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BIOLOGICAL SCIENCES

STUDY OF THE SALT-RESISTANCE QUALITIES OF PALLIDIUM 596 (*HORDEUM VULGARE* SUBSP. *VULGARE* VAR. *PALLIDIUM*) BARLEY SAMPLE USING DIFFERENT DIAGNOSTIC METHODS

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Abstract

It is a known fact that salt stress causes a number of physiological and biochemical processes in plants. Using various diagnostic methods we attempted to study these processes, to provide preliminary information regarding the plants' salt-resisting qualities. The study was carried out on Pallidium 596 (*Hordeum vulgare* subsp. *vulgare* var. *pallidum*) barley variety.

The first phase of the impact of salt stress on the plants' growth were studied. It has been known that the salt stress causes the accumulation of inhibitors slowing the plants growth which, in turn, lowers the number of growth facilitating hormones.

One of the methods used to determine the plant's stress resistance has been the study of changes in quantity of chlorophyll (a+b). The study of this indicator has shown that the impact of 0.25% salt exposure did not cause significant changes in the amount of chlorophyll (a+b) in leaves of studied variety compared to the control variant. Due to the 0.5% salt exposure, the amount of chlorophyll (a+b) in the leaves decreased slightly compared to the control, which suggests that this variety is more resistant to salt.

Keywords: barley, salt resistance, growth inhibition, chlorophyll (a+b)

Introduction

The recent climate changes on the earth have caused the aggravation of the ecological situation and salinization of arable lands. Therefore, finding plant varieties and forms that are resistant to stress factors, but at the same time economically important, ensuring their cultivation in such lands is one of the urgent problems of the day. One of the stress factors is salinity. During the impact of salt on the plant body, at the initial stage, the body tries to adapt resisting the conditions in which it finds itself. At this time, a number of physiological and biochemical processes occur in the plant body. Thus, the processes of breaking down starch into sugar and proteins into amino acids lead to an increase in the amount of non-protein nitrogen and, as a result, damage to cells. Also, the activity of the ribonuclease enzyme increases, which accelerates the breakdown of RNA and stops the synthesis of DNA.

Also, salt stress affects the height of the plant. During this time, growth retarding inhibitors (abscisic acid and ethylene) accumulate, the amount of height-stimulating auxin and gibberlin decreases. As a result, growth inhibiting hormones are greater than growth stimulating hormones, resulting in retardation of plant growth.

During salt stress, organic compounds such as sorbitol, glycine betanin, and at the same time proline amino acid, repeatedly increase. Also, due to salt stress, the breakdown of green plastids occurs, which naturally leads to a decrease in the contribution of chlorophyll. The less the amount of chlorophyll changes due to stress exposure, the more resistant that plant is

considered, which allows genotypes to be evaluated according to resistance to stress [Aliyev, Abbasov, Rahimli, 2014].

Therefore, in recent times, various diagnostic methods are used to study the physiological-biochemical processes that ensure the resistance of plants to unfavorable environment.

Salt tolerance is the ability of plants to accelerate normal growth and development in salinity conditions. If the NaCl in the soil exceeds 0.5% of salt, such soils are considered saline. 30% of arable land in the world is under salinity stress [Aliyev, 2015].

Using them, the study aimed to study the effect of salt stress on the Pallidium 596 barley sample.

Materials and research methods

The study was carried out on Pallidium 596 (*Hordeum vulgare* subsp. *vulgare* var. *pallidum*) variety. Various diagnostic methods were used in the study.

In order to study the effect of salt stress, the seeds of the above-mentioned variety were planted in pots. The research work was carried out with the scheme of control-soil+0.25%, NaCl-soil+0.5%. The seeds of each variety were planted in pots according to this scheme. After one week, the height of the plants in the experimental variants compared to the control was measured and samples were taken from the leaves for the determination of the amount of chlorophyll (a+b) and proline amino acid. The changes in the amount of chlorophyll were carried out based on the methodology proposed by the Russian Institute of Botany [Udovenko, 1975]. 96% alcohol was added to the taken leaf circles. After keeping in a dark place for 5-6 days (until

the circles turn completely white), the amount of chlorophyll was determined in a spectrophotometer (UV-3100PC) at 2 wavelengths (E665-649nm), and the amount of carotenoids was determined at 450nm. After the impact of stress (xl "a" and xl "b"), the degree of stress-depression was found by comparing the percentage of change with respect to the control, and the extent to which those samples were resistant to stress factors was determined. The less the amount of pigments changes due to the impact of stress, the more resistant the samples become.

The amino acid proline is also of great importance in assessing the resistance of plants to salt stress tolerance. Under normal physiological conditions, proline is transported to the reproductive organs of plants. This acid is essential for seed and pollen formation.

Under stressful conditions, proline amino acid accumulates and increases in quantity, acting as an antioxidant and protecting the plant from negative effects of the environment. Therefore, this indicator is used as a biochemical marker of sustainability. The amount of proline amino acid was determined by the Bates method at a wavelength of 520 nm [Bates, Woldren, Teare, 1973].

Research results and discussion

It is known that a number of physiological and biochemical processes occur in plants during stress. Since

many of these processes are of a defensive nature, they enable the plant to adapt to its environment. If the stress lasts temporarily, the plant has the ability to restore itself.

The soil environment in which plants grow and develop is the carrier of soluble salts that they use. However, when the amount of soluble salts is higher than the tolerance limit of plants, a number of difficulties arise.

In one of the research-experimental options which was carried out in comparison with control, 0.25% NaCl was added to the soil in one pot, and 0.5% NaCl was added to the soil in another pot. After one week, the height of the plants in the experimental variants compared with control is measured and content of chlorophyll (a+b) and proline amino acids in the leaves is determined.

Observations on plants showed that the difference between the height of plants growing in soil with added 0.25% salt and the height of plants growing in the control variant is very small and growth retardation was 5% compared to the control variant.

Growth retardation of plants was observed mostly due to the effect of 0.5% salt. So, compared to the control, this indicator is 14%.

