqaza səfər etməli idi və Türklərin Azərbaycan İttifaqına və Qafqaz dağlıları İttifaqına müstəqil dövlət kimi çıxış etməyə daha qadir və onların təbliğatının güclü mərkəzi kimi müsbət yanaşdıqları məlum olduğundan, çox güman ki, Dərbənd yaxınlığında Biçarakova qarşı əməliyyatlar aparmaqla yanaşı, bunun üçün də çalışırlar.

7. Türklər 18 oktyabr tarixinə qədər atəşkəs əldə etməyi düşündükləri zaman ermənilərə münasibətlərini bir qədər dəyişdirmiş kimi görünür, çünki o gün Ənvər heç bir Türk ordusunun Ermənistan ərazisinə, xüsusən də Qarabağa girməməsi və Türk komandirlərinin ermənilər arasındakı mübahisələrdə heç bir iştirak etməməsi barədə əmr verdi. Bəlkə də bu bir hiylə idi, eyni zamanda Türklərin erməniləri Alman tərəfdarı olan gürcülərə qarşı qaldırmaq niyyətində olduqları və əvvəlcə Tatarların sonrakı fəthləri üçün kompensasiya ola biləcək mübahisəli bir bölgə təmin etdikləri bildirilir.

Bu arada türklərin Fars Azərbaycanını boşaltması nəticəsində Təbriz və Tehrandakı almanlar gediş-gəlişini*, alman qoşunları isə Qafqazdan çəkilmək ərafındadırlar. Lakin Almaniya Təbrizdə konsul vəzifəsini yerinə yetirmək üçün yola düşən Litten hələ də səyahətini davam etdirir və Fon Kress və Alman mülki heyəti, ehtimal ki, 500 nəfərlik mühafizəçi ilə mümkün qədər uzun müddət qalmalıdırlar. Fon Kress xahiş etmişdi ki, Almaniyanın nüfuzunu qorumaq və ermənilərin və gürcülərin təcili tələblərini təmin etmək üçün daha çox sayda qoşun saxlanılmalıdır [7/s.1].

8. Bundan əlavə, 23 oktyabrda Türk Baş Komandanlığı, Brest-Litva sərhədindən kənarda olan İran və Qafqazın (yəni Qars, Ərdahan və Batumi bölgələri) boşaldılmasını qətiyyətlə əmr etdi və Şərqi ordu qrupu rəsmi olaraq ləğv edildi, lakin Türklər ermənilərin, xüsusən də Andranikin hərəkətlərindən narahat idilər, çünki ermənilər indiki sərhədləri daxilində qalmağa və hər hansı bir düşmən hərəkətindən çəkinməyə məcbur oldular. Onlara tədbir görməmələri barədə xəbərdarlıq edildi.

Bu arada, İran Azərbaycanının Türkiyə tərəfindən təxliyəsi nəticəsində Təbriz və Tehrandakı almanlar

dekommünizasiyanı gözləyirlər*, alman qoşunları isə Qafqazdan geri çəkilməyə hazırlaşdılar. Bununla birlikdə, Almaniya Təbrizdə konsulluq vəzifəsini tutmaq üçün yola çıxan Litten, səyahətini davam etdirir və Von Kress və Alman mülki işçiləri, ehtimal ki, 500 nəfərlik mühafizə korpusunda mümkün qədər uzun müddət qalacaqlar, baxmayaraq ki Von Kress Almaniyanın nüfuzunu qorumaq və ermənilərin və gürcülərin təcili ehtiyaclarını ödəmək üçün daha çox əsgərin işə götürülməsini istədi.

9. Bununla birlikdə, 6-cı paragraf 5-ci bənddə göstərilən Qafqaz diviziyasının geri çəkilməsinə dair heç bir işarə yoxdur və Türklərlə bağlı ümumi bir nəticə budur ki, Ənvər tərəfdarları ingilislərin fars bitərəfliyi əsasında farsdan təxliyəsinin təmin etməyə çalışır, eyni zamanda təhlükəsizliyi təmin etmək üçün gözlənilməz "Ənvərçi" nüvəsini qoruyur. "Öz müqəddəratını təyin edən" Azərbaycan üzərində nəzarət, beləliklə gələcək üçün Panturan və ya ümumi İslam fəaliyyətinin güclü və yaxşı yerləşdirilmiş mərkəzinin təmin edir.

10. Almanlara gəldikdə, onların əsas məqsədi Gürcüstanda kredit verdikləri və Gürcüstanın xarici işlər naziri Çxenkeli öz agentliyi vasitəsi ilə fəaliyyət göstərən von Kressin fəaliyyəti sayəsində əhəmiyyətli siyasi uğurlar qazandıqları bir nəzarət payı qurmaqdır. Bu siyasət Bakı üzərində nəzarəti nəzərdə tutur və bildiyiniz kimi, bu yaxınlarda almanlar oraya ekspert qrupu, eləcə də konsul göndəriblər. Türklərin Azərbaycandan rəsmi şəkildə getməsi ilə əlaqədar yəqin ki, rahatlıq tapsalar da, çox güman ki, onların maliyyə maraqları Ənvər və onun qohumlarının maraqları ilə üst-üstə düşür, çünki Ənvərin Almaniya saxlanıldığı məlumdur. Ancaq bu məqam dəstəkləyici dəlillər tələb edir.

11. Ümumi nəticə ondan ibarətdir ki, Türklər Azərbaycanda, Almanlar isə Gürcüstanda öz müqəddəratını təyin etməyə iddialıdırlar və əgər sülh konfransında bu plana diqqətlə əməl olunmasa, gələcəkdə Xəzər regionunda ciddi hərbi öhdəliklərlə üzləşə bilərik.

* - Oktyabrın 26-da Təbrizdəki Alman konsulu Vustrovun lazım olduqda arxivlərlə Tbilisiyə getməsinə icazə verildi. Sentyabrın 24-də Tehrandakı Sommer Berlinə Almaniyanın İranda maraqlarını qorumaq üçün Madridə yaxınlaşmağı təklif etdi.

^ - Ancaq qeyd etmək olar ki, Türk təbəçiliyində olanlar, xüsusən İran Azərbaycanı vəziyyətində özlərini mümkün qədər repressiv göstərdilər. Digər tərəfdən, Azərbaycan əhalisinin 80 faizi savadsızdır.

> - Qeyd etmək lazımdır ki, Solf Von Kress-ə 16 oktyabr tarixli bir teleqramda almanların evakuasiya ilə əlaqədar Prezident Vilson ilə yarı yolda görüşmək məcburiyyətində qaldıqlarını, əks halda sülh təkliflərinin rədd ediləcəyini bildirdi; evakuasiyanın həm Şərqi, həm də Qərbi aid olduğu aydın deyil, lakin Von Kress mümkün Gürcüstan hökumətini almanların geri çəkilməsinə qarşı çıxmağa inandırmalıdır. Türkiyənin narahatlıqları, Tehrandakı ingilis və Amerika nazirlərinin Azərbaycandan və Şimali Qafqazdan gələ biləcək tanınma tələbləri ilə bağlı narahatlıqları ilə də təsdiqlənir.

ORDU BAŞ QƏRARGAHI
DÖYÜŞ BÜROSU (İmza və möhür var).
31 Oktyabr, 1918-ci il. [8/s.2]

Nəticə. Azərbaycan Xalq Cümhuriyyətinin qurulması zamanı baş verən hadisələr geniş şəkildə ələ alınmış, Sentrokaspi Diktaturası dövrü analiz edilmiş və ingilislərin Bakı üçün qurduğu planlara apardığımız arxiv araşdırmalarına və Bakı ilə Londra arasında keçən tapılmış gizli kəşfiyyat yazışmalarına əsaslanaraq yeni bir bucaqdan yanaşılmışdır. Bu məqalə Londonda saxlanılan arxiv materiallarının ilk dəfə təqdim olunmasıyla elmə yenilik gətirməsiylə xüsusi əhəmiyyət kəsb edir.

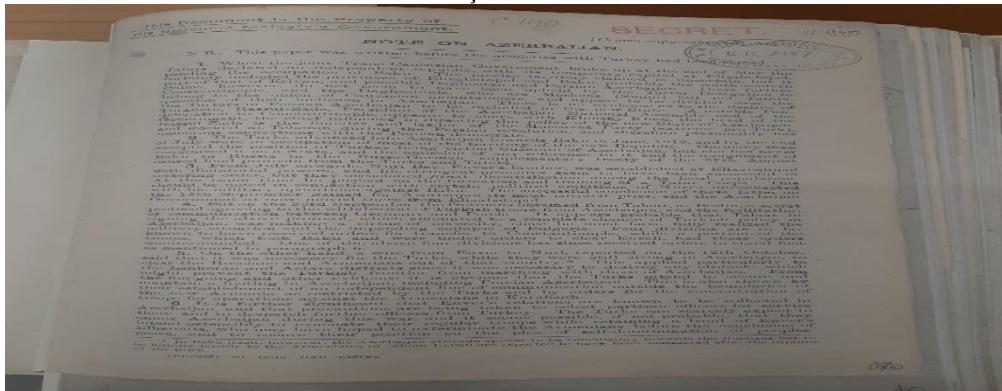
Bakıda 26 Bakı Komissarını həbs edən İngilis Ordu Qərargahı buranı daim nəzarətdə saxlamaq istəmiş, Osmanlı Ordusu Bakını işğaldan necə azad etməsi, Bakıda siyasi –ictimai vəziyyəti analiz edən ingilis ordusu gizlicə Londona analitik məxvi teleqraf məktubları göndərmişdir. Böyük ehtimaldır ki Osmanlı Dövlətində Hərbiyyə Naziri olmuş Ənvər Paşanın bu dövrdə əl silahı istehsal edən silahlarla dolu zavod açmasından ingilislər çəkinmiş və Bakını tərk etmişdilər. Çünki Ənvər Paşa və onun qardaşı Qafqaz Ordusu Komandanı Nuri Paşa dan analitik təhlillər verən materiallarda Türklərin artıq Bakıda Rəsulzadə ilə birlikdə döyünən ürək olduğunu sənədlərdə vurğulamışdılar. İlk dəfə ingilis arxivi ilə yazışmalarımızla əldə etdiyimiz bu məxvi sənədlər Qafqazdakı siyasi-ictimai vəziyyət haqqında dolğun məlumat verən ilk dəfə

araşdırılan sənədlər olması ilə ölkəmizdə elmə yenilik gətirmişdir.

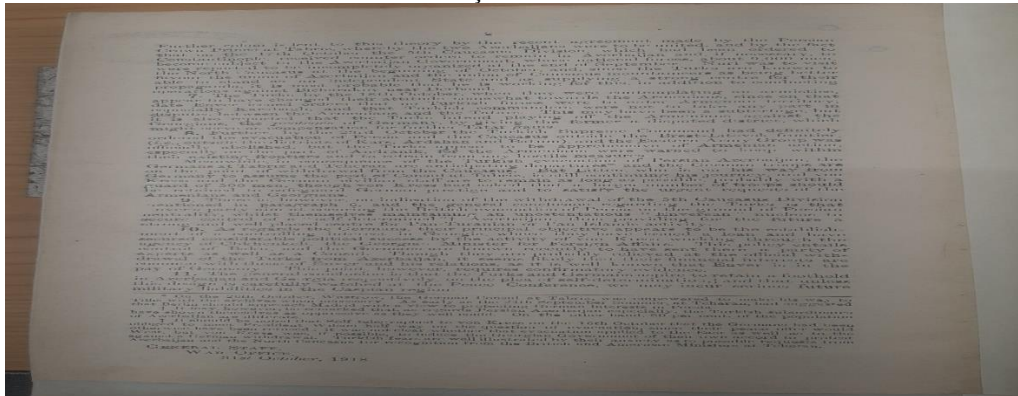
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Şəkil-1.



Şəkil -2.



Rəyçi: Prof.Dr. Şahingöz M.

MATHEMATICAL SCIENCES

UDC 517.946+681.3

CONDITIONS FOR THE EXISTENCE OF A UNIQUE SOLUTION TO THE BOUNDARY VALUE PROBLEM FOR A PARTIAL DERIVATIVE DIFFERENTIAL EQUATION WITH A NEGATIVE SIGN FOR THE HIGHER DERIVATIVE

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УДК 517.946+681.3

УСЛОВИЯ СУЩЕСТВОВАНИЯ ЕДИНСТВЕННОГО РЕШЕНИЯ КРАЕВОЙ ЗАДАЧИ ДЛЯ ДИФФЕРЕНЦИАЛЬНОГО УРАВНЕНИЯ В ЧАСТНЫХ ПРОИЗВОДНЫХ С ОТРИЦАТЕЛЬНЫМ ЗНАКОМ ПРИ СТАРШЕЙ ПРОИЗВОДНОЙ

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Abstract

The article examines about the existence of a unique solution to a boundary value problem for a second-order partial differential equation with a negative sign at the highest derivative. This equation was obtained as a result of mathematical modeling of creeping movements in a two-layer viscous fluid, when the density of the lower layer is less than the density of the upper layer, and is limited on both sides by «walls». It is known that due to the difference in the layers, a violation of the equilibrium state of the boundary between them occurs; the materials in the bottom layer go up and the definition of the law of changes in the boundary between layers. Here the need arose to solve a differential equation, the form of which differs from the usual parabolic type equation in that the sign of the highest derivative is negative. This difference from a well-studied equation of parabolic type leads to the need to study the existence of a unique solution to the problem for such a partial differential equation.

Аннотация

В статье рассматриваются вопросы о существовании единственного решения краевой задачи для дифференциального уравнения в частных производных второго порядка с отрицательным знаком при старшей производной. Данное уравнение получено в результате математического моделирования ползущих движений в двухслойной вязкой жидкости, когда плотность нижнего слоя меньше, чем плотность верхнего слоя, и ограниченного с двух сторон «стенками». Известно, что из-за разности плотностей слоев возникает нарушение равновесного состояния границы между ними; материалы нижнего слоя поднимаются вверх, а материалы верхнего слоя – вниз. Математическое описание этих движений привело к определению закона изменения границы между слоями. Здесь возникла потребность решения дифференциального уравнения, вид которого отличается от обычного уравнения параболического типа тем, что знак при старшей производной является отрицательным. Подобное отличие от хорошо исследованного уравнения параболического типа, приводит к необходимости исследования вопросов существования единственного решения задачи для такого дифференциального уравнения в частных производных.

Keywords: partial differential equations with a negative sign at the highest derivative, hydrodynamic instability, motion in a two-layer fluid, general solution of the equation, boundary value problem.

Ключевые слова: дифференциальные уравнения в частных производных с отрицательным знаком при старшей производной, гидродинамическая неустойчивость, движения в двухслойной жидкости, общее решение уравнения, краевая задача, существование единственного решения.

Постановка проблемы. Многочисленные исследования природных процессов [1-7], происходящих в земных недрах, начатые активно с середины двадцатого века и продолжающиеся в настоящее время, показали актуальность и эффективность применения методов математического моделирования для их изучения. Одной из важных задач в этих исследованиях была связана с изучением тектонических движений из-за различия физических свойств, в частности, различия плотностей верхних слоев Земли. Различие физических свойств земных слоев является одним из источников происходящих

тектонических процессов, изучение которых является актуальной проблемой [1-7]. Модельное исследование в лабораторных условиях впервые было проведено [5] с применением центрифуги.

В результате математического моделирования процессов, происходящих на границе «ползущих» слоев с различными плотностями, были получены различные задачи уравнений математической физики [8-12]. Актуальность исследования этих процессов связана с изучением причин образования земных структур и их последствий.

$$\Delta = \begin{pmatrix} c & 1 & 0 & 0 & 0 & 0 & 0 & 0 & \dots & 0 & 0 & 0 \\ 1 & c & 1 & 0 & 0 & 0 & 0 & 0 & \dots & 0 & 0 & 0 \\ 0 & 1 & c & 1 & 0 & 0 & 0 & 0 & \dots & 0 & 0 & 0 \\ 0 & 0 & 1 & c & 1 & 0 & 0 & 0 & \dots & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & c & 1 & 0 & 0 & \dots & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & c & 1 & 0 & \dots & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & c & 1 & \dots & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & c & \dots & 0 & 0 & 0 \\ & & & & & & & & \dots & & & \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \dots & 1 & c & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \dots & 0 & 1 & c \end{pmatrix} \quad (11)$$

Вычисление определителя (11). Для вычисления данного определителя целесообразно поступить следующим образом. Пусть рассматриваются определители различных порядков, получаемых из данного определителя (11):

$$\begin{aligned}\Delta_1 &= c; \\ \Delta_2 &= \begin{vmatrix} c & 1 \\ 1 & c \end{vmatrix} = c^2 - 1; \quad \Delta_2 = c \cdot \Delta_1 - 1; \\ \Delta_3 &= \begin{vmatrix} c & 1 & 0 \\ 1 & c & 1 \\ 0 & 1 & c \end{vmatrix} = c \cdot \Delta_2 - \Delta_1; \\ \Delta_4 &= \begin{vmatrix} c & 1 & 0 & 0 \\ 1 & c & 1 & 0 \\ 0 & 1 & c & 0 \\ 0 & 0 & 1 & c \end{vmatrix} = c \cdot \Delta_3 - \Delta_2; \\ \Delta_5 &= \begin{vmatrix} c & 1 & 0 & 0 & 0 \\ 1 & c & 1 & 0 & 0 \\ 0 & 1 & c & 0 & 0 \\ 0 & 0 & 1 & c & 1 \\ 0 & 0 & 0 & 1 & c \end{vmatrix} = c \cdot \Delta_4 - \Delta_3;\end{aligned}$$

Продолжение этих операций позволяет получить следующую рекуррентную формулу для вычисления определителей матриц различного ранга:

$$\Delta_k = c \cdot \Delta_{k-1} - \Delta_{k-2}, \quad k = 3, 4, 5, \dots, n-1. \quad (12)$$

При этом значение искомого определителя (11) системы линейных алгебраических уравнений (8) будет вычислено следующей формулой:

$$\Delta = \Delta_{n-1} = c \cdot \Delta_{n-2} - \Delta_{n-3}.$$

Пусть рассматриваются частные случаи, когда заданы различные соотношения между значениями шагов по переменным x и t . Здесь рассматриваются различные значения параметра $c = \frac{h^2}{\tau} - 2$. Можно рассматривать конкретное значение $n = 100$, т.е. $h = 0,02$, если $a = 1$.

1⁰. Случай, когда $\frac{h^2}{\tau} = 1$ или $c = -1$. Тогда формулами для вычисления определителей будут следующие:

$$\Delta_1 = -1; \quad \Delta_2 = -\Delta_1 - 1; \quad \Delta_k = -\Delta_{k-1} - \Delta_{k-2}, \quad k = 3, 4, 5, \dots, n-1.$$

. Вычисления по этим рекуррентным формулам позволяют получить следующую повторяющуюся последовательность:

$$\begin{aligned}\Delta_1 &= -1; \Delta_2 = 0; \Delta_3 = 1; \Delta_4 = -1; \Delta_5 = 0; \Delta_6 = 1; \\ \Delta_7 &= -1; \Delta_8 = 0; \Delta_9 = 1; \Delta_{10} = -1; \Delta_{11} = 0; \Delta_{12} = 1; \\ \Delta_{13} &= -1; \Delta_{14} = 0; \Delta_{15} = 1; \Delta_{16} = -1; \Delta_{17} = 0; \Delta_{18} = 1; \\ \Delta_{19} &= -1; \Delta_{20} = 0; \Delta_{21} = 1; \Delta_{22} = -1; \Delta_{23} = 0; \Delta_{24} = 1; \\ \Delta_{25} &= -1; \Delta_{26} = 0; \Delta_{27} = 1; \Delta_{28} = -1; \Delta_{29} = 0; \Delta_{30} = 1; \\ &\dots \dots \dots \\ \Delta_{91} &= -1; \Delta_{92} = 0; \Delta_{93} = 1; \Delta_{94} = -1; \Delta_{95} = 0; \Delta_{96} = 1; \\ \Delta_{97} &= -1; \Delta_{98} = 0; \Delta_{99} = 1.\end{aligned}$$

Отсюда следует, что искомое значение определителя (11) равно $\Delta = \Delta_{99} = 1$. Это означает, что система алгебраических уравнений (8) для данного случая $c = -1$ или $\frac{h^2}{\tau} = 1$ имеет единственное решение, что позволяет использовать любой из существующих методов для ее решения. Это, в свою очередь, дает возможность решения поставленной краевой задачи для дифференциального уравнения (1) – (4).

Эти операции были выполнены для $n = 1000$ и $n = 10000$, в результате которых получены те же значения для определителей основных матриц систем, состоящих из 999 и 9999 алгебраических уравнений $\Delta_{999} = \Delta_{9999} = 1$.

2⁰. Случай, когда $\frac{h^2}{\tau} = 2$ или $c = 0$. В этом случае система алгебраических уравнений (8) не имеет решения, потому что определитель ее основной матрицы будет равняться нулю. Доказательство этого утверждения следует из вычислений определителей матриц различного рангов, которые показаны в виде следующей последовательности чисел:

$$\begin{aligned}\Delta_1 &= 0; \Delta_2 = -1; \Delta_3 = 0; \Delta_4 = 1; \Delta_5 = 0; \Delta_6 = -1; \\ \Delta_7 &= 0; \Delta_8 = 1; \Delta_9 = 0; \Delta_{10} = -1; \Delta_{11} = 0; \Delta_{12} = 1; \\ \Delta_{13} &= 0; \Delta_{14} = -1; \Delta_{15} = 0; \Delta_{16} = 1; \Delta_{17} = 0; \Delta_{18} = \\ &-1; \\ \Delta_{19} &= 0; \Delta_{20} = 1; \Delta_{21} = 0; \Delta_{22} = -1; \Delta_{23} = 0; \Delta_{24} = 1; \\ \Delta_{25} &= 0; \Delta_{26} = -1; \Delta_{27} = 0; \Delta_{28} = 1; \Delta_{29} = 0; \Delta_{30} = \\ &-1; \\ &\dots \dots \dots\end{aligned}$$

$$\Delta_{91} = 0; \Delta_{92} = 1; \Delta_{93} = 0; \Delta_{94} = -1; \Delta_{95} = 0; \Delta_{96} = 1; \\ \Delta_{97} = 0; \Delta_{98} = -1; \Delta_{99} = 0.$$

Отсюда видно, что значение определителя основной матрицы системы алгебраических уравнений $\Delta = \Delta_{99} = 0$.

3⁰. Случай, когда $\frac{h^2}{\tau} = 3$ или $c = 1$. Тогда формулами для вычисления определителей будут следующие:

$$\Delta_1 = 1; \quad \Delta_2 = 0; \quad \Delta_k = \Delta_{k-1} - \Delta_{k-2}, \quad k = 3, 4, 5, \dots, n-1.$$

В данном случае повторяющаяся последовательность значений определителей матриц различного рангов будет записана в следующем виде:

$$\begin{aligned}\Delta_1 &= 1; \Delta_2 = 0; \Delta_3 = -1; \Delta_4 = -1; \Delta_5 = 0; \Delta_6 = 1; \\ \Delta_7 &= 1; \Delta_8 = 0; \Delta_9 = -1; \Delta_{10} = -1; \Delta_{11} = 0; \Delta_{12} = 1; \\ \Delta_{13} &= 1; \Delta_{14} = 0; \Delta_{15} = -1; \Delta_{16} = -1; \Delta_{17} = 0; \\ \Delta_{18} &= 1; \\ \Delta_{19} &= 1; \Delta_{20} = 0; \Delta_{21} = -1; \Delta_{22} = -1; \Delta_{23} = 0; \\ \Delta_{24} &= 1; \\ \Delta_{25} &= 1; \Delta_{26} = 0; \Delta_{27} = -1; \Delta_{28} = -1; \Delta_{29} = 0; \\ \Delta_{30} &= 1; \\ &\dots \dots \dots\end{aligned}$$

$$\Delta_{91} = 1; \Delta_{92} = 0; \Delta_{93} = -1; \Delta_{94} = -1; \Delta_{95} = 0; \\ \Delta_{96} = 1; \\ \Delta_{97} = 1; \Delta_{98} = 0; \Delta_{99} = -1.$$

Это означает, что для данного случая искомое значение определителя равно $\Delta_{99} = -1$. Следовательно система алгебраических уравнений (8) для $c = 1$ или $\frac{h^2}{\tau} = 3$ имеет единственное решение.

Заключение. В данной работе рассмотрена постановка краевой задачи для дифференциального уравнения в частных производных, отличающегося от обычного уравнения параболического типа знаком при старшей производной по координате x . Разностные уравнения для заданного дифференциального уравнения представляют собой систему линейных алгебраических уравнений, условие единственности ее решения в данном случае является важным для выполнения последующих операций

для получения искомого решения поставленной задачи. В связи с этим поставлена задача об определении условий существования единственного решения системы линейных алгебраических уравнений, которая получена в результате дискретизации дифференциального уравнения. Для решения этой проблемы было определено значение определителя основной матрицы полученной системы линейных алгебраических уравнений. В результате получена рекуррентная формула для вычисления определителя для различных случаев выбора шагов по независимым переменным x и t . Рассмотрены три частных случая; здесь показаны два случая, когда система алгебраических уравнений может иметь единственное решение и один случай, когда она не имеет решения.

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MEDICAL SCIENCES

RESULTS OF THE APPLICATION OF OVERDENTURES

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Currently, dental prosthetics continue to evolve, largely due to the integration of various types of dental implants into clinical practice, as well as the ongoing development of dental materials and prosthetics technologies. Modern prosthetics have certain features, mainly due to the increasing use of dental implants. To ensure the reliability of orthopedic treatment, proper preparation of the dental implant site is necessary. Modern endodontic procedures have enhanced the reliability of orthopedic treatments.

In the mid-1970s, with the development of new dental treatments, it became possible to more widely use preserved single teeth, particularly their roots, for dental prosthetics. This led to the emergence of various fixed and removable dentures, in which the remaining roots of teeth served as support. One of the most common orthodontic constructions that emerged during this period was the overdenture. The development of dental implants and the introduction of new approaches to the design of overdentures with implant supports significantly contributed to the improvement of the overdenture prosthetics technology, leading to their more frequent use in clinical practice.

Overdentures are hybrid prostheses, consisting of both fixed and removable parts. The defining feature of these prostheses is the base of the fixed elements of the construction, which are supported by the roots of teeth or implants (Fig. 1). Implants can also serve as support elements for the prosthesis base. These prostheses were designed with the features of the dental status in mind, aiming to slow down or prevent the inevitable atrophy of the alveolar ridge that occurs after tooth extraction. This remains the primary indication for choosing this type of construction [5,6].

Preserved Roots Provide Support and Retention, Enhancing the Fixation and Stabilization of Overdentures

Preserved roots serve as support and retention elements, allowing for better fixation and stabilization of overdentures compared to full removable dentures [1-8]. Additionally, periodontal receptors are maintained, which play a critical role in the neuromuscular function of the masticatory system. As a result, the adaptation process to the prosthesis is significantly facilitated [1,4,5,7,8].

The use of such prostheses aims to improve functional efficiency, shorten adaptation times, and create a favorable psychological environment for the transition to full removable dentures. With the use of dental implants in edentulous jaws, it is possible to transition to overdentures.

The accumulated clinical experience with overdentures requires clarification on several fundamental issues.

Objective of the Study:

Clarification of terminology and classification, as well as the peculiarities of prosthetic treatment with overdentures.

Results:

The term "overdenture" (synonym: "covering denture") encompasses several design variations. It is noted that while overdentures resemble full removable dentures in their external structure, there are significant differences. The external similarity between overdentures and full removable dentures lies in the removable part, which consists of a base, artificial gums, and teeth. However, in the overdenture design, there may be additional elements to interact with the fixed part.

The main distinction is biomechanics. When a full removable denture is used, the chewing pressure from the structure is transferred only to the mucous membrane and then to the bone, which is considered a non-physiological mechanism. In contrast, with an overdenture, the chewing load is distributed through the mucous membrane, the periodontal ligament of the tooth, and the implant to the bone. Thus, the mechanism of transferring chewing pressure is semi-physiological (Fig. 3). Therefore, the biomechanics of overdenture prosthetics have certain advantages in terms of a more physiological transfer of chewing pressure.

Advantages and Disadvantages of Overdentures Compared to Full Removable (Total) Dentures:

When evaluating the features of orthopedic treatment using overdentures, several fundamental disadvantages should be noted:

- The complexity of motivating the patient by the dentist for this type of prosthetics;
- Multi-stage and complex preparation for prosthetics (endodontic treatment, surgical correction of the gums, hemisection of the tooth, etc.);

- Technological complexity in the fabrication of prostheses (use of different fixation methods: telescopic fixation, lock attachments, etc.);
- Higher cost of orthopedic treatment;
- Certain difficulties in prosthesis and oral hygiene care.

Disadvantages of Overdentures Compared to Full Removable Dentures:

In contrast to full removable dentures, overdentures have the following disadvantages:

- Without the removable part, the bite height becomes non-fixed, which leads to a range of problems, the most common of which is temporomandibular joint dysfunction.
- The cost of overdenture prosthetics is significantly higher.
- Maintaining the functioning of the overdenture requires more effort from both the dentist and the patient.

Advantages of Overdentures:

Overdentures have several advantages, which include:

- They help slow down the atrophy of the alveolar ridge by reducing pressure on the mucosa.
- They improve the fixation of removable prostheses in cases of severe alveolar ridge atrophy, thanks to better stability and retention.
- They enhance functional efficiency by transferring pressure to the supporting teeth, offering better stability and retention.
- They allow for a reduction in the size of the prosthesis base, especially on the upper jaw, where the palate can be partially open.
- They require a shorter adaptation period.

Advantages Over Full Removable Dentures:

Thanks to the distribution of chewing load on the mucosa and the periodontal ligaments of the teeth, overdentures offer several advantages over full removable dentures:

- Functional stabilization due to the preservation of the alveolar ridge contours.
- Improved fixation, especially when using attachments.
- Enhanced chewing efficiency due to improved fixation and stabilization.
- Reduced pressure on the mucosal membrane.
- The ability to shorten the base border of the prosthesis (especially the distal border on the upper jaw), which is often psychologically important for the patient.
- Accelerated adaptation, facilitated by all of the aforementioned factors.

Dental Status for Using Overdentures:

There are four main approaches to using these prostheses:

1. **Dental Implantation – Especially in Terms of Social Rehabilitation:** This group includes prosthetics for edentulous jaws using conditionally removable constructions.

2. **Significant Tooth Loss in the Jaw:** This includes prosthetics in cases where only the roots remain in the jaw.

3. **Severe Pathological Tooth Wear.**

4. **Periodontal Disease (Stages II-III).**

Conclusion and Recommendations:

Advances in the improvement of orthopedic treatment using overdentures allow for a broad clinical application. The use of dental implants to support overdentures has become especially relevant in clinical practice. Dental implantation for subsequent overdenture prosthetics enhances the effectiveness of orthopedic dental care. This type of dental prosthesis can be recommended for practical clinical use, including in social medicine.

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ROLE OF VITAMIN D SUPPLEMENTATION IN MODIFYING OUTCOMES AFTER SURGERY**Shkiryak A.***CEO and chief medical officer "Shkiryak Clinic"**Ukraine**Neurosurgeon**MD, MsSc**ORCID: <https://orcid.org/0000-0002-2282-8285>***Khanenko S.***"Shkiryak Clinic"**Ukraine**Family doctor**MD, MBA**ORCID: <https://orcid.org/0009-0000-4237-1158>**<https://doi.org/10.5281/zenodo.15220763>***Abstract****Background**

Vitamin D deficiency is a very common occurrence in cardiac patients. It has been proved that cardiac surgery and cardiopulmonary bypass accelerate the deficiency further. The postoperative outcomes of patients deteriorate in the presence of vitamin D deficiency. Perioperative supplementation of vitamin D is the only solution to the problem. Hence, the present systematic review was conducted to derive the efficacy and safety of vitamin D supplementation on postoperative outcomes in cardiac surgery patients.

Method

Publications over duration of last 10 years was searched from different database and web sites. The data from full-text research articles were analyzed for the effect on different postoperative outcomes and side effects.

Result

Eight randomized control trials were retrieved on the effect of perioperative vitamin D supplementation in cardiac surgery patients and their postoperative outcomes. Six articles (75%) were found to be in favor of improvement in postoperative outcome. Two articles (25%) did not find any difference of outcome between the control and treatment group. All the studies observed the restoration of vitamin D to normal and no adverse effects from supplementation.

Conclusion

Perioperative vitamin D supplementation improves the postoperative outcomes after cardiac surgery. It is effective and safe to supplement vitamin D in cardiac surgery patients.

Keywords: vitamin D, surgery, postoperative outcomes.

Introduction

Vitamin D deficiency (VDD) is highly prevalent worldwide due to the environmental pollution, minimal exposure to sunlight, dietary deficiency, and lifestyle changes of mankind (1). It is detected in all the age groups. Commonly VDD has been associated with infection, respiratory illness, cardiovascular diseases, cancer, preeclampsia, dental caries, and neurological diseases (1). Greater proportions of people with cardiovascular disease have low vitamin D level compared with general populations. Patients undergoing cardiac surgery are at risk of arrhythmia, myocardial ischemia, ventricular dysfunction, bleeding, and infections. The risks may be aggravated by VDD (2). Many patients have low vitamin D levels before and after open heart surgery, but those levels can be restored to normal with supplementation with vitamin D (3). Vitamin D supplementations taken by patients with chronic heart failure are associated with improved cardiac function (4). Low blood levels of vitamin D have increased risks of heart disease like stroke, hypertension, and aortic dissection that create problems in postoperative outcome. Low vitamin D level may be a potential risk to respiratory complications in intensive care unit (ICU) (5). Low

levels of vitamin D have been linked to high blood pressure. The postoperative ICU stay and complications are higher in pediatric cardiac surgery patients with VDD (3).

However, a few recent articles have not detected any difference in postoperative outcome of VDD patients related to atrial fibrillation and other parameters (6). In the hospital setup, perioperative vitamin D therapy is the way forward to normalize the serum level. Hence, the outcome of the therapy needs to be systematically reviewed for clinical recommendation.

In the present systemic review, all the available literatures related to impact of vitamin D therapy on postoperative outcomes in cardiovascular surgical patients over duration of 10 years are analyzed. The efficacy, safety, and public health impact of vitamin D therapy in cardiac surgical patients on postoperative period were assessed.

Methodology

Inclusion criteria: Only original articles were included. The original papers were from clinical trials, observational, cross-sectional, and cohort studies. The studies were both prospective and retrospective. Studies with all age groups and all types of cardiac surgery

were included. The full-text articles with complete data on postoperative outcome were chosen.

Exclusion criteria: Review, systematic review, meta-analysis, case report, letter to editor, editorial papers, and stand-alone abstract were excluded. Papers of the patients with emergency surgeries, redo surgeries, transplantation, New York Heart Association class 4, and multisystem illness undergoing cardiac surgery were also excluded.

Publications search method: Published full-text studies were searched in PubMed, Embase, Google Scholar, and Cochrane database with the keywords of vitamin D supplementation, VDD, postoperative cardiac outcome, cardiac surgery, cardiac anesthesia, perioperative period, ICU, and hospital stay for 10 years during year 2012 to 2022.

Result

Total 10,407 articles were retrieved. Out of which eight full-text original studies were found suitable for the systemic review and critical analysis after applying the study protocol and exclusion criteria. All the eight articles were randomized control trials (RCT).

Most of the studies reported a significant fall in vitamin D level in the patients during and after cardiac surgery. Valve and congenital heart surgery patients had maximum fall in vitamin D level. All the RCTs detected restoration of vitamin D level back to normal value after supplementation of vitamin D. Six studies (75%) showed more than or equal to 1 parameter improvement in postoperative outcome after cardiac surgery because of vitamin D supplementation. Two studies (25%) reported no significant difference on postoperative outcomes (7, 8). Three studies (37.5%) detected significant reduction in postoperative atrial fibrillation (POAF) by vitamin D therapy (9, 10). Two studies (25%) detected significant reduction in inotrope requirement postoperatively compared with control group (11). One study (12.5%) observed marked reduction in duration of ICU and hospital stay in vitamin D supplementation group compared with control (9). One study (12.5%) detected small reduction of interleukin-10 in vitamin D supplementation group compared with placebo without any difference in postoperative acute kidney injury (12). One study (12.5%) observed anti-inflammatory effect with high-dose supplementation but without any difference in prevention of acute kidney injury both in control and treatment group (12). There was an insignificant lesser incidence of adverse cardiac events like pacemaker insertion and cardiomyopathy, POAF, and postoperative heart failure with vitamin D supplementation in one RCT (7). All the eight RCT did not found any adverse effects with vitamin D supplementation and detected to be safe in all patients even with high doses.

Conclusion

To conclude, VDD is very common after cardiac surgery. Vitamin D supplementation will restore vitamin D level to normal in all patients. The systematic review detected one or more improvement in postoperative outcomes after cardiac surgery from 75% studies.

Vitamin D supplementation was found to be safe in clinical practice even with high-dose regime. Further studies, followed by meta-analysis and systematic reviews, will provide more knowledge on the perioperative use of vitamin D supplementation in cardiac surgery patients.

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VITAMIN D'S ROLE IN NEUROPATHIC PAIN – A SYSTEMATIC REVIEW

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Chronic neuropathic pain (NP) is a debilitating condition characterized by persistent pain caused by nerve damage. This condition significantly impacts the quality of life, leading to functional limitations, emotional distress, and economic burden. Various underlying conditions, including diabetes, carpal tunnel syndrome, and chronic widespread pain contribute to the NP development. While traditional pharmacological interventions often provide limited relief and have associated side effects, recent research has explored the potential therapeutic benefits of vitamin D. A systematic review was conducted adhering to the PRISMA guidelines to evaluate the efficacy of vitamin D supplementation in managing NP. Seven studies (2016-2024) were included in the analysis, encompassing a total of 561 participants with diverse NP etiologies. The studies investigated the impact of various vitamin D dosages (2000-600,000 IU), administered orally or intramuscularly, for 8 to 20 weeks. Despite the heterogeneity in vitamin D dosage and treatment regimens across the included studies, a consistent trend emerged: a significant reduction in pain scores was observed in all studies following vitamin D supplementation. Moreover, some patients reported improvements in functional mobility and overall quality of life. However, it was difficult to draw a conclusion on the optimal dose of vitamin D for neuropathic pain due to variability on the dose and the route of administration. The findings of this systematic review provide compelling evidence for the potential therapeutic role of vitamin D in the NP management. While further research is warranted to elucidate the optimal dosage, treatment duration, and underlying mechanisms of action, vitamin D supplementation holds promise as a valuable adjunct therapy for individuals suffering from chronic neuropathic pain. Future studies should explore the synergistic effects of vitamin D with other therapeutic interventions and investigate its potential to mitigate the debilitating impact of NP.

Keywords: vitamin D, neuropathic pain.

Introduction

Neuropathic pain (NP), a debilitating condition characterized by lesions or disease in the somatosensory system, significantly impacts both individual productivity and societal function (1). This condition affects an estimated 7-10% of the general population and 30% of individuals with diabetes mellitus. It also often leads to insufficient or incomplete treatment (2, 4). A study involving 70 NP patients found that 65% of patients with diabetic peripheral neuropathy (DPN) missed work or experienced reduced productivity due to pain (5). Several studies also highlight the substantial economic burden of this condition, estimated at \$US10 billion annually in the United States alone (6).

NP manifests as a spectrum of unpleasant sensory experiences, including allodynia, hyperalgesia, and paresthesia (7). Allodynia is defined as a painful perception in response to non-noxious stimuli, such as light touch or slight temperature changes. Hyperalgesia, on the other hand, is defined as an excessive response to a noxious stimulus including mechanical, chemical, and thermal induction (8). Paresthesia encompasses a range of abnormal sensations, ranging from tingling and pricking to burning and electrical

shocks, further contributing to the debilitating nature of NP (3). These diverse sensory features profoundly impact the quality of life and contribute significantly to the morbidity associated with the condition (9).

Numerous condition associated with neuropathic pain, including trigeminal neuralgia caused by trigeminal nerve dysfunction; painful polyneuropathies, represented by diabetic neuropathy and chronic widespread pain (CWP); postherpetic neuralgia due to previous herpes zoster infection; painful radiculopathy, originating from spinal nerve root compression; central neuropathic pain, caused by lesions within the central nervous system; and mononeuropathies, including carpal tunnel syndrome (CTS), affecting specific nerve distributions. This condition provides valuable insights for diagnosis and treatment (10).

While diagnosing and managing neuropathic pain (NP) remains challenging, due to the lack of standardized biochemical assessment tools (3), clinical symptoms remain as a main clue. To support the diagnosis, validated pain severity scales, including Visual Analogue Scale (VAS), Numeric Rating Scale (NRS), Douleur Neuropathique en 4 Questions (DN4), and Leeds assessment of neuropathic symptoms and signs

(LANSS) can be used. Moreover, quality-of-life questionnaires (NeuroQol) can be performed to see the full picture of how NP affects each patient. By combining these insights with physical examination and imaging results, tailored treatment strategies can be made to alleviate the pain and restore function to those struggling with this often-debilitating condition (11).

Current treatment for neuropathic pain includes a combination of several drugs classes such as weak opioids, non-opioid analgesics, antidepressants, and anti-convulsants like gabapentinoid (1). However, these treatments exhibit variable efficacy, potentially requiring increasing dose, and raising safety concerns, particularly in the elderly population. Several studies demonstrated an increasing risk of mortality, dizziness, cognitive decline, and respiratory depression when using opioid and gabapentinoids combination (12, 13). Pharmacokinetic and pharmacodynamic interactions might be responsible for this condition, where opioids enhance gabapentinoids bioavailability, and further cause respiratory distress, such as in high-dose pregabalin administration (14). Consequently, the need for novel therapeutic agents that potentiate analgesic efficacy while minimizing adverse effects is evident.

The research interest in vitamin D, its properties and recommendations for its intake has not decreased. In fact, it has increased significantly in recent years, making vitamin D one of the most studied nutrients. This has spurred interest in nutraceuticals, including vitamins, minerals, such as vitamin D, as potential supplementation to the main therapies in combating neuropathic pain (15). These agents might improve pain management with a potentially safer profile. Vitamin D supplementation is a method that has gained interest in the treatment of neuropathic pain because it is recognized to be crucial for nerve health and pain regulation (16). Although several studies have shown an association between low vitamin D levels and increased neuropathic pain sensitization, the exact mechanisms that link the two are still not fully understood.

While clinical research on Vitamin D's efficacy in chronic pain, particularly neuropathic pain, remains in its early stages, compelling evidence suggests its involvement in the pathogenesis of this condition through its anti-inflammatory, analgesic, antioxidant, and neuroprotective properties (9, 11, 17). This review (registered in PROSPERO CRD42023433300); therefore, it aims to systematically evaluate the effectiveness of Vitamin D as a potential therapeutic agent for neuropathic pain. In addition, this review also aims to identify and analyse future prospects regarding the use of vitamin D as an additional therapy in neuropathic pain cases with more personalized approach that could lead to more effective clinical management in the future.

Materials and Methods

Literature Search Strategy

The search, screening, and data abstraction were independently conducted by HMS and RR. In June 2023, the search was carried out in the Scopus and PubMed databases. Two medical subject headings (MeSH) phrases were utilized in the search. The keyword combinations used in searches: “((vitamin D*[MeSH

Terms]) OR (Calcitriol[MeSH Terms])) OR (cholecalciferol[MeSH Terms] AND (neuropathic*[MeSH Terms]) OR (pain*[MeSH Terms]) OR (burn*[MeSH Terms]) OR (allodynia[MeSH Terms])) OR (hyperalgesia[MeSH Terms]) OR (dysesthesia[MeSH Terms])). An English language and period of study from 2003 to 2024 filter was applied in this search.

Inclusion and Exclusion Criteria

Each paper was reviewed for screening by two reviewers, and a discussion with third reviewer was performed if there was ambiguity or disagreement. Articles had to focus on vitamin D as a therapeutic option for patients suffering from neuropathic pain associated with a variety of conditions, including spinal cord injury, post-stroke, multiple sclerosis, cervical radiculopathy, sciatica, diabetic and non-diabetic neuropathies, HIV/AIDS, post-herpetic neuralgia, osteoarthritis with a neuropathic pain component, and trigeminal neuralgia. Additionally, only studies involving human participants above the age of 18 were included, ensuring the generalizability of findings. Selection criteria did not discriminate based on race, ethnicity, gender, or geographical location. Participants in all included studies were diagnosed with neuropathic pain by a physician based on a combination of symptoms, signs, and/or validated neuropathic pain scoring systems such as DN4. Pain assessment primarily utilized tools like the VAS, NRS, and DN4. Furthermore, functional status outcomes were often evaluated using measures like the Boston Symptoms Severity Scale (SSS), Boston Functional Status Scale (FSS), Pain Disability Index (PDI), and NeuroQol. There were no specific dosages, routes of administration, combinations, durations, or forms of vitamin D. The outcome of the intervention studies was a change in neuropathic pain in terms of pain score and functional outcome. The exclusion criteria were studies with the child population, pregnant women, pain caused by acute trauma, accidents or operations, case reports, case series <20 participants, pre-clinical studies, and studies with multiple publications.

Data Collection Process

To ensure systematic data management and maintain a comprehensive record of collected materials, the authors employed Mendeley Reference Manager software for literature organization. Prior to formal screening against inclusion criteria, researchers conducted a preliminary review of titles and abstracts to identify potentially relevant studies. Articles deemed suitable for inclusion underwent thorough summarization, capturing key details such as research design, pain etiology, participant demographics, sample size, country of origin, intervention and comparator characteristics, study duration, evaluation instruments, data outcomes, and any reported limitations. All included papers underwent a final re-evaluation during the manuscript writing stage.

Synthesis of Results

This study followed the recommended guidelines elements for systematic reviews and meta-analyses (PRISMA) criteria (18). Due to the significant heterogeneity of the included studies, data were synthesized and presented in a narrative format. The analysis focused on examining the effectiveness of vitamin D for

different underlying neuropathic pain conditions, primarily diabetic neuropathy, CTS, and CWP.

Assessment of Bias

Bias assessment was conducted using appropriate tools based on the study design. For randomized controlled trials (RCTs) eligible for risk-of-bias evaluation (n=3), the Cochrane Collaboration's risk-of-bias 2 (RoB 2) tool was utilized. This tool assesses five key domains: randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of the reported outcome. Each domain was categorized as low, high, or of some concern. For non-randomized studies (n=4), the Methodological Index for Non-Randomized Studies (MINORS) was employed for evaluating quality. This index comprises 12 items scored on a 0-2 scale (0=not reported, 1=reported but inadequate, 2=reported and adequate). A perfect score for non-comparative studies is 16. Studies were categorized into quality levels based on their total score (0-5=poor, 6-10=moderate, 11-16=good).

Future Perspective: The Role of Vitamin D

Vitamin D has emerged as a fascinating candidate for many diseases, including neuropathic pain management, recognized as a potent and multifaceted neurosteroid within the brain, exhibits hormonal, paracrine, and autocrine activities (58). Notably, Vitamin D supplementation holds promise even for individuals without overt hypovitaminosis D, suggesting its potential independent of bone metabolism (20). This vitamin D and its receptors participate in numerous metabolic possess and possesses specific neurotrophic properties, demonstrating a crucial role in both regulating the expression of inflammatory cytokines involved in pain processing and restricting neurotrophic deficits to promote nerve healing (16). Furthermore, Vitamin D has been shown to upregulate the expression of genes pivotal for nerve regeneration, such as *Osteopontin (Spp1)*, *Acyl-CoA synthetase 4 (Acls4)*, and *Angiotensin II receptor 1a (Agt1a)* (11, 19). Studies have shown that vitamin D upregulates various antioxidant enzymes that protect cells from oxidative damage (21). Furthermore, vitamin D stabilizes calcium levels by up-regulating voltage-gated calcium channels (VGCCs), which regulate calcium influx into neurons and promote nerve growth factor expression (22). In addition, vitamin D enhances the myelination of dorsal root ganglion (DRG) neurons and regulates the expression of genes involved in axon growth. It also influences neurotransmitters such as acetylcholine, serotonin, and GABA, and may modulate opioid peptide genes (POMC, PDYN, and PENK), thereby contributing to pain relief (16). Emerging evidence highlights vitamin D's potential role in managing neuropathic pain, particularly given the consistently low vitamin D levels observed in patients. While the exact reasons for this deficiency remain unclear, vitamin D is thought to influence both peripheral and central nerve function. As a neuroprotective agent, vitamin D may reduce inflammation, oxidative stress, and promote neurotrophic factors, while modulating immune responses (16). Taken together, the combination of conventional treatments like gabapentinoids with vitamin D supplementation

could offer a more comprehensive approach by modulating multiple pathways involved in neuropathic pain.

This review points to the potential application of vitamin D therapy as part of a more holistic strategy for the management of neuropathic pain. The potential role of personalized vitamin D supplementation plans also shows promise. This approach could allow for a more tailored treatment plan based on factors such as vitamin D levels in the body, underlying disease type, and individual response to therapy (23). By utilizing genetic, lifestyle, and medical condition data, healthcare providers could develop personalized supplementation plans that may involve specific vitamin D dosage recommendations, frequency, and duration of supplementation tailored to each individual's unique needs, thereby increasing therapeutic efficacy, reducing side effects, and providing long-term benefits in the management of neuropathic pain (23, 24). As the understanding of the role of vitamin D in the regulation of the nervous system and metabolism of the body increases, personalized vitamin D therapy and supplementation have the potential to become an integral part of future medical approaches, bringing new hope to the treatment of neuropathic pain with various disease etiologies.

Conclusion

This systematic review highlights the potential effects of vitamin D in reducing pain symptoms of neuropathic pain, and improving its function in patients with PDN, entrapment CTS, and CWP. However, a critical gap remains in our understanding of optimal dosage and treatment duration for neuropathic pain management. The current evidence base encourages initiating treatment with the standard recommended oral vitamin D dosage while closely monitoring serum levels to ensure adequate repletion and adjusting as needed.

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THE ROLE OF 24-HOUR AMBULATORY BLOOD PRESSURE MONITORING IN THE ASSESSMENT OF ARTERIAL HYPERTENSION IN PATIENTS WITH ULCERATIVE COLITIS**Khairnasova A.***PhD candidate*

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Cardiovascular diseases, including atherosclerosis and arterial hypertension, are a priority for the World Health Organization. Indeed, cardiovascular disease is the leading cause of death, accounting for one third of deaths worldwide. A growing body of evidence shows that the pathogenesis of hypertension is closely linked to dysbiosis of the intestinal microbiota. When the intestinal barrier function is normal and intestinal permeability is low, it can effectively prevent the leakage of intestinal pathogens, enteroendotoxins and other substances into the body, thus reducing acute and chronic inflammation in all organs. Ulcerative colitis, which is an inflammatory bowel disease, is believed to occur in people with a genetic predisposition after exposure to environmental factors; defects in the intestinal epithelial barrier, changes in the microbiota and dysregulation of the immune response.

Given the relevance of the topic, this article describes the mechanisms that affect the intestinal microbiota in patients with hypertension and ulcerative colitis, as well as the 24-hour ambulatory blood pressure monitoring to understand the cause of high blood pressure in patients with ulcerative colitis.

Keywords: cardiovascular system, cardiovascular diseases; blood pressure; arterial hypertension; 24-hour ambulatory blood pressure monitoring; intestines; ulcerative colitis.

Main text.

Arterial hypertension (AH) remains the most common risk factor for cardiovascular disease (CVD) [1]. It affects more than one billion adults worldwide, and 10% of global healthcare costs are directly related to hypertension and its complications [2].

The prevalence of AH among adults is higher in low- and middle-income countries (31.5%, 1.04 billion people) than in high-income countries (28.5%, 349 million people) [3]. AH is a complex disease that is influenced by genetic and environmental factors, such as physical inactivity, obesity, alcohol consumption, smoking, stress, diet, and microbiome [4]. Both genetic and environmental factors act through changes in the regulatory systems of the cardiovascular system (CVS), leading to an increase in systemic vascular resistance, which is a characteristic feature of the haemodynamic abnormality responsible for the increase in blood pressure (BP) in almost all patients with AH. Over the past few years, important new evidence has been obtained

for the genetically determined development of AH, with the identification of biochemical and pathophysiological pathways through which they act. Environmental factors such as polluted air and noise can influence the development of AH. In addition, new experimental and clinical studies have confirmed that changes in several major cardiovascular control systems can contribute to chronic AH [5].

A growing body of evidence suggests that the pathogenesis of AH is closely linked to dysbiosis of the intestinal microbiota [6]. The human microbiome refers to the community of microorganisms that live in or on the human body. They influence human physiology by interfering with a number of processes, such as the provision of nutrients and vitamins. The gut microbiota contributes to blood pressure homeostasis and the pathogenesis of AH by producing, modifying, and degrading various microbial bioactive metabolites [7]. Metabolites derived from the microbiota are either beneficial (e.g., short-chain fatty acids and indole-3-lactic acid) or

harmful (e.g., N-trimethylamine oxide) and can activate several signalling pathways through G-protein-coupled receptors or by direct activation of immune cells [8]. When the function of the intestinal barrier is normal, intestinal permeability is low, which can effectively prevent intestinal pathogens, enterotoxins and other substances from leaking into the body, thus reducing acute and chronic inflammation in all organs [9], and to a certain extent reducing inflammatory damage to blood vessels and lowering blood pressure. Intestinal barrier dysfunction refers to an abnormal change in intestinal permeability and structural damage to the intestinal mucosa caused by various causes, which leads to the movement of bacteria and toxic products into the bloodstream and causes systemic inflammation [10]. These changes lead to endothelial cell dysfunction and vascular sclerosis, thus causing or exacerbating the development of AH [11]. In addition, intestinal barrier dysfunction can affect the growth of beneficial gut microflora, leading to an imbalance in the gut microbiota and an increase in intestinal pathogenic bacteria and lipopolysaccharides. These harmful substances can enter the bloodstream through the mesentery, which further increases blood pressure [12].

The mucous layer and intestinal epithelium are the first physical and chemical barriers against intestinal bacteria, pathogens and food antigens. Dysregulation of the mucosal immune response, characterised by changes in the innate immune system, activation of effector T-cells, increased presence of B-cells and antibody production, and increased production of pro-inflammatory mediators, plays an important role in the pathogenesis of inflammatory bowel disease (IBD) [13].

IBD is a chronic, progressive immune-mediated inflammatory condition of the gastrointestinal tract. Environmental risk factors play a role in the development of any type of IBD, Crohn's disease and ulcerative colitis (UC) [14]. Although the exact cause of IBD is still unknown, it is hypothesised that individuals with a genetic predisposition may develop IBD when exposed to environmental factors, altered gut microbiome and dysregulated immune response [15].

UC is a lifelong inflammatory disease that affects the rectum and colon to varying degrees. In 2023, the prevalence of UC was estimated at 5 million cases worldwide, and the incidence is increasing. It is believed that UC occurs in people with a genetic predisposition after exposure to environmental factors; defects in the intestinal epithelial barrier, changes in the composition of the microbiota and dysregulation of the immune response [16]. Thus, the intestinal microbiota plays an important role in the homeostasis and functioning of the immune system. It is currently believed that various environmental and genetic factors may contribute to changes in this microbiota. The formation of pathogenic microflora in genetically predisposed individuals is associated with changes in epithelial function, impaired gastrointestinal immune function and persistent intestinal inflammation, and the entry of toxins into the vascular bed through defects in the intestinal epithelial barrier [17].

The development of AH is often triggered by stress. Stress controls the autonomic response by stimulating the sympathetic nervous system, which causes the adrenal medulla to secrete excess adrenaline and norepinephrine, subsequently causing central and peripheral tissues to over-secrete inflammatory mediators, or pro-inflammatory cytokines. The intestine is well innervated, which is called the enteric nervous system. Neurons of the sympathetic and parasympathetic nervous system communicate with the nerves of the intestine, forming a complex neural network called the brain-gut axis. The enteric nervous system contains a large number of neurons that are responsible for regulating many functions of the gastrointestinal tract. Stress-induced activation of the sympathetic nervous system excites the enteric nervous system and increases the density of nerve fibres and the number of cholinergic neurons in the intestinal mucosa, which leads to increased permeability of the intestinal epithelium. Clinical studies have shown that lesions in patients with UC have a greater number of submucosal nerve plexuses and increased epithelial permeability [18].

Thus, AH and UC share some common etiological factors, genetic predisposition, and environmental influences. Stress worsens the course of each other, which is due to an increase in the permeability of the intestinal epithelium, leading to a vicious circle.

Current guidelines for AH recommend using the average of several blood pressure (BP) readings obtained both in and out of the office for the diagnosis and treatment of hypertension. In-office BP measurement using an upper arm cuff is the evidence-based reference method for current BP classification and treatment goals. However, out-of-office BP assessment using ambulatory BP measurement or home BP monitoring is recommended by all major medical associations to obtain additional information about a person's BP profile and its relationship to daily activities [19].

This study complies with international regulations and laws of Ukraine: «Fundamentals of Ukrainian Healthcare Legislation» (1993), «On Medicines» (1996), «On Personal Data Protection» (2010). The clinical trial was approved by the Ethics Committee of the Shupyk National Healthcare Institution of Ukraine (protocol № 6, dated 03.10.2022).

All patients were explained the essence and stages of the study, and patients signed informed consent to participate in the clinical trial. The study was conducted in compliance with the principles of bioethics and legal requirements: The Declaration of Helsinki (2000) and Ukrainian legislation, and participation was voluntary and anonymous. It was possible to refuse to participate in the study at any stage, with the subsequent receipt of the necessary medical care. The presented research is a fragment of the dissertation for the degree of Doctor of Philosophy at the Department of Therapy of the Shupyk National University of Health of Ukraine on the topic: «Minimally invasive methods of diagnosis and evaluation of the effectiveness of treatment in patients with ulcerative colitis and concomitant arterial hypertension».

The dissertation is a fragment of the research work of the Department of Therapy of the Shupyk National

University of Health Care of Ukraine on the topic: «Clinical and pathogenetic aspects of diagnosis and treatment of patients with combined pathology of internal organs (diseases of the cardiovascular system, digestive system, endocrine system)», state registration number 0119U101507, term of implementation 2019-2025.

This study included 142 patients and 30 healthy individuals. In 96 patients, UC was confirmed clinically, endoscopically and pathologically. During 24-hour ambulatory blood pressure monitoring, 95 patients were diagnosed with AH. Of these, 49 patients had UC + AH and 46 patients had AH without UC. 47 patients out of 142 had UC without concomitant AH. Table 1 shows the patients' age and blood pressure values.

Table 1.

Patients' age and blood pressure values

Parameter	Group	N	M	Me	SV	MIN	MAX
Age, years	UC + AH	49	39,90	38	12,49	19	59
	UC without AH	47	40,17	41	10,82	19	59
	AH without UC	46	40,41	40,5	11,97	20	57
SBP, mmHg	UC + AH	49	153,02	153	7,25	142	170
	UC without AH	47	126,49	127	8,43	110	137
	AH without UC	46	151,28	150	5,81	142	165
DBP, mmHg	UC + AH	49	96,02	95	4,25	85	107
	UC without AH	47	80,98	83	6,59	65	95
	AH without UC	46	95,17	95	4,05	84	106

Notes:

SBP – systolic blood pressure

DBP – diastolic blood pressure

M – arithmetic mean

Me – median

SD – standard deviation

MIN – minimum value

MAX – maximum value

In 95 patients, 24-hour ambulatory blood pressure monitoring was successful: the number of reliable measurements (31 during the day and 8 at night, 93% in total) was satisfactory. In the UC+AH group, a rise in blood pressure was more often observed during tenesmus and during defecation. The manifestations of UC included bloody diarrhea with or without mucus, rectal urgency, tenesmus, and abdominal pain of varying degrees, which often decreased during the defecation. Patients recorded their poor health and the feeling of high blood pressure in a notebook. In the group of AH without UC, blood pressure rose more often during emotional overload and the white coat effect was observed.

Conclusions.

AH is an important public health problem because it is associated with a number of serious diseases, including CVD and stroke. The importance of assessing hypertension taking into account different BP profiles and BP variability is becoming increasingly important. Daily BP monitoring is the gold standard for diagnosing AH and assessing 24-hour BP and provides data on several important parameters that cannot be obtained using any other form of BP measurement [20]. Given the close relationship between the development of hypertension in patients with UC, careful monitoring of BP in IBD is necessary. In the present observations, we found a close relationship between the rise in BP directly during the act of defecation in UC. Given the frequent urge to defecate and the feeling of stress in patients with UC, dynamic monitoring of BP and timely

correction of hypertension treatment along with the achievement of remission in UC are necessary.

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**INTRACARDIAC HEMODYNAMIC REGULATION OF EQUALITY OF BLOOD FILLING OF
PAIRED CHAMBERS OF THE HEART, INCLUDING THE CAVITIES OF BOTH CARDIAC
AURICLES****Kornilova – Kolesinskaya R.***MD, PhD, Associate Professor S.D. Asfendiyarov
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Ministry of Health of the Republic of Kazakhstan.***ВНУТРИСЕРДЕЧНАЯ ГЕМОДИНАМИЧЕСКАЯ РЕГУЛЯЦИЯ РАВЕНСТВА
КРОВЕПОЛНЕНИЯ ПАРНЫХ КАМЕР СЕРДЦА, ВКЛЮЧАЯ ПОЛОСТИ ОБОИХ УШЕК
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<https://doi.org/10.5281/zenodo.15220769>***Abstract**

The research paper outlines findings of the cardiac cycle analysis (heart cycle). The cardiac cycle described in the paper demonstrates activity through curves reflecting pressure changes in the left and right heart cavities during one cardiac cycle. The research revealed that paired chambers are filled synchronically (simultaneously) in structures of each pair– left and right atria, left and right ventricles. The filling mechanisms differ for each pair.

Аннотация

В статье изложены результаты анализа сердечного цикла (кардиоцикла). Процессы кардиоцикла в кинематике впервые зафиксированы в виде девяти кривых изменений давления в полостях левого и правого отделов сердца в течение одного кардиоцикла. Выявлены механизмы кровенаполнения парных камер. Они своеобразны у каждой пары.

Keywords: adjacent chambers; septal motion; interventricular septum; pressure gradients.

Ключевые слова: смежные камеры; движения перегородок; межжелудочковая перегородка (МЖП); градиенты давления.

Введение

Несмотря на колоссальное количество работ, посвященных исследованию деятельности сердца, нерешенные проблемы, связанные с работой данного органа, возникают вновь и вновь. Этот факт свидетельствует о том, что данный орган является уникальным. А это значит, что сердце обладает свойствами, которые ещё не выявлены. Но в период эволюционного развития возможности и способности человека увеличиваются, и некоторым исследователям удаётся сравнительно легко решать те проблемы, решение которых ранее считалось невозможным.

Вполне допустимо, что появление новых проблем в деятельности сердца в какой-то степени связано с быстрым и успешным развитием технических наук, что сопровождается нередко изобретениями и внедрениями в медицинскую практику новых методов, технологий, новых приборов, аппаратов и прочее.

Нередки случаи, когда специалисты, используя новые технологии и методы, открывают особенности изучаемых органов, о которых они, специалисты, ранее не знали, или знали, но не придавали им должного значения. Так, хирурги-кардиологи 5 специалистов и соавторов (Никитин А.С., Лобачева Г.В., Бахтадзе З.Ш., Сайдалиева З.О., Макрушин И.

М.) во главе с академиком Бокерия Л.А., применили эхокардиографию (УЗИ сердца) с целью непрерывного наблюдения за состоянием сердца во время операции на этом же сердце. Было обнаружено, что причиной раннего послеоперационного осложнения является **остановка движений межжелудочковой перегородки (МЖП)** [1,2].

Хирурги, определив причину раннего послеоперационного осложнения, приступили к организации целенаправленного лечения.

Физиологи, ознакомившись с данной информацией, провели исследование по выявлению роли движений МЖП в здоровом сердце взрослого человека. Результаты исследования показали, что в течение кардиоцикла наблюдаются движения не только МЖП, но и обе атриовентрикулярные перегородки (АВП) смещаются в виде выпячивания или вдавливания в сторону смежной камеры. При этом давление в камерах изменяется – в полости, куда смещается перегородка, ёмкость уменьшается, что сопровождается повышением давления, а в камере, из которой перегородка выпячивается, всё наоборот – ёмкость увеличивается, давление падает, возникает всасывательный эффект.

Однако при попытке выявить механизмы изучаемых процессов обнаружено, что механическая деятельность сердца изучена недостаточно. В приведённом выше примере для выявления механизма,

формирующего равенства объемов крови между артериальным выбросом и венозным возвратом, не достаёт информации о деятельности правого желудочка во время фазы изгнания. При исследовании механизма наполнения парных камер сердца равными объемами крови, оказалось, что для этой цели тоже не хватает информации о кардиоцикле правого отдела сердца.

Долгие поиски кимограммы с синхронной записью всех процессов одного кардиоцикла как будто закружаются. Выбор пал на две, подходящие нам, структуры. Одна из них находится в книге учебное пособие «Функции сердца» автор немецкий физиолог Г. Антони, (1986, рис.17-25), [3]. А так же классический учебник «Медицинская физиология» (рис. 9-5) авторы Артур Гайтон, Джон Холл, 2006. [4]. На обоих рисунках кроме регистрации кривых изменений давления в левом предсердии, левом желудочке, аорте и кривой изменения объема левого желудочка, синхронно записаны также ЭКГ и ФКГ (тоны сердца). Всего 6 кривых, из них 4 показателя кардиоцикла структур левой половины сердца. ЭКГ и ФКГ информация о работе сердца берётся с поверхности тела, как обычно, но с соблюдением синхронности с другими показателями.

Участие в кардиоцикле процессов правого отдела сердца нигде не зафиксировано, что свидетельствует о неполном использовании показателей кардиоцикла.

Принятое в литературе описание последовательности периодов и фаз, а так же их длительность в долях секунды, представлялись в форме таблицы типа «систола-диастола» (смотреть табл.№1 в конце данной статьи). При этом предполагается, что ПЖ якобы в точности повторяет действия ЛЖ, поэтому в описании кардиоцикла пишется часто не ЛЖ (единственное число), как это есть на самом деле, а желудочков. Кардиоцикл предсердий вовсе не упоминается и в таблицу не вставляется.

Несмотря на утверждение, что ПЖ якобы точно повторяет движения ЛЖ, в источниках учебной литературы появлялись в то время (1986) сообщения об особенностях кардиоцикла ПЖ, о фазовых расхождениях между левым и правым желудочками сердца и прочее. Но сами авторы считали, что можно не брать во внимание эти сообщения и вот почему: «Все эти фазовые различия относительно невелики (10 - 30мс) и практически не влияют на гемодинамику» [3, стр.77]. Но если учесть, что эти различия не эпизодичны, а стационарные, т.е. переходят от цикла к циклу, то с данным заключением трудно согласиться. Тем не менее, чтобы принять или отклонить высказанное предположение необходимо тщательное изучение кимограммы с синхронной (одновременной) записью показателей кардиоцикла всего сердца. Это значит, что к 6-ти показателям цикла левого отдела необходима синхронная запись ещё 3-х показателей правого отдела сердца. Это кривые изменений давления в полостях правого желудочка, правого предсердия и в лёгочной артерии, т.е. 3 показателя цикла правого отдела сердца.

Итак, **необходима синхронная запись девяти кривых, характеризующих полный кардиоцикл, т.е. цикл всего сердца.** Такие записи кривых дав-

ления делаются через катетер (зонд). Поэтому сначала проводят мини операцию. Ее называют катетеризация сердца [5].

Первая в мире катетеризация сердца была выполнена в 1929 году выпускником Берлинского университета Вернером Форсманом. Будучи молодым врачом – урологом, Форсман произвёл катетеризацию полости *собственного* правого предсердия. В дальнейшем, дальше правого предсердия в сердце Форсману пройти не удалось. Начальник на следующий день, увидев рентгеновские снимки, строго, вплоть до увольнения с работы, запретил вводить катетер в собственное сердце, а тем более пациентам.

При катетеризации сердца катетер (зонд) (специальная гибкая полая трубка) вставляется в периферическую вену. Форсман носик катетера вставил в локтевую вену собственной левой руки. Затем под контролем рентгена катетер правой рукой довёл до собственного правого предсердия. Катетеризацией сердца по Форсману начали заниматься американские врачи и физиологи в годы 2-ой мировой войны. Примерно в 1947г. доктор Циммерман впервые в мире ввёл катетер в ЛЖ. В левый желудочек катетер вводят через периферическую артерию в аорту, из аорты – в левый желудочек, затем в левое предсердие, т.е. ретроградно. В ~1948г тот же врач – хирург и рентгенолог Циммерман разработал одномоментную 4-х камерную катетеризацию сердца. Через катетеры можно изучать сердце с внутренней его поверхности. Но для этого необходимо иметь специальные приборы. Размер, форма и масса (вес) этих вещей, а также инструментов, зависят от величины диаметра катетера. Кроме того, много других технических трудностей удалось преодолеть, и катетеризация сердца для диагностики и лечения болезней сердца заработала. Для записи данных вводят миниатюрные датчики давления: в правые желудочек и предсердие, в лёгочную артерию; и так же в левые - желудочек и предсердие, в выносящий сосуд -- в аорту. Всего 6 датчиков, 7-ой датчик давления вводят в полость перикарда для регистрации кривой изменения объема желудочков в течение каждого кардиоцикла.

Вставленные датчики реагируют на постоянные изменения давления в полостях исследуемых органов. Принятые изменения давления трансформируются в датчиках на нервные импульсы, которые выходят от датчиков по тонким проводам к усилителю, а от него в блок регистрации. В блоке регистрации к 7 вышеуказанным кривым добавляется еще две записи, характеризующие состояние сердца в течение кардиоцикла. Это электрокардиограмма (ЭКГ) и фонокардиограмма (ФКГ, тоны сердца). Информация о состоянии сердца берется с поверхности тела. Все 9 кривых регистрируются синхронно (одновременно).

Данные операции проводятся в специально оборудованных лабораториях, со строгим соблюдением специально разработанных правил. Выполняются эти операции с диагностической и лечебной целью. У лиц со здоровым сердцем катетеризация этого органа запрещена согласно морально этическим законам. В тоже время кривые изменения давления и объема крови для анализа нормального сердечного цикла должны быть записаны у пациента с

заведомо здоровым сердцем, с синхронной регистрацией 9-ти показателей, характеризующих циклическую деятельность **обоих** отделов сердца. Эта процедура довольно рискованная и трудная, как с морально этической точки зрения, так и методической (технической) стороны.

Учитывая, описанные барьеры, которые выявлялись по мере разработки и применения разных способов катетеризации сердца, можно предположить, что копии кимограмм с синхронной записью 9-ти показателей кардиоцикла могут быть размещены в ранее изданных источниках научной и учебной литературы. Целенаправленный поиск дал быстрый результат. Рисунок с копией необходимой кимограммы был найден в учебнике «Физиология человека» под редакцией чл. - корр. АМН СССР Г.И. Косицкого издание третье, переработанное и дополненное (2-ое вышло в 1972 г.). Москва «Медицина» 1985. 544 с., ил.

В учебнике на стр. 252 расположен Рис. 125 с подписью: Схематизированные кривые изменений давления в правых (а) и левых (б) отделах сердца, тонов сердца (в), объёма желудочков (г) и электрокардиограмма (д.). Несколько ниже мелким шрифтом идёт нумерованный перечень (от 1 до 8 включительно) фаз кардиоцикла. Фазы на рис. отделены друг от друга вертикальными линиями, в правом и левом отделах раздельно. Расстояние между линиями означает продолжительность фаз. Временной масштаб размещён в верхней части рис. В тексте учебника на той же стр. написано: «Пример регистрации фаз сердечного цикла приведён на рис.125. Кривые записаны при частоте сердечных сокращений 75 в минуту. В этом случае общая длительность сердечного цикла – систола, диастола, пауза – равна 0,8 с.». Далее продолжается описание фаз сердечного цикла. На основании приведённых цитат можно заключить следующее – первоиздатель учебника довольно убедительно утверждает, что **рис.125 является копией кимограммы с синхронной записью показателей цикла обоих (левого и правого) отделов сердца**. Однако редакторы журнала, будучи уверенными в том, что рисунок, взятый из учебника, нельзя применять (не может быть использован) в качестве материала для научного исследования, поэтому статью печатать отказали.