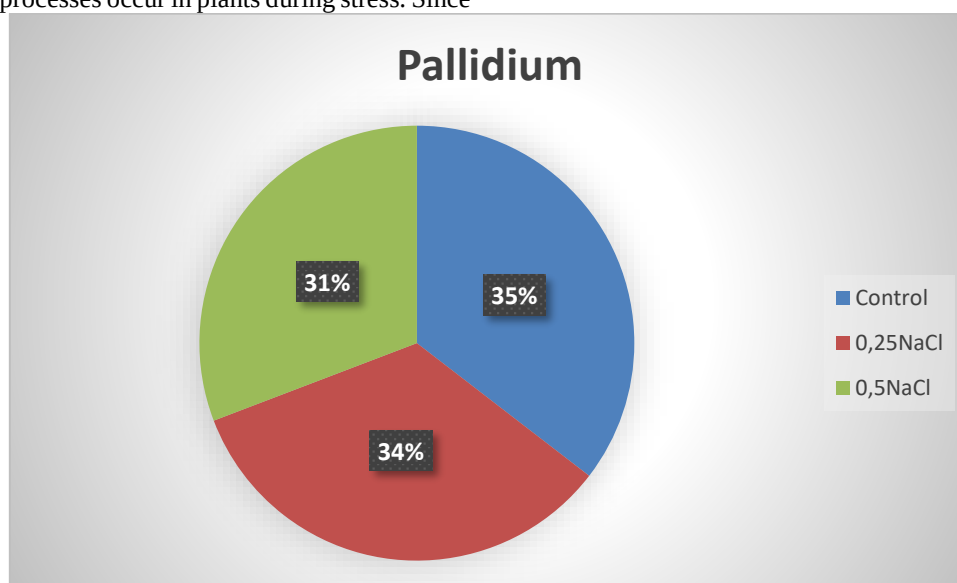


Fig. 1. Changes in plant height due to the effect of salt stress of different concentrations.

The effect of 0.25% salt did not cause significant changes in the amount of xl (a+b) compared to the control variant. Due to the effect of 0.5% salt, the amount of xl (a+b) in the leaves was depressed by 4%. This

change in the amount of chlorophyll (a+b) as a result of stress suggests that the Pollidium 596 variety is salt tolerant. This result is consistent with the results of other researchers [Ivanov, 2013].

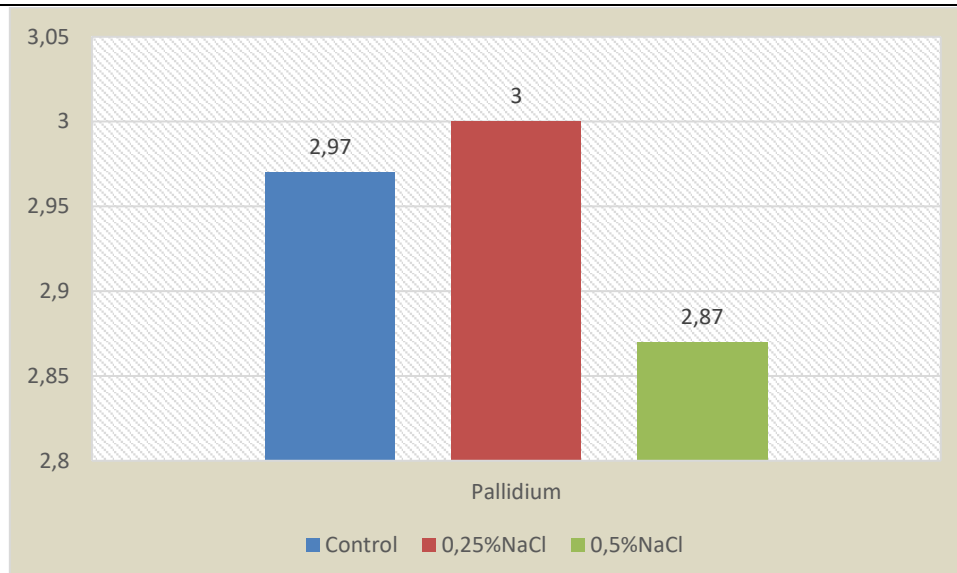


Fig. 2. Changes in the amount of chlorophyll (a+b) due to salt stress with different concentrations.

The amount of proline amino acid, which is a biochemical marker of sustainability, was slightly decreased due to the effect of 0.25% salt compared to the control, and this indicator is equal to 0.5%. In our opinion, the slight reduction in the amount of proline amino acid due to the effect of 0.25% salt is the result of the adaptation of the plant to this dose of stress, as the reserve acid is broken down and used for metabolism as a result of stress [Bates, Woldren, Teare, 1973; Kolupaev, Weiner, Yastreb, 2014].

On the contrary, due to the effect of 0.5% salt, the amount of proline amino acid increased by 1.2% in this variety. The increase in the amount of proline amino acid after this concentration of salt is the response of plants to this concentration. At this time, the organism's metabolism stops temporarily, and proline amino acid accumulates without consumption, protecting the plant from stress.

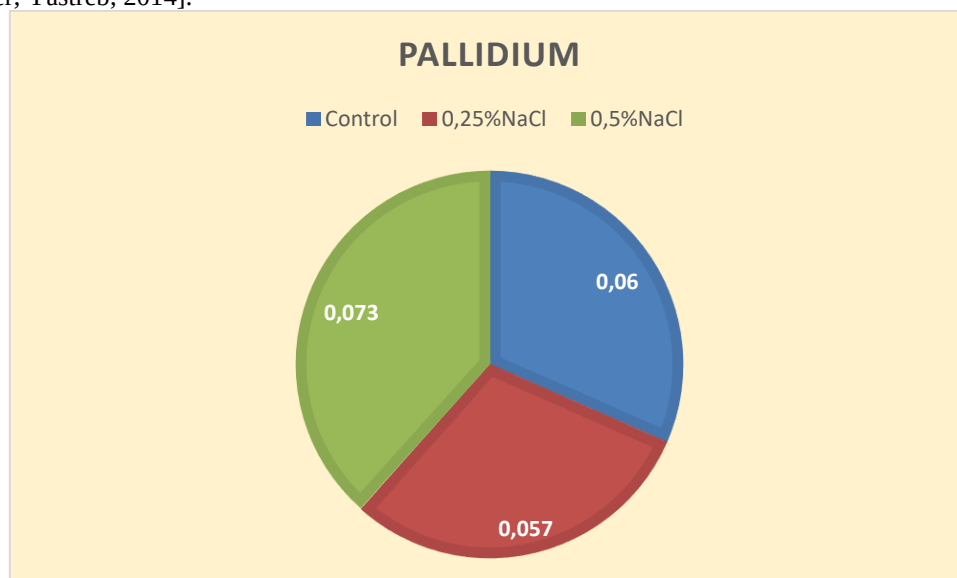


Fig. 3. Changes in the amount of proline amino acid under the influence of salt stress of different concentrations.