История зонда (катетера) в лечебном заведении города Москва.

Отсутствие возможности приобрести нужный материал для исследования неизученных механизмов деятельности здорового сердца, послужили стимулом для изучения истории становления методов прижизненного внутрисердечного исследования, применяя зонд (катетер) в Московских лечебных заведениях. С помощью компьютера найдено, что в 1950-51гг. была создана группа, проводившая данные исследования под руководством проф. А.Н. Бакулева при кафедре факультетской хирургии 2-го Московского медицинского института. В 1953 г. доктор Мешалкин Е.Н. на этом материале защитил диссертацию на тему: «Ангиография у больных с врождёнными пороками сердца». Примерно в 1952 г. к этой группе присоединился проф. Бабский Е.Б., который в данное время руководил физиологической лабораторией Центрального научно-исследо-

вательского института протезирования и протезостроения. Поскольку в научные интересы профессора входило создание новых аппаратов и приборов, а так же усовершенствование действующих приборов, данный переход профессора всех устраивал. Позднее лаборатория была преобразована в лабораторию клинической физиологии при кардиохирургической клинике, руководимой А.Н. Бакулевым. В 1956 г. создаётся Институт грудной хирургии на базе 1-- Градской клинической больницы. Академик Бакулев – создатель Института, он же стал его первым директором. Группа по внутрисердечным исследованиям работу продолжает в Институте. К нему присоединяют лабораторию клинической физиологии. Проф. Бабский Е.Б. возглавил работу по созданию новых методик и приборов для изучения состояния сердечно-сосудистой системы и для изучения опорно-двигательного аппарата. Вот тут-то, вероятно, группой исследователей под руководством проф. Бабского Е.Б. была собрана и заработала установка для одномоментной 4-х камерной катетеризации сердца.

Следовательно, группой исследователей руководили двое крупных учёных – академик Бакулев А.Н. хирургической частью работ и профессор Бабский Е.Б. физиологическим комплексом этих исследований.

В 1959 г. доктор Савельев В.С. на этом материале защитил докторскую диссертацию на тему: «Гемодинамика при врождённых пороках сердца». Заглавие диссертации напрямую свидетельствует о том, что установка для синхронной регистрации 9-ти показателей для каждого сердечного цикла работает здесь. Данное утверждение подкрепляется следующими событиями.

В 1966 г. в Москве на базе рентгенологического отделения института грудной хирургии открыли лабораторию внутрисердечных методов исследования. Спустя 5 лет, в 1971г. лабораторию переименовали в отделение рентгенохирургических методов исследования и лечения сердца и сосудов, что свидетельствует о росте данного заведения. В эти годы в Москве других лабораторий подобного направления не обнаружено.

Важно отметить, что в том же 1966 г. издание «Медицина» Москва выпустило учебник «Физиология человека» под редакцией Е.Б. Бабского с со-редакторами. Это 1-ое издание учебника. В этой книге на одной из страниц размещён рис. с копией кимограммы с синхронной записью показателей цикла не только левого, но и правого отделов сердца. Подпись рис. и пояснения в тексте те же, что и приведёны выше в 3-тём издании учебника. Спустя 6 лет после выхода 1-го издания, т.е. в 1972 г., вышло 2-ое издание учебника «Физиология человека» под ред. Бабского с со-редакторами примерно с теми же, что и 1-ое и 3-ье издания. Последнее, переработанное и дополненное, вышло, спустя 13 лет после выхода 2-го изд., но под ред. профессора Косицкого Г.И. Фамилия Бабский Е.Б. в чёрной рамке стоит первой в списке соавторов учебника.

Во всех 3-х выше перечисленных изданиях учебника в главе по физиологии кровообращения имеется выше упомянутый рисунок с размещённой на нём копией кимограммы. Причем фазы правого

и левого желудочков вертикальными линиями отделены друг от друга. Подписи в рис. и разъяснения в тексте во всех 3-х изданиях одинаковы.

Измерение длительности фаз сердечного цикла это лишь начало, вернее подготовка рисунка к его расшифровке. Рисунок с 9 кривыми, характеризующими полный кардиоцикл всего здорового сердца, позволяет получить полную информацию о кардиоцикле. Например, выявить точные сведения о работе каждого из 2-х желудочков сердца, детали их взаимодействия; в частности о значении их фазовых расхождений, а также решить ряд вопросов, которые не поддаются решению без данных об одновременном (синхронном) действии всего кардиоцикла. Например, изучить гемодинамическую регуляцию процессов, протекающих в течение кардиоцикла; раскрыть до конца работу механизма, поддерживающего равенство между венозным возвратом (правое предсердие) и артериальным выбросом (ЛЖ); выявить механизмы, обеспечивающие мгновенную и адекватную реакцию сердца на запросы метаболизма. В общем кимограмма с синхронной записью цикла обоих желудочков у человека со здоровым сердцем и сосудами содержит большое количество информации о деятельности самого сердца и может значительно расширить знания о принципах непрерывной работы здорового сердца в течение всей жизни человека.

Безусловно, это понимали и первообладатели обсуждаемого нами рисунка, но у них, вероятно, были другие цели и задачи, связанные с внутрисердечным исследованием гемодинамики. Об этом можно судить, исходя из названия тем, упомянутых выше, защищенных докторских диссертаций.

Первообладатели этой чрезвычайно ценной записи поступили **исключительно мудро**. Они подготовили кимограмму к анализу, снабдили её временным масштабом и разместили как рисунок в учебнике. Учебник переиздавался, и рисунок переходил из одного издания в другое и, наконец, (спустя ~50 лет) оказался **востребованным**. Мы **должны** с благодарностью принять этот ценный подарок и постараться оправдать надежды исследователей, сделавших синхронную запись процессов сердечного цикла обеих половин сердца и сумевших размножить и сохранить её в течение ~50-и лет, как раз полвека! Следует учесть, что сроки перехода рисунка с кимограммой из одного издания учебника в другое приходят к концу. Так, в 2003г. учебник снова переиздан. Рис. с кимограммой сохранился и в этой книге, но **без временного масштаба**, что осложняет возможность применения этой кимограммы для фазового анализа сердечного цикла. А в следующем издании может не быть и самого рисунка в переизданном, переработанном и дополненном учебнике. Вот почему мы дорожим копией этой кимограммы, которая по существу является очень ценным документом.

С целью подтвердить необходимость данной кимограммы для изучения механизмов, обеспечивающих непрерывное нормальное кровообращение у взрослого человека со здоровым сердцем, приводим ниже по тексту описание работ при прямой и обратной связи между правым предсердием и левым желудочком сердца. Благодаря этим связям ве-

личина объема крови, поступающей в круги кровообращения примерно одинакова. Что очень важно для нормального тока крови по большому и малому кругам кровообращения. Фаза **медленного наполнения камер сердца кровью**

В эту фазу кровь по приносящим венам непрерывно продолжает поступать в предсердия. Какие либо косвенные влияния на кровоток в виде, например, всасывательного эффекта и другие, в этот период отсутствуют. Поэтому **энергия притока венозной крови, оттекающей от всех органов и тканей по полым венам в правое предсердие, отображает в частности, линейная и объёмная скорости кровотока, уровень метаболизма в организме и соответственно запросы метаболизма в текущий момент** (Гайтон А., Холл Дж. [6]).

Итак, во время фазы медленного наполнения желудочков кровь, втекающая по полым венам в правое предсердие, а затем в желудочек, несёт правому отделу сердца информацию об уровне метаболизма в организме и о запросах метаболизма в текущий момент.

Фаза медленного наполнения желудочков является продолжением фазы быстрого наполнения этих камер или вторым этапом их кровенаполнения. Кровь по приносящим венам поступает в предсердия, затем, из предсердий транзитом через открытые АВ клапаны течёт в желудочки, дополняя их до уровня, **приближённого** к конечному диастолическому объёму (КДО). По мере наполнения желудочков кровью, кровь начинает задерживаться в **предсердиях**, наполняя их. При наполнении кровью стенки предсердий, будучи тоньше, чем у желудочков, начинают растягиваться, создавая давление в этих камерах.

С этого момента давление в правом предсердии становится **адекватным стимулятором** (раздражителем) биоэлектрических структур, заложенных в стенке правого предсердия.

Но это другая тема. Она требует собственного рассмотрения. Мы это сделаем, но не сейчас. Сейчас сделаем попытку расшифровать прямую и обратную связи между правым предсердием и левым желудочком, какую роль играют эти связи в деятельности кардиоцикла и наконец, как осуществляются данные связи.

Прямая и обратная внутрисердечные связи между правым предсердием и левым желудочком в кардиоцикле.

Нас, конечно, интересует связь, которая существует в кардиоцикле и передаётся с помощью перегородок от правого предсердия к левому желудочку – прямая связь. Она проявляется во время систолы желудочков, которые вызываются потенциалами действия (ПД). Малейшие изменения кровотока, происходящие в правом предсердии (ПП), сразу передаются правому желудочку (ПЖ) через правую предсердножелудочковую перегородку и тут уже потребуется вмешательство ЛЖ, так как выявилась новая тема, требующая собственного рассмотрения, как и выше объявленная.

Читателю предлагается внимательно просмотреть кимограмму и две таблицы (№1 и №2). Все эти приложения расположены после окончания данного текста.

Таблица 1

Описание кардиоцикла «систола-диастола» желудочков по типу, принятому в литературе.

Цифры – время в долях сек.

I. Систола желудочков - 0,33 сек.

- 1). Период напряжения желудочков **0,08 сек.**
 а) фаза асинхронного сокращения 0,05 сек.
 б) фаза изоволюметрического напряжения 0,03 сек.
 2). Период изгнания крови 0,25 сек.
 а) фаза быстрого изгнания крови 0,12 сек.
 б) фаза медленного изгнания крови 0,13 сек.

II. Диастола желудочков – 0,37 сек.

- 1). Протодиастолический период 0,04 сек.
 2). Период изоволюметрического расслабления 0,08 сек.
 3). Период наполнения желудочков кровью 0,25 сек.
 а) фаза быстрого наполнения 0,08 сек.
 б) фаза медленного наполнения 0,17 сек.
 4). Период пресистолический - наполнение кровью желудочков до уровня КДО за счет систолы предсердий 0,10 сек.

Таблица 2

Длительность периодов и фаз в долях сек. кардиоцикла желудочков (левого и правого отдельно) и предсердий.

Периоды, фазы желудочков	желудочки		Периоды, фазы предсердий	Сек.
	Левый секунды	Правый секунды		
Пресистола желудочков: а) Проведение ПД от СА узла к АВ Узлу	ПД СА УЗЛА и рецепторов		Пресистола предсердий Возбуждение КМЦ УС и предсердий	0,03
	0,03	0,03		
б) Наполнение желудочков кровью, обусловленное систолой предсердий	0,1	0,1	СИСТОЛА УС и предсердий	0,1
в) Асинхронное проведение возбуждения к желудочкам по ПСС	0,04	0,06	Протодиастола а) Расслабление б) Закрытие АВ клапанов.	0,04
СИСТОЛА желудочков:	0,28	0,3	ДИАСТОЛА предсердий:	0,72
1. Изоволюметрическое напряжение желудочков	0,06	0,02	Наполнение УС кровью Открытие полулунных клапанов ПЖ, затем ЛЖ	0,04 0,02
2. Изгнание крови из желудочков	0,22	0,28	Всасывание крови в предсердия	0,24
ДИАСТОЛА желудочков Протодиастола ЛЖ Продолжение изгнания крови из ПЖ	0,02	0,02 + 0,01	Всасывание крови в предсердия	0,02
Изоволюметрическое расслабление ЛЖ Протодиастола ПЖ Изоволюметрическое расслабление ПЖ	0,06	0,02 0,01	Всасывание крови в предсердия	0,06
Быстрое затем медленное наполнение сердца кровью	0,12 + 0,30	0,12 + 0,28	Быстр затем медленное пассивное перетекание крови из предсердий в желудочки	0,12+ 0,28

Внимание! Если цифры длительности фаз в долях сек обоих желудочков стоят на одном уровне –

это значит, что оба желудочка начали работать одновременно. Если цифры находятся на разных уровнях, то раньше начинает работу тот желудочек,

цифры которого находятся выше. **Значение сокращений, которые имеются в таблице:**

ПД САУ – потенциал действия синоатриального узла; **КМЦ** – кардиомиоцит; **УС** – ушко(и)

сердца; **ПСС** – проводящая система сердца; **АВ** – атриовентрикулярный или предсердножелудочковый; **ЛЖ** – левый желудочек; **ПЖ** – правый желудочек

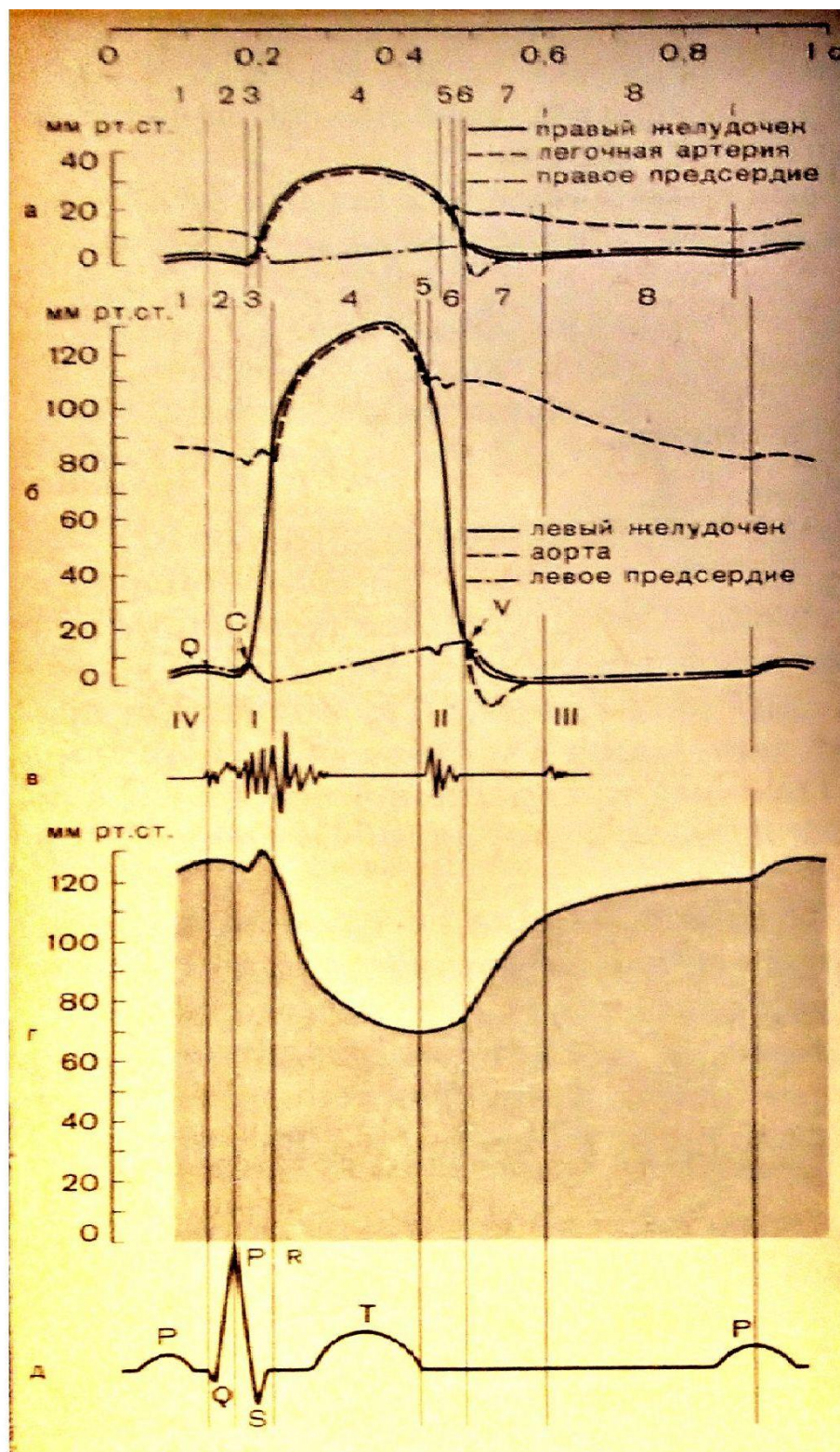


Рис.1. Схематизированные кривые изменений давления в правых (а) и левых (б) отделах сердца; тонов сердца (в); объёма желудочков (з) и электрокардиограмма (д).

I – IV – тоны ФКГ; 1- фаза систолы предсердий; 2 – фаза асинхронного проведения ПД к желудочкам по ПСС; 3 – фаза изоволюмет-го напряжения желудочков; 4 – фаза изгнания; 5 – протодиастолический период; 6 – фаза изоволюмет-го расслабления желудочков; 7 – фаза быстрого наполнения желудочков; 8 – фаза медленного наполнения желудочков.

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MYOCARDIAL REMODELING IN PATIENTS WITH CORONARY ARTERY DISEASE AND TYPE 2 DIABETES MELLITUS

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Abstract

The aim of the work was a comparative study of the structural and geometric remodeling of the myocardium in patients with coronary heart disease with and without concomitant type 2 diabetes. 110 patients with coronary artery disease who had previously undergone myocardial revascularization were examined, with an average age of 58.3 ± 4.9 years. The patients were divided into two groups. The first main group consisted of 56 patients with coronary artery disease. Stable angina pectoris FC 2 with concomitant type 2 diabetes, the second comparison group included 54 patients with coronary heart disease, without diabetes. The control group consisted of 20 practically healthy individuals. All examined patients underwent medical history collection, ECG, EchoCG, and blood determination of glycated hemoglobin. There was a tendency to decrease LVEF, an increase in cavity dilation and an increase in LV myocardial mass in the group of coronary heart disease with type 2 diabetes compared with the group of coronary heart disease without diabetes. Concentric LVH was found in 14 (25%) patients, concentric LV remodeling in 24 (42.8%) patients, eccentric LVH in 14 (25%) patients, and normal left ventricular geometry in 4 (7.1%) patients. The relationship between the level of glycated hemoglobin and the presence of left ventricular hypertrophy was revealed: in the main group in 14 patients, 80% of them had HbA1c levels of more than 6.5%, including HbA1c levels of more than 7.5% to 45.4% of patients ($p < 0.05$). Thus, the study of the features of the structural and functional restructuring of the left heart in patients with coronary artery disease with type 2 diabetes should be taken into account in predicting cardiovascular risk.

Keywords: remodeling, coronary heart disease, type 2 diabetes mellitus, left ventricular hypertrophy

Introduction. Coronary heart disease remains an important medical and social problem leading to high mortality [1,2]. Concomitant diabetes mellitus plays an important role [3,4]. At the same time, numerous evidences of a close relationship between diabetes and cardiovascular diseases (CVD) have been accumulated, it is coronary heart disease that is the most common cause of death in patients with diabetes. One of the first studies where this relationship was convincingly demonstrated was the Framingham study, according to which the absolute risk of coronary death in diabetes was twice as high in men and 4.7 times in women, compared with people without diabetes [5,6].

Remodeling of the heart is a process of complex disruption of its structure and function and includes an increase in myocardial mass, dilation of cavities and a change in the geometric characteristics of the ventricles [16]. There is evidence of the effect of cardiac remodeling on the prognosis of arrhythmias, the development and progression of chronic heart failure and cardiovascular mortality [7].

In type 2 diabetes (DM2), it is the heart that is recognized as the most important target of damage. The combination of insulin resistance, hyperinsulinemia, and hyperglycemia accelerates the development and

progression of atherosclerosis-related diseases, increasing the risk of cardiovascular complications [10]. LV diastolic dysfunction (DD) is considered an early marker of myocardial damage in DM2. A pathogenetic relationship between DD and LV hypertrophy during the development and progression of CHF has been noted [8,9]. Despite the availability of clinical data on the pathogenesis of remodeling, there is no complete data reflecting the holistic picture of the formation of structural and functional disorders of the heart in patients with T2DM with coronary artery disease. The question of the severity of heart changes and risk factors for LV remodeling in DM2 remains unresolved [11,12].

In this regard, the aim of our study was to compare the parameters of structural and geometric remodeling of the heart in patients with coronary heart disease with and without concomitant type 2 diabetes.

Materials and methods. 110 patients with coronary artery disease (65 men and 45 women) with an average age of 58.3 ± 4.9 years, who had previously undergone myocardial revascularization, were examined. Depending on the glycemic status, the patients were divided into two groups. The first main group consisted of 56 patients diagnosed with coronary heart disease. Stable angina pectoris FC 2 with concomitant type 2

diabetes. The second group (the comparison group) included 54 patients with coronary artery disease, angina pectoris without diabetes. The control group consisted of 20 practically healthy individuals. The diagnosis of T2DM was established based on criteria recommended by WHO [9].

The exclusion criteria were: type 1 diabetes, bronchial asthma and obstructive pulmonary diseases with respiratory insufficiency of grades II-III, diseases of the systemic hematopoiesis, oncological diseases, non-sinus rhythm, heart defects, endocarditis, myocarditis, pericarditis, liver failure and participation in any other study within 30 days before selection.

Research methods. Glycated hemoglobin levels were examined in all patients, and a 12-lead ECG was recorded using a Schiller device.

The EchoCG study was performed on a Samsung medison ultrasound device "Accuvix.V20" (Korea) using a sector sensor with color mode and pulse-wave, continuous-wave mode with a frequency of 2-4 MHz in standard echocardiographic positions in M- and B-modes according to the recommendations of the American Echocardiographic Society (ASE) (Schiller N.B. et al., 1989).

Based on relative wall thickness (OTC) and The LV myocardial mass index (IMMI) was evaluated by the geometric model of LV and the types of its remodeling were distinguished.

Statistical processing. The materials used in this study were statistically processed using parametric and nonparametric methods. Statistical processing and analysis of the obtained results were carried out in the statistical analysis system MS Excel 2010. When estimating the linear relationship between the values, the Pearson pair correlation coefficient was calculated. Spearman's rank correlation coefficient was used to study the relationship between quantitative features. The differences were considered statistically significant at $p < 0.05$.

Results. As part of the study, structural and functional changes in the myocardium were studied using EchoCG. When analyzing the left ventricular ejection fraction (LVEF), there was a tendency to decrease this indicator in the main group to $50.8 \pm 3.2\%$ compared with patients in the comparison group, where LVEF was $54.2 \pm 2.4\%$, $p < 0.05$ (Table 1).

Table 1

The state of central hemodynamics in the groups of studied IHD patients with and without type 2 diabetes

Index	Control group (n-20)	Main group (n-56)	Group comparison (n-54)
EDV, ml	120,7 $\pm$ 4,1 *	170,3 $\pm$ 5,8*/***	149,7 $\pm$ 4,1 ***
ESV, ml	36,4 $\pm$ 2,9**	77,5 $\pm$ 3,7***	61,4 $\pm$ 2,9**/***
EF, %	65,6 $\pm$ 4,8	50,8 $\pm$ 3,2***	54,2 $\pm$ 2,4***
ΔS , %	37,4 $\pm$ 0,6	28,1 $\pm$ 0,6	29,9 $\pm$ 0,7
LV PWT, cm	9,0 $\pm$ 0,9	12,3 $\pm$ 0,32	11,4 $\pm$ 0,24
IVS, cm	9,0 $\pm$ 0,7	12,5 $\pm$ 0,32	11,0 $\pm$ 0,25
Total thickness LV, cm	0,37 $\pm$ 0,03	0,52 $\pm$ 0,03	0,47 $\pm$ 0,05
LVM, g	99,5 $\pm$ 3,5**	302,4 $\pm$ 9,5	268,9 $\pm$ 9,2**
LVMI, g/m ²	106,7 $\pm$ 12,6*	144,6 $\pm$ 6,8*/***	117,8 $\pm$ 4,5***

Note: * - $p < 0.05$ differences are significant between the values of the control group and the main group, ** - $p < 0.05$ differences are significant between the values of the control group and the comparison group, *** - $p < 0.05$ differences are significant between the values of the main group and the comparison group.

An analysis of the structural and geometric parameters of the left chambers of the heart showed that in the main group, in comparison with the comparison group, there was an increase in cavity dilation (final diastolic and systolic volume) and an increase in LV myocardial mass.

A similar trend was obtained when quantifying the fraction of systolic shortening of the anteroposterior size of the left ventricle – in the main group, the indicator was $28.1 \pm 0.6\%$, in the comparison group – $29.9 \pm 0.7\%$. The analysis of individual data on OTC and LV IMM made it possible to determine the presence of

structural and geometric remodeling of the left ventricle in 52 (92.8%) patients of the main group and 45 (83.3%) patients in the comparison group.

Significant differences in the nature of LV remodeling were found between the groups of patients. In combination with coronary heart disease and DM2 (the main group), the following variants of structural and geometric remodeling of the heart were identified: concentric LVH in 14 (25%) patients, concentric LV remodeling in 24 (42.8%) patients, eccentric LVH in 14 (25%) patients, and normal geometry in 4 (7.1%) patients. left ventricle (Table 2).

Table 2

Features of structural and geometric LV remodeling in the group of CHD patients with and without type 2 diabetes

Remodeling indicators	Main group (n-56)	Comparison group (n-54)
Eccentric hypertrophy, %	14 (25%)	9 (16,6%)
Concentric remodeling, %	24 (42,8%)	22 (40,7%)
Concentric hypertrophy, %	14 (25%)	5 (9,2%)
Normal geometry, %	4 (7,1%)	18 (33,3%)

In the comparison group, the normal type of geometry was noted in 18 (33.3%) of the observed, concentric remodeling prevailed in 22 (40.7%), concentric LV hypertrophy and eccentric LV hypertrophy were registered in 5 (n=9.2%) and in 9 (n=16.6%) cases. The analysis suggests that groups with and without DM2 are comparable in terms of the frequency of concentric remodeling. In patients with impaired carbohydrate metabolism, the option of left ventricular remodeling according to the type of concentric LVH significantly prevailed (25%). It should be noted that patients with

eccentric (n = 14) and concentric (n = 14) hypertrophy had a higher incidence of myocardial infarction (9, 10, and 11 patients, respectively) and clinical manifestations of CHF (94.3%, respectively) compared with patients with concentric LV remodeling (n = 24). 98.4% and 64.2%). It was interesting to study the features of left ventricular remodeling at different levels of glycated hemoglobin in a group of CHD patients with type 2 diabetes (Table 3).

Table 3

Parameters of structural and geometric remodeling of the left ventricle at different values of glycated hemoglobin in groups of patients with CHD with and without type 2 diabetes

Remodeling indicators	<6,5%	6,5-7,5%	>7,5%
Eccentric hypertrophy, %	2	5	7
Concentric remodeling, %	5	7	12
Concentric hypertrophy, %	3	5	6
Normal geometry, %	1	1	2

A study of the results of quantifying the parameters of LV structural and geometric remodeling and the level of glycated hemoglobin (HbA1c) between groups of CHD patients with and without type 2 diabetes revealed a relationship between the level of glycated hemoglobin and the presence of left ventricular hypertrophy: LVH was detected in 14 patients in the main group, 80% of them with HbA1c levels higher than 6.5%, including with an HbA1c level of more than 7.5% to 45.4% of patients ($p<0.05$).

It is known that a high risk of developing cardiovascular complications in carbohydrate metabolism disorders is associated with the development of LV remodeling. The predominance of the concentric type of LV remodeling in patients of both groups (24 (42.8%) and 22 (40.7%), respectively, is explained by the compensatory nature of LV hypertrophy. On the other hand, an increase in the frequency of concentric and eccentric LV hypertrophy in patients with T2DM in combination with coronary heart disease (37.0%) may indicate an increase in structural and geometric changes in the heart, contributing not only to a violation of the geometric shape of the ventricle and an increase in the tension of its walls, but also to a further increase in myocardial stress, which is accompanied by the progression of heart failure.

LV remodeling in coronary heart disease in combination with T2DM is based on hormonal, neurohumoral and metabolic processes, the triggering factors of which are insulin resistance and hyperinsulinemia. Apparently, activation of the sympathoadrenal system, stimulation of renin and angiotensin II production, followed by an increase in aldosterone formation, contributes to the transformation of the hyperkinetic variant of hypertension into a volume-dependent one, while hypertrophic and proliferative processes leading to concentric LVH are complemented by processes of cardiac volume overload, which may contribute to eccentric LV remodeling, which also prevails in DM patients (in the main group – 25%), in contrast to patients without impaired carbohydrate metabolism (in the comparison group – 16.6%). All this indicates the presence of

additional metabolic and hormonal factors in the pathogenesis of disorders of the structure and function of the heart muscle in patients with type 2 diabetes mellitus. The study of the features of the structural and functional restructuring of the left heart in patients with coronary artery disease with type 2 diabetes should be taken into account in predicting cardiovascular risk.

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FEATURES OF ENDOTHELIAL DYSFUNCTION AND CARDIAC REMODELING IN CORONARY HEART DISEASE

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Abstract

Currently, cardiovascular diseases are the most common cause of death in adults. Therefore, the search for a new molecular marker that can predict cardiovascular diseases is one of the highest priorities of medicine. VEGF and ET-1 are among the reliable predictors of cardiovascular disease. Our goal is to find out the relationship of VEGF and ET-1 biomarkers with the remodeling of the left ventricle of the heart in patients with coronary artery disease.

Keywords: endothelin 1, vascular endothelial growth factor; remodeling, left ventricle

Cardiovascular diseases (CVD) are the leading cause of death worldwide. It is estimated that 17.9 million people died from cardiovascular diseases in 2019, accounting for 32% of all deaths worldwide. 85% of these deaths were due to myocardial infarction and stroke [1]. Currently, coronary heart disease remains one of the most pressing problems of the internal medicine clinic, due to both the prevalence of cardiovascular diseases in the population and their contribution to the mortality structure. The interest in the treatment of cardiovascular diseases is determined by the widespread occurrence of coronary heart disease (CHD), its leading role in the causes of disability and mortality of the population, which gives the problem not only medical but also social significance [2-4]

By the beginning of the 21st century, the attention of clinicians focused on the role of endothelial dysfunction in the formation of coronary heart disease [1,5,6]. Endothelial dysfunction (DE) is an imbalance between the production of vasodilating, antiproliferative factors (NO, prostacyclin, tissue plasminogen activator, C-type natriuretic peptide, endothelial hyperpolarizing factor) on the one hand and vasoconstrictive, prothrombotic, proliferative factors (endothelin 1, superoxide anion, thromboxane A₂, tissue activator inhibitor plasminogen) - on the other side. The leading role in the development of the latter belongs to a violation of the bioavailability of endothelium-produced nitric oxide (NO), activation of endothelin 1 and a decrease in vascular endothelial growth factor (VEGF). Inhibition of NO synthesis is considered as one of the main pathogenetic mechanisms of cardiovascular diseases [3,7,8,9]

Disruption of the structure and function of the endothelium in coronary heart disease has a significant effect on the tone and thrombogenicity of the vascular wall and the neurohormones produced by it can exacerbate vascular and cardiac remodeling [5, 10]

The search for possible new markers of vascular remodeling and DE development in CVD patients is of great interest. Considering the above, it is of interest to study the clinical, hemodynamic and humoral markers

of the development of endothelial dysfunction during the course of the disease and remodeling processes in patients with coronary artery disease. The aim of the study was to study the relationship between myocardial and endothelial remodeling and the concentration of markers of endothelial dysfunction.

The study included 108 patients with coronary artery disease. The diagnosis was based on the clinical picture – clinical signs of angina pectoris of functional classes II-III, a history of myocardial infarction (MI) or electrocardiographic signs. The verification of the diagnosis was based on coronary angiography and coronary revascularization. Background diseases such as hypertension, type 2 diabetes mellitus, insulin resistance syndrome (according to the insulin resistance index in patients with glycemic levels within the reference standards), and hyperuricemia were recorded in all patients.

Criteria for inclusion in the study: 1) verified (coronographically) coronary artery disease, stable course; 2) regular (at least 3 months before inclusion in the study) intake of basic therapy for coronary artery disease, including beta blockers, antiplatelet agents, statins, neprilysin receptor antagonists; 3) age of patients 25-70 years; 4) consent of patients to be included in the study.

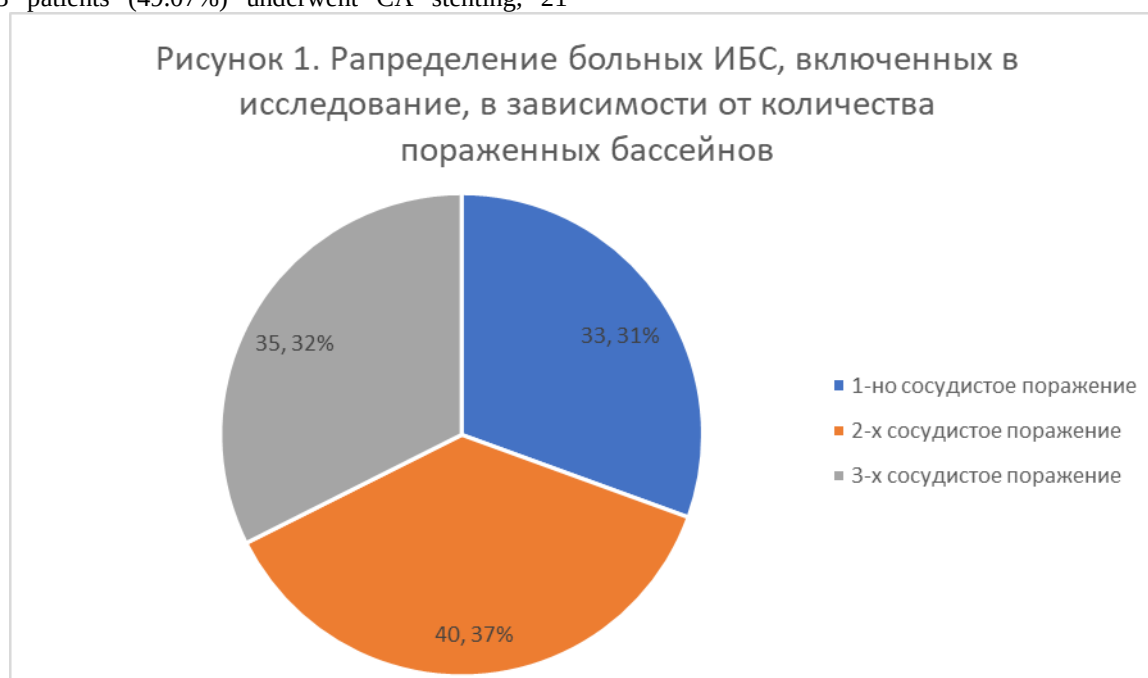
Criteria for non-inclusion of patients in the study: 1) febrile state of any etiology; 2) malignant neoplasms; 3) destabilization of the course of coronary heart disease during the previous 2 months; 4) persistent form of atrial fibrillation; 5) terminal period of organ failure.

The average age of the patients was 55.94±1.29 years, height – 170.24±1.12cm, weight – 77.72±1.79kg. As a control group (KG), the study included 20 healthy volunteers without signs of damage to the cardiovascular system, of comparable age and anthropometric characteristics. 74 patients had a history of MI, including 18 patients with 2 and 10 patients with 3 MI.

All patients included in the study underwent diagnostic coronary angiography during the previous year.

According to the results of the study, all patients were distributed depending on the number of affected pools. 53 patients (49.07%) underwent CA stenting, 21

patients (19.44%) underwent surgical revascularization.



All patients included in the study received basic therapy for coronary heart disease (Table 1).

Table 1
Basic therapy of patients included in the study

Medications	number	Relative share (%)
B blocker	102	94,44%
Angiotensin converting enzyme inhibitors	32	29,63%
angiotensin receptor blockers	76	70,37%
sacubitril	51	47,22%
calcium channel blockers	28	25,93%
Antiplatelet	106	85,19%
anticoagulants	12	20,37%
Statins	99	91,67%

Note: Ace inhibitors are angiotensin converting enzyme inhibitors; ARBs are angiotensin receptor blockers, and BCC are slow calcium channel blockers.

During the study, all patients and persons with CG included in the study were examined, during which the structural and functional state of the myocardium (echocardiography - EchoCG) and the features of the functional state of the endothelium (endothelium-dependent vasodilation test, concentration of VEGF and ET-1) were studied.

An EchoCG examination was performed using an Affiniti 50G ultrasound scanner. A convex sensor with a frequency of 2-7.5MHz was used. The examination was carried out in the morning in the position of the patient on his left side and on his back, after a 10-minute rest. The examination included scanning using standard ultrasound windows and EchoCG positions. The study protocol included registration of parameters of the structural and functional state of the heart and features of intracardiac blood flow.

The concentration of VEGF was determined in blood serum by solid-phase enzyme immunoassay using a set of VEGF-ELISA-BEST reagents manufactured by Vector-Best CJSC (Russia) with a measuring

range of 6.25-4000pg/ml, the reference norm in blood serum was 6.25-600pg/ml.

The concentration of ET-1 was determined in peripheral venous blood by enzyme immunoassay, the range of values was 0-10 mmol/L.

Endothelial function. The assessment of endothelium-dependent vasodilation was based on a change in the diameter of the brachial artery at the 5th second after arterial decompression during a 5-minute cuff test. The Affiniti 50G ultrasound scanner was used, equipped with a linear sensor with a frequency of 15 mhz. Statistical processing was carried out using the Student's confidence criterion for paired and unpaired values. Multiple comparisons were also performed using the Student's criterion, adjusted by the Bonferroni correction for multiple comparisons.

Research results. The study found that humoral markers of endothelial dysfunction were significantly increased in patients with coronary heart disease compared with the group of healthy volunteers (Table 2).

Thus, the concentration of VEGF in patients with coronary heart disease was increased by 11.09 times ($p<0.001$), ET-1 – by 10.33 times ($p<0.001$).

Correlation analysis revealed a strong positive relationship between VEGF concentration and the number of affected coronary basins ($r=0.84$, $p<0.01$), as

well as an average positive relationship between ET-1 concentration and the number of affected basins ($r=0.68$, $p<0.01$) and between ET-1 concentration and VEGF concentration ($r=0.68$, $p<0.01$).

Table 2

Structural and functional state of the endothelium in patients with coronary artery disease and healthy individuals

Index	КГ (n=20)	ИБС (n=108)
VEGF, пг/мл	76,45±10,90	848,09±77,50***
ET-1, фмоль/л	0,22±0,02	2,27±0,15***
Arteria brachialis 0, мм	4,19±0,15	4,18±0,07
Arteria brachialis 1, мм	4,35±0,15	4,25±0,07
endothelium-dependent vasodilation, %	16,55±0,46	7,08±0,62**

Note: * - the reliability of the difference between the groups. One character – $p<0.05$, two characters - $p<0.01$, three characters - $p<0.001$.

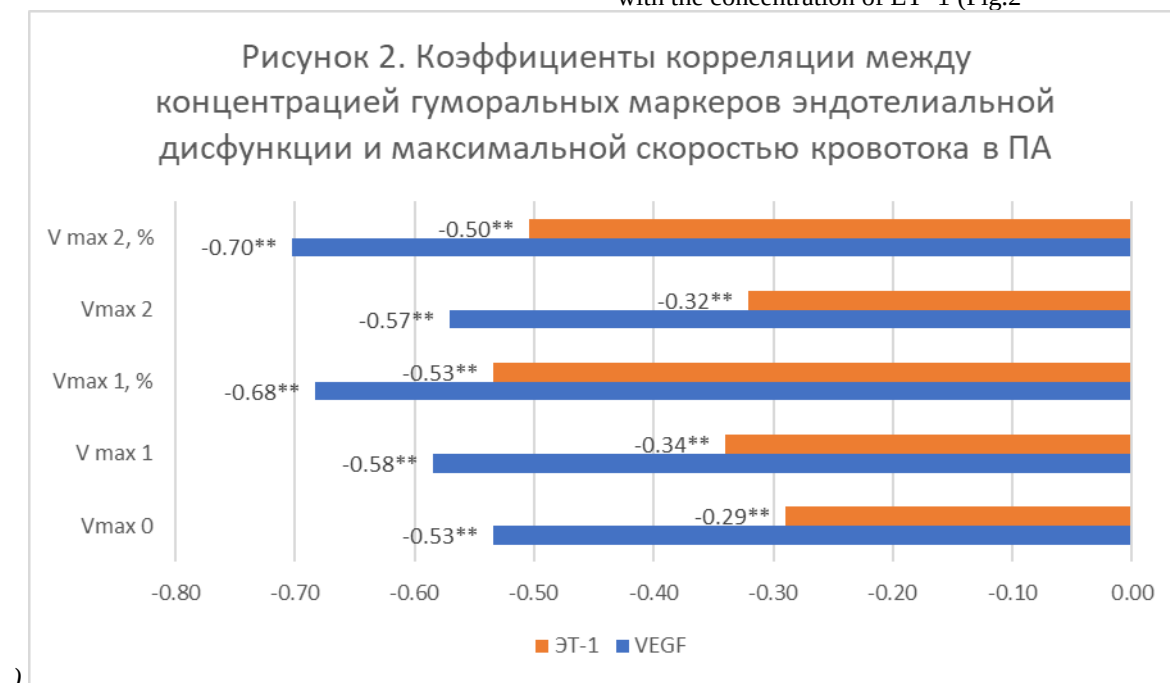
Functional vascular remodeling was also characterized by a 2.34-fold decrease in the degree of endothelium-dependent vasodilation compared with healthy individuals ($p<0.001$). In the group of patients with coronary heart disease, the majority of patients (55.55%) had insufficient ESRD (less than 10%), and 11.11% of patients had paradoxical vasoconstriction.

In patients with coronary artery disease, despite the development of endothelial dysfunction, the diameter of the PA did not differ from the diameter of the vessel in the group of healthy individuals, both initially and after 5-minute compression of the artery.

Correlation analysis showed that there is a significant negative relationship between the value of EDV and the concentration of markers of endothelial dysfunction: strong with a concentration of VEGF ($r=-0.80$, $p<0.01$) and moderate with a concentration of ET-1 ($r=-0.61$, $p<0.01$).

Analysis of the dynamics of maximum blood flow velocities in the PA revealed that at all stages of the study in patients with coronary artery disease, the maximum velocity was lower than in the group of healthy volunteers (1.21 times initially, 1.51 times on the 5th and 1.39 times on the 60th second of decompression), with a lower degree of speed increase after removal compressions: thus, the relative dynamics by the 5th second of decompression in the IHD group was 20.48±0.59% versus 51.25±3.48% in KG (dynamics 2.50 times less, $p<0.001$), by 60-1 seconds – 10.19±0.36% and 26.20±1.50%, respectively (2.57 times less, $p<0.001$).

Correlation analysis showed the presence of significant negative associations between the blood flow rate in the PA at all stages of the test with humoral markers of endothelial dysfunction, more pronounced with the concentration of VEGF and less pronounced with the concentration of ET-1 (Fig.2



Note: * - reliability of the correlation coefficient. One character – $p<0.05$, two characters – $p<0.01$.

An EchoCG study revealed that in patients with coronary heart disease, dilation of all heart chambers was noted compared with CG (Table.4): the increase in LP in patients with coronary heart disease compared with CG was 59.27%, LV – by 37.86%, RV – by 31.56% and PP – by 49.18% (the reliability of intergroup differences for all indicators is $p<0.001$). The thickness of the MBP in patients with coronary heart disease was significantly higher (by 10.72%) compared with KG ($p<0.01$), reflecting myocardial hypertrophy in response to ischemic apoptosis. The thickness of the CSF in the groups did not differ. The predominance of dilation over hypertrophy led to a significant decrease in the OTC index in patients with coronary heart disease (by 14.74%, the significance of intergroup differences was $p<0.01$). Dilation of the heart cavities was accompanied by measurement of the geometry of the cavities, as LVH in patients with coronary heart disease increased by 18.88% ($p<0.001$).

LV myocardial mass in patients with coronary artery disease was increased by 90.06% compared to KG ($p<0.001$). Thus, in the group of patients with coronary heart disease, the majority of patients (93 people – 86.11%) had LV hypertrophy (LVH, LVEF 110 g/m² or more).

LV systolic function was characterized in patients with coronary heart disease by an increase in INRS, reflecting regional contractility disorders, compared with CG (by 53.09%, $p<0.001$), as well as a decrease in total systolic function, LVEF (-14.00% relative to CG, $p<0.001$).

The systolic function of the pancreas was characterized by a decrease in the FUP index, an analogue of the RV for the pancreas, calculated by area due to the

complex geometry of the pancreatic cavity. The LVF in patients with coronary heart disease was 8.27% less than in KG ($p<0.05$).

Diastolic function revealed various variants of dysfunction in 100% of patients with coronary heart disease, while in KG diastolic dysfunction was observed only in 11 patients (10.97%, the significance of an intergroup difference in the frequency of various types of diastolic dysfunction between groups chi squared $4 \times 2 = 57.67$, $p<0.001$). Among the disorders of diastolic function, the variant of delayed relaxation prevailed.

The diastolic filling of the pancreas was also impaired in patients with coronary heart disease (59.26% of patients), while in representatives of KG the diastolic filling was normal (the reliability of the intergroup difference in the frequency of occurrence of various diastolic filling variants chi squared $2 \times 4 = 23.70$, $p<0.001$).

Impaired LV diastolic and systolic function in patients with coronary heart disease led to an increase in the average pressure in the LP cavity and in the LA system by 64.17% ($p<0.001$). In 80 patients of the CHD group (74.07%), the average pressure in the LA, determined by the ratio of acceleration time to expulsion time on the LA valve, exceeded the normal value (19 mmHg).

The study examined the Tei index, an integral index of myocardial functioning that characterizes the efficiency of the myocardium, that is, the time required for effective changes in intraventricular pressure. In patients with coronary heart disease, the Tei index was increased compared with the CG index (by 27.19% for LV, $p<0.01$, and 18.35% for RV, nd).

Table 4

Comparative characteristics of the structural and functional state of the myocardium in patients with coronary heart disease and healthy individuals

Index	КГ	Пациенты с ИБС
LA, ml/m ²	26,90±1,75	42,84±0,87**
LVI, мл/м ²	51,55±1,55	71,06±2,20*
EF LV, % (Simpson)	61,00±1,25	52,46±0,94*
LVMI, г/м ²	87,20±2,52	165,73±4,93**
TW, отн ед	0,37±0,01	0,31±0,01*
IVS, мм	9,40±0,23	10,41±0,19*
PW LVT, мм	9,55±0,20	9,61±0,12
Sphericity index, отн ед	0,54±0,07	0,64±0,01*
Regional Myocardial Contractility, балл	1,00±0,00	1,53±0,04*
Tei LV, отн ед	0,60±0,01	0,77±0,06*
срР PA, мм.рт.ст	14,85±0,27	24,38±0,68*
Tei RV, отн ед	0,63±0,01	0,75±0,06
RVI, см ² /м ²	19,70±0,54	25,91±0,70*
FC RV, %	48,40±1,53	44,40±0,63*
RAI, см ² /м ²	15,25±1,12	22,75±1,28*

Note: * - the reliability of the difference between the groups. One character – $p<0.05$, two characters - $p<0.01$, three characters - $p<0.001$.

Correlation analysis showed a significant relationship between the concentration of humoral factors of endothelial function VEGF and ET-1 and the characteristics of myocardial remodeling: a positive relationship with the volume of the chambers of the heart, LVEF,

RMC, срР LA and RVF, and a negative relationship with the thickness of the LVL, the value of TW, LVEF (Fig.2). The relationship is more reliable with a concentration of VEGF compared to ET-1 concentration.



Рисунок 3. Коэффициенты корреляции Пирсона между концентрациями гуморальных маркеров эндотелиальной функции и характеристик миокардиальной функции у больных ИБС

Note: * - reliability of the correlation coefficient. One character – $p < 0.05$, two characters – $p < 0.01$.

Thus, the results of our study showed that coronary heart disease is associated with a marked decrease in the degree of EDVD in 56% of patients, and in 11% of patients with paradoxical vasoconstriction.

It was revealed that ischemic myocardial remodeling is characterized by dilation of the heart cavities, spherical deformation of the LV cavity, thinning of the walls, an increase in LVEF and an increase in the time to achieve an effective pressure gradient between the chambers (Tei). Structural and functional remodeling of the myocardium is accompanied by a decrease in regional and global contractility of the left and right ventricles, as well as a violation of active diastolic relaxation, and the formation of postcapillary pulmonary hypertension.

In patients with coronary artery disease with myocardial remodeling, the concentration of VEGF and ET-1 is more than 10 times higher than the values typical for healthy individuals. The concentration of VEGF and ET-1 in venous blood correlates with the severity of pathological myocardial remodeling and the degree of EDV impairment.

Factors associated with LV systolic dysfunction in patients with coronary heart disease are LV remodeling and dilation, three-vessel damage to the coronary bed, VEGF concentration in venous blood above 654 pg/ml, ET-1 concentration in venous blood above 1.95 fmol/l.

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PEDAGOGICAL SCIENCES

ECTS – ONE OF THE TOOLS TO ACHIEVE SELECTED GOALS

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Abstract

The article by Polumeeva I.N. considers the issue of ECTS as motivating tool in the learning process, identify advantages and disadvantages of point rating system, indicates the need of taking into consideration personalized approach in education, draws attention to the use of feedback to achieve educational goals both by teacher and student.

Keywords: point rating system, ECTS, motivation, information transparency, feedback, educational process

The teacher and the student are the main participants in the educational process, and all other structures function to ensure a favorable effective environment, to create conditions under which both participants can achieve their goals: for teacher, it is important to transfer knowledge, and for student- to receive knowledge and apply in practice. Learning is defined as the activity of a teacher aimed at transferring knowledge, skills, and abilities; a process designed to teach students. [1, c.250] A student may have different motivations, both external and internal, and a point rating system (based on ECTS) may affect learning motivation. Today, the point rating system predicts the systematic, maximum

and motivational work of a student, as well as determines the level and quality of teaching. Information transparency increases the interest of students in more complete preparation for the upcoming control. [2, c.267]

After completing the first session, a survey was conducted among first-year university students of full-time and part-time education, and they were asked to indicate what opportunities they see for themselves in the point rating system. As a result of the survey, 76% of the participants noted that they have a positive attitude towards the ECTS system, although it has drawbacks. Figure 1 shows the percentage of opportunities that, in the opinion of students, ECTS offers.

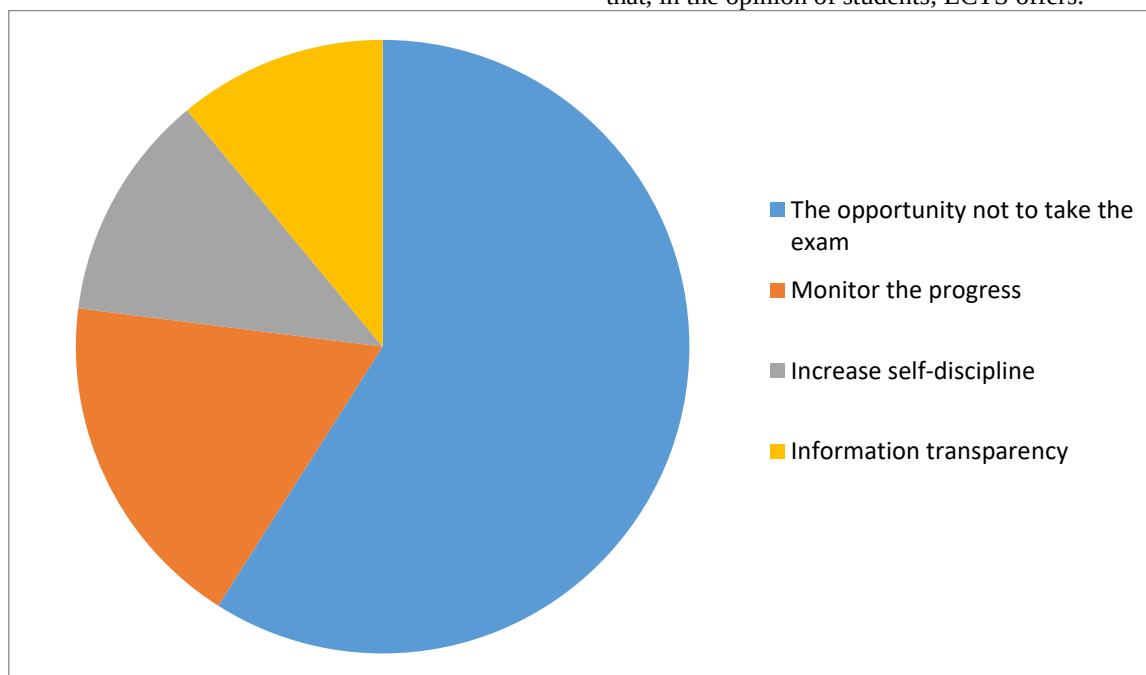


Figure 1. Capability of the ECTS system

Thus, 59% of respondents noted the possibility of not taking an exam or a test if they receive the required number of points during the semester, 18% believe that the system makes it possible to monitor progress in the study of disciplines. For 12%, it is important to increase the self-discipline, for example, while meeting deadlines for assignments and teacher requirements, to get a high score for good work, and 11% chose the information transparency of the system.

Having gained experience in the distribution of points and ratings by teachers, students were able to assess the advantages of the point rating system and also note the disadvantages that they considered. A group of students was asked to note the advantages and disadvantages of the point rating system, the other group chose from the proposed advantages and disadvantages. We can see the results of the choice in Figures

2 and 3. Thus, Figure 2 shows the advantages of the point rating system, according to the students.

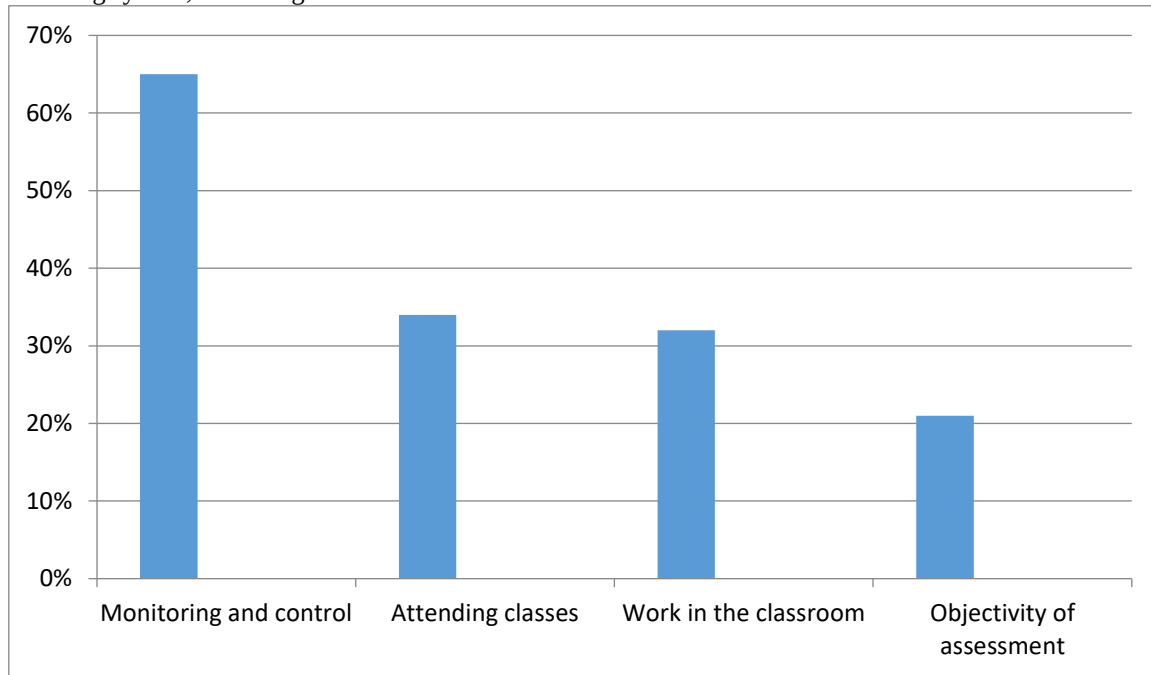


Figure 2. Advantages of point rating system

The number of points exceeds 100%, as one respondent could choose several answers. Monitoring and control were the most often chosen – 65%, with 34% of the choice coming in second place to attending classes and 32% to work in the classroom, 21% was the objectivity of the assessment. The advantages of the point rating system that stimulate motivation for learning include the following:

- systematic work in the classroom and extra-curricular activities;
- the opportunity not to take the exam / test if you have enough points;
- objectivity of the assessment;
- information transparency.

The transparency of the system makes it possible to monitor your progress, know the number of points

and approach the end of the semester with an idea of the total number of points in the disciplines before the exam or test. The point-rating system increases motivation for permanent work throughout the semester, increases student attendance and extracurricular work, makes it possible to identify difficulties in studying the discipline in a timely manner and adjust learning activities. [3, c.3] Based on individual feedback, the teacher in his/her turn can also adjust the teaching methods and pedagogical approach to a particular student, using corrective and descriptive feedback to indicate where mistakes are and identify general recommendations for improving the quality of work. [4, c.89]

The disadvantages of the point rating system, which were noted by the respondents, can be seen in Figure 3.

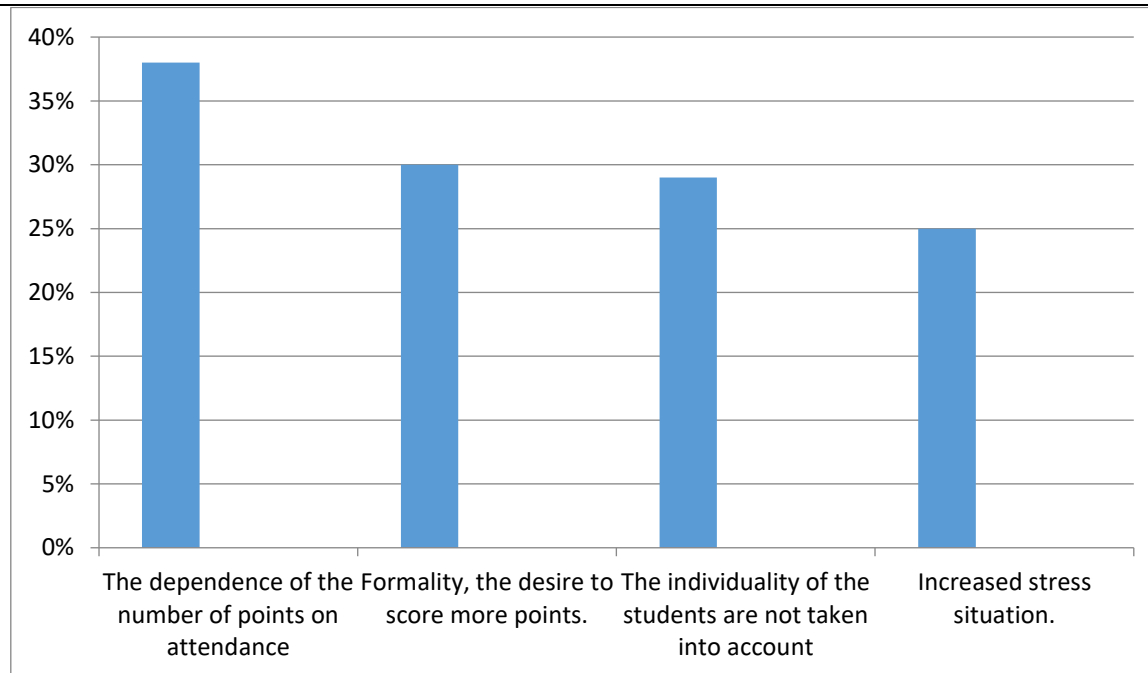


Figure 3. Disadvantages of the point rating system

The disadvantages were mainly noted by part-time students, and the dependence of points on attendance was in the first place with 38% of the choice. A student skips classes for a good reason and loses points at the same time, as well as a student who skips classes for no good reason. The desire to score more points and a formal approach to study accounted for 30% of the choice. The disadvantages also include the fact that the point rating system does not take into account the individuality of students - 29% of the choice. Constant monitoring of the number of points, the fear of missing classes and not getting points, not being able to complete work on time – all this can put students in a stressful situation - 25% of choice. The disadvantages of point rating system include:

- skipping classes reduces the student's rating;
- individuality of students and the personalized approach to learning are not taken into account;
- formality, in an effort to score points, preference is given to completing only those tasks for which points are awarded;
- constant scoring and rating monitoring increases students' anxiety levels.

To achieve the educational goals of learning, a point rating system acts as a motivational tool, allowing you to adjust learning methods based on a personalized approach. After analyzing the survey results about distribution of points and the rating of students, the following should be taken into consideration:

1. Give students who have missed classes for a good reason the opportunity to complete additional assignments.
2. Taking into account the individual and psychological characteristics of students, the teacher creates conditions under which students can realize their creativity.

3. Use the university's electronic information and educational environment to post assignments, which will enable interested parties to monitor points and ratings during the semester.

4. The point rating system should not be a system 'to get the exam by default' sometimes the desire to score more points calls into question the true goals and objectives of learning. [5, p.140]

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METHODICAL BASIS OF MODELS AND EXPLANATIONS OF TEXT-TYPE TEST TASKS USED IN THE EXIT EXAMS ORGANIZED IN THE XI GRADE ON THE AZERBAIJAN LANGUAGE SUBJECT IN COMPREHENSIVE SCHOOLS**Sadaqat S.***teacher, Azerbaijan*<https://orcid.org/0009-0006-9280-6926>**ÜMUMTƏHSİL MƏKTƏBLƏRİNDƏ AZƏRBAYCAN DİLİ FƏNNİ ÜZRƏ XI SİNİFDƏ TƏŞKİL OLUNAN BURAXILIŞ İMTAHANLARINDA İSTİFADƏ EDİLƏN MƏTN TIPLI TEST TAPŞIRIQLARI MODELƏRİ VƏ İZAHLARININ METODİKİ ƏSASLARI****Sədaqət S.***müəllim, Azərbaycan*<https://orcid.org/0009-0006-9280-6926><https://doi.org/10.5281/zenodo.15220779>**Abstract**

The article discusses the importance of correct and clearer teaching of text-type test tasks in the teaching of the Azerbaijani language in comprehensive schools for the high-level preparation of students for the XI grade final exams, as well as the formation of broad worldviews in them towards the development of rapid reading and comprehension skills. The article also highlights the methodology for explaining text-type test tasks used in the 11th grade final exams in a clearer and faster way so that students can answer them in a shorter time and in an easier way.

Xülasə

Məqalədə ümumtəhsil məktəblərində Azərbaycan dili fənninin tədrisində mətn tipli test tapşırıqlarının düzgün və daha aydın öyrədilməsinin təhsilalanların həm XI sinif üzrə buraxılış imtahanlarına yüksək səviyyədə hazırlanmalarına, həm də onlarda sürətli oxuyub-anlama bacarıqlarının inkişaf etdirilməsi istiqamətində geniş dünyagörüşlərinin formalaşdırılmasının mühüm əhəmiyyətindən bəhs edilir. Həmçinin məqalədə XI sinif buraxılış imtahanlarında istifadə edilən mətn tipli test tapşırıqlarının şagirdlər tərəfindən daha qısa vaxt ərzində asan üsullarla cavablandırılması üçün daha aydın və sürətli təhlil üzrə izah metodikası ön plana çəkilmişdir.

Keywords: innovative learning, plan, thesis, image, fact, premise, creative thinking, critical thinking.

Açar sözlər: innovativ təlim, plan, tezis, obraz, fakt, müddəa, yaradıcı təfəkkür, tənqidi təfəkkür.

Aparığımız araşdırmalara əsasən deyə bilərik ki, təhsil dəyişdikcə, tədrisin əsas nüvəsi olan dərslin xarakteri və bununla yanaşı imtahanlarda istifadə olunan sual tiplərinin məzmunu da dəyişir və yenilənir. Fənn kurikulumlarında məzmun standartlarının bilik və bacarıqlar formasında verilməsi şagirdlərin hərtərəfli inkişaf etdirilməsinə, onların gələcəyin qurucuları kimi yetişmələrinə imkan verir. Lakin bu prosesin səmərəli olması üçün Azərbaycan dilinin tədrisi müasir tələblərə uyğun qurulmalı, hər bir tədris vahidinə uyğun hazırlanan mətn tipli imtahan suallarına uyğun düzgün izah metodikası müəyyənəşdirilməlidir.

Innovativ texnikalarının tətbiqi ilə reallaşdırılan buraxılış imtahanlarında istifadə edilən mətn tipli test tapşırıqlarının şagirdlər tərəfindən daha aydın mənimsənilməsi və daha qısa vaxt ərzində düzgün cavablandırılması metodikası ümumtəhsil məktəblərinin məhz aşağı siniflərdən formalaşdırılmalıdır. Müəllim tərəfindən mətn tipli tapşırıqların tədris olunan mövzuya uyğun metodlar əsasında düzgün müəyyən edilməsinə, eləcə də, şagirdlər tərəfindən bu tapşırıqların əməkdaşlıq çərçivəsində maksimum hansı səviyyədə düzgün və ya vaxtında yerinə yetirilməsi nəzarət edilməlidir. Ümumtəhsil məktəblərində Azərbaycan dili fənninin tədrisində mətn tipli test tapşırıqlarının düzgün öyrədilməsi metodikası təhsilalanların həm XI sinif üzrə buraxılış imtahanlarına yüksək səviyyədə

hazırlanmalarına, həm də şagirdlər də geniş dünyagörüşünün formalaşdırılmasında mühüm əhəmiyyət kəsb edir.

Mətn tipli test tapşırıqlarının düzgün seçilməsi şagirdlərin məntiqi, tənqidi və yaradıcı təfəkkürlərinin formalaşdırılmasında mühüm əhəmiyyət kəsb edir. Mətn tipli test tapşırıqlarının düzgün izah edilmə texnikası şagirdlərin mövzu ilə əlaqədar bu tapşırıqları müstəqil və qısa zaman ərzində yerinə yetirmələrinə şərait yaratmaqla yanaşı onlarda özünü tənqid, özünü qiymətləndirmə, özünə nəzarət kimi şəxsi keyfiyyətlərin də yüksək səviyyədə formalaşdırılmasına şərait yaradır.

➤ Plan- bir işin hazırlanması üçün əvvəlcədən düşünülmüş, ardıcıl surətdə həyata keçirilən tədbirlər sistemidir. Mətnin planının hazırlanmasını tələb edən sual tipində şagird əsas hadisələri yarımbaşlıqlar şəklində ifadə etməlidir.

Nümunə sual 1: X sinif Azərbaycan dili dərslində verilmiş "Vətən torpaq, Vətən eldir, Vətən!!!" mətnini əhatə edən üç bəndlik plan qurun.

İzah: Şagird plan tərtib edərkən ardıcılığa mütləq əməl etməlidir. Şagird mətnin tərkib hissələrinə yarımbaşlıqlar- söz birləşmələri ilə cavablandırmalıdır. İstinad edilən mətn nümunəsi əsasında plan quraq:

1. Vətənin haradan başlanması
2. Vətənə olan borcumuz
3. Basılmaz qala- Vətən

➤ Mətn tapşırıqları arasında geniş yayılmış sual tiplərindən biri də mətdə obrazların xarakterik xüsusiyyətlərinin müəyyənəşdirilməsidir.

Nümunə sual 2: VII sinif Azərbaycan dili dərslərində verilmiş “Mübariz” mətninə əsasən obrazın ən azı iki xarakterik xüsusiyyətini qeyd edin.

İzah: Xarakterik xüsusiyyət bir şəxsi və ya bir şeyi digərlərindən fərqləndirən xüsusiyyətdir. Şagird bu tipli suallarda obrazın əməllərini deyil, həmin obrazın özünəməxsus xarakterini isim, sifət, yaxud feili sifətlərlə ifadə etməyi bacarmalıdır. Qeyd edilən mətnə istinadən şagird Mübarizin vətənpərvər, cəsarətli, qətiyyətli olduğunu müəyyən edərək tapşırığı düzgün şəkildə cavablandırma bilər.

➤ Mətn tapşırıqları arasında şagirdlərin çətinlik çəkdiyi sual tiplərindən biri də tezis qurulmasıdır. İlk öncə qeyd edək ki, tezis geniş mülahizənin qısa izahı, doğruluğu sübut edilməli olan müddədir. Tezis termini müxtəlif sahələrdə fərqli mənalarda istifadə oluna bilər, lakin ümumilikdə o, müəyyən bir iddianı və ya fikri qısa, konkret şəkildə ifadə edən bir cümlə və ya fikirlər toplusudur. Buraxılış imtahanlarında mətnə əsasən tezis müəyyən edilməsi qəbul imtahanlarında tezislə bağlı qarşıya çıxacaq əsas sual tipidir. Şagird tezis anlayışını tam mənimsəmək üçün bu məqamlara diqqət etməlidir:

1. Tezis mətndən götürülmüş faktlarla sübut edilməlidir;

2. Tezis mətdə irəli sürülən əsas müddəaları özündə əks etdirməlidir;

3. Tezis mətndən başa düşülən fikrin bir-iki cümlə formasında ifadə edilməsidir.

Nümunə sual 3: Mirzə Hüseyn Qayıbzadə Qori Müəllimlər Seminariyasında Azərbaycan dili və şəriət müəllimi vəzifəsinə təyin edilmişdi. O, şəriət qanunlarının çox güclü olduğu bir dövrdə azərbaycanlıların dünyəvi təhsil alması yolunda böyük xitmətlər göstərmiş, Azərbaycan təhsili tarixində silinməz izlər qoymuşdur.

Verilmiş nümunə əsasında tezis yazın.

İzah: Tezis yazarkən şagird ilkin olaraq mətdə olan fakta istinad etməli, daha sonra özü oxucu kimi müddəə irəli sürməlidir. Qeyd edilən nümunəyə əsasən şagird yazmalıdır:

- Müddəə: Mirzə Hüseyn Qayıbzadə pədaqoji fəaliyyətlə məşğul olmuşdur. (Şagird müddəanı özü irəli sürməlidir)

- Fakt: Mirzə Hüseyn Qayıbzadə Qori Müəllimlər Seminariyasında Azərbaycan dili və şəriət müəllimi vəzifəsinə təyin edilmişdi. (Şagird mətnə istinad etməlidir)

Beləliklə, ümumtəhsil məktəblərində Azərbaycan dilinə aid mövzuların tədrisində mətn tipli test tapşırıqlarının düzgün izah edilməsi metodikası şagirdlərin aktiv idrak fəaliyyətlərinin, məntiqi, tənqidi və yaradıcı təfəkkürlərinin inkişaf etdirilməsi ilə yanaşı həmçinin əldə etdikləri yeni biliklərinin buraxılış imtahanlarında mətn tipli tapşırıqlarına daha asan üsullarla qısa vaxt ərzində düzgün tətbiq etmə bacarıqlarının inkişaf etdirilməsində müstəsna əhəmiyyət kəsb edir.

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METHODOLOGY OF CULTIVATING HUMANISTIC QUALITY EDUCATION IN VOCATIONAL COLLEGES

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Abstract

Vocational colleges annually supply a large number of high-quality skilled talents to society. In the context of rapid social and economic development, these institutions have made significant contributions to social progress with their unique characteristics and nature. Gradually, they have entered public view and gained recognition from all sectors of society, creating a favorable situation where they occupy half of higher education, holding a very important position in China's higher education system. Therefore, strengthening humanistic quality education in vocational colleges and cultivating students' humanistic spirit has become an essential prerequisite and foundation for their future development. Based on this, in-depth analysis and research are conducted on methods and strategies for nurturing humanistic spirit in vocational colleges, aiming to better promote their positive development.

Keywords: higher vocational colleges; humanistic quality education

Introduction

In the context of the rapid development of contemporary vocational education, higher vocational colleges, as important grounds for cultivating high-quality technical and skilled talents, not only need to focus on enhancing students' professional abilities but also emphasize the deepening and expansion of humanistic quality education. (Zhong Binglin, 1999) Humanistic quality education is crucial for the all-round development of students, serving as a key link in shaping their values, perfecting their personalities, and cultivating their social adaptability. However, there is a widespread tendency in current higher vocational education to prioritize skills over humanities, leading some students to lack cultural depth, innovative thinking, and professional ethics, making it difficult for them to meet the future society's demand for versatile talents. (He Kekang, 2015)

In this context, exploring the scientific methodology of humanities quality education in higher vocational colleges is of great significance. Methodological research not only needs to take into account the characteristics of vocational education but should also be grounded in the laws of student development. Through multiple pathways such as optimizing the curriculum system, immersing students in campus culture, and empowering practical activities, a distinctive model of humanities quality education for higher vocational colleges can be constructed (Shi Mingyan, 2011). At the same time, driven by digitalization and industrial transformation, methods of humanities quality education must also continuously innovate. They need to both inherit classics and integrate contemporary spirit, ultimately achieving coordinated development between technical skills and humanistic qualities, laying a solid foundation for students' lifelong growth (Hu Lian, 2008).