As a result of the research carried out with the help of various diagnostic methods, it was determined that the Pallidium 596 variety of barley is resistant to salt, and as the concentration of salt in the soil increases, the effect of stress also increases, which significantly manifests itself in the morphological, physiological and biochemical indicators of the plant.

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MYCOBIOTIC DIVERSITY AND PHYTOPATHOGENIC FUNGI OF APPLE TREES IN THE GREATER CAUCASUS**Cabrayilzade S.,**

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МИКОБИОТИЧЕСКОЕ РАЗНООБРАЗИЕ И ФИТОПАТОГЕННЫЕ ГРИБЫ ЯБЛОНЬ БОЛЬШОГО КАВКАЗА**Джабраилзаде С.**

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<https://doi.org/10.5281/zenodo.15657600>**Abstract**

This study is devoted to the study of fungal diseases of apple trees grown on the southern slopes of the Greater Caucasus. Within the framework of the study, samples were collected from apple orchards and their mycobiotic composition was analyzed. The identified fungal species include *Sphaerotheca mali* Burr, *Gymnosporangium tremelloides* R. Harting, *Sclerotinia fructigena* Aderh and *Monilinia fructigena* Aderk, *Venturia inaequalis* Aderh, as well as *Septoria* sp.

The genus *Malus* includes more than 60 species. Two wild species of this genus are naturally distributed in the flora of the Caucasus and Azerbaijan. Other species and varieties are mainly cultivated in private farms.

In general, plants belonging to the genus *Malus* develop in the form of trees or shrubs. All species and varieties of apple shed their leaves in the winter months, and these plants usually reach a height of 5–10 meters.

Apple fruits are used in fresh, dried form, as well as in the preparation of jam, jam, vinegar, kvass, preserves, puree and wine. Edible oil is obtained from its seeds. Its fruits are rich in vitamins A, B and C, sugar and iron. Vaccines are obtained from its peel and stem.

Various apple varieties, widespread on the southern slopes of the Greater Caucasus, are affected by a number of fungal diseases. Therefore, the study of the mycobiota of this economically and biologically important plant was identified as the main goal of the research.

Аннотация

Данное исследование посвящено изучению грибковых заболеваний, обнаруженных у яблонь, произрастающих на южном склоне Большого Кавказа. В рамках исследования были отобраны образцы из яблоневых садов и проанализирован их микобиотический состав. Идентифицированные виды грибов включают *Sphaerotheca mali* Burr, *Gymnosporangium tremelloides* R. Harting, *Sclerotinia fructigena* Aderh и *Monilinia fructigena* Aderk, *Venturia inaequalis* Aderh, а также *Septoria* sp.

Род Яблоня (*Malus*) насчитывает более 60 видов. Два диких вида этого рода естественным образом распространены во флоре Кавказа и Азербайджана. Остальные виды и сорта выращиваются в основном в частных хозяйствах.

В основном растения рода яблонь развиваются как деревья или кустарники. Все виды и сорта яблонь сбрасывают листья в зимние месяцы, и эти растения обычно достигают высоты 5–10 метров.

Яблоки употребляют в свежем виде, сушат, а также используют для приготовления джемов, желе, уксуса, кваса, варенья, пюре и вина. Из семян получают пищевое масло. Его плоды богаты витаминами А, В и С, сахаром и железом. Вакцины получают из его коры и стебля.

Различные сорта яблонь, широко распространенные на южных склонах Большого Кавказа, поражаются рядом грибковых заболеваний. По этой причине изучение микобиоты этого экономически и биологически важного растения было определено в качестве основной цели исследования.

Keywords: *Malus* spp., mycobiota, fungal diseases, phytopathogenic fungi, Greater Caucasus**Ключевые слова:** *Malus* spp., микобиота, грибковые заболевания, фитопатогенные грибы, Большой Кавказ.**Материалы и методы**

Необходимые для исследования материалы были собраны с растений яблони (*Malus* spp.) с тер-

риторий, расположенных на южном склоне Большого Кавказа, и доставлены в микологическую лабораторию кафедры ботаники Бакинского государственного университета. Здесь было проведено

микроскопическое и культуральное определение образцов.

В ходе исследования использовались различные питательные среды для культивирования и идентификации грибов - агар Чапека-Докса, агар Семени, картофельно-глюкозный агар, агар Чапека и рисовый агар.

Грибы, особенно относящиеся к роду *Septoria*, вызывают образование на поверхности листьев пятен разного цвета и размера. На начальной стадии пятна небольшие, но со временем разрастаются, покрывая значительную часть листа. Эти пятна имеют оттенки белого, серого, коричневого, зеленого и красного. Центральная часть пятен темнее, а края светлее, что считается типичным визуальным признаком.

Пикниды гриба *Septoria* в основном имеют шаровидную форму и располагаются под эпидермисом листа. Конидии бесцветные, стебельчатые, цилиндрические, с одной или несколькими перегородками. Интересным аспектом является то, что конидиальные структуры у этого гриба либо очень малы, либо вообще не наблюдаются.

Пикниды, выделенные из пораженной ткани растения, сначала стерилизовали 2%-ным раствором формальдегида в течение 30–60 секунд, затем промывали стерильной дистиллированной водой. После выдерживания пикнид в стерильной камере в течение 5–6 часов полученные из них споровые суспензии высевали на различные питательные среды.

Образцы грибов хранили в чашках Петри в термостате при температуре 27–28°C, наблюдения проводили каждые три дня и результаты регистрировали.

Для определения видовой принадлежности *Septoria* и других родов грибов использовались перечисленные выше различные питательные среды. В ходе морфобиологических исследований изучали цвет, диаметр, внешний вид колоний, время образования мицелия, стадии формирования конидиальных структур и конидий.