This paper aims to systematically analyze the practical difficulties of humanistic quality education in higher vocational colleges, put forward feasible principles,

paths and methods of training, and provide theoretical reference and practical reference for higher vocational education to realize the fundamental task of "establishing virtue and cultivating people".

1. The significance of implementing humanistic quality education in higher vocational colleges

Nowadays, with the rapid development of economy and increasingly fierce market competition, there are more and more high requirements for students in higher vocational colleges. Employers not only need employees to master skills and professional knowledge, but also require them to have humanistic quality and good psychological quality.

1.1 The rapid development of higher vocational education highlights the role of humanistic quality education

In recent years, China's economy has been developing at an increasingly rapid pace, requiring more and more talent. The cultural education level of students in higher vocational colleges is generally lower compared to that of undergraduate students. However, most higher vocational colleges prioritize employment as their primary "selling point" to expand their scale, neglecting the cultivation of students' humanistic qualities. As a result, while many higher vocational students possess strong technical skills, they lack a sense of humanistic spirit. Some students engage in littering and verbal abuse, and some even harbor negative psychological tendencies that harm society. Therefore, only by emphasizing humanistic quality education can higher vocational colleges foster well-rounded individuals with comprehensive high-quality attributes.

1.2 The strong demand for talent education in social work

The rapid economic development has intensified market competition, making an already saturated market even tighter. This has made the already challenging job market even more severe. The current employment environment is complex and places high demands on college graduates. Not only do they need professional

skills, but also good moral qualities. A lack of humanities education can lead to difficulties for students in future employment and life. Therefore, to change this situation, it is essential to place greater emphasis on students' humanities education and help them develop comprehensive vocational abilities.

1.3 Humanities education is indispensable in the structure of modern talents

Humanistic quality education can enhance students' humanistic literacy and spirit, strengthen their sense of mission and responsibility, and improve their creativity and innovative awareness. The most fundamental aspect of humanistic quality is cultural literacy. Teachers in vocational colleges cultivate students' cultural literacy through humanistic education, changing the previous emphasis on education over moral education and breaking the bad habit of focusing solely on technical skills while neglecting overall quality. Therefore, strengthening humanistic quality education is crucial.

2. Problems and causes of humanistic quality education in higher vocational colleges

2.1 Problems existing in the humanistic quality education of students in higher vocational colleges

1. Lack of action plan

In the humanistic quality education of higher vocational colleges, the Ministry of Education has provided relatively clear guidelines. However, in terms of implementation from macro to micro levels, higher vocational colleges lack specific recommendations and are insufficiently innovative, leading to a lack of action-oriented planning in the process of humanistic quality education. This is specifically manifested in: no fixed schedule for teaching time planning, and a lack of a sound system in course design.

2. The overall system of the course design

individual level	The group level	social aspect
The concrete expression of aesthetic taste	The paradigm innovation of academic community	The reproduction of cultural space
Poetic reconstruction of lifestyle	Construction of campus cultural symbol system	Ethical turn of public cultural policy
The value consciousness of professional behavior	Living inheritance of intangible cultural heritage	Cultural governance in the digital age

System linkage mechanism: the three forms a spiral upward structure of "knowledge input-value transformation-practice output":

1. Cognitive iteration: Dunhuang mural copying (knowledge) -> reconstruction of artistic aesthetic standards (quality) -> global communication of Digital Dunhuang (form)

2. Value feedback: community poetry festival (form) stimulates people's enthusiasm for reading classics (knowledge), and forms cultural confidence (quality)

This three-dimensional system not only responds to the symptoms of the era of the expansion of instru-

In the humanistic quality education of higher vocational colleges, the content mainly includes the transmission of humanistic knowledge, the cultivation of humanistic literacy, and the shaping of humanistic forms. These three aspects are not only complete processes but also progressive ones. However, at present, most higher vocational colleges only achieve the first stage in educating students' humanistic qualities, while the cultivation of humanistic literacy and the shaping of humanistic forms are either neglected or barely addressed.

The content system of humanistic quality education can be systematically divided into the following three dimensions, which are interrelated and progressive:

(1) Humanities knowledge transmission (cognitive foundation)

Core positioning: to build a framework of humanistic cognition with systematic knowledge, and form cultural memory and ideological coordinates.

Content category: Interdisciplinary knowledge map: general education covering literature, art, history, religion, ethics and other fields

(2) Cultivation of humanistic literacy (value internalization)

Core mission: to transform knowledge into stable value judgment and spiritual character, and build a subjectivity of human personality.

Practice carrier: Academy system and tutor system: the transmission of values through the community of teachers and students

Service learning project: cultivating social responsibility in community oral history collection.

(3) Humanistic form shaping (practical externalization)

The ultimate goal is to transform inner qualities into observable cultural practices and build a benign interaction between individuals and society.

Performance dimension:

mental rationality, but also provides a humanistic solution for the construction of "warm technology civilization".

3. The implementation of humanistic quality education is poor

In some higher vocational colleges, school leaders do not elevate humanistic quality education to a high enough level and pay less attention to it. As a result, humanistic quality education is increasingly neglected in practical teaching, leading to the decline of the status of humanistic quality education in higher vocational colleges.

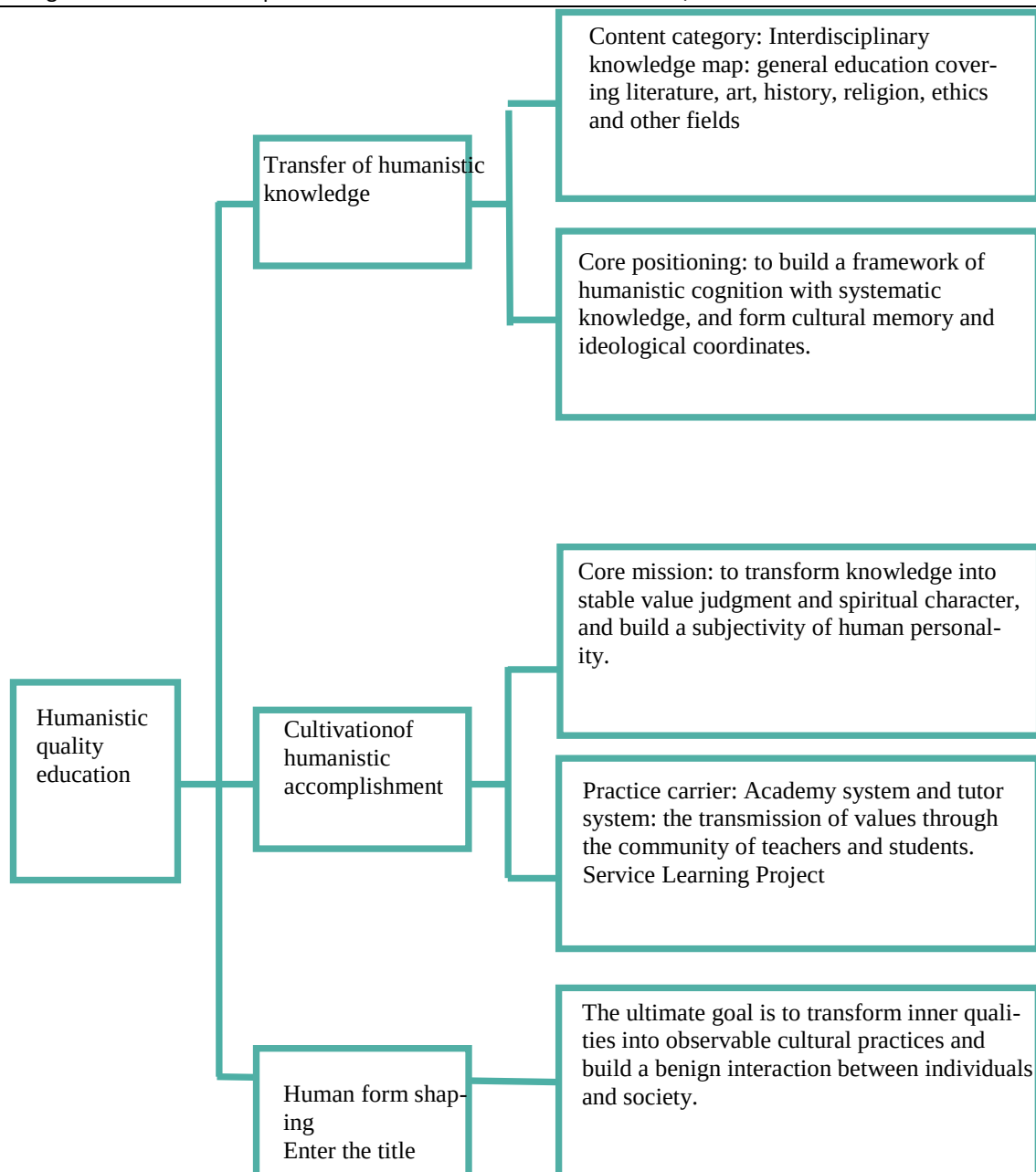


Figure 2-1 Humanities education

2.2 The reasons for the problems in students' humanistic quality

education in higher vocational colleges:

1. Wrong educational philosophy

In terms of talent training, vocational colleges often have the phenomenon of inaccurate understanding. Vocational colleges should not only cultivate students with certain abilities and relevant practical abilities, but also pay attention to cultivating students' humanistic quality, which also shows that it is essential to carry out relevant humanistic quality education.

2. Lack of educational resources

To successfully promote humanistic quality education, it is essential to have both a positive atmosphere for such education and a team of highly qualified humanistic educators. Most vocational colleges in China were established in the late 1990s. Due to their relatively short history and many having roots as local secondary vocational schools, they lack sufficient cultural

depth and historical accumulation. This makes it difficult to cultivate a team of high-quality humanistic educators, leading to the current shortage of such teachers in vocational colleges.

3. Imperfect education mechanism

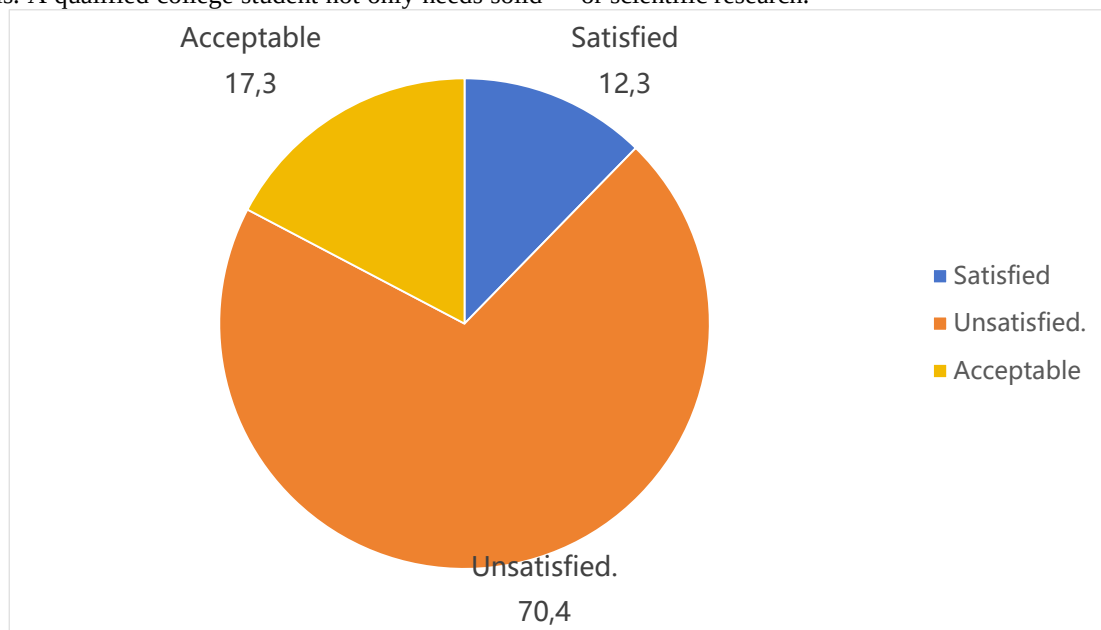
Humanistic quality education, as an indispensable part of the educational system in higher vocational colleges, should place humanistic quality education on par with technical professional education. However, in practice, it falls short of expectations. Most school activities revolve around academic affairs, and the cultivation of professional skills is given a more prominent position in the teaching system.

3. Third, ideas and measures to improve the humanistic quality education of college students

3.1 Ideas to improve the humanistic quality education of college students

A survey on the current state of college students' writing skills after entering society shows that 12.3% of all college students have decent writing abilities, while 70.4% are very dissatisfied with their writing skills. A qualified college student not only needs solid

professional knowledge but also strong humanistic qualities, and writing ability is a crucial part of these qualities. It's hard to imagine someone with poor writing skills achieving significant success in future work or scientific research.



3-1 College students' written expression ability questionnaire

The overall poor performance of college students in written expression can be attributed to multiple factors. Primarily, there is insufficient practical training due to the intense pressure of college entrance exams before enrollment. Secondly, it is closely related to the imperfect and unreasonable curriculum design and training models of higher education institutions. How to improve students' humanistic qualities, reform course instruction to better cultivate their innovative and practical abilities, has become one of the key contents of curriculum reform.

1. Reform of Required Courses. First, in response to the common weakness in Chinese language among college students, both "College Chinese" and "Basic Writing" courses are offered in the first year of all majors. Second, to enhance students' cultural literacy and innovation capabilities, elective courses and advanced courses can be added to most major curricula in higher education institutions. Elective courses are designed for students who struggle with learning, aiming to help them achieve success continuously, thereby gradually building their confidence and fostering a positive cycle of learning; Advanced courses not only assist teachers in broadening students' thinking and deepening their understanding but also primarily aim to allow students to showcase their talents and achieve greater improvement. Students have the autonomy to choose between these two types of courses, thus enhancing their choice in required courses and reflecting personalized teaching. Third, by integrating, interweaving, expanding, and adding new knowledge and methods into the textbook content, students can perceive the latest information, which stimulates their innovative awareness and cultivates their innovative spirit.

2. The setup of elective courses. Starting from the actual needs of students, we strengthen the basic content of humanistic quality education: literature, history, philosophy, and art; cultural courses both domestically and internationally. In line with the credit system requirements, students must complete 16 credits of humanistic quality education courses. All students must select 4 credits of art courses and 12 credits of humanities and social sciences courses during their undergraduate studies. In short, the rich variety of elective courses provides a broad space for students to choose teachers and courses.

3. Offer research-based learning courses. Focus on cultivating students' innovative spirit and practical abilities, aiming to develop their character and enhance their adaptability to society. Specific measures include: organizing research activities with different content for various subjects, guiding students in exploratory research to foster their awareness, habits, and attitudes towards scientific research, and teaching them how to conduct research methods.

3.2 Measures to improve the humanistic quality education of college students

1. Continuously explore in teaching design philosophy, emphasizing the cultivation of students' divergent thinking. An important task of teaching design is to bridge the gap between students' book world and real life through the processual, explicit, typical, intuitive, practical, and lifelike nature of teaching content. This facilitates interaction between knowledge and cognition, as well as between individuals and their environment, thereby activating static knowledge and maximizing its effectiveness. Secondly, fully liberate both students and teachers—teachers must design questions and provide guidance with selectivity, openness, and inspiration, addressing issues such as narrow, closed,

and uniform teaching approaches. This provides ample space for students to question, think independently, and imagine freely. Therefore, teachers must prioritize the cultivation of divergent thinking in humanities courses.

Traditional education emphasizes convergent thinking (also known as focused thinking, consensus-seeking thinking, or positive thinking) while neglecting divergent thinking (also known as creative thinking, reverse thinking, or multi-directional thinking). This has deep roots in educational philosophy. The traditional teaching model centers on the teacher, emphasizing one-way knowledge transmission from the teacher to students, treating them as passive recipients of information. The goal is to cultivate students into application-oriented talents who can effectively understand, digest, and apply previous knowledge and experience (but not adept at creating new theories or knowledge). Under this educational philosophy, understanding and assimilating the basic theories and concepts of a subject, as well as comprehending and internalizing what the teacher imparts, becomes the highest requirement and ultimate objective of teaching. Students' ideas and their understanding of all issues must be concentrated and unified within the theoretical framework and fundamental concepts of the discipline. This is precisely the goal that convergent thinking aims to achieve.

Aggregative thinking, due to its requirement that both the content and outcomes of thought be concentrated and unified under traditional concepts or existing ideas, has the advantage of facilitating the transmission of disciplinary knowledge and the mastery of predecessors' knowledge and experience. However, its drawback is that it can easily lead students to believe in textbooks, teachers, and authority, assuming everything in books is classic and everything taught by teachers is truth, without daring to raise any doubts. Therefore, focusing solely on aggregative thinking will keep our understanding at the level of predecessors, making it impossible to generate new theories or new ideas. To innovate, divergent thinking must be emphasized; without divergent thinking, there can be no creative sprout or creative achievement. It can be said that all creation originates from divergent thinking.

2. In the content of instructional design, emphasize key points and focus on cultivating students' innovative spirit and intuitive thinking. Teaching is both a science and an art. Superior teaching skills first manifest in teachers clearly defining the goal of developing students' intelligence: stimulating thought through questioning to promote moderate intellectual activity, fostering the depth, flexibility, and uniqueness of students' thinking. Secondly, teachers should engage all senses—seeing, listening, speaking, moving, and touching—to fully involve students in both hemispheric coordination activities, thereby cultivating their innovative thinking abilities. Thirdly, highlight the importance of guiding students' thinking processes. Teachers should demonstrate their insights based on key and difficult issues, not only helping students understand knowledge but also learning the methods and approaches used in lectures. Teachers should also pay attention to identifying students' moments of insight—timely praising, encouraging, and affirming innovative

ideas and methods—and provide opportunities for self-exploration, self-reflection, and self-creation. This is crucial for developing a scientific learning attitude. Finally, teachers should leave room for imagination, inspiring students to engage in rich and full imagination, enhancing their interest in learning and fostering positive emotions, willpower, and character. In summary, teachers must not only focus on developing students' analytical and reasoning skills but also train them in the thinking patterns needed for innovative activities, using known knowledge to explore unknowns and discover new ideas and rules.

3. Break through the teaching mode of teaching-oriented and establish a new classroom teaching mode

The new classroom teaching mode should inherit and carry forward the advantages of the traditional teaching mode, make up for its shortcomings, reconstruct and design on the basis of the new idea of quality education. It should have the following characteristics:

(1) Establish a multilateral interactive teaching mechanism with students as the main body. The establishment of a new type of classroom teaching model should first consider the status and interrelationships among various elements in the basic teaching process (teachers, students, content). According to traditional educational views, the teaching process consists of two aspects: "teaching" and "learning," with teachers being the main body of "teaching" and students being the main body of "learning." This has established the concept of "dual-subjectivity." However, the perspective of quality-oriented education holds that there is only one purpose of education—comprehensively fostering and enhancing the qualities of those being educated. Therefore, "teaching" and "learning" are inherently integrated, with "teaching" existing because of "learning." After the student's primary position is established, various relationships between teachers and students, among teachers, between teachers and textbooks, between students and textbooks, as well as among students themselves, will sequentially form a network structure. Once this subject-oriented multilateral interactive mechanism is established, it provides more options for teaching practice.

(2) Enhance the diversity and complementarity of teaching methods. The holistic view of quality education dictates that the complexity and variability of the teaching process impose higher demands on classroom instruction. Focusing solely on one type or category of teaching method is no longer sufficient to achieve basic educational goals; it is at least detrimental to the comprehensive development and growth of students' overall qualities. Therefore, we can explore humanistic interactive classroom teaching models primarily based on "cooperative," "communicative," and "discussion" learning methods. Each teaching method has its own strengths and weaknesses, and only through flexible integration and mutual reinforcement can we adapt to new circumstances. We should also increase efforts in inspiration, research, and independent learning, shifting the focus of teaching towards student-centered approaches.

CONCLUSION

In summary, only when students themselves recognize the importance of humanistic spirit can they, under effective external conditions and proper guidance from teachers, truly integrate humanistic spirit with their personal qualities. They can then gain insight into the essence of China's excellent traditional culture, thereby enriching their character and knowledge base.

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FORMATION OF FOREIGN LANGUAGE COMMUNICATIVE COMPETENCE IN PRIMARY SCHOOL STUDENTS

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Abstract

This article examines the features of developing foreign language communicative competence in primary school students. Special attention is given to the importance of early foreign language learning, the significance of cognitive and social aspects of education, and the methods that contribute to effective language acquisition. Modern pedagogical technologies are considered, including game-based methods, multimedia resources, and the principles of embodied learning. The article analyzes the challenges associated with teaching a foreign language at the primary level and proposes possible solutions.

Keywords: foreign language, communicative competence, primary school, game-based methods, multimedia technologies, embodied learning, cognitive development.

The development of foreign language communicative competence in primary school students is a crucial task in modern pedagogy, as this stage is critical for shaping children's linguistic abilities. In today's world, where knowledge of foreign languages provides access to international communication, education, and career opportunities, early language learning has become a priority in many countries' educational systems. The primary school years (ages 6 to 10) represent a period of high cognitive plasticity, making children particularly receptive to acquiring new language material. Research in cognitive psychology confirms that at this age, children adapt more easily to new linguistic systems due to their strong imitative abilities, high memory retention, and lack of fear of making mistakes [2]. Additionally, early phonetic development helps children acquire more natural pronunciation, making language learning especially effective during this period.

However, teaching foreign languages in primary school presents several challenges. Traditional teaching methods, which rely on memorizing grammatical rules and vocabulary lists, do not always align with the cognitive and emotional characteristics of young learners. Due to their developmental stage, children do not perceive language as a set of rules but rather acquire it through natural communication. Therefore, foreign language instruction in primary school should incorporate play-based learning, elements of the communicative approach, and multimedia technologies that engage students in the learning process through active interaction. In recent years, there has been growing interest in methods that immerse children in the language environment. These methods include communicative techniques, project-based learning, theatrical performances, and

embodied learning strategies that connect language acquisition with movement and sensory experiences. Studies suggest that such methods not only enhance motivation for language learning but also help develop strong communicative skills. Thus, the relevance of this study lies in the need to identify effective approaches to foreign language education in primary schools. This article examines key aspects of developing foreign language communicative competence, analyzes modern pedagogical technologies, and proposes solutions to existing challenges in teaching young learners foreign languages.

According to the Critical Period Hypothesis proposed by Lenneberg [5], children acquire phonetics, vocabulary, and grammatical structures more effectively at an early age. During this period, the brain exhibits greater neural plasticity, enabling children to absorb language naturally, much like they acquire their first language. This phase not only lays the foundation for linguistic competence but also contributes to the development of intercultural awareness, which plays a crucial role in future socialization and academic success. Early exposure to a foreign language fosters an intuitive understanding of linguistic structures, pronunciation, and even cultural nuances, helping children develop a more authentic accent and deeper linguistic proficiency compared to those who start learning later in life. Furthermore, research indicates that early foreign language acquisition positively influences various cognitive functions, including memory, attention, and analytical thinking [4]. Studies have shown that bilingual or multilingual children demonstrate greater cognitive flexibility, problem-solving skills, and an enhanced ability to switch between tasks. Learning a second language strengthens neural connections and improves executive functioning, which benefits overall intellectual

development. Additionally, early exposure to multiple languages has been linked to improved creativity, higher adaptability in learning new concepts, and even a delay in age-related cognitive decline later in life. Another important aspect of early foreign language learning is its impact on academic performance. Research suggests that children who study foreign languages from a young age tend to perform better in subjects such as mathematics, reading comprehension, and critical thinking. The mental discipline required to learn and differentiate between multiple languages enhances overall learning strategies, helping students become more effective learners in general. Moreover, multilingual individuals often exhibit superior problem-solving skills, as they are accustomed to processing and analyzing information from different linguistic and cultural perspectives.

In addition to cognitive benefits, early language learning also enhances social and emotional development. Exposure to different languages and cultures at an early stage fosters empathy, cultural tolerance, and a broader worldview. Children who learn foreign languages early tend to be more open-minded, adaptable, and confident in cross-cultural communication. This not only prepares them for global citizenship but also gives them a competitive advantage in an increasingly interconnected world. Given these numerous advantages, integrating foreign language education into early childhood curricula is essential for maximizing children's linguistic potential and cognitive development. The next section will explore effective teaching strategies for fostering foreign language communicative competence in primary school students.

Key Approaches to Developing Foreign Language Communicative Competence. Developing foreign language communicative competence in primary school students requires a diverse set of teaching strategies that align with children's cognitive and social development. Effective methodologies must engage students in interactive, meaningful, and engaging activities that promote natural language acquisition. This section explores three key approaches: game-based learning, embodied learning, and multimedia-assisted instruction, all of which contribute to creating a dynamic and immersive language-learning environment.

Game-based learning is a highly effective tool for fostering communicative skills among young learners. It creates an engaging, low-stress environment where students can practice the target language naturally. Role-playing activities, songs, rhymes, and interactive tasks help build an immersive language atmosphere and reduce language anxiety, making learning more enjoyable and effective. One widely recognized method is Total Physical Response (TPR), developed by James Asher [1]. TPR combines language learning with physical movement, requiring students to perform actions in response to verbal commands given in the target language. This method enhances vocabulary retention and reinforces grammatical structures by linking verbal input with motor responses. Because children are naturally active learners, integrating movement helps reinforce learning through multiple sensory channels, ultimately leading to stronger long-term retention. In

addition to TPR, other play-based strategies such as storytelling games, interactive group challenges, and board games can encourage spontaneous speech production. For instance, role-playing games allow students to assume different identities and engage in meaningful dialogues, helping them develop confidence and fluency in a relaxed, supportive setting.

Embodied learning refers to the integration of physical activities into the language-learning process. Research suggests that movement-based learning enhances memory retention, engagement, and cognitive flexibility. This approach is based on the idea that cognition is deeply connected to sensory and motor experiences, making physical interaction with language a crucial component of effective learning. Incorporating gestures and physical actions into foreign language instruction allows students to associate words with real-world experiences, leading to deeper comprehension. For example, using hand gestures to illustrate meanings of words, mimicking actions while learning new verbs, or enacting short dialogues with movement-based cues can make abstract linguistic concepts more tangible. Another innovative application of embodied learning is language quests, where students move around the classroom or school environment in search of answers to questions in the target language. These activities encourage active participation, collaborative learning, and practical application of language skills in real-world contexts. Additionally, incorporating dance, music, and drama into language lessons fosters an immersive experience. For example, using dramatization and storytelling not only enhances vocabulary acquisition but also promotes emotional engagement, helping learners form meaningful connections with the language.

Advancements in educational technology have transformed foreign language teaching, providing interactive, multimodal, and adaptive learning opportunities. Multimedia tools cater to different learning styles by incorporating audio, video, text, and interactive elements, aligning with the principles of multimodal learning theory [3]. These tools create a rich linguistic environment where students can practice listening, speaking, reading, and writing skills in an integrated manner. One of the most effective ways to use technology in language learning is through educational applications and digital platforms. Programs such as Duolingo, Kahoot!, and Quizlet offer game-based exercises that reinforce vocabulary, grammar, and pronunciation in an engaging format. Additionally, language-learning apps often use adaptive learning algorithms, personalizing content based on individual student progress. Interactive smart boards and digital storytelling platforms also enhance the learning experience. Teachers can use multimedia presentations, animated stories, and interactive quizzes to make lessons more visually and aurally stimulating. Virtual reality (VR) and augmented reality (AR) tools further enhance engagement by allowing students to experience real-life language immersion without leaving the classroom. Furthermore, online communication tools such as video conferencing and collaborative digital projects connect students with native speakers and peers from different countries. Virtual

pen-pal programs and online discussion forums provide authentic communicative experiences, helping students develop cultural awareness and real-world conversational skills. The development of communicative competence in young learners requires a multi-faceted, interactive, and student-centered approach. Game-based learning, embodied learning, and multimedia-assisted instruction all contribute to a stimulating and immersive language-learning environment. By integrating these methods, educators can create a more natural and effective foreign language learning process, fostering greater fluency, motivation, and cognitive development in primary school students.

While early foreign language learning offers numerous benefits, its successful implementation in primary education is often accompanied by several challenges. These challenges stem from pedagogical, institutional, and socio-cultural factors, which can hinder the effective development of communicative competence in young learners. One of the primary difficulties in foreign language acquisition for young learners is the limited exposure to real-life language use. In non-English-speaking environments (or any other foreign language being taught), children often lack opportunities for authentic language interaction outside the classroom. Since language learning is a social and interactive process, immersion and frequent practice are crucial for achieving fluency. However, in many educational settings, students only engage with the foreign language for a few hours per week, which is insufficient for developing strong communicative skills. Research suggests that language acquisition is most effective when learners are constantly exposed to meaningful, context-rich input. Without real-world exposure, students may struggle with oral fluency, pronunciation, and spontaneous speech production.

Another significant challenge is the disparity in access to high-quality teaching materials and technological tools. While multimedia learning, online applications, and smart classroom technologies can significantly enhance language instruction, not all schools—especially those in rural or underfunded areas—have the necessary infrastructure. Many institutions still rely on traditional textbooks, which may not fully support communicative and interactive learning approaches. The lack of modern teaching aids, such as interactive whiteboards, digital storytelling platforms, and augmented reality applications, limits the diversity of instructional methods that can be used in the classroom. The effectiveness of foreign language instruction largely depends on the teacher's expertise in both language proficiency and modern pedagogical methodologies. Many teachers, especially in non-immersion schools, may not have sufficient training in communicative language teaching (CLT), embodied learning, or game-based methodologies. Additionally, teachers often face curriculum constraints, where rigid lesson structures and standardized assessments do not allow for creativity, student-centered activities, and interactive learning methods. For young learners, engaging and dynamic approaches—such as role-playing, task-based learning, and cross-curricular integration—are crucial for motivation and long-term retention.

By shifting towards performance-based evaluation, schools can ensure that students are not only memorizing language structures but also developing functional and spontaneous communication skills. Language learning, especially in the early years, is heavily influenced by students' motivation, confidence, and attitudes towards the target language. However, young learners may develop anxiety, fear of making mistakes, or frustration if they struggle with pronunciation or comprehension. This issue is particularly relevant in traditional classrooms, where students may feel pressured to produce correct answers rather than experiment and engage freely with the language. To create a more positive and motivating learning environment, teachers should: Foster a low-anxiety classroom atmosphere, where mistakes are seen as part of the learning process rather than failures. Integrate storytelling, humor, and play-based learning, ensuring that lessons are engaging and emotionally rewarding. Use student-centered activities, allowing children to express themselves creatively through role-play, drawing, music, and movement. Encourage personalized learning goals, where students track their own progress and celebrate their achievements. Despite the challenges associated with early foreign language learning, strategic curriculum planning, teacher training, and technological integration can significantly enhance communicative competence in young learners. By addressing the lack of language practice, resource constraints, teacher preparedness, assessment methods, and motivational barriers, educators can create a more effective, engaging, and sustainable language-learning environment. Investing in innovative methodologies and inclusive language programs will not only improve student outcomes but also contribute to the development of globally competent, multilingual individuals.

To enhance the effectiveness of foreign language instruction in primary schools, a comprehensive approach should be adopted, integrating both traditional and innovative teaching strategies. One of the key aspects is the development of communicative skills through role-playing, storytelling, and interactive games that encourage spontaneous speech production. These activities create a natural language environment, helping students to use the language in meaningful contexts rather than simply memorizing isolated vocabulary and grammar rules. Another important method is the use of gestures, movement, and visual aids to reinforce language comprehension and memory retention. Embodied learning, which connects physical actions with linguistic input, has been shown to enhance cognitive processing and long-term retention of new information. Teachers can incorporate techniques such as using hand signals for specific words, acting out verbs, or engaging students in activities that require movement to help them internalize language structures more effectively. Integrating digital technologies into the learning process also plays a crucial role in modern language education. Educational applications, virtual simulations, and interactive whiteboards provide students with a diverse and engaging way to practice language skills. Digital tools allow for personalized learning experiences, enabling students to progress at their own

pace while receiving instant feedback. Platforms like Duolingo, Quizlet, and Kahoot! make language practice more enjoyable, fostering motivation and sustained interest in learning. In addition to classroom-based strategies, organizing language camps and extracurricular clubs can provide students with valuable opportunities for real-life language practice. These settings encourage communication in an informal and supportive environment, helping children build fluency and confidence. Interaction with peers and exposure to authentic language use outside the classroom significantly contribute to the development of communicative competence. Research confirms that a blended approach, combining structured instruction with playful and experience-based learning, enhances student motivation and supports the development of long-term communicative competence. Additionally, fostering a positive and low-stress classroom atmosphere encourages students to take risks in language use, making learning both effective and enjoyable. By implementing a combination of these methods, educators can create a rich linguistic environment that facilitates natural language acquisition and prepares young learners for further linguistic and academic success.

The formation of foreign language communicative competence in primary school students plays a crucial role in developing their linguistic abilities, cognitive functions, and intercultural awareness. Early foreign language learning contributes to better acquisition of phonetics, grammar, and vocabulary while also positively impacting memory, attention, and analytical thinking. However, to achieve high learning efficiency, it is essential to consider children's developmental characteristics and apply modern pedagogical approaches.

Game-based methods, embodied learning, and multimedia technologies create a favorable language environment that actively engages students in the learning process. The use of role-playing games, movements, gestures, and digital tools makes foreign language acquisition more natural and productive. At the

same time, challenges such as a lack of language practice, limited resources, insufficient teacher training, and difficulties in assessing communicative skills must be addressed.

To improve teaching methodologies, a comprehensive combination of traditional and innovative approaches is necessary, including the active use of interactive methods, the establishment of language clubs and camps, and the development of assessment systems for oral communication and communicative skills. Research confirms that integrating various methods enhances student motivation, supports language development, and fosters strong communication skills in a foreign language.

Thus, the successful development of foreign language communicative competence requires flexibility, creativity, and continuous improvement of teaching strategies. Further research in language education will help develop even more effective methodologies, ensuring high-quality foreign language instruction from an early age.

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THE CONCEPTUALIZATION OF THE PERSON IN ENGLISH-LANGUAGE MEDIA DISCOURSE THROUGH LEXICAL UNITS AND FIGURATIVE LANGUAGE ELEMENTS

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Abstract

Both grammatical structures and lexical elements, including figurative language, play a significant role in the conceptualization of individuals across various genres of media discourse. The rationale for examining lexical units alongside metaphors in this chapter stems from the close interaction between these two essential linguistic tools in shaping the representation of individuals in media texts. Accordingly, the objective of this study is to identify the linguistic metaphors commonly employed in English-language news texts, to elucidate their function in the conceptualization of individuals, and to analyze the influence of metaphorical language on participants engaged in this genre of discourse.

In order to gain a deeper understanding of the function of metaphors particularly conceptual metaphors in the process of conceptualization, it is instructive to draw upon the foundational work of (Lakoff and Johnson 2003) on Conceptual Metaphor Theory, as well as the more recent extension of this theory by (Kovecses Zoltan 2020) in his *Extended Conceptual Metaphor Theory* (Cambridge University Press).

In contemporary linguistic research, metaphors are broadly categorized into conceptual and linguistic types. The seminal work “*Metaphors We Live By*” (Lakoff & Johnson, 1980) laid the groundwork for this distinction and significantly contributed to the development of cognitive linguistics. Conceptual metaphors are understood to pertain not to language itself, but to patterns of thought, whereas linguistic metaphors are the means by which these conceptual structures are expressed verbally.

Hungarian linguist Zoltán Kövecses, a prominent figure in cognitive linguistics, further elaborates on this distinction in his 2020 work *Extended Conceptual Metaphor Theory*, asserting that “conceptual metaphors can be expressed in language through linguistic metaphors” (Kovecses, 2020, pp. 2–3).

So, these theoretical frameworks provide a crucial lens through which to understand the formation of concepts and conceptual metaphors, a process that unfolds within discourse itself.

In her book *Metaphor in Discourse*, Y. Semino defines metaphor as “...an event in which something is spoken of and potentially thought of in terms of something else,” and approaches it through the lens of discourse analysis (Semino, Elena. 2008. *Metaphor in Discourse*. Cambridge: Cambridge University Press, p. 1). She explores the use of metaphor across various discourse types and genres, including artistic, political, scientific, and educational contexts. A substantial body of scholarly work has also been produced in this domain (e.g., Kennedy, Victor. 2000. “Metaphor in the News Introduction.” *Metaphor and Symbol* 15(4): 209–211, London: Routledge; Cameron, Lynne. 2003. *Metaphor in Educational Discourse*. London: Continuum; Musolff, Andreas and Jörg Zinken, eds. 2009. *Metaphor and Discourse*. Palgrave Macmillan; Molek-Kozakowska, Katarzyna. 2014. “Coercive Metaphors in News Headlines.” *Brno Studies in English* 40(1): 149–173, etc.).

In the aforementioned studies, scholars—particularly those adopting a linguistic perspective—investigate metaphors (i.e., conceptual metaphors) and linguistic metaphors across a range of discourse types and genres. To conduct such analyses more effectively and systematically, it is essential to develop clear criteria and methodological principles for identifying linguistic metaphors within discourse.

It is within this framework that the *Method for Linguistic Metaphor Identification* (MLMI) was introduced by a research group known as the Pragglejaz Group (Steen, Gerard, Aletta Dorst, Berenike Herrmann, Anna Kaal, Tina Krennmayr, and Tryntje Pasma. 2010. *Method for Linguistic Metaphor Identification*. Amsterdam: John Benjamins, 238 p.). The authors highlight the importance of closely analyzing lexical units—i.e., words and phrases—in order to identify linguistic metaphors. The first step in this method involves determining the direct or primary meaning of the lexical unit. The researchers explain: “The direct meaning is usually used in different contexts and is specific. If the lexical unit has a more basic meaning in other contexts than in a specific context, it is determined that the contextual meaning differs from the main meaning, but can be understood in comparison with it” (pp. 5–6).

It is noteworthy that the authors primarily apply their method to news discourse, which they argue is “...naturally particularly rich in metaphor” (p. 43). However, in our view, it is not only news discourse but media discourse more broadly that offers a fertile ground for metaphor analysis. Accordingly, in the following subsection, we will apply this method to examine how lexical units and linguistic metaphors jointly contribute to the conceptualization of the individual across various genres within media discourse.

Various lexical units, including words denoting a person, names of a person, profession, position, rank, scientific degree, nicknames, often act as dominant components of metaphors based on transfer (metaphor) and association (metonymy). For example, in the famous metaphor such as “Iron lady”, the dominant component is the word “lady” denoting a person and gender, and it is on the basis of the initial, that is, basic meaning of this word that the metaphor “Iron lady” is formed, referring to strong women. N. Dobric notes that metaphor forms the basis of the conceptualization of a person and is directly involved in the formation of

human names (Dobric Nicola 2010 Theory of Names and Cognitive Linguistics: The Case of the Metaphor. *Filozofija i Društvo* Vol. 21. Issue 1, 135-147). In this sense, the participation of linguistic metaphors in the conceptualization of a person in various types of discourse, including media discourse, is particularly interesting. This type of discourse can provide us with extensive and rich material for analyzing figurative language. In this regard, we will consider the role of linguistic metaphors in the conceptualization of the person in news discourse using the method presented by J. Steen and colleagues.

According to the egocentric model discussed in the previous chapter, the conceptualization of the person in discourse occurs in time and space. According to A. Mammadov and M. Mammadov, "Time, space, and person have traditionally played the role of categorical frameworks for meanings" (Mammadov Azad and Misgar Mammadov 2019 Contextualizing and conceptualizing time, space, and person in political discourse. *International Review of Pragmatics*. 11, 137-152, p. 138). They further note that "This is expressed in language because the person conceptualizes time, space, and self by expanding meaning to understanding through words and metaphorically used expressions". According to the method we use, the first step is to determine the contextual meanings of the words and expressions being analyzed. Then, "the next step is to discover the existence of a meaning that is more direct or fundamental than the contextual meaning" (17, p. 45).

The use of linguistic metaphors in the process of conceptualizing the person makes news discourse, especially headlines, not only laconic and effective, but also extremely interesting for the audience. In this respect, the use of linguistic metaphors based on similarity and comparison is very symptomatic. Consider the following news headlines broadcast on BBC television:

BBC News
OCTOBER 12, 2024

Fifth peacekeeper wounded in southern Lebanon, UN says

A UN peacekeeper has been wounded in southern Lebanon after being hit by gunfire, the UN Interim Force in Lebanon (Unifil) has said, the fifth member of the multinational force to be injured in recent days.

In a statement on Saturday, Unifil said the peacekeeper was injured at its headquarters in the southern city of Naqura on Friday night amid "ongoing military activity nearby", though added that it did not know the origin of the fire.

"He underwent surgery at our Nagoura hospital to remove the bullet and is currently stable," it said.

And:
BBC News
OCTOBER 13, 2024

A luxury hotel, a mini bar and a relentless feud between 'soccer wives'

It's a saga worthy of a soap opera, as Coleen Rooney and Rebekah Vardy's dispute returned to court.

What attracts attention in these headlines is the compound word peacekeeper formed from the words peace and keeper and the expression 'soccer wives' formed from the words soccer and wives. In the first

example, the word peace, which has no direct connection with a person, is used metaphorically by combining it with the person-conceptualizing keeper in the compound word frame thanks to the suffix *er*. Although this linguistic metaphor that conceptualizes a person is also created as a result of transfer, the person who is the source of the transfer in this headline is not explicit, but implicit. The personal pronoun *He* used in the news text following the headline acts as a metaphorical source of transfer. In the second example, the word soccer, which has no direct connection with a person, is used metaphorically by combining it with the person-conceptualizing word wives in the frame of a phrase. Unlike the first example, here the persons who are the sources of the transfer are explicitly conceptualized through personal names in the next sentence within the same headline frame. In both cases, this word and expression acquire a new contextual meaning. The following advertising text prepared by Turkish Airlines, which was broadcast on CNN, is also interesting in this respect:

CNN
Turkish Airlines
Dining Onboard

Discover the world's finest flavors with Turkish Airlines. We offer our passengers an unequaled flight experience, combining Turkish hospitality with the most exquisite tastes of the world and Turkish cuisine prepared by our Flying Chefs. Our award-winning dishes, courtesy of Turkish DO & CO, will satisfy the most discerning of palates.

The metaphorical expression Flying Chefs, which is very interesting in terms of the metaphorical conceptualization of the person, attracts attention in this advertising text. The metaphoricalization of this expression based on comparison was possible due to the fact that one of the two lexical units that formed it, Chefs, acquired a new contextual meaning (chefs flying on the plane and chefs on the ground). As a result, a very effective metaphorical expression plays a central role in this advertising discourse in terms of its impact on the audience.

Personal names and nicknames also play an important role in the conceptualization of the person in the discourse. In this regard, N. Guluzadeh notes that "The characteristic feature of these lexical elements is that many of them arise as a result of metaphor. Metaphorical names in the text, events and information from different eras and texts provide certain information and data about people. The reason for this results in a great variety of metaphorical names. They include names of historical figures, mythological characters, literary characters, etc.." (Guluzadeh Nisa NAMES AS A REPRESENTATION OF KNOWLEDGE IN ENGLISH DISCOURSE Doctor of Philosophy Dissertation Abstract, Baku 2021, 28 pp., p. 18). Let us consider the following article published in The Guardian newspaper dedicated to Mary (Mother Mary), who is considered a saint in the Christian world:

The Guardian
24 December 2024
Zeyneb Sayilgan

I grew up Muslim in a Catholic community – and Mary represented common ground

I had just finished teaching a class on “the Muslim Mary”. Many non-Muslims who attended were puzzled to find out that Muslims had a connection with Mary at all, and had no knowledge of how important she is to our belief and practice. This came as no surprise. Half of Americans report they know “not much” or “nothing at all” about Islam.

As a Muslim girl growing up in the overwhelmingly Catholic state of Rhineland-Palatinate in Germany, Mary was a constant presence in my life. Her images and statues, dotted across my city, smiled at me as I walked to school. At Christmas time, I joined with my classmates to sing songs such as *Stille Nacht, heilige Nacht*.

At home and in the mosque, I was fascinated to learn about Mary’s exceptional character, courage and devotion. She is one of the most honoured women in Islam and the Qur’an dedicates the entire chapter 19 to show her high status. She is special, not only because she was the mother of Jesus but because of her exemplary spirituality, worship and service to God.

For me and many Muslims, she remains a role model of how to cultivate moral character, trust and hope in God in times of despair. She demonstrates that in uncertainty, there is also possibility. Mary was faced with so many struggles, yet she persisted. As a young woman who experienced many obstacles because of my Muslim headscarf, Mary encouraged me not to surrender to prejudice and stereotypes. Like her, I pressed forward in finding my place in the world.

As I grew older, I continued to listen to Muslim Christmas songs with my daughters, one of whom I named Maryam – Mary’s Arabic name in the Qur’an. In naming my daughter after Mary, I prayed that she too would embody her piety and those beautiful virtues of compassion, humility, courage and hope.

Mary’s presence is visible in many parts of the Muslim world. The mihrab – the wall structure in every mosque that points in the direction of the Kaaba in Mecca, the shared focal point for Muslims in prayer – is also the name of Mary’s private sanctuary room as mentioned in the Qur’an.

Often I would take my students to Mother Mary’s House (Meryem Ana Evi), a pilgrimage site in Turkey where Muslims and Christians honour this holy figure. We would of course also visit the Hagia Sophia in Istanbul and look up at Mary, who watches over all the worshippers who enter the mosque for prayer. Out of respect to Islamic monotheism, which does not allow any images or statues, Mary’s beautiful painting is typically covered during prayer times.

Mosques in the United States take pride in naming themselves after Mary and Jesus. The Maryum Islamic Center in Maryland, the Maryam Islamic Center in Texas and the Jesus, Son of Mary mosque in New York – all point to the sacred connections between Islam and Christianity.

While getting to know more about the Christian Mary throughout my life, I have not compromised my own Muslim beliefs or glossed over those important theological differences. For Christians, Mary

remains the mother of God (Theotokos) and occupies a high position in the idea of “God made flesh”. Muslims, however, see her as the mother of the Prophet Jesus, who is fully human and not God incarnate. Her significance comes from her own traits, such as her purity and devotion. I learned to live with healthy disagreement and affirmed those unresolvable tensions.

Similarly, in exploring the Muslim portrayal of Mary, I hope that my students left my class with a richer and greater appreciation of her spiritual legacy. We all agreed about her expansive compassion and her embodiment of hope.

Christians and Muslims together make up more than half of the world’s population. I hope that we can honour Mary together in working for more mutual understanding and the betterment of our human family.

The author of the article draws attention to the respect for Mother Mary in the Islamic world. In that context, a number of expressions based on the initial or direct meaning of this person’s name are used (The Muslim Mary, Maryam- Mary’s Arabic name, Mary’s exceptional character, Mary was faced with so many struggles, Mary’s private sanctuary room, as mentioned in the Qur’an, Muslim portrayal of Mary, In naming my daughter after Mary). The article also contains metaphors formed by this person’s name together with other lexical units based on similarity or comparison: Mary was a constant presence in my life, she remains a role model, Mary’s presence is visible in many parts of the Muslim world. These metaphorical expressions arise from the contextual meanings of the corresponding lexical units.

Thus, linguistic metaphors or metaphorically used words and expressions directly participate in the conceptualization of a person in media discourse. As a result of their use, media texts are sometimes short and laconic, and sometimes stylistically diverse. The main point is that these metaphorical expressions are one of the most effective means of influencing the audience in media discourse. Linguistic metaphors participate in the process of conceptualizing a person in media discourse in harmony with lexical-grammatical means. They make this conceptualization more efficient from both pragmatic and cognitive points of view. As a result, it is revealed how various language means (lexical and grammatical units) create meaning and significance. Thus, linguistic metaphors participating in the conceptualization of a person in media discourse perform a very important function both from a pragmatic (as a means of laconicism, persuasion and influence) and cognitive (role in conceptualization) point of view.

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PHYSICAL SCIENCES

MATHEMATICAL EXPRESSION OF THE THEORY OF MULTIPHASE SYSTEMS

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Abstract

A deeper study of many biological processes occurring in the body and the metabolism of substances transported by blood is one of the urgent issues facing biophysical science. In order to study these processes in depth, the requirements imposed by the food, pharmacological and medical industries on the separation and purification of mixtures of biological particles in order to study each of their components separately are constantly increasing. Therefore, a number of special methods have recently been developed for the purification of biological substances. The most effective, simple and economically viable method for the separation and purification of biological materials is the method of uneven distribution of substances in water-polymer two-phase systems. The requirements for the purification and separation processes of biological materials force this method to be further improved. It is obvious that the results obtained for two-phase systems are also used for various purposes. Thus, the results obtained allow us to understand the mechanism of the distribution of substances in biological systems and lead to the idea of viewing a living organism as a multiphase system in equilibrium with each other. In the presented work, an attempt was made to improve the method of uneven distribution of substances in water-polymer two-phase systems and to apply this theory to multiphase systems. At the same time, a mathematical expression for multiphase systems was obtained based on the mathematical expression used for two-phase systems and obtained from experiments. Finally, the advantages of this new method were emphasized.

Keywords: Biological processes, water-polymer two-phase systems, multiphase systems, partition coefficient, non-uniform distribution method.

Introduction. The process of separating and purifying any substances, including biologically active substances themselves and their components, from mixtures is a difficult process requiring great sensitivity, and the requirements placed on this area by the food, pharmacological and medical industries are constantly increasing. The numerous methods available for the separation and purification of chemical substances are not suitable for the purification of biological substances, and biological materials, as they are easily denatured under the influence of various factors, lose their biological activity. Therefore, a number of special methods have recently been developed for the purification of biological substances. However, these methods are very complex and relatively expensive. Recently, a simple, inexpensive and effective method for the separation and purification of biological materials has been developed - the method of uneven distribution of substances in two-phase water-polymer systems. This method is based on the separation of a mixture of aqueous solutions of two polymers with different chemical properties into two phases at a certain value of the concentration of the components. At the end of the 19th century, Bayerik observed that mixtures of aqueous solutions of gelatin with aqueous solutions of both agar and starch separated into two phases at certain values of the concentration of the components. (Figure1) [1].

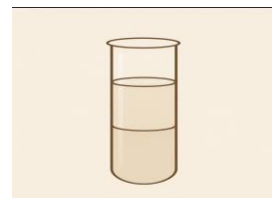


Figure 1.

This experimental fact, which remained unnoticed by experts, attracted the attention of scientists again 40 years later when studying the compatibility (or incompatibility) of polymer pairs in a common solvent. When studying phase equilibria in polymer-water systems, Dobri found that only 4 out of 35 pairs of polymers formed homogeneous solutions [6]. Studies of water-soluble polymers have shown that phase separation is a common phenomenon in such systems. It should be noted that phase separation is observed not only when two polymers are dissolved in a common solvent, but also in mixtures of solutions of one polymer with organic or inorganic salts. Polymer-water two-phase systems formed by various types of polymers were first systematically re-examined by the Swedish scientist Albertson [3,4]. Albertson's monograph showed a large number of different polymer pairs forming two-phase systems. After the publication of this monograph, it attracted the attention of biologists and biochemists, who saw that the method of uneven distribution of these substances in two-phase aqueous polymer systems would

be a highly effective method for the separation and purification of various biological materials. Note that the solvent in the phases is water and constitutes the basis of both phases (~70-95%). When a mixture of proteins or cells is introduced into this type of two-phase system, one protein and cell accumulate more in one phase and less in the other [2]. Such uneven distribution is due to the individual properties of the biological particles and the distribution conditions (nature of polymers, concentration, additives, etc.). In some cases (this can be called an ideal case), when distributing a mixture of several types of proteins in two-phase systems, all of the mentioned proteins accumulate in one phase, and the rest in the other phase. Given that the solvent in both phases of the system is water, proteins, nucleic acids, viruses, cells, various cell organelles, etc. can be separated and purified in this system. These objects are unevenly distributed in a two-phase aqueous polymer system without losing their intact properties [6]. It should be noted that any unstable (sensitive) biological materials are not damaged and do not lose their biological activity when distributed in such a two-phase polymer-water system. Any pair of natural and synthetic polymers can be used to create two-phase water-polymer systems. Currently, the most widely used polymer pair to create two-phase systems in the world is dextran-polyethylene glycol [8]. These polymers are artificial blood substitutes. One of the most important advantages of the method of distribution in water-polymer two-phase systems (compared to other methods used for separating and purifying biological objects) is that this method can be implemented seamlessly from laboratory to industrial conditions and using simple equipment. It should be noted that recently, in addition to the purification of biological particles, two-phase systems have also been used for the analytical analysis of natural compounds. Calculations show that the distribution and purity control of biological substances, including drugs, in two-phase water-polymer systems is approximately 3-5 times cheaper than ultrafiltration and other existing methods [2]. The widespread application of the distribution method in two-phase water-polymer systems in industry, despite all its advantages, has been hampered for many years as a result of the formation of two-phase systems and the incomplete understanding of the mechanisms of distribution of substances in these systems. Due to the lack of a scientific basis for the method, the solution of all technological issues, the selection of phase-forming polymers, etc. was carried out empirically. It should be noted that in all the various two-phase systems selected and used in practice, the phase separation medium is water, and one of the components forming the system is of a macromolecular nature. We have noted that the main medium carrying substances in these systems is water. Analysis of the results obtained from experiments shows that a

pair of polymers with different chemical natures are more compatible. This contradicts the generally accepted rule that substances dissolve better in substances similar to themselves. This contradiction shows that in order to understand the incompatibility of two polymers, that is, the mechanism of phase separation, it is necessary to take into account all the specific interactions of the polymers with each other and with the solvent of any of them [8]. Let us touch on some characteristics of two-phase systems. As we have seen, water-polymer two-phase systems resemble blood-tissue fluid, blood-lymph, etc. systems, that is, they can be considered as their models. Note that in such a system, the distribution coefficient (k) of the substance is determined by the ratio of its concentrations in the phases (C_1 , C_2) (Fig. 2) [1,5]:

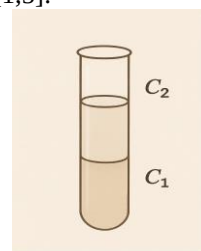


Figure 2.

$$k = \frac{C_1}{C_2} \quad (1)$$

Since the free energy of phase transition of a substance is small compared to the energy of thermal motion, if we use the Boltzmann distribution and the equality of the chemical potentials of the components of the phases, we can calculate the distribution coefficient

$$k = \frac{C_1}{C_2} = e^{\frac{\Delta G}{kT}} \quad (2)$$

We can write it as. From here, for the logarithm of the distribution coefficient

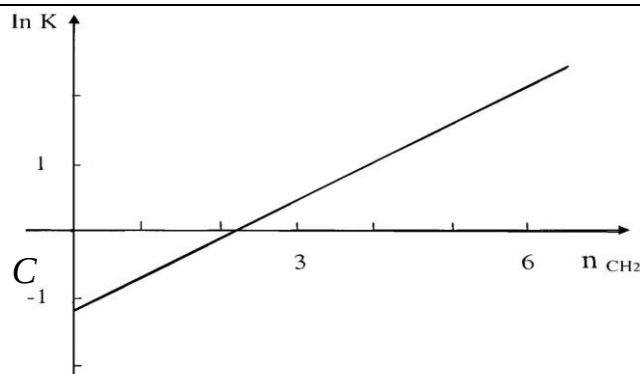
$$\ln k = -\frac{\Delta G}{RT} \quad (3)$$

and for the free energy of interphase transition,

$$\Delta G = -RT \ln k \quad (4)$$

We can write the expression. As can be seen, $\ln k$ can characterize the relative hydrophobicity or water avidity of the substance. The distribution coefficient of some marker substances from the same homologous series in a two-phase system depends on the number of CH_2 groups (n_{CH_2}) The dependence is shown in the

figure. As can be seen from the figure $\ln K \propto n_{\text{CH}_2}$ addition



Şakil 3. Dependence of the logarithm of the partition coefficient in two-phase systems on the number of CH₂ groups in amino acids $\ln K \sim n(\text{CH}_2)$

$$\ln K = C + E \cdot n_{\text{CH}_2} \quad (5)$$

is described by the linear equation. Here, the physical meanings of E and C are the constants known below. If we multiply each side of equation (5) by RT

$$RT \ln K = RTC + RTE \cdot n_{\text{CH}_2} \quad (6)$$

we get. According to (4) $RT \ln k = -\Delta G$ Considering that in (6)

$$\Delta G_{II \rightarrow I}^{\text{mad}} = -RTE n - RTC \quad (7)$$

can be. E-is the free energy of the transition. These results obtained for two-phase systems are successfully used for various purposes. Thus, the results obtained allow us to understand the mechanism of distribution of substances in biological systems and lead to the idea of viewing a living organism as a multiphase system in equilibrium with each other. It should be noted that the distribution of substances between the blood and tissues of the body corresponds to the distribution of substances, for example, between the phases of multiphase systems. Taking into account the importance of two-phase systems and the advantages of the method of unequal distribution in Water-Polymer two-phase systems and using some theories, it is possible to improve this method. The organism is a very complex system that is multiphase, multicomponent, and in equilibrium with each other[2]. Therefore, there will be many advantages to using multiphase systems. These advantages will mainly be time saving and a reduction in the error rate. In the metabolic process of a living organism, substances are constantly transported from the membrane in one direction or another due to the concentration gradient. There is a continuous transport of substances from the cell environment through the double membrane into the cell, and then to the cell organelles - the nucleus, mitochondria, ribosomes, and the Holci complex. The transported substance is then distributed in a multiphase system, and its concentrations in the phases can be represented as C₁, C₂, C₃, and C₄. As we mentioned above, if we take into account that water plays the main role in the transport of substances and based on the Flory-Huggins theory, we can say that the energies spent on the entry and exit of substances will be equal: E = -E. Taking into account these things, it is possible to simplify the model of a multiphase system. It is convenient to study the processes occurring in

such systems by modeling them. Thus, living organisms can be viewed as multiphase, multicomponent systems, and the processes occurring there occur analogously to the processes occurring in multiphase systems. As we know, equation (6) is satisfied only for two-phase systems. Therefore, it is necessary to simplify the mathematical expression characterizing multiphase systems in such a way that equation (6) is satisfied for them as well. For this, let us treat the phases with concentrations C₁, C₂, C₃ as the general 1st phase, and the last phase with concentration C₄ as the 2nd phase. Let us denote the general concentration of the 1st phase we have adopted by C'. The only problematic issue will be to find the value of the concentration C'. We can reduce the existing problem by taking the value of the concentration C' as the numerical average of these three concentrations (Figure 4).

$$C' = \frac{C_1 + C_2 + C_3}{3} \quad (8)$$

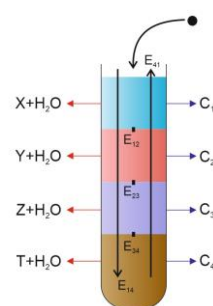


Figure 4

Since we analyze multiphase systems as two-phase systems based on this model, equation (5) will be satisfied.

$$\ln K_{14} = RTC + RT \cdot n_{\text{CH}_2} E_{14} \quad (9)$$

Since matter expends energy each time it transitions to a new phase, the total transition energy will be equal to the sum of these energies:

$$E_{14} = E_{12} + E_{23} + E_{34} \quad (10)$$

The graph of linear equation (9) will be as shown in Figure 3. Taking this into account, we can write equation (6) for the multiphase system under consideration.

$$RT \ln K_{24} = RTC + RT \cdot n_{\text{CH}_2} \cdot E_{14}$$

$$RT \ln \frac{C'}{C_4} = RTC + RT \cdot n_{\text{CH}_2} (E_{12} + E_{23} + E_{34}) \quad (11)$$

Considering expression (8) in (11),

$$RT \ln = \frac{C_1 + C_2 + C_3}{3C_4} = RTC + RT \cdot n_{CH_2} (E_{12} + E_{23} + E_{34})$$

is obtained. Of course, the organism is very complex, that is, it cannot be limited to 4 phases. Therefore,

$$RT \ln = \frac{C_1 + C_2 + \dots + C_{n-1}}{(n-1)C_n} = RTC + RT \cdot n_{CH_2} (E_{12} + E_{23} + \dots + E_{(n-1)n})$$

The last mathematical expression we obtained is an analytical expression of the uneven distribution of substances in multiphase systems.

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it is necessary to generalize this expression for a system with an arbitrary number of phases. Taking into account the above facts and the sequence in expression (12), we obtain:

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SOCIAL SCIENCES

FRAMING THE JOURNEY: A COMPARATIVE STUDY OF TRAVEL TELEVISION PROGRAMS IN MONGOLIA AND CHINA

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Abstract

This study presents a comparative analysis of travel television programs in Mongolia and China, examining their thematic content, production styles, and audience perceptions. Using a mixed-methods approach, the research combines content analysis of selected programs—*1000 Cities I Travelled* (Mongolia) and *Welcome–Hello Russia* (China)—with survey data collected from 491 viewers in both countries. The findings reveal that Chinese travel programs, supported by state funding and advanced technology, tend to prioritize visual appeal and national image-building, often operating under ideological constraints. In contrast, Mongolian travel programs emphasize content and editorial freedom but are limited by financial and technical resources. Audience feedback in both countries indicates a shared desire for more authentic, culturally rich, and less commercialized travel content. This research contributes to the growing body of literature on travel journalism, media representation, and cross-cultural communication by highlighting how structural, cultural, and political factors shape the production and reception of travel media in Northeast Asia.

Keywords: travel journalism, media representation, destination image, Mongolia, China, television studies, cross-cultural communication

Introduction

Globalization has intensified the voluntary and involuntary mobility of people across borders. Among the various forms of movement, tourism has emerged as one of the world's largest economic sectors, driven by both business and leisure travel (Urry, 1990). As countries increasingly rely on tourism for economic and cultural exchange, media representations of travel destinations have gained scholarly attention for their role in shaping perceptions, constructing national identities, and influencing travel decisions (Gallarza, Saura, & García, 2002; Gartner, 1994; Gunn, 1988).

Television travel programs are a particularly influential medium in this context, as they present curated narratives of place, people, and culture. These programs are not merely entertainment—they serve as ideological texts that communicate values, aesthetic preferences, and socio-political perspectives (Hanusch, 2010). For audiences with limited direct experience of a country, such programs may be the primary source of cultural information, thus shaping mental constructs of destinations (Reynolds, 1965; Echtner & Ritchie, 1991).

This study offers a comparative analysis of travel programs from Mongolia and China, two neighboring countries with increasing cultural and economic interdependence through tourism. In 2024, Chinese tourists accounted for 18.3% of international arrivals in Mongolia, making China one of the key markets for Mongolian tourism. Conversely, Mongolia represents a

niche yet symbolically significant destination for Chinese tourists as part of cultural diplomacy and regional outreach.

Mongolia and China have distinct media landscapes and approaches to travel journalism. Mongolian travel programs often emphasize informative and critical content, though they are constrained by limited financial and technical resources. In contrast, Chinese programs tend to be visually elaborate, entertainment-oriented, and government-supported, reflecting broader objectives of national image-building and tourism promotion (Said, 1979; Munro & Richards, 2011).

Drawing on survey data from 491 respondents and content analysis of selected travel programs—namely Mongolia's *1000 Cities I Travelled* and China's *Welcome–Hello Russia*—this study investigates the stylistic, thematic, and ideological differences in travel programming. It contributes to the literature on media representation, tourism discourse, and cross-cultural communication by examining how travel television reflects and shapes cultural narratives in Northeast Asia.

Literature Review

Travel Journalism and Media Representation

Travel journalism has evolved into a significant genre within both the media and tourism industries. Often termed “couch travel,” this genre allows audiences to experience distant cultures vicariously and plays a key role in shaping perceptions of foreign countries (Hanusch, 2010). As Hanusch (2010) suggests, travel journalists function as a type of foreign correspondent,

not only reporting on places but also interpreting them through cultural, historical, and political lenses. This mediation influences how audiences understand global cultures and motivates potential tourists' destination choices.

Edward Said's (1979) work on Orientalism provides a critical foundation for understanding the ideological implications of media portrayals of foreign cultures. Said argues that Western media often constructs non-Western societies through a lens of exoticism and superiority. While Said's critique focused primarily on Western media, similar dynamics may be observed in travel journalism across other regions, including East Asia. In the context of Mongolia and China, travel programs may either reproduce or challenge national narratives and stereotypes through visual storytelling.

Image Formation in Tourism

The formation of a destination image is a multifaceted process that is significantly influenced by media content. According to Gunn (1988), image formation involves both organic sources—such as word-of-mouth and personal experience—and induced sources like media and advertising. Gartner (1994) expands on this by categorizing destination images into cognitive, affective, and conative components, emphasizing how media can trigger emotional and behavioral responses in audiences.

Gallarza, Saura, and García (2002) present a comprehensive model for understanding destination image, noting that it is the result of a complex interplay of psychological, cultural, and communicative factors. Their work underscores the importance of both content and delivery in shaping tourist perceptions. In the same vein, Echtner and Ritchie (1991) distinguish between common functional attributes (e.g., price, weather) and unique psychological attributes (e.g., atmosphere, friendliness), both of which are communicated through travel media.

Cultural Representation and Cross-Cultural Communication

Television travel programs are instrumental in constructing cultural representations that affect international understanding and dialogue. These representations are shaped not only by the content of the program but also by the cultural context in which they are produced (Munro & Richards, 2011). The framing of culture in media can either foster mutual understanding or reinforce existing prejudices, depending on how narratives are constructed, and which voices are amplified.

Urry (1990) highlights the interconnection between tourism and modern concepts of work and leisure, suggesting that tourism functions as a structured form of escape facilitated by media. Furthermore, the global circulation of travel content allows for broader cultural encounters, though these are often filtered through national interests and production constraints.

Media Systems and Policy Influence

The structure and governance of media systems significantly influence how travel content is produced and presented. In countries like China, where media is closely tied to government agendas, travel programs often serve as tools of soft power, promoting domestic tourism and shaping international perceptions in line

with state objectives (Zhao, 2008). In contrast, Mongolia's media system allows for more editorial freedom, but limited financial and technological resources affect the quality and scope of travel journalism.

Studies comparing media systems (Hallin & Mancini, 2004) show that political, economic, and cultural environments play a crucial role in defining journalistic practices and content production. These structural differences are evident in the contrasting styles, formats, and ideological framings of travel programs in China and Mongolia.

Method

This study employed a mixed-methods research design to examine and compare travel programs in Mongolia and China. By integrating both quantitative and qualitative approaches, the research aimed to understand not only the structural and stylistic characteristics of the travel programs but also the perceptions and viewing habits of audiences in both countries.

Research Design

The research was conducted in two stages: (1) a survey of audience members in China and Mongolia, and (2) a content analysis of selected travel television programs. This combined approach allowed for a comprehensive examination of both media production and audience reception.

Survey

A structured questionnaire was developed to assess audience engagement with travel programs, including frequency of viewing, preferred programs, and perceptions of content quality. The questionnaire included both closed-ended questions (e.g., Likert scales and multiple-choice items) and open-ended questions to allow for qualitative insights.

A total of 491 respondents participated in the survey: 309 Chinese citizens and 182 Mongolian citizens. The Chinese respondents represented 18 provinces, 30 cities, and two autonomous regions (including Hong Kong and Macau), while the Mongolian respondents came from 21 cities and provinces, including Ulaanbaatar, Darkhan, and Erdenet.

Demographic information such as age was also collected. Among Chinese respondents, 54.05% were aged 21–35, while 71.43% of Mongolian respondents were under 20 years old. Data were analyzed to identify patterns in viewership behavior, platform usage (e.g., TV vs. mobile), and audience critiques of current travel programming.

Content Analysis

To gain a deeper understanding of program content, a comparative content analysis was conducted on two representative travel television programs:

- Mongolian program: *1000 Cities I Travelled*
- Chinese program: *Welcome—Hello Russia*

These programs were selected based on popularity, accessibility, and representation of national travel media styles. The analysis focused on:

- Thematic elements (e.g., cultural representation, history, nature, food, and customs)
- Visual and production techniques (e.g., camera work, editing, use of effects)

- Narrative tone and ideological framing (e.g., promotional vs. critical discourse)
- Degree of government involvement or editorial independence

A coding scheme was developed to systematically evaluate the structure, format, and communicative intent of each program. Comparisons were made based on visual style, content richness, audience engagement strategies, and alignment with national tourism goals.

Ethical Considerations

All participants were informed of the purpose of the research and participated voluntarily. Data collected from the surveys was anonymized and used solely for academic purposes. The analysis of television content was limited to publicly broadcast programs, ensuring compliance with ethical research standards.

Findings

Audience Demographics

The study surveyed a total of 491 individuals, including 309 Chinese and 182 Mongolian respondents. The age distribution showed significant differences between the two samples. Among Chinese respondents, 54.05% were between 21 and 35 years old, while in Mongolia, the majority—71.43%—were under the age of 20. This suggests that the Mongolian travel program audience tends to skew younger.

Viewing Frequency and Platform Preferences

Viewing frequency varied significantly between the two countries. In Mongolia, 86.26% of respondents reported watching travel programs "sometimes," whereas in China, 66.99% selected the same option. However, the percentage of viewers who "never" watch travel programs was notably higher in China (24.6%) than in Mongolia (2.75%). The proportion of respondents who watch travel programs "often" was similar in both groups (Mongolia: 4.4%, China: 4.21%).

Device usage also revealed distinct media consumption patterns. 71.98% of Mongolian viewers accessed travel programs via television, while 55.34% of Chinese viewers preferred phones and laptops, suggesting greater digital media engagement in China.

Audience Perceptions of Travel Programs

Respondents from both countries expressed critical views of current travel programming. Among Chinese viewers:

- 58.58% described the content as overly promotional.
- 27.51% reported a lack of originality.
- 26.21% found the programs boring.
- 24.92% rated them as uninteresting.

Mongolian audiences were slightly less critical but still expressed concerns:

- 39.56% found programs too promotional.
- 23.08% noted a lack of freshness.
- 17.58% labeled the content as boring.

Despite these criticisms, 50.55% of Mongolian and 43.69% of Chinese respondents considered travel programs useful for travel planning.

Preferred Travel Programs

When asked to name their favorite travel programs, Chinese viewers selected:

1. *Sister Over Flowers*

2. *Travelling Around China*
3. *Faraway Home*
4. *Couple Journey*

Mongolian viewers favored:

1. *Backpacking Trip*
2. *1000 Cities I Travelled*
3. *A Mongolian Who Is Looking for Mongolians*
4. *To Japan with Tumurbaatar*

These preferences indicate both regional production trends and differing audience tastes in tone and format.

Open-Ended Responses: Desired Program Features

Open-ended survey responses revealed contrasting preferences for travel content. Chinese audiences desired documentary-style programs, emphasizing humor, realism, history, and culture, while also preferring minimal advertising. Respondents expressed interest in travel content that explores daily life, legends, rural lifestyles, and forgotten cultural practices.

Mongolian audiences emphasized realism, educational value, and cultural representation. Environmental awareness, archaeological themes, and the opportunity to explore lesser-known and remote areas. They also supported the idea of affordable, independent travel, and content that promotes scientific thinking and personal development.

Discussion

This study set out to compare travel television programs in Mongolia and China, analyzing both audience perceptions and the structural characteristics of selected broadcasts. The findings reveal major differences in production quality, narrative framing, and audience expectations, shaped by each country's media system, technological resources, and cultural values.

Audience Engagement and Media Consumption Patterns

The survey results demonstrate that while interest in travel programming exists in both countries, Mongolian audiences appear more consistently engaged, with a higher percentage watching at least occasionally and fewer respondents reporting complete disinterest. This may reflect differences in media saturation and the availability of alternative entertainment sources, as Chinese audiences have access to a broader range of digital and mobile content.

Device preferences also reflect a technological divide. Mongolian viewers primarily access travel content via television, while Chinese audiences increasingly rely on phones and laptops. This suggests that Mongolian travel programs may not yet be optimized for multi-platform distribution, limiting their reach among younger and more digitally active viewers.