При идентификации конидий учитывались такие морфологические характеристики, как цвет, цвет и толщина клеточной стенки, а также то, являются ли они одноклеточными или септированными. Видовой состав образцов грибов определялся на основании всех перечисленных выше признаков [1].

Основные грибковые заболевания яблонь *Sphaerotheca mali* Burr.

Мицелий на листьях, изначально белый, позднее темнеет и становится серым. Хорошо развитый мицелий образует на листе толстый слой. Гаустории проникают во внутренние ткани листа. При рассмотрении через увеличительное стекло отчетливо видны конидиальные структуры и конидии внутри мицелия. Конидии неразветвленные и имеют простое строение. Конидии бесцветные, одноклеточные, яйцевидной или эллиптической формы. Конидии яйцевидной формы расположены цепочками на конидиеносце. Эта стадия представляет собой конидиальную стадию гриба, называемую Оидий. Размер конидий 60–90×35–40 мкм.

Размер плодового тела составляет 180–200 мкм. Размеры мешочков составляют 60–85×30–40 мкм. В каждом мешочке находится от 2 до 8 спор, иногда золотистых, бесцветных, эллиптических (размеры 40–40×20–25 мкм). Этот гриб считается опасным патогеном не только для сортов яблонь, но и для других растений. В результате заболевания процесс фотосинтеза в листьях прекращается, листья засыхают и опадают. Интересно, что конидиальная стадия у рода *Sphaerotheca mali* хорошо известна. Заболевание распространяется как с одного листа на другой, так и с одного растения на другое через конидии.

Gymnosporangium tremelloides

Этот грибок наблюдается на листьях, молодых ветвях и плодах яблони. Пикниды имеют черный цвет и располагаются на поверхности листа, окруженные красной каймой. Эцидии располагаются на нижней поверхности листа, имеют цилиндрическую форму и размеры 35–40×30–35 мкм. Уредоспоры имеют очень короткие ножки и размеры 40–45×40–40 мкм. Телеитоспоры темно-каштанового цвета, с толстой шляпкой и ножковидной ножкой (35–60×20–35 мкм). Грибок может поражать все сорта яблок.

***Sclerotinia fructigena* Aderh.**

Этот патоген вызывает гниение плодов у различных сортов яблок. Конидии развиваются преимущественно на поврежденных плодах. Такие плоды могут оставаться на дереве до поздней осени. Больные плоды, упавшие на землю, могут быть носителями инфекции до двух лет, а конидии сохраняют свою инфекционную способность в течение длительного времени. Плодовое тело гриба — апотеций, которое образуется группами и полностью покрывает поверхность плода. В гнилых (восковых) плодах эти тельца имеют черный цвет и форму открытых чашек или блюдец. Интересно, что плодовое тело имеет цилиндрическую длинную ножку. Размеры мешочков составляют 120–190×10–15 мкм, а спор — 10–15×5–5,5 мкм. Конидиальная стадия гриба *Monilia grataegi* Погибла. называется [3–7].

***Monilia fructigena* Aderh.**

Грибок поражает преимущественно спелые плоды яблок. Инфекция проникает в поврежденные плоды через насекомых или ветер. Фрукты с трещинами на кожуре более восприимчивы к инфекции. Конидии попадают на поверхность плода, образуют мицелий и проникают внутрь, вызывая гниение. У зараженных плодов наблюдается размягчение и побурение. На поверхности образуются оранжевые конидиальные подушечки. Эти подушечки состоят из коротких конидиеносцев и цепочек овальных конидий. Этот период называется стадией гриба *Oidium*. Грибок продолжает развиваться на опавших плодах. В конце лета на поверхности плодов образуются сине-черные склероции. Склероции зимуют, а весной развиваются конидиальные подушечки. Апотеции у этого вида не наблюдались. Размер плодового тела 250–280×180–220 мкм, размер мешочков 110–120×15,5–16 мкм, размер

спор 12–14×6–7,5 мкм. Конидиальный цикл *Monilinia fructigena* Aderh. характеризуется [7].

***Venturia inaequalis* Aderh.**

Это заболевание, широко распространенное во всех районах возделывания яблони в республике, особенно на южных склонах Большого Кавказа, имеет большое практическое значение. Основным симптомом заболевания является образование на поверхности листьев яблони оливкового цвета, бархатистых грибковых масс. Эти скопления состоят из конидиеносцев и конидий, принадлежащих паразиту. Эта стадия грибка называется *Fusicladium*. Следует отметить, что *Fusicladium* может образовывать конидии до 10 раз в течение вегетационного периода, что приводит к быстрому и повсеместному распространению заболевания. Созревающие конидии прорываются через кутикулу листа, выходят наружу и перемещаются на здоровые листья.

Плодовое тело гриба — черный шаровидный псевдотеций (иногда встречаются также перитеции). Внутри мешочков находятся псевдопарафизы в форме булавок. Кисты имеют оливковый цвет и септированную структуру. Гриб зимует на растительных остатках. Размер псевдотециев составляет 0,09–0,15 мм, размер мешочков — 50–80×8–10 мкм, размер спор — 8 мкм [1,2,7].

***Septoria* – sp.**

Сначала на листьях яблони появляются отдельные красновато-розовые пятна. К концу вегетации эти пятна разрастаются и покрывают всю поверхность листа. После того, как пятна полностью распространятся, листья засыхают. Внутри пятен образуются многочисленные пикниды гриба. Размеры сферических пикнид составляют 190–450 мкм. Конидии имеют цилиндрическую форму, 4–5 перегородок и размеры 30–40 × 5,5–6,5 мкм.

При выделении рассматриваемого грибка из естественной среды обитания и его культивировании в искусственных питательных средах наблюдается ряд интересных закономерностей. Так, если в естественных условиях пикниды на листьях яблони формируются в течение 60–70 дней, то в искусственных питательных средах этот период сокращается до 28–30 дней. При этом наблюдается изменение размеров пикнид — в искусственной среде их размер составляет 120–180 мкм. Это изменение также отражается на размере конидий. В искусственных питательных средах их размер составлял 15–20 × 2,5–3,5 мкм.