Audience Criticism and Quality Expectations

Both Chinese and Mongolian respondents expressed dissatisfaction with the promotional tone, lack of freshness, and repetitive content in current travel programming. However, the criticism was more pronounced among Chinese viewers, possibly due to higher expectations stemming from greater investment in production quality and more competitive media environments.

The responses also suggest that audiences are increasingly looking for authentic, educational, and rich cultural content. This reflects global trends in travel journalism, where viewers seek programs that provide deep cultural insights, local perspectives, and unfiltered experiences (Hanusch, 2010). Both Mongolian and Chinese respondents emphasized the need for less commercialism, more realism, and a greater focus on culture, history, and daily life.

Differences in Production and Narrative Framing

The content analysis confirmed significant differences in style and production values. Chinese travel programs such as *Welcome–Hello Russia* benefit from state funding, advanced equipment, and government coordination, allowing for polished visuals, diverse formats, and detailed storytelling. However, this comes at the cost of editorial independence, as Chinese programs are often subject to censorship and designed to promote state-sanctioned narratives.

In contrast, Mongolian travel programs like *1000 Cities I Travelled* exhibit greater narrative freedom, with hosts able to discuss sensitive topics such as politics and social issues. Yet, budget constraints, limited technical resources, and tight production timelines restrict their visual and thematic scope. The result is a more informative but less immersive viewer experience.

These differences align with Hallin and Mancini's (2004) media systems framework, which links media content and quality to broader institutional factors such as government regulation, market structure, and professional norms.

Cultural Perspectives and Travel Ideologies

Audience preferences reflect deeper cultural values. Chinese viewers emphasized aesthetic experience, emotional storytelling, and historical depth, which align with the country's broader emphasis on national heritage and soft power diplomacy. Mongolian viewers prioritized environmental awareness, realism, and personal development, pointing to a travel ideology that is educational and introspective rather than entertainment driven.

The contrast in tone—Chinese programs as visually poetic and Mongolian programs as content-oriented and modest—illustrates differing national attitudes toward travel, culture, and media. These distinctions are not only stylistic but also ideological, reflecting how nations position themselves and their citizens in a global tourism discourse.

Conclusion

This study provides a comparative analysis of Mongolian and Chinese travel television programs, exploring differences in audience engagement, program content, production style, and cultural representation. Through the combination of survey data and content analysis, the research highlights how media systems, economic conditions, and cultural priorities influence the nature of travel journalism in both countries.

Mongolian travel programs are characterized by their informative tone, editorial independence, and focus on local authenticity, but they are constrained by limited funding, technical resources, and a narrow range of program formats. In contrast, Chinese travel

programs are visually rich, well-funded, and professionally produced, supported by state institutions that use media as a tool of soft power and cultural diplomacy. However, these advantages come with ideological constraints, as program content must align with state narratives and avoid politically sensitive issues.

Audience responses from both countries reveal an ardent desire for more realistic, educational, and less commercialized travel content. Viewers value programs that offer genuine insight into culture, history, and everyday life, indicating a growing demand for travel journalism that moves beyond surface-level tourism promotion.

Ultimately, travel television plays a vital role in constructing national images, fostering cross-cultural understanding, and influencing tourist behavior. In an era of increasing mobility and global interconnection, the evolution of travel programming in both Mongolia and China will likely continue to reflect broader transformations in media, culture, and international relations. Further research could expand this comparison by incorporating other countries, platforms (e.g., YouTube, social media), and audience segments to better understand the global dynamics of travel media.

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THE STATE'S CARE FOR THE FAMILY IN THE INFORMATION SOCIETY

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ЗАБОТА ГОСУДАРСТВА О СЕМЬЕ В ИНФОРМАЦИОННОМ ОБЩЕСТВЕ

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байджана, Азербайджанская Республика, г. Баку*<https://doi.org/10.5281/zenodo.15220793>**Abstract**

This article examines the problems of family security and their solution within the framework of the state's social policy. The author of the work analyzes in detail social resolutions and presidential decrees on providing social protection to the population. According to the author, the institution of family in Azerbaijani society is one of the main pillars of the state, therefore the adoption of laws ensuring equality of rights and responsibilities in the family serves both the development of society and the progress of national statehood.

Аннотация

Данная статья рассматривает проблемы безопасности семьи и их решение в рамках социальной политики государства. Автор работы детально анализирует социальные резолюции и указы президента по оказанию социальной защиты населению. По мнению автора, институт семьи в азербайджанском обществе является одним из основных опор государства, поэтому принятие законов, обеспечивающих равенство прав и обязанностей в семье, служит как развитию общества, так и прогрессу национальной государственности.

Keywords: Azerbaijan, information society, social policy, family, quality of life, standard of living**Ключевые слова:** Азербайджан, информационное общество, социальная политика, семья, качество жизни, уровень жизни

Сегодня вызывающее во всем мире беспокойство бытовое насилие, наряду с нарушением прав и свобод человека, принимают как фактор, мешающий использованию других прав, равенства и развития. Основные причины такого насилия — это бедность, материальная и психологическая зависимость, низкая культура семьи, ранние браки, незнание своих прав жертв насилия и другие факторы.

По данным ООН, каждая третья женщина в мире, по крайней мере, один раз в жизни подвергается насилию и грубым отношениям на основе результатов исследований, проведенных в странах Европейского Совета, 45 % женщин подверглось той или иной форме насилия, 20—25 % хотя бы один раз в жизни стали жертвой насилия, 12—15% женщин старше 16 лет подверглись бытовому насилию. В рекомендации Парламентской Ассамблеи Европейского Совета под названием «Насилие против женщин в Европе» за №1450 от 2000 года отмечается, что бытовое насилие самая распространенная форма насилия.

Решением Генеральной Ассамблеи ООН от 17 декабря 1999 года объявить 25 ноября «Международным днем по ликвидации насилия против женщин», 31 октября 2000 года Советом Безопасности ООН была принята Резолюция за № 1325, связанных с вопросами женщин, мира и безопасности. Все

эти вопросы нашли отражение в Декларации Миллениума ООН от 2000 года. На Мадридской конференции, проведенной в 2006 году Совет Европы начал кампанию «Борьба против насилия над женщинами в 2006—2008 годах, включая и бытовое насилие» Азербайджан присоединился к этой кампании, Милли Меджлисом было принято специальное заявление и приняты парламентские слушания. В это же время 25 февраля 2008 года Генеральный секретарь ООН призвал начать кампанию «Положим вместе конец насилию в отношении женщин», включая 2003—2015 годы. В рамках Программы деятельности ООН были определены 5 целей этой кампании и претворение их в жизнь ООН. Азербайджанская Республика также принимает активное участие в этих процессах.

В 1998 году по инициативе общенационального лидера Г. Алиева было подписано распоряжение «о мерах по усилению роли женщин в Азербайджане», в 2000 году подписан приказ, «об усилении государственной политики в отношении женщин», в 1998 г. было создан Государственный Комитет по проблемам женщин и проведены значительные работы по увеличению возможностей женщин, аннулированию пристрастного отношения к ним, поддержанию женского движения и других областях.

С целью пресечения бытового насилия, защиты, женщин прав женщин и детей в 2006 году был принят закон, «Об обеспечении тендерного (мужчин и женщин) равенства», в 2007 году Кабинетом Министров была утверждена, «Комплексная Республиканская программа по борьбе с повседневным насилием в демократическом обществе», в государственной программе на 2008—2015 годы «Уменьшение бедности и неуклонное развитие» тендерные вопросы были выделены как отдельный раздел. В национальном плане деятельности по защите прав человека 22 июня 2010 года был принят особый закон «о борьбе против бытового насилия», связанный с борьбой против бытового насилия над женщинами, в том числе и бытового насилия и таким образом были аннулированы все формы пристрастного отношения к женщинам. Новый закон распространялся на являющихся близкими родственниками членов семьи бывших мужа и жену, а также определенные законом другие категории лиц.

Известно, что в Азербайджанском обществе модель семьи считается одной из основных опор государства, по этому принятие этого закона служит прогрессу именно национальной государственности. Начиная с 60-х годов XIX века, проблема семьи начала исследоваться в социально-философском аспекте. Этим вопросом стали заниматься английский биолог Джон Леббок («Происхождение культуры») и др. Ф. Энгельс в своем произведении «Происхождение семьи, частной собственности и государства» выдвигает свои собственные суждения о семье. Американский ученый Морган писал: «Семья — это активное начало, она никогда не стоит на одном месте, когда общество направляется с нижней ступени на верхнюю, она тоже с нижней формы переходит на верхнюю» Родственные системы же наоборот пассивны, прогресс в семье проявляет себя, спустя долгое время и лишь при основательном изменении семьи они меняются очень быстро [1, с. 61].

Следует отметить, что сегодня вопрос поднятия уровня жизни семей является одним из самых важных. В связи с этим с целью помощи малообеспеченным семьям 2 марта 2001 года под №640 президент Азербайджана Г. Алиев издал указ «Программа безопасности продовольствия в Азербайджанской Республики 20 февраля 2003 года под № 854 подписал приказ о «Государственной Программе по экономическому развитию на 2003—2005 годы и снижению бедности в Азербайджанской Республике», издан закон Азербайджанской Республики «О социальной службе для престарелых», 24 ноября 2003 года под № 4 президент Азербайджанской Республики подписал приказ «О мерах ускорению социально-экономического развития в азербайджанского Республике», того необходимо подготовить нормальные правовые акты о минимальном уровне жизни и прожиточном минимуме, определить критерии малообеспеченности и контингент населения, нуждающихся в социальной помощи и на их основе провести работу по оказанию

социальной защиты и являющиеся ее неотъемлемой частью адресной социальной помощи [6, с. 85].

Для увеличения социального пособия семьям особое значение приобретают обязательства, взятые после ратификации Европейской социальной хартии в 16-й статье которой отмечено: «С целью создания необходимых условий для всестороннего развития семьи, являющийся основной ячейкой общества, стороны обязуются поддержать экономическую, правовую и социальную защиту семей посредством социальных и семейных пособий, льготных налогов, стимулирования строительства жилых домов соответственно нуждам семей, оказания помощи молодым семьям и другими соответствующими мерами». Это поставило перед нами новые задачи по усовершенствованию системы адресной социальной помощи и внедрению системных пособий. С этой целью подготавливается несколько вариантов для улучшения системы назначения и пособий. Основной аргумент — это правильное определение доходов семьи. Семейное пособие стабилизирует потребность семьи в ее тяжелом положении [2, с. 320].

Для активизации экономических функций семьи в районах следует создать центры социальной помощи людям, подразделения адресной социальной помощи. Из основных направлений их деятельности можно отметить следующие:

- помощь в решении вопросов занятости, направление их на переподготовительные курсы;
- оказание помощи многодетным, неполным, малообеспеченным семьям, воспитанникам школ-интернатов и детских домов на первых порах до достижения ими совершеннолетия и материальной независимости ни от кого;
- организовать мероприятия (выставки-продажи одетых вещей, благотворительные акции, лотерея и др.) с целью сбора средств для оказания помощи малообеспеченным семьям;
- дать рекомендации по социально-правовым вопросам (жилищным, семейным, имущественным, пенсионному законодательству, правам детей, женщин и инвалидов);
- оказать содействие в погашении компенсаций, получении скидок, пособий, кредитов, алиментов, помощь деньгами и натурой, улучшении жилищных условий в рамках законодательства;

Все это играет большую роль в решении проблемы семьи в современном глобализирующемся, информационном обществе.

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FEATURES AND TRENDS OF DEVELOPMENT OF THE MONGOLIAN PERIODICAL PRESS

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<https://doi.org/10.5281/zenodo.15220797>***Abstract**

This article attempts to identify the features, trends, current state, and challenges of the development of Mongolian periodical press using specific examples of modern newspapers and magazines. Despite the problems pertaining to the development of periodicals due to the advancement of new information technologies, newspapers and magazines are actively working to maintain their positions in the information market and modernize their activities. The author provides an overview of these topics in the article and suggests ways to addressing the pressing problems.

Аннотация

В данной статье предпринята попытка выявить особенности, тенденции, современное состояние и проблемы монгольской периодической печати на конкретных примерах современных газет и журналов. Несмотря на трудности, с которыми сталкивается развитие периодических изданий в связи с развитием новых информационных технологий, газеты и журналы ведут активную работу по сохранению своих прежних позиций на информационном рынке и модернизации своей деятельности. Автор обобщает все это в статье и предлагает пути решения насущных проблем.

Keywords: periodical press, local newspapers, public television, multi-party system, pluralism, publicity, media convergence

Ключевые слова: периодическая печать, местные газеты, общественное телевидение, многопартийная система, плюрализм, гласность, конвергенция СМИ

Введение. Основы монгольской журналистики были заложены 112 лет назад, когда 6 марта 1913 года в Урге впервые вышла в свет газета “Шинэ Толь хэмээх бичиг” (“Новое зеркало”). Первая революционная газета “Монголын үнэн” (“Монгольская правда”) была издана 10 ноября 1920 года в Иркутске (Россия) и является единственной газетой, которая непрерывно издавалась на протяжении более 100 лет. В 1923 году был издан первый в Монголии журнал “Монгол ардын нам” (“Монгольская народная партия”) [2, с.189], и с этого времени начали издаваться газеты, специализирующиеся на профессиях и темах читателей, включая военные, женские, детские и юношеские, профсоюзные, педагогические, а также литературные и юмористические. Монгольское информационное агентство, ныне известное как МОНЦАМЭ, было создано 19 июля 1921 года. Радиожурналистика зародилась 1 сентября 1934 года, когда на всю страну вышла в эфир первая радиопередача.

Основы киножурналистики были заложены в 1935 году, когда при участии советских специалистов был снят первый документальный фильм. С 1942 года началось издание газет в аймаках и местностях, а к 1948 году газеты появились во всех аймаках. С созданием Монгольского телевидения 27 сентября 1967 года в 1970-х годах по сути была создана система средств массовой информации (СМИ) Монголии [4, с.86].

В 1994 году компания Датаком начала свою деятельность в Интернете, создав возможности для быстрого развития электронных СМИ и социальных сетей [1, с.93]. В 2005 году был принят Закон об общественном радио и телевидении, который предоставил крупнейшему государственному СМИ-Монгольскому радио и телевидению-статус “национального общественного”, что ознаменовало начало развития общественных СМИ в Монголии.

С 1960 года Национальный университет Монголии осуществляет подготовку национальных

журналистов. С 1990-х годов частные университеты, колледжи готовят журналистов, и сегодня 11 государственных и частных университетов готовят журналистов в различных областях СМИ. С 1994 года введена иерархическая система образования: бакалавриат, магистратура и докторантура по журналистике. Значительно возросло и число профессиональных и неправительственных организаций, занимающихся вопросами журналистики. Среди них активны такие организации, как Конфедерация монгольских журналистов, Пресс институт, НО “Глоб интернетшл”, Консул по этике журналистов.

Основная часть

Газета “Шинэ Толь”, изданная 6 марта 1913 года, была первым периодическим изданием Монголии. Начиная с 1920-х годов газеты и журналы стали более разнообразными по слоям населения, профессиям читателей и освещаемым темам. Например, начали издаваться журнал “Манай зам” (“Наш путь”, 1923) для молодёжи, газета “Манай үнэн” (“Наша правда”, 1924), военные издания “Ардын цэрэг” (“Народный солдат”, 1924), газета “Улаан од” (“Красная звезда”, 1924), “Харилцан туслалцах хоршооны сонин” (“Кооперативная газета”, 1924) для кооперативных и торговых работников, журнал “Худалдааны мэдээлэл” (“Новости торговли”, 1924), журнал “Бүсгүйчүүдийн санал” (“Мнение женщины”, 1925) для женщин, журнал “Залгамжлагч” (“Наследник”, 1926) для детей и др. До демократической революции 1990 года издавалось всего 84 газеты и журнала [3, с.173].

В соответствии с принятым в 1998 году Законом «О свободе прессы» в 1999 году все государственные периодические издания были приватизированы и переданы под контроль редакций, и за короткий срок было издано много новых частных газет и журналов.

По данным на 2024 год, в Монголии действуют 486 средств массовой информации, из них 125 телевизионных (16 вещательных, 71 кабельное телевидение и т. д.), 72 радио (3 общенациональных, 5 региональных, 23 столичных, 41 местного значения) и 201 периодическое издание (111 газет, 90 журналов). Кроме того, существует более 150 новостных сайтов, из которых около 70 относительно активны в плане слежки за пользователями¹. Из более чем 200 газет и журналов 5 являются ежедневными. Сегодня в каждом аймаке издается 2-3 периодических издания. Кроме того, большинство крупных и влиятельных газет и журналов теперь имеют свои собственные онлайн-версии. Число газет и журналов, размещающих рекламу, также растёт.

Интенсивное развитие интернет-журналистики и социальных сетей оказывает существенное влияние на количество подписчиков и объёмы продаж периодических изданий. Например, объём продаж газет снизился на 17

процентов по сравнению с 2022 годом и на 25 процентов по сравнению с 2024 годом [7, с.39]. Это общая тенденция, наблюдаемая в развитии периодических изданий не только в Монголии, но и во всем мире.

Периодические издания на протяжении многих лет занимают центральное место в системе СМИ Монголии и ныне по-прежнему продолжают сохранять свои позиции. Невозможно представить журналистику в Монголии без газет и журналов, равно как и рассматривать газеты без развития других СМИ. Поэтому, чтобы определить тенденции развития современных газет и журналов, необходимо кратко остановиться на основных факторах, влияющих на развитие журналистики в целом.

В результате демократической революции 1990 года была заложена основа свободной и демократической журналистики, в результате которой система монгольской журналистики трансформировалась в совершенно новую систему, а СМИ стали трибуной плюрализма и гласности. Следующие факторы способствовали становлению свободной журналистики в Монголии:

- В результате демократической революции изменилась вся общественная система и страна перешла от однопартийной к многопартийной системе.

- С упразднением Агентства по контролю за печатью (Главлита) в конце 1980-х годов цензура за содержанием публикаций и программ была ликвидирована.

- Была принята новая Конституция 1992 года, провозгласившая свободу слова и выражения мнения граждан или плюрализм.

- В 1992 году с утверждением новых правил создания средств массовой информации в соответствии с Постановлением правительства № 267 любой гражданин получил возможность создать СМИ.

- 26 августа 1998 года был принят Закон «О свободе прессы», вступивший в силу 1 января 1999 года, что позволило государственным СМИ приватизироваться и развиваться самостоятельно.

В результате вышеперечисленных факторов была заложена основа свободной демократической журналистики в Монголии, а также произошли серьезные изменения в следующих пяти направлениях:

1. Вся система СМИ изменилась. Переход от однопартийной системы к многопартийной привел к появлению различных типов и форм СМИ, а плюрализм и гласность стали реальностью.

2. Произошли существенные изменения в содержании публикаций и программ СМИ. Расширился круг тем, освещаемых в газетах и программах, а также увеличилось количество статей, которые ранее были табуированы, поднимая вопросы и критикуя темы.

¹ www.gov.mn — Официальный сайт Комитета по регулированию телекоммуникаций Монголии.

3. Произошли изменения в навыках и мастерстве работников СМИ. Журналисты начали писать и думать свободно, освободившись от ограничений и стереотипов, начали внедряться в практику СМИ западные методы журналистики.

4. Произошли серьезные изменения в жанрах публикаций периодической печати и программ радио и телевидения. Общее количество жанров сократилось, информационные жанры стали доминирующими, художественно-публицистические жанры стали редкими, стали заметны признаки слияния жанров СМИ и т. д.

5. Произошли серьезные изменения в менеджменте и маркетинге СМИ. Произошло радикальное изменение подхода к управлению СМИ, при этом решающую роль стал играть информационный рынок [5, 231].

Сегодня тенденции развития журналистики в мире и в Монголии определяют четыре основных процесса или фактора. Это:

- Глобализация (*globalization*). Ключевую роль в этом играют новые информационные технологии, интернет-журналистика, новые средства коммуникации и новые направления журналистики.

- Демассовизация (*demassification*). Число потребителей традиционных СМИ сократилось, они разделились на множество групп, а при расширении выбора аудитории стало невозможным идентифицировать целевых получателей.

- Конгломерация (*conglomeration*). Наблюдается тенденция к централизации СМИ в руках одного человека или одной компании, а одна и та же информация передается по нескольким каналам.

- Конвергенция (*convergeration*). Это процесс, в котором новые медиа сближаются и конвергируют, новые технологии сокращают разрыв между новыми и традиционными медиа, а новые и традиционные медиа используются в сочетании. Можно также сказать, что в этом процессе отдельный медианоситель одновременно включает в себя характеристики нескольких медиа.

Теперь кратко обсудим, как вышеперечисленные факторы влияют на монгольскую журналистику, в том числе на развитие газет и журналов.

С 1999 года все государственные СМИ были приватизированы и переведены в систему свободной прессы, в которой они действуют независимо.

- Виды и типы СМИ стали богаче, и они начали диверсифицироваться в соответствии с потребностями аудитории и определенными темами, а количество СМИ резко возросло за короткий срок.

- В практику журналистики начали активно входить такие новые направления, как журналистские расследования, экологическая, гражданская, экономическая, парламентская журналистика, интернет-журналистика (мобильная журналистика и т. д.), реклама для СМИ. Кабельное телевидение и

радиостанции ультракоротких волн (FM) также стали реальностью.

- Что касается тенденций развития СМИ, то количество телевизионных и электронных изданий неуклонно растет и интенсивно развивается, в то время количество периодических изданий и число подписчиков сокращаются. В сельской местности число радиослушателей осталось стабильным, в центральных и городских районах оно начало резко сокращаться.

- Появились новые формы и виды СМИ, конкуренция между ними за подписчиков, рекламу и информационные рынки стала реальностью, а оперативность и доступность информации резко возросли. Это новое явление, никогда ранее не наблюдавшееся в Монгольской журналистике.

- В результате развития новых информационных технологий, которые являются ощутимым проявлением вышеупомянутой глобализации, онлайн журналистика получила интенсивное развитие, а социальные сети стали повседневной необходимостью. Оперативность, доступность и насыщенность журналистской информации возросли, став не ограниченными пространством и временем. Также мобильная журналистика начала набирать популярность. Количество новостных сайтов постоянно увеличивается, а число пользователей растет с каждым днем. Это приводит к сокращению числа потребителей традиционных медиа, уменьшению числа подписчиков и существенному изменению структуры пользователей.

Газеты и журналы активно работают над тем, чтобы минимизировать влияние этой тенденции и сохранить свои старые позиции. Эта тенденция также начала оказывать сильное влияние на монгольские газеты и журналы, и сегодня на информационном рынке доминируют три типа газет: качественные газеты, таблоиды и периодические издания, сочетающие в себе характеристики качественных и таблоидных газет. Количество таблоидных газет уменьшается с каждым днем, а количество газет, сочетающих в себе характеристики как таблоидных, так и качественных газет, увеличивается. Наблюдается тенденция к сокращению числа ежедневных газет, их слиянию друг с другом и выпуску в разных форматах и цветах. Значительно возросло количество проблемных, критических и расследовательских статей. Это попытка привлечь внимание читателей посредством более глубокого изучения фактов и проблем, освещаемых в оперативных новостях других СМИ, анализа событий и проблем, привлечших внимание общественности, указания причин и следствий, и их поиска решений. Увеличивается также число субботних и воскресных приложений ежедневных газет и рекламных газет для досуга и отдыха читателей.

Еще одной тенденцией развития периодической печати Монголии является то, что все крупные и влиятельные газеты и журналы теперь имеют электронные версии. Электронная версия обычно публикуется после того, как бумажное издание становится доступным для общественности, и в ней содержатся наиболее важные материалы из газеты

того дня, которые могут привлечь внимание общественности. Это один из основных способов, с помощью которых периодические издания привлекают читателей и подписчиков.

Конгломерация является ярко выраженной тенденцией в глобальной информационной коммуникации, и она также быстро проникает в современную монгольскую журналистику. В руках одной компании сосредоточено от 4 до 10 СМИ, наблюдается процесс слияния СМИ. Такие медиакомпании, как “Монгол Ньюс”, “Монгол Масс медиа”, “Масс медиа”, “Эрхэт гоёо”, группа “Женко” и “Медиа” имеют ежедневные газеты, журналы, веб-сайты, телевизионные станции и радиостанции ультракоротких волн (FM), что является яркими примерами этого [6, с.198]. Большинство СМИ, принадлежащих вышеуказанным компаниям, являются периодическими изданиями, что свидетельствует о том, что газеты и журналы не утратили своих позиций в Монголии и остаются одним из основных средств получения информации для граждан.

Наблюдается тенденция к конвергенции или слиянию СМИ, когда границы между СМИ постепенно стираются и одно СМИ вбирает в себя характеристики нескольких других СМИ. Сегодня все основные газеты и журналы имеют электронные версии, радио- и телестанции подключены к Интернету, открыты вторые и третьи каналы, что влияет на диверсификацию СМИ в зависимости от информационных потребностей, интересов, возраста, пола и профессии их потребителей.

Еще одной четко наблюдаемой тенденцией является демассовизация, когда СМИ все больше диверсифицируют свою аудиторию по возрасту, полу, профессии, интересам и основным темам, отказываясь от возможности охватить большую аудиторию одновременно. Это важно для достижения больших результатов за относительно короткий период времени и привлечения потребителей.

Сегодня появились специализированные каналы по образованию, спорту, кино, музыке, моде, экологии и были созданы вторые и третьи каналы крупных телестанций. Газеты и журналы также начали диверсифицироваться по тематике, возрасту читателей, полу, профессиональному и образовательному уровню. Примером этого является распространение в последние годы привлекательных печатных и электронных журналов, которые издаются в относительно короткие сроки. Подавляющее большинство из более чем 90 журналов нашей страны являются именно такими специализированными журналами. Число читателей периодических изданий сократилось, число подписчиков электронных изданий и зрителей телевидения увеличилось, а число слушателей радио осталось стабильным. Наблюдается тенденция к росту числа специализированных СМИ в соответствии с потребностями и интересами аудитории. Это общая тенденция, наблюдаемая не только в монгольской журналистике, но и в мировой журналистике, и эта тенденция будет продолжать усиливаться в будущем.

Исследователи массовой коммуникации полагают, что новая эра потребления медиа началась с

появлением цифровой журналистики, социальных сетей и Интернета в качестве повседневных средств использования. Это происходит по нескольким причинам:

- Благодаря развитию информационных технологий сфера применения СМИ расширилась, а ее доступность повысилась до нового уровня.

- На информационном рынке существуют различные типы и формы СМИ, и конкуренция между ними усилилась.

- Оперативность передачи информации возросла, и она больше не зависит от времени и пространства.

- В результате глобализации доступ людей к информации резко возрос.

- Развитие многополярных международных отношений расширило возможности получения информации из мировых СМИ на разных языках по множеству каналов.

- Наряду с развитием общества постоянно растут осведомленность, культура и уровень образования потребителей, что привело к иному подходу к СМИ. Это заставляет нас пересматривать роли, цели и методы работы СМИ и работать по-другому.

- СМИ стали больше концентрироваться на вопросах менеджмента и маркетинга, отдавая приоритет информационным потребностям и желаниям потребителей в рыночных условиях.

- Если до 1990 года руководящие органы знали, что будет писать СМИ, то сегодня потребители в основном определяют политику в отношении публикаций и программ медиа. Ни одна СМИ не может работать без учета информационных потребностей и предпочтений своей аудитории.

- В обществе рыночной экономики невозможно выжить без рекламы, и сегодня, помимо рекламных газет, радио- и телеканалов, реклама занимает 25–40% ежедневных газет Монголии.

- Количество монгольских СМИ сократилось вдвое за последние 15 лет, СМИ объединяются, а несколько СМИ концентрируются в руках одного человека или одной компании, что также связано с потребительскими факторами. С другой стороны, это естественное явление в рыночном обществе.

- Сегодня также происходят серьезные изменения в возрастной и социальной структуре пользователей СМИ. Примером этого является то, что число читателей периодических изданий сокращается, число потребителей электронных СМИ увеличивается, а среди постоянных читателей газет и журналов преобладают зрелые интеллектуалы и пожилые люди, в то время как основными пользователями телевидения и веб-сайтов являются молодые люди, а радио в основном слушают скотоводы, фермеры и водители.

Поскольку монгольские СМИ не проводят опросы удовлетворенности потребителей, большинство СМИ работают рутинно, без четкой политики или ориентации в отношении медиа контента. В будущем необходимо создать исследовательские отделы в крупных медиаорганизациях или

поручить исследователям, неправительственным организациям, работающим в сфере СМИ проводить опросы удовлетворенности пользователей и действовать на основе полученных рекомендаций. Это окажет существенное влияние на улучшение деятельности СМИ, содержания и мастерства публикаций и программ, а также расширение их жанров.

Принимая во внимание текущее состояние монгольской медиаиндустрии в целом можно сказать, что чрезмерное количество СМИ по сравнению с общей численностью населения привело к потере информационного баланса, сосредоточению внимания на нескольких банальных темах, повторению друг друга, доминированию мнения авторов. Все это серьезно влияет на качество публикаций и программы, на ухудшение мастерства журналистов и приведение к сплетням и сенсационности. В будущем возникнет острая необходимость перехода от количества к качеству.

Заключение. Глобальные тенденции в журналистике оказали сильное влияние на современную монгольскую журналистику, что привело к серьезным изменениям в медиасистемах, содержании, мастерстве и жанрах СМИ. Это пример того, что наша журналистика находится на правильном пути, идя в ногу с развитием свободной и демократической журналистики мира. Монгольская журналистика начала делать явный шаг к переходу от либертарианской журналистики к социально ответственной журналистике. Несмотря на то, что количество СМИ достаточно, они значительно отстают от по-

требностей и запросов общества и требований времени. Поэтому необходимо предпринять целенаправленные, масштабные и решительные шаги по переходу от количества к качеству. Необходима четкая государственная политика в отношении журналистики, улучшение правовой среды независимой прессы, развитие ответственной и этичной журналистики. Также важно и дальше совершенствовать подготовку и переподготовку журналистов, развивать журналистские исследования и критику СМИ. Принятие мер по улучшению социальных вопросов и условий труда журналистов является одним из актуальных вопросов.

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TECHNICAL SCIENCES

INFLUENCE OF SUBGRADE REACTION

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Abstract

This work discusses model of building and ground (base) interaction on the static influence and their joint operation determines the stressed deformed condition of the construction. Calculation is conducted by using the computer program complex (LIRA SAPR 2014", which is based on finite element method. Calculation is conducted by changing the building rigidity (thickness of fundament tile is changed), one also uses different methods of calculating on flexible base. One has done analysis of obtained results.

Keywords: subgrade reaction, rigidity, stressed-deformed condition of the building

Introduction

Ground variety has an important influence over the stressed deformed condition of the building. Correctly determined ground properties and then correctly described data in the projecting would give us the opportunity to make the building more rentable along with reliability. Developing the modern program complexes gives opportunity to make the joint operation of provided ground and buildings (construction) as close as possible. By means of computer calculating program, selected by us, it's possible to study the joint operation of building and ground. This work discusses calculation results of really constructible 11 storied building on the clay ground.

Modeling

Calculation by linearly deformed semi-space method

In computing program LIRASAPR 2014, used as the research tool, base modeling happens by using the subgrade reaction, which are calculated by three methods [2], [4].

The first method: according to the first method subgrade coefficient is calculated according to the Poisson's ratio and flexibility module of average importance.

Subgrade reaction is calculated with the following

$$\text{formula: } C_1 = \frac{E_{zp}}{H_C(1-2m_{zp}^2)} \quad (1).$$

The second method: subgrade reaction is calculated by this method by using the Winkler foundation:

$$C_1 = \frac{q}{S} \quad (2), \text{ where } q = \frac{P}{\eta b^2} \text{ is the average pressure}$$

on the foundation bottom. b – Minimal size of the foundation; η – ratio of the maximal side of the foundation with the minimal one; S – foundation closure;

The third method: for determining the subgrade reaction in the third method one uses formula of the first method (1). Difference among these methods is that for determining the module of the average deformation of ground one uses the coefficient correcting the module of the average deformation of ground. This coefficient is changed $u_1 = 1$ from the benchmark of the foundation bottom $u_1 = 12$ up to H_C limit of the active zone (before finishing the compressed zone).

$$u = \frac{11z^2}{H_C^2} + 1 \quad (3). \quad C_2 - \text{Subgrade reaction for}$$

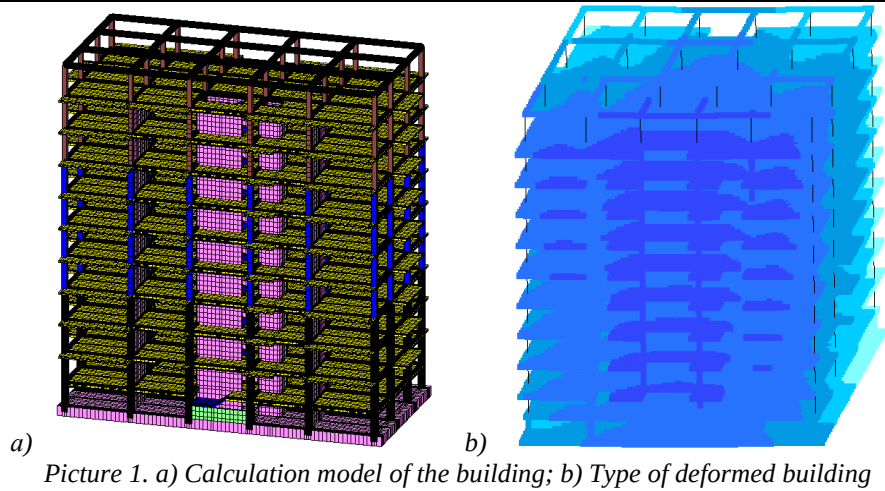
all three methods is calculated by one common for-

$$\text{mula: } C_2 = \frac{C_1 H_C^2 (1-2m_{zp})}{6(1-m_{zp})} \quad (4).$$

Determining the subgrade reaction in the used computer program is possible by two versions, averaged and ground modeling. In both versions one can determine the subgrade reaction by above-mentioned three methods. We would use ground model version, as it exactly describes joint operation of construction and base and the subgrade reaction is not averaged on the whole space. Calculation was conducted according to the norms of **CHП2.02.01-83***, **SP50-101-2004**, **SP22.13330.2011**. Difference among the results obtained according to these three norms is insignificant. Regarding the above-mentioned methods, results obtained from them are different from each other (see the schedule 1). Building rigidity has the influence on the account results. Influence of the building construction on the account is foreseen and modeled by changing the thickness of base tile (see the schedule 1). [1], [3].

Calculation

Calculating subgrade reaction obtained by the ground model



Schedule 1. Results of theoretical calculation

Regulatory document СНП2.02.01-83*	Tile thickness (mm)	Maximal closure of build- ing (mm)	მაქსიმალური დაბრუნება							
			საძირკვლის ფილა					სვეტი		
			M_x tm/m	M_y tm/m	Q_x t/m	Q_y t/m	R_z t/m ²	M_y t/m	Q_y t	N t
Method 1	60	-58.7	87.4	75.3	-502	-530	-21.8	26.9	-39.4	-235
	80	-63	87.2	74	433	-465	-21.9	23	-31	-226
	100	65	86.2	73.3	382	-404	-22.7	19	-25	-219
Method 2	60	-38.7	93	65.2	439	-541	-44.8	34	-30.5	-216
	80	-40.8	106	71.1	-416	-499	-44.6	32.5	-23	-214
	100	-41.8	116	75.2	-366	-458	-46.3	-29.6	19	213
Method 3	60	-25	59	47.3	-199	221	-21.8	-19.5	-35	-232
	80	-26	62.6	47.9	-193	209	-21.9	-17.4	-28.8	-225
	100	-27.2	62.9	51.4	-183	197	-22.5	-15.4	-23.8	-220

Conclusion

In case of three methods increasing the building rigidity (thickness of building tile) may increase the closures, and flexible moments and transverse forces are different in the base tile and columns. In case of the first method increasing the thickness of vase tile may reduce the flexible moments and cutting forces, in the base as well in columns. In case of the second and third methods flexible moments in the base tile are increasing, and transverse forces are reduced. And in case of columns cutting forces, as well flexible moments are reduced, and meanings of longitudinal forces in the columns in three methods are reduced when increasing the thickness of base tile.

As calculation shows, meanings of subgrade reaction, calculated by different methods, are different from each other within approximately 30-50%.

With the purpose of increasing the reliability of calculated results in future one considers comparing the theoretical importance of deformed building with the importance of really constructible building.

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PERFORMANCE COMPARISON OF JAVA AND C++ IN HIGH-LOAD SERVER APPLICATIONS DEVELOPMENT**Smirnov A.***master's degree, Perm National Research Polytechnic University,
Perm, Russia***СРАВНЕНИЕ ПРОИЗВОДИТЕЛЬНОСТИ JAVA И C++ В РАЗРАБОТКЕ
ВЫСОКОНАГРУЖЕННЫХ СЕРВЕРНЫХ ПРИЛОЖЕНИЙ****Смирнов А.В.***магистр, Пермский национальный исследовательский
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Пермь, Россия*<https://doi.org/10.5281/zenodo.15220801>**Abstract**

This article presents a comparative analysis of the performance of the Java and C++ programming languages in the development of high-load server applications. Special attention is given to key aspects affecting computational efficiency, such as memory management, multithreading, and code optimization. The impact of JIT compilation on code adaptation to real execution conditions is examined. Examples of optimizations, including inlining, escape analysis, and branch prediction, are considered, along with their role in improving program execution speed. The advantages and limitations of both languages in the context of server computing are identified.

Аннотация

В данной статье проводится сравнительный анализ производительности языков программирования Java и C++ в разработке высоконагруженных серверных приложений. Особое внимание уделяется ключевым аспектам, влияющим на вычислительную эффективность, таким как управление памятью, многопоточность и оптимизация кода. Исследуется влияние JIT-компиляции на адаптацию кода к реальным условиям выполнения. Рассматриваются примеры оптимизаций, таких как inlining, escape analysis и прогнозирование ветвлений, а также их роль в повышении скорости выполнения программ. Выявляются преимущества и ограничения обоих языков в контексте серверных вычислений.

Keywords: Java, C++, performance, high-load server applications, memory management, multithreading, JIT compilation, static compilation.

Ключевые слова: Java, C++, производительность, высоконагруженные серверные приложения, управление памятью, многопоточность, JIT-компиляция, статическая компиляция.

Введение

На фоне стремительного роста объемов обрабатываемых данных и увеличения требований к отказоустойчивости серверных систем выбор языка программирования становится одним из ключевых факторов, определяющих производительность и масштабируемость приложений. Java и C++ это два широко используемых языка, применяемых для разработки высоконагруженных серверных решений, каждый из которых предлагает уникальный подход к управлению ресурсами. Их различия в организации работы с памятью, многопоточностью и механизмами компиляции оказывают значительное влияние на вычислительную эффективность, что делает их сравнение особенно актуальным.

Современные серверные приложения должны грамотно использовать вычислительные мощности и адаптироваться к изменяющимся условиям нагрузки, при этом обеспечивая стабильную и предсказуемую работу. В этом контексте важно учитывать, какие механизмы управления памятью и потоками предлагает язык, а также насколько хорошо он способен оптимизировать выполнение кода. Разные принципы компиляции и оптимизационные стратегии Java и C++ влияют на скорость вы-

полнения программ, потребление ресурсов и возможности масштабирования, что требует детального анализа их преимуществ и ограничений в реальных условиях эксплуатации.

Цель данной статьи – оценить и сопоставить производительность Java и C++ в контексте высоконагруженных серверных приложений, выявить сильные и слабые стороны каждого подхода. Актуальность исследования обусловлена растущей конкуренцией между технологиями и необходимостью выбора оптимальных инструментов для реализации особенно важных приложений. Методы исследования включают сравнительный анализ архитектурных особенностей, экспериментальное тестирование и анализ существующих бенчмарков, что позволяет оценить производительность рассматриваемых языков.

Основная часть. Сравнительный анализ управления памятью и многопоточности в Java и C++

Эффективность работы высоконагруженных серверных приложений во многом определяется тем, как язык программирования обрабатывает память и организует многопоточное выполнение кода. Java и C++ предлагают разные подходы к

этим ключевым аспектам, что оказывает значительное влияние на производительность.

Одно из наиболее значимых различий между Java и C++ заключается в **способе управления памятью**. В Java используется автоматический сборщик мусора (Garbage Collector, GC), который освобождает память, занятую объектами, на которые нет ссылок [1]. Это снижает вероятность утечек памяти и упрощает разработку, так как IT-специалисту не нужно явно освобождать ресурсы. Однако автоматическая сборка мусора приводит к дополнительным накладным расходам и может приводить к паузам в выполнении программы, особенно в условиях высокой нагрузки. Современные алгоритмы GC, такие как G1 и ZGC, минимизируют задержки, но не устраняют их полностью.

В C++ управление памятью возложено на программиста, что предоставляет больший контроль над распределением и освобождением ресурсов. Этот подход позволяет избежать накладных расходов, связанных с работой GC, и гарантировать более предсказуемое использование оперативной памяти. Однако ошибки управления памятью, такие как утечки, разыменование нулевого указателя и использование освобожденной памяти, могут приводить к серьезным сбоям в работе приложения.

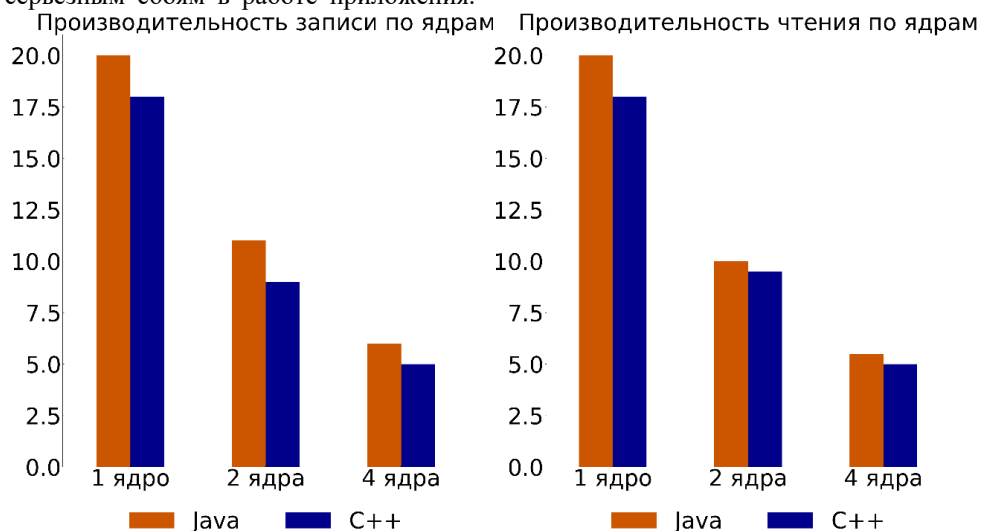


Рисунок 1. Сравнение производительности Java и C++ в многопоточных операциях [2]

В C++ стандартная библиотека предлагает более низкоуровневый механизм работы с потоками через `std::thread`, `std::mutex` и `std::atomic`. Хотя это обеспечивает большую гибкость, разработчик вынужден самостоятельно управлять созданием и завершением потоков. Для упрощения работы с многопоточностью применяются библиотеки, такие как **Intel Threading Building Blocks (TBB)** и **OpenMP**, которые реализуют высокоуровневые механизмы управления параллельными вычислениями.

Разница между Java и C++ также проявляется в модели памяти и способах синхронизации. В Java применяется модель **Java Memory Model (JMM)**, которая строго определяет поведение потоков при доступе к разделяемым данным и гарантирует предсказуемость выполнения [3]. В C++ аналогичная модель появилась только в стандарте C++11, но

Для упрощения управления памятью в C++ широко используются механизмы **RAII** (Resource Acquisition Is Initialization) и **умные указатели** (`std::unique_ptr`, `std::shared_ptr`), которые частично автоматизируют процесс работы с ресурсами.

Разработка многопоточных программ требует эффективных механизмов управления потоками и синхронизации. Java предоставляет высокоуровневую модель работы с потоками через **java.util.concurrent**, что позволяет использовать **пулы потоков (ThreadPoolExecutor)**, **асинхронные задачи (CompletableFuture)** и другие инструменты для эффективной работы с параллельными вычислениями. Основное преимущество Java заключается в переносимости многопоточных решений: виртуальная машина (JVM) абстрагирует реализацию потоков от конкретной операционной системы, обеспечивая кроссплатформенную стабильность. Хотя Java предлагает удобные инструменты для работы с потоками, бенчмарки показывают, что в задачах с интенсивными операциями чтения и записи ее производительность может уступать C++ из-за накладных расходов на управление потоками и JVM (рис. 1).

она предоставляет более низкоуровневый контроль за работой потоков, что может дать прирост производительности в критически важных сценариях.

Существенным преимуществом Java является **автоматическое управление потоками на уровне виртуальной машины**, что позволяет JVM оптимизировать работу многопоточных приложений в зависимости от нагрузки. В C++ многопоточность более эффективна в случаях, когда важно минимизировать накладные расходы, так как отсутствуют промежуточные абстракции, свойственные JVM.

В многопоточных средах Java предлагает удобные инструменты для конкурентного программирования, что снижает сложность разработки. Однако накладные расходы, связанные с управлением потоками и синхронизацией, могут сделать Java менее эффективной в высокопроизводительных вы-

числительных задачах. C++ требует большего объема кода для реализации многопоточных решений, но предоставляет больше возможностей для низкоуровневой оптимизации, что особенно важно в распределенных системах, таких как микросервисы [4].

Выбор между Java и C++ зависит от конкретного сценария использования. Если критична предсказуемость работы с памятью и низкие задержки, C++ может быть предпочтительнее. Если важны простота разработки, кроссплатформенность и удобная работа с многопоточностью, Java становится более подходящим выбором.

Оптимизация кода и влияние JIT-компиляции на производительность

Производительность серверных приложений во многом зависит от эффективности выполнения машинного кода. Java и C++ используют разные подходы к компиляции и оптимизации, что напрямую влияет на скорость выполнения программ, адаптацию к нагрузкам и общее потребление ресурсов.

Так C++ использует **статическую компиляцию**, при которой весь код компилируется в исполняемый файл до запуска программы. Это позволяет выполнять различные оптимизации на этапе компиляции, такие как разворачивание циклов, удаление неиспользуемого кода и агрессивное inline-встраивание функций. Код C++ напрямую компилируется в машинные инструкции процессора, что даёт воз-

можность использовать специфичные для архитектуры CPU оптимизации, такие как векторизация и предсказание ветвлений.

В отличие от этого, Java применяет **динамическую (Just-In-Time, JIT) компиляцию**, что означает, что код сначала транслируется в байт-код, а затем JVM во время выполнения преобразует его в машинные инструкции [5]. Такой подход позволяет адаптировать исполняемый код под реальные условия работы, применять профильные оптимизации и избегать статических ограничений. JIT-компиляторы, такие как HotSpot, способны анализировать участки кода и переоптимизировать их в процессе работы приложения.

Основное различие между этими подходами заключается в том, что в C++ программа оптимизируется один раз перед выполнением, а в Java – динамически, на основе реальных данных о ее работе. Это дает JIT-компилятору возможность применять агрессивные оптимизации, которые невозможно реализовать статически. Однако в Java есть дополнительный этап интерпретации байт-кода перед компиляцией, что приводит к увеличению времени старта программы.

JIT-компилятор в Java применяет ряд техник, которые позволяют ему в ряде случаев достичь или даже превзойти по производительности статически скомпилированный код C++. Одними из ключевых технологий являются адаптивная компиляция, динамическое inlining-встраивание функций и другие (таблица 1).

Таблица 1.

Влияние JIT-оптимизаций на производительность Java [6, 7]

Оптимизация JIT	Описание	Влияние на производительность
Inlining	Замена вызова функции ее телом.	Уменьшает накладные расходы на вызовы функций.
Escape analysis	Определение объектов, не покидающих метод, для размещения в стеке.	Снижает нагрузку на GC, ускоряет выполнение.
Branch prediction	Перестановка кода на основе реальных данных исполнения.	Повышает эффективность выполнения условных операторов.
Adaptive compilation	Постепенное улучшение кода во время работы программы.	Долговременный прирост производительности.
Deoptimization	Возвращение к менее оптимизированному коду при изменении условий.	Повышает стабильность работы программы, снижая вероятность деградации производительности

В C++ аналогичная оптимизация escape analysis возможна только на этапе статической компиляции, однако для ее реализации требуется явное использование механизма **placement new** или ручное управление памятью. Что касается deoptimization (обратной деоптимизации), в C++ такой механизм отсутствует, так как код оптимизируется заранее и не может изменяться во время выполнения. Хотя C++ традиционно считается более производительным языком благодаря отсутствию накладных расходов на виртуальную машину и динамическую компиляцию, в некоторых случаях Java также может демонстрировать высокую производительность и обеспечивать конкурентоспособные результаты.

Во-первых, в приложениях с долгим временем выполнения и повторяющимися вычислениями JIT-

компилятор способен со временем значительно ускорить выполнение кода. В таких системах JIT анализирует реальные данные и подстраивает оптимизации в зависимости от нагрузки, в то время как в C++ код остаётся неизменным после компиляции.

Во-вторых, работа с многопоточностью в Java может быть более эффективной за счет того, что JVM оптимизирует переключение потоков и управляет их состоянием на уровне байт-кода. В C++ программист вынужден самостоятельно учитывать особенности платформы, на которой запускается приложение, что усложняет создание универсального многопоточного кода.

Третьим важным аспектом является оптимизация кэш-памяти и прогнозирование ветвлений. JIT-компилятор может перестраивать код таким образом, чтобы он лучше соответствовал конкретной

архитектуре процессора. В C++ такие оптимизации выполняются компилятором заранее и не могут изменяться во время работы программы.

Наконец, стоит отметить, что современные интерпретаторы JVM поддерживают предварительную компиляцию (AOT, Ahead-of-Time), что позволяет сократить время старта приложения [8]. Это снижает традиционный недостаток Java – медленный запуск, делая ее конкурентоспособной с C++ в задачах, требующих быстрой инициализации.

Java и C++ представляют два разных подхода к компиляции и оптимизации кода. Статическая компиляция C++ позволяет заранее достичь высокой производительности за счёт глубоких оптимизаций на этапе компиляции. Однако JIT-компиляция в Java дает возможность динамически подстраиваться под реальные условия работы, что позволяет оптимизировать выполнение кода в зависимости от текущей нагрузки.

Выводы

Сравнение производительности Java и C++ в разработке высоконагруженных серверных приложений показывает, что каждый язык обладает своими преимуществами и ограничениями. C++ обеспечивает высокую производительность за счет статической компиляции, низкоуровневого управления памятью и возможности тонкой настройки программного кода. Это делает его предпочтительным выбором для систем, где критически важна минимизация накладных расходов и предсказуемость работы. В то же время, Java предлагает мощные механизмы динамической оптимизации, включая JIT-компиляцию и автоматическое управление памятью.

Выбор между этими языками зависит от требований к производительности, гибкости и удобству поддержки кода. C++ лучше подходит для задач, требующих максимального контроля над ресурсами, таких как разработка системных программ, игр и высокопроизводительных серверных компонентов. Java же показывает высокую эффективность в длительно работающих приложениях с изменяющейся нагрузкой, например в корпоративных и облачных системах. При проектировании высоконагруженных серверных решений важно

учитывать как базовые показатели скорости выполнения, так и архитектурные особенности языка, влияющие на долговременную масштабируемость и устойчивость системы.

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USE OF GIS AND UA TECHNIQUES IN HYDROLOGICAL MODELLING

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<https://doi.org/10.5281/zenodo.15220803>**Abstract**

Providing water management; can be achieved sustainably on a basin basis by evaluating hydrological, ecological and economic aspects together and in harmony. Hydrological modeling studies, which are the basis of all components within the framework of water management practices, are an indispensable part of decision support systems. Hydrological models, which provide scientific support to decision makers in decision-making processes, play an important role in taking measures to protect and improve current situations of investments, solutions to problems through scenario-based estimations.

The aim of this study is to compare the soil moisture and snow-covered area data, which are the outputs of the hydrological modeling study conducted with the HBV model in the Upper Basin of Lake Manyas, one of the important wetlands in terms of ecosystem in Turkey, with remote sensing methods. Satellite images produced by the European Center for Medium-Range Weather Forecasts (ECMWF) for soil moisture and the National Oceanic and Atmospheric Administration (NOAA) for snow-covered areas were used to perform verification analyses covering the water years 2012-2015 in the study basin. According to the results, there is a successful agreement between the hydrological model outputs and satellite data, which indicates that reliable model parameters were selected.

Keywords: hydrological modeling, snow cover area, soil moisture, remote sensing

INTRODUCTION

Nowadays, as the importance of water increases, revealing the distribution of hydrological components, solving a specific problem regarding the amount of water within a study area or determining the situation can be done through hydrological modeling studies, which are increasing day by day.

In the last quarter of the twentieth century, water management at the basin scale has come to the forefront, and the current situation is being presented with a holistic approach and solutions to problems are being sought. The methods that have been developed since the 1900s are currently used as both packaged product software and open source coded hydrological models. The complexity of hydrological systems, the lack of understanding in detail and system behavior and reactions can be resolved through models.

There are two main purposes of basin-based hydrological modeling. The first is to better understand the functioning of the system and the effects of changes in the system. The second is to produce time series for prediction and design. However, the purposes of hydrological modeling in practice can be detailed as follows in the studies carried out on water management [2].

- Forecasting the data needed for the planning, operation and development of dams and facilities built to increase the usability of water resources
- Producing hydrological data in basins where measurement data is not available
- Determining the effects of changes such as land use change and climate change on the basin

- Calculating water budgets and managing and estimating the amount in order to ensure water allocation on a sectoral basis

- Determining and estimating the flows to be used in mass balance studies for the evaluation of water quality in surface waters

- Hydrological modeling studies are carried out for purposes such as estimating hydrological events such as drought and flood, which are considered natural disasters.

In this context, the basin extraction and spatial analyses that form the basis of the study were carried out on the GIS platform and the soil moisture and snow-covered area data obtained from the hydrological modeling study carried out in the Upper Basin of Manyas Lake between 2012 and 2015 were compared with remote sensing methods. This study reveals the importance of remote sensing data regarding the verification and reliability of hydrological models.

MODEL STUDIES

Hydrological Modeling studies have been carried out in many areas from the beginning of the twentieth century to the present and have taken their place in the literature.

The basin of the Sava River, one of the largest rivers in Slovenia, was modeled by Primožič et al. [4] with the HBV model of Swedish origin. The Sava River Basin, which has a basin area of 10,700 km², is also an important tributary of the Danube River. The model was structured according to daily calibration by creating 26 sub-basins. The model, which was run between 1990-2006, was calibrated between 1990-1999. The

years 2000-2006 were used for validation purposes. An average model efficiency of 0.86-0.90 was obtained.

Normand and his colleagues ran the HBV model in the Tamor basin in Eastern Nepal between 1987 and 1996 and calibrated it with the GAP (genetic algorithm package) optimization method. The study showed that low flows were well simulated, with a model efficiency of 69%. In capturing peak flows, the model efficiency dropped to 62%, and there was less agreement than in low flows [3].

Study Area

In this study, the Manyas Dam Lake Upper Basin was selected as a basin where there is no or very little anthropogenic impact in order to carry out the hydrological modeling application in a healthy and accurate approach.

The Upper Basin of Manyas Lake, determined as the study area, covers the area formed by the streams draining into Manyas Lake, which is administratively

located within the borders of Bandırma and Manyas in Balıkesir province, and the geographical coordinates are between 40°10' North and 28°00' East.

HBV Model

The HBV model used in this study was first used in the 1970s in the "Hydrologiska Byråns Vattenavdelning" unit of the Swedish Meteorological and Hydrological Institute (SMHI) for the purpose of modeling the flow in the basin. Over the years, the HBV model has been developed by the Swedish Meteorological and Hydrological Institute (SMHI) and is widely used for flow simulation purposes. However, HBV and its modified versions are implemented in approximately 45 countries [1].

The working flow diagram in the HBV model is shown in the flow diagram in Figure 1 as snow module, soil module, groundwater module and current module, respectively.

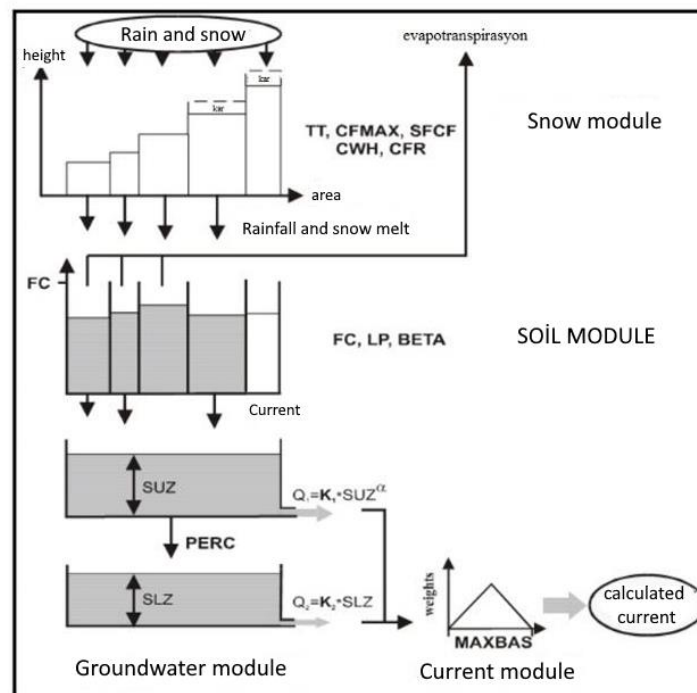


Figure 1. HBV flow diagram.

Model Inputs

The HBV model requires historical data including precipitation [mm/Δt], temperature [°C] and flow values [mmΔt], and long-term monthly average values for evaporation data [mm/Δt]. Daily data was used in this study, which was carried out with the model that accepts data at time steps such as different time series (hourly, daily, seasonal).

The institutions responsible for hydrometeorological data in Turkey are the General Directorate of State Hydraulic Works (DSI) and the General Directorate of

Meteorology (MGM). The necessary data for this study were obtained from the institutions in question. Considering the location of the Upper Basin of Lake Manyas, which is the study area, 9 observation stations from which data could be obtained were identified in the MGM databases. Daily flow data collected at the Flow Observation Stations (FOB) operated by DSI were obtained from 3 stations by investigating the FOBs located within the basin that were currently open and had data (Figure 2).

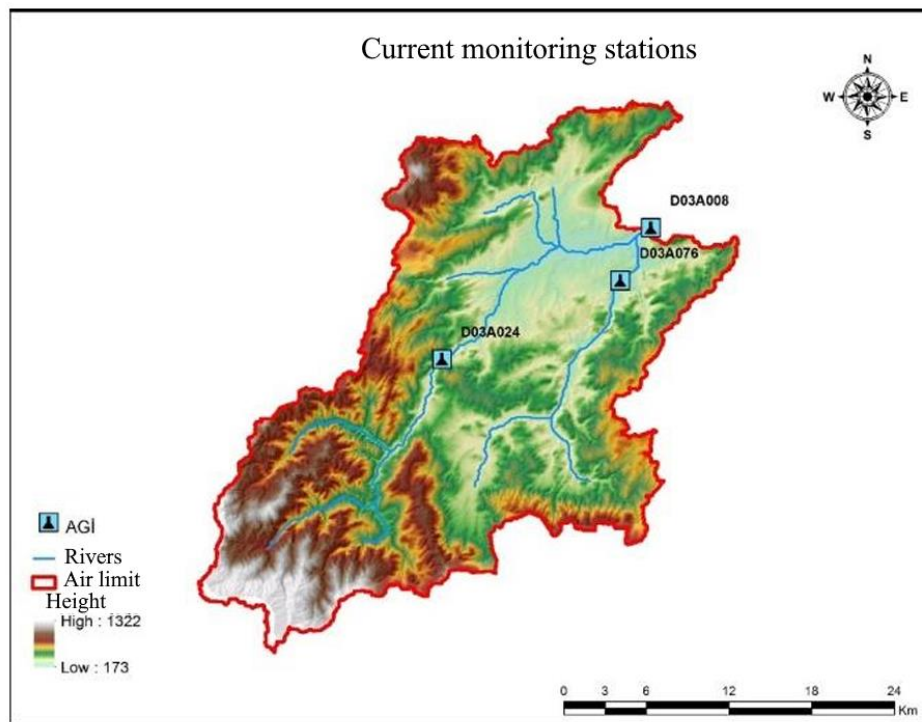


Figure 2. Hydrometeorological station in the study area

Within the scope of this study, the Manyas Lake Upper Basin Contour Map was created and the data belonging to the area was calculated in the GIS environment and the model was used as a semi-distributed model. As a result of the examination of the obtained data on the scale of the impact on the basin, the meteorological stations determined in figure 2 were used, which were accepted to best represent the basin: Bergama in the south, Burhaniye in the west and Balıkesir Airport stations in the east.

Calibration and Validation

Calibration refers to the optimization of the fit by converting inputs into outputs using mathematical equations and making changes to the parameters called model parameters that constitute the mathematical equations of the input-output fit. Calibration of a hydrological model is usually carried out by trial and error method [1].

Validation is the process of applying parameters whose suitability has been accepted to the outputs obtained by using inputs in the time interval outside the calibration. Validation is, in a sense, the verification of the parameters, and therefore the model.

Different criteria are used to evaluate the compatibility of observed and modeled values in order to evaluate calibration studies. For Hydrological Models, this

criterion is usually the Nash-Sutcliffe (NSE) model efficiency criterion. Model efficiencies also mean the objective function for hydrological models. The objective function defined as $Reff$ can be calculated over logarithmic, maximum, minimum and weighted values.

$$Reff = 1 - \frac{\sum (Qsim(t) - Qobs(t))^2}{\sum (Qobs(t) - Qobs(t))^2} \quad (1)$$

Within the scope of this study, the model was calibrated using 5 different objective functions ($Reff$, $LogReff$, $PeakReff$, $0.5Reff + 0.5 PeakReff$ and $0.5Reff + 0.5 LogReff$) in the Manyas Lake Upper Basin.

In the application, the hydrological years 2003-2015 were taken as basis and the calibration period was chosen between 2007-2011 in order to include different hydrological periods (dry, rainy, normal) and to be the period that gives the most efficient results together with the preliminary study. Validation of the model was carried out between 2003-2006 and 2012-2015.

The optimum objective function obtained as a result of this study and the efficiency values according to these other objective functions are given in Table 1, and the hydrograph comparison showing the validation results between 2012-2015 is given in Figure 3.

Table 1.

Results of the Optimum Objective Function.

Objective function	Year	Weighted $Reff$	R^2	$Reff$	$Reff_{Peak}$	$Log Reff$
$0.5Reff$ + $0.5 LogReff$	2003-2006 (val)	0.68	0.63	0.62	0.31	0.73
	2007-2011 (kal)	0.66	0.70	0.60	0.55	0.72
	2012-2015 (val)	0.57	0.67	0.51	0.32	0.76

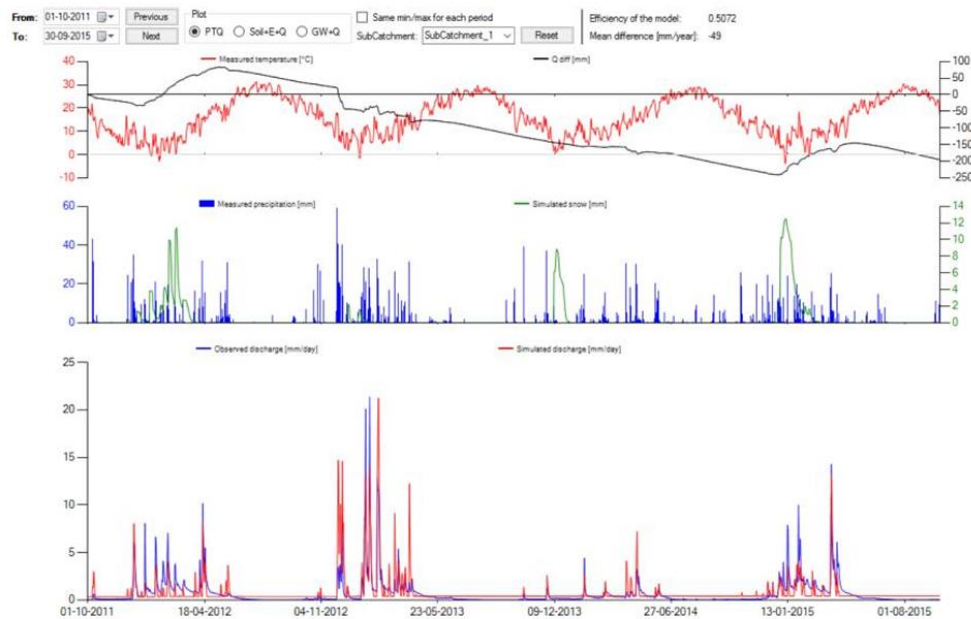


Figure 3. Validation results for the years 2012-2015.

In addition to verifying the parameters obtained as a result of calibration, the model results produced between the periods of 2012-2015 within the scope of this study were verified with soil moisture and snow-covered area data obtained using remote sensing methods.

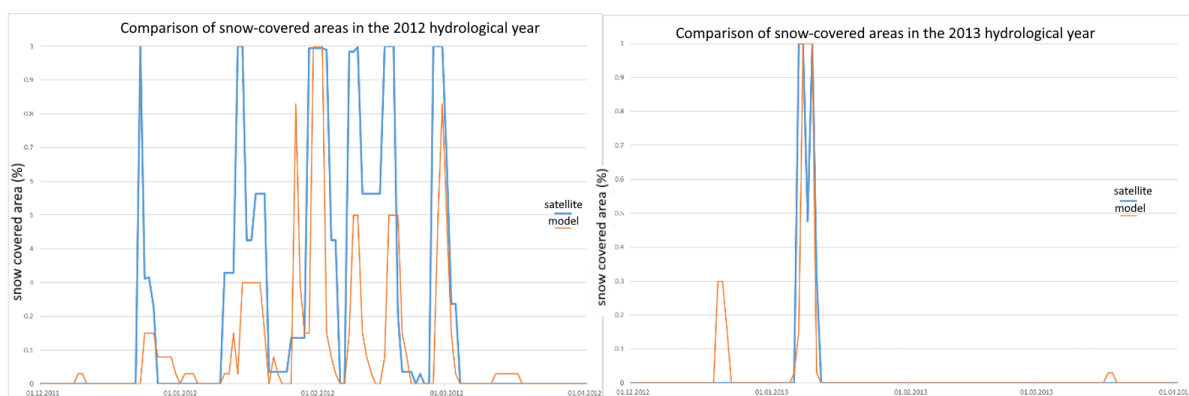
Remote Sensing Data

The processing of satellite images and their use in many studies around the world has become quite widespread today. In addition, important weather centers and organizations provide satellite imagery data within the scope of collecting data on water resources and components. In this context, the snow-covered area data in this study was obtained from the National Oceanic and Atmospheric Administration (NOAA), an institution of the United States of America, for the purpose of researching weather and sea events on Earth.

The soil moisture data for the 2013-2015 hydrological years was obtained from the European Center for Medium-Range Weather Forecasts (ECMWF) satellite images and used as layers of 4 different heights.

Results. In this study, soil moisture and snow-covered area data obtained from the hydrological modeling application carried out in the Manyas Lake Upper Basin were compared with the data obtained from satellite images using remote sensing methods.

Within the scope of the evaluation made by taking into account the number of snow-covered days between the model and observation results, the comparisons of snow-covered areas in the winter months of 2012-2015 hydrological years are shown in Figure 4.



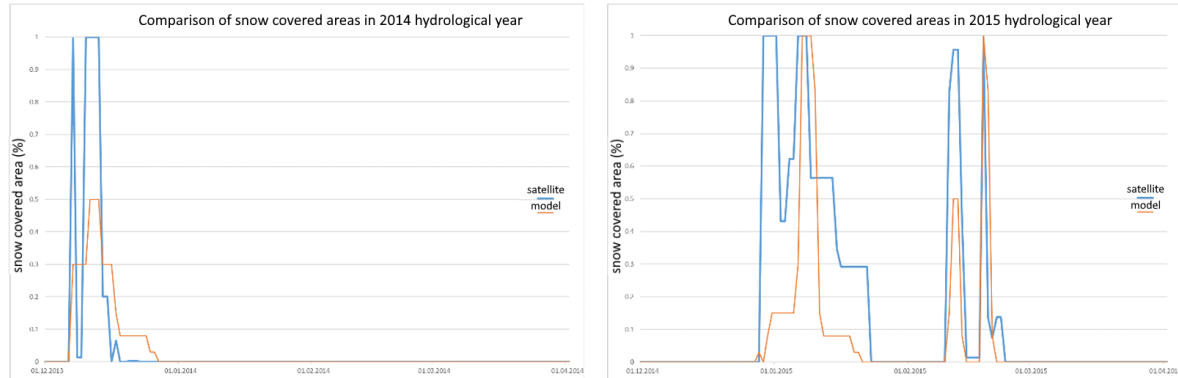


Figure 4. Comparison of snow-covered area between 2012 and 2015 water years.

The model results and observation values agree in terms of order and general tendency. However, the percentage relationship between the number of days covered with snow in the observation and model results was found to be 93%, 98%, 98%, 97% for the years 2012, 2013, 2014, and 2015, respectively, considering

the months of 01 December-01 June (184 days) when snow is likely to be found. These values show that the snow module of the model works with high accuracy.

Model and satellite image comparison results for soil moisture data for the 2013-2015 hydrological years are given in Figure 5.

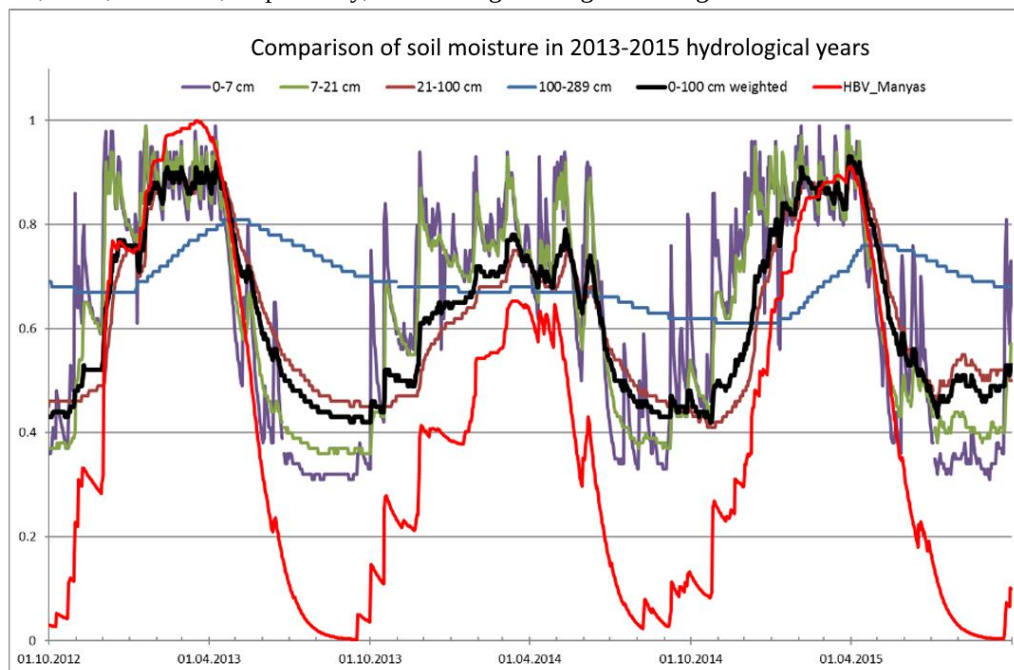


Figure 5. 2013-2015 water year soil moisture comparison.

As can be seen from the graph given in Figure 5, the average soil moisture observed up to one meter and the model results are compatible with each other in terms of order and trend, especially in winter and spring. It shows that in summer, the soil module brings the soil moisture values closer to 0. It is thought that this situation is caused by the parameters of the model affecting the soil moisture, and a separate study should be conducted to observe its effects. However, the fact that the soil moisture pulses have a common trend shows that the soil module works correctly. The observation values for the study area show that the soil moisture does not fall below 40%. This situation reveals the idea that the model should limit the soil moisture with a threshold parameter.

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