В ходе исследований данный гриб был испытан на пяти различных питательных средах и подробно изучены морфобиологические особенности видов, относящихся к роду *Septoria*. Исследования показали, что наиболее подходящей питательной средой для выращивания этого гриба является среда Чапека-Докса. Особенно интересно, что в этой среде мицелий равномерно покрывает всю поверхность чашки Петри, визуально создавая впечатление, что чашка заполнена ватой. Хотя в других средах цвет гриба варьируется от розового до каштанового, в среде Чапека-Докса он приобретает ярко-красный цвет. В этой среде для образования пикнид достаточно 20–25 дней.

На основании результатов исследований можно сказать, что культивирование рода *Septoria* на питательной среде Чапека-Докса дает как более быстрые, так и более качественные результаты. Следует отметить, что род *Septoria*, выделенный из листьев яблони, нами изучен впервые, и до настоящего времени данных об изучении этого рода на этом растении не обнаружено [2,3,7].

Закключение

В результате проведенных исследований изучены морфологические и биологические особенности основных микобиотических возбудителей, распространенных на растениях яблони, а также установлен механизм их воздействия на растения и условия развития.

Установлено, что мучнистая роса (*Sphaerotheca mali* Burr) и ржавчина (*Gymnosporangium tremelloides* R. Hartig) являются грибковыми патогенами, которые наносят наибольший ущерб листьям и молодым органам растений яблони. Эти заболевания значительно замедляют развитие растений, ослабляя процесс фотосинтеза.

Грибы, вызывающие гниение плодов, — *Sclerotinia fructigena* и *Monilinia fructigena* — снижают урожайность плодов, в результате чего больные плоды долгое время остаются на дереве и в почве, являясь источником инфекции.

Впервые на листьях яблони выявлен гриб рода *Septoria* и изучены его морфобиологические особенности на искусственных питательных средах. Исследования показали, что наиболее благоприятные условия для развития гриба *Septoria* создаются на питательной среде Чапека-Докса. В этой среде как развитие мицелия, так и образование пикнид происходят более быстро и интенсивно.

В целом изучение микобиоты растений яблони имеет большое значение с точки зрения охраны их здоровья, повышения продуктивности и разработки эффективных мер борьбы.

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CHEMICAL SCIENCES

PHYSICAL-CHEMICAL STUDIES OF INTERACTION AND GLASS FORMATION IN THE $\text{As}_2\text{Te}_3\text{-Tl}_2\text{Se}$ SYSTEM

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Abstract

Physicochemical studies of interaction and glass formation in the $\text{As}_2\text{Te}_3\text{-Tl}_2\text{Se}$ system were carried out using the following methods: differential thermal analysis (DTA), X-ray diffraction analysis (XRD), microstructural analysis (MSA), and by measuring microhardness and density, T-x was constructed phase diagram. The system is a partially quasi-binary diagonal section of the ternary reciprocal system Tl,As//Se,Te . When the component ratio is 1:1, a quaternary compound of the composition $\text{Tl}_2\text{As}_2\text{SeTe}_3$ is formed, which melts congruently at 270°C . It has been established that the $\text{Tl}_2\text{As}_2\text{SeTe}_3$ compound crystallizes in the tetragonal syngony with lattice parameters: $a=11.47 \text{ \AA}$; $c=9.50 \text{ \AA}$, $z=6$, $\rho_{\text{pucn.}}=7.98 \text{ g/cm}^3$, $\rho_{\text{X-ray}}=8.13 \text{ g/cm}^3$. In the system at room temperature, solid solutions based on As_2Te_3 reach 3.3 mol % Tl_2Se , and solid solutions based on Tl_2Se are practically not established. Under normal conditions, extensive areas of glass formation based on $\text{Tl}_2\text{As}_2\text{SeTe}_3$ were found in the concentration range of 35-70 mol % Tl_2Se .

Introduction

One of the important tasks facing the chemistry and physics of semiconductors is the study of the synthesis and properties of materials consisting of energy converters with photo- and thermoelectric properties for the efficient use of alternative energy sources. Obtaining phase diagrams of the corresponding systems in new semiconductor materials with complex properties is of great importance.

It is known that arsenic chalcogenides and alloys based on them, new complex phases, are materials with photoelectric [1-8], luminescent [9,10], properties widely used in color television, IR optics in memory centres [11-13].

In recent years, chalcogenide fibres [14-19] based on As_2S_3 and As_2Se_3 have been used to transmit light in the mid-IR range and have found application as a compact nonlinear medium allowing Raman amplification [20] and lasing [21]. The As_2Te_3 compound does not form glass under normal conditions, but ternary and quaternary compounds obtained in systems consisting of thallium chalcogenides are glassy and form large areas. The As_2Te_3 compound and the complex phases obtained on its basis are materials with photoelectric properties [22,23]. Many systems involving arsenic and thallium chalcogenides have been studied in the literature [24-27].

The purpose of this work is to study the interaction and glass formation in the $\text{As}_2\text{Te}_3\text{-Tl}_2\text{Se}$ system, as well as the search for new semiconductor phases.

The initial components of the system As_2Te_3 and Tl_2Se are characterized by the following data: The As_2Te_3 compound melts at 381°C and crystallizes in a monoclinic syngony with lattice parameters: $a = 1.4339$; $b = 0.4006$; $c = 0.9873 \text{ nm}$, $\beta = 95^\circ$, sp. gr. C2/m [28]. The Tl_2Se compound melts the open maximum at 390°C and crystallizes in a tetragonal syngony with lattice parameters: $a = 0.854 \text{ nm}$, $c = 0.271 \text{ nm}$, density $\rho = 9.65 \text{ g/cm}^3$ [29].

Experimental part

To study the $\text{As}_2\text{Te}_3\text{-Tl}_2\text{Se}$ system, alloys were synthesized from the As_2Te_3 and Tl_2Se components in evacuated quartz ampoules at a pressure of 0.133 Pa in the temperature range $500\text{-}700^\circ\text{C}$. Then the alloys were homogenized by annealing at 190°C for 540 hours. After homogenization of the alloys, the systems were studied using the methods of physicochemical analysis (DTA, X-ray diffraction, MSA), as well as density and microhardness measurements. Differential thermal analysis of the samples was carried out using a THERMOSCAN-2 device. Al_2O_3 was used as standard, heating rate was 5 deg/min .

X-ray phase analysis was performed on a D2 PHASER X-ray diffractometer. A $\text{CuK}\alpha$ cathode and a

Ni filter were used as irradiators. Microhardness was measured using a PMT-3 metallographic microscope. Microstructural analysis of the alloys was carried out using a MIM-8 microscope.

Results and its discussion

Alloys of the $\text{As}_2\text{Te}_3\text{-Tl}_2\text{Se}$ system were synthesized from As_2Te_3 and Tl_2Se components in quartz ampoules evacuated to 0.133 Pa at a temperature of 700-800°C. The melts were cooled slowly at a rate of 150 deg/h. up to 400°C, then at a speed of (50-60) deg/h. Alloys containing 35-70 mol % Tl_2Se is obtained in glassy form. Alloys with a high content of As_2Te_3 are stable in water and air at room temperature; they dissolve in mineral acids HCl, HNO_3 and alkalis NaOH, KOH.

To homogenize the alloys, the $\text{As}_2\text{Te}_3\text{-Tl}_2\text{Se}$ systems were annealed at 190, 250 and 300°C for 750 hours. After annealing, the alloys were studied using a set of methods of physicochemical analysis: DTA, XRF, MSA, microhardness and density measurements.

Some physicochemical properties of alloys of the $\text{As}_2\text{Te}_3\text{-Tl}_2\text{Se}$ system were studied before and after annealing (Table 1.2). Thermal analysis showed that in the concentration range of 35-70 mol. % Tl_2Se on thermograms of cast alloys a softening temperature of 155-125°C is observed. DTA indicates that with the exception of alloys in the range of 20-80 mol % Tl_2Se all effects, in the thermograms of the obtained alloys, are endothermic and reversible. Glass-crystalline regions are observed in the concentration range of 20-35 mol % Tl_2Se and 70-80 mol % Tl_2Se .

The XRF results also confirm the DTA and MSA data. In the diffraction patterns of alloys of the $\text{As}_2\text{Te}_3\text{-Tl}_2\text{Se}$ system in the range of 35-70 mol % Tl_2Se no intense diffraction maxima are observed (Fig. 1). After long-term annealing, softening temperatures disappear from the glass region in the heating curves of the alloys, and intense diffraction reflections appear in the diffraction pattern (Fig. 2). In Fig. 1 shows X-ray diffraction patterns of alloys from the region of glasses of the $\text{As}_2\text{Te}_3\text{-Tl}_2\text{Se}$ system containing 30, 50, 60 and 70 mol % Tl_2Se .

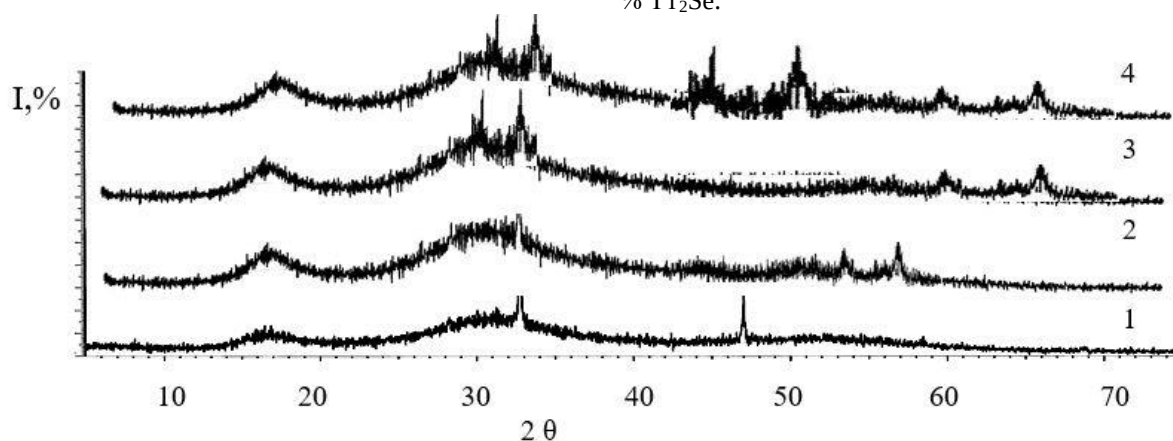


Fig.1. X-ray diffraction patterns of alloys from the glass region of the $\text{As}_2\text{Te}_3\text{-Tl}_2\text{Se}$ system. 1-40 mol %, 2-50 mol %, 3-60 mol %, 4-70 mol. % Tl_2Se .

A microscopic study of alloys of the $\text{As}_2\text{Te}_3\text{-Tl}_2\text{Se}$ system showed that alloys in the concentration range of 35-70 mol % Tl_2Se are glasses, and in the region of 15-35 mol % Tl_2Se and 70-80 mol. % Tl_2Se are glasses with crystalline inclusions. Finally, it was revealed that with slow cooling in the system, the glass formation region based on $\text{Tl}_2\text{As}_2\text{SeTe}_3$ extends from 35 to 70 mol % Tl_2Se . Some physicochemical properties of the alloys of the system before and after annealing are given in (Tables 1 and 2). As can be seen from Table 1, the softening temperature T_g of alloys from the glass region, in the concentration range of 20-70 mol % Tl_2Se , varies between 155-125°C. The microhardness of alloys from the glass region varies within the range (810-

850) MPa (Table 1). After prolonged annealing in the concentration range of 35-70 mol % Tl_2Se in thermograms of glassy alloys, the temperature T_g disappears, and the temperatures associated with the liquidus and solidus remain unchanged (Table 2).

This means that after heat treatment, glassy alloys are completely crystallized. As can be seen from table. 1 and 2, the microhardness of alloys from the glass region is greater than from the crystalline state. On the other hand, the density of glassy alloys is lower compared to the density of crystalline alloys. The results obtained are in good agreement with the literature data on the properties of glasses.

Table 1.

Composition, DTA results, microhardness measurements and determinations density of alloys of the As₂Te₃-Tl₂Se system before annealing (S₁- Tl₂As₂SeTe₃), (S₂- Tl₂As₂Se₃Te)

Composition, mol %		Thermal effects, °C	Density, g/cm ³	Microhardness, MPa				
As ₂ Te ₃	Tl ₂ Se			α	S ₁	S ₂	Tl ₂ Te	Tl ₂ Se
				P=0,15 N				
100	0,0	381	6.23	1650	-	-	-	-
97	3,0	285.365	6.27	1690	-	-	-	-
95	5,0	245.350	6.40	1700	-	-	-	-
90	10	190.340	6.57	1700	-	-	-	-
80	20	155.190.285	6.91	1700	-	-	-	-
75	25	150.90.235	7.08	-	-	-	-	-
70	30	150.190	7.32	Eutec.	Eutec.	-	-	-
65	35	140.190;225	7.42	-	810	-	-	-
60	40	130.190.240	7.60	-	830	-	-	-
55	45	125.190.260	7.76	-	840	-	-	-
50	50	125.270	7.98	-	850	-	-	-
45	55	125.255,265	8,,10	-	850	-	-	-
40	60	125,225.255.260	8.28	-	850	-	-	-
35	65	125.225.245.290	8.45	-	Eutec.	Eutec.	Eutec.	
30	70	125.225.325	8.63	-	-	980	-	-
25	75	320.350	8.79	-	-	980	550	-
20	80	300.315.345	8.97	-	-	980	560	-
15	85	300.310.340	9,13	-	-	-	-	-
10	90	300.345	9.31	-	-	Eutec.	Eutec.	Eutec.
5.0	95	300.345.365	9.47	-	-	-	-	540
3,0	97	300.345.380	9.55	-	-	-	-	530
0.0	100	390	9.65	-	-	-	-	520

When measuring microhardness, five rows of values were obtained (Tables 1 and 2). After annealing at 190°C for 540 hours (Table 2), microhardness for the gray phase (1650-1700) MPa (α-phase based on As₂Te₃), for the dark phase (730-760) MPa (Tl₂As₂SeTe₃), for light gray phase (980) MPa (Tl₂As₂Se₃Te), for the light phase (550-560) MPa (Tl₂Te) and for the dark gray phase (520-540) MPa (Tl₂Se).

Table 2.

Composition, DTA results, microhardness measurements and determinations densities of alloys of the As₂Te₃-Tl₂Se system after annealing (S₁- Tl₂As₂SeTe₃), (S₂- Tl₂As₂Se₃Te)

Composition, mol %		Thermal effects, °C	Density, g/cm ³	Microhardness, MPa				
As ₂ Te ₃	Tl ₂ Se			α	S ₁	S ₂	Tl ₂ Te	Tl ₂ Se
				P=0,10 N				
100	0,0	381	6.23	1650	-	-	-	-
97	3,0	285.365	6.27	1690	-	-	-	-
95	5,0	245.350	6.40	1700	-	-	-	-
90	10	190.340	6.57	1700	-	-	-	-
80	20	190.285	6.91	1700	-	-	-	-
75	25	190.235	7.18	-	-	-	-	-
70	30	190	7.40	Eutec.	Eutec.	-	-	-
65	35	190.225	7.52	-	730	-	-	-
60	40	190.240	7.70	-	730	-	-	-
55	45	190.260	7.87	-	740	-	-	-
50	50	270	8.11	-	750	-	-	-
45	55	225.255.265	8.16	-	760	-	-	-
40	60	225.255.260	8.38		760	-	-	-
35	65	225.245.290	8.55	-	Eutec.	Eutec.	Eutec.	
30	70	225,325	8.68	-	-	980	-	-
25	75	320.350	8.79	-	-	980	550	-
20	80	300.315.345	8.97	-	-	980	560	-
15	85	300.310.340	9.13	-	-	-	-	-
10	90	300.345	9.31	-	-	Eutec.	Eutec.	Eutec.
5.0	95	300.345.365	9.47	-		-	-	540
3,0	97	300.345.380	9.55	-	-	-	-	530
0,0	100	390	9.65	-	-	-	-	520

The microhardness of the glassy compound $\text{Tl}_2\text{As}_2\text{SeTe}_3$ before and after annealing changes noticeably (Tables 1, 2). The state diagram of the As_2Te_3 - Tl_2Se system is shown in Fig. 2. The nature of the chemical interaction in the As_2Te_3 - Tl_2Se and As_2Te_3 - Tl_2S systems is the same. Both systems are partially quasi-binary and represent diagonal sections of the ternary reciprocal systems $\text{As}, \text{Tl}/\text{Se}, \text{Te}$ and $\text{As}, \text{Tl}/\text{S}, \text{Te}$, respectively.

One chemical compound of the composition $\text{Tl}_2\text{As}_2\text{SeTe}_3$ is formed in the system, which melts congruently at 270°C . The $\text{Tl}_2\text{As}_2\text{SeTe}_3$ compounds have a similar character and can be considered derivatives of $\text{Tl}_2\text{As}_2\text{X}_4 = \text{TlAsX}_2$. Here, isomorphic substitution of chalcogens occurs.

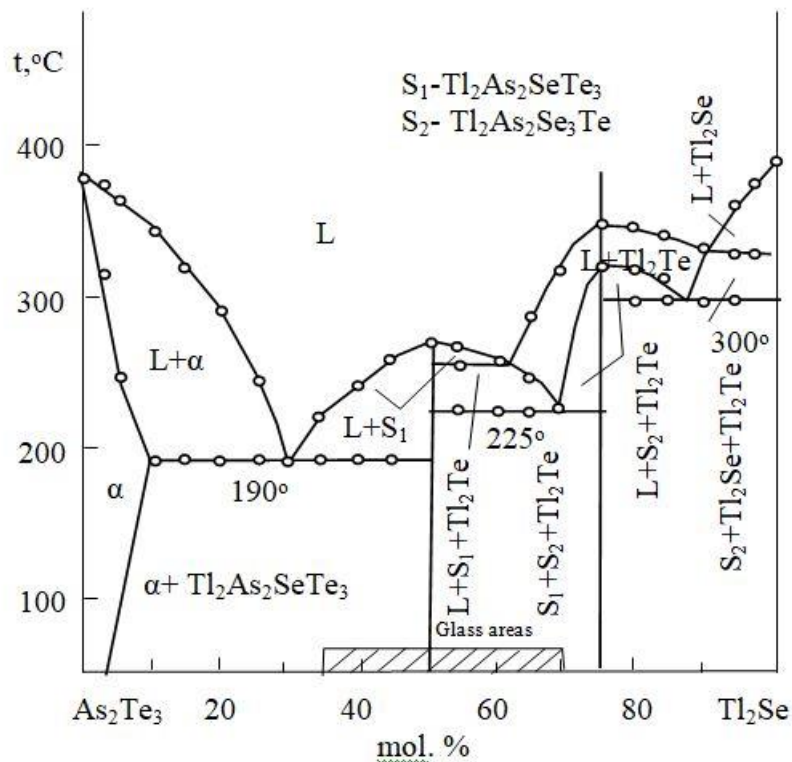


Fig.2. Phase diagram of the As_2Te_3 - Tl_2Se system.

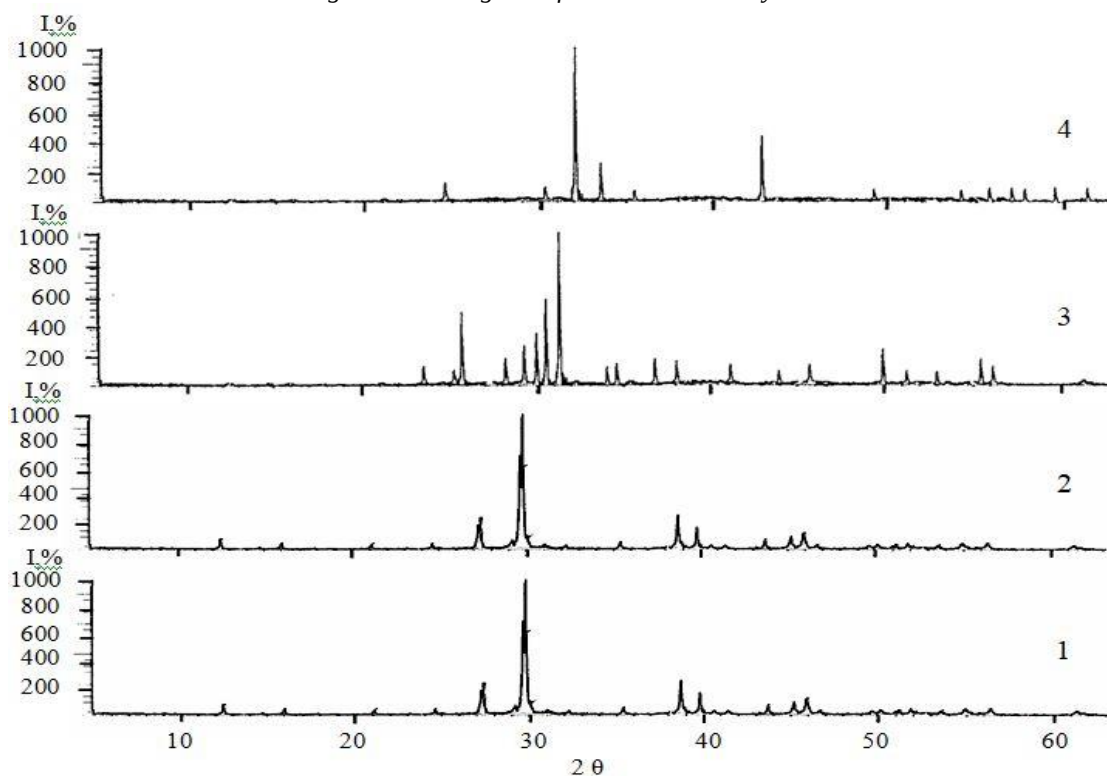


Fig.3. Diffraction patterns of alloys of the As_2Te_3 - Tl_2Se system.
1- As_2Te_3 , 2-3 mol %, 3-50 mol % ($\text{Tl}_2\text{As}_2\text{SeTe}_3$), 4-100 mol % Tl_2Se .

The existence of the $\text{Tl}_2\text{As}_2\text{SeTe}_3$ compound was confirmed by methods of physicochemical analysis (DTA, XRF, MSA, determination of microhardness and density). The XRD results of alloys of the As_2Te_3 - Tl_2Se system are shown in Fig. 3. As can be seen from Fig. 3, the X-ray diffraction pattern of the 1:1 alloy ($\text{Tl}_2\text{As}_2\text{SeTe}_3$) contains diffraction lines that differ from the lines of the original components both in intensity and in the value of interplanar distances (Fig. This indicates the presence of a new phase in the As_2Te_3 - Tl_2Se

system, formed by the reaction: As_2Te_3 - $\text{Tl}_2\text{Se} = \text{Tl}_2\text{As}_2\text{SeTe}_3$

Interplanar distances and line intensities in the X-ray diffraction patterns of the remaining alloys, excluding the regions of solid solutions, indicate the presence of a mixture of other phases in them. Identification of the powder pattern shows that $\text{Tl}_2\text{As}_2\text{SeTe}_3$ crystallizes in the tetragonal syngony with lattice parameters: $a=11.47 \text{ \AA}$; $c=9.50 \text{ \AA}$, $z=6$, density $\rho_{\text{puc}}=7.98 \text{ g/cm}^3$, $\rho_{\text{X-ray}}=8.13 \text{ g/cm}^3$. Table 3 shows the crystallographic data of the compound $\text{Tl}_2\text{As}_2\text{SeTe}_3$.

Table 3.

Crystallographic data of the compound $\text{Tl}_2\text{As}_2\text{SeTe}_3$

No	I, %	$d_{\text{exp}}, \text{\AA}$	$d_{\text{cal}}, \text{\AA}$	h	k	l
1	17	3,7319	3,7920	2	2	1
2	12	3,3903	3,3903	3	1	1
3	57	3,2318	3,1814	3	2	0
4	21	3,1605	3,1670	0	0	3
5	29	3,0780	3,0846	2	2	2
6	96	2,9785	2,9785	3	0	2
7	61	2,9308	2,9501	1	1	3
8	100	2,8665	2,8687	4	0	0
9	14	2,6397	2,6943	3	2	2
10	19	2,5996	2,6011	3	3	1
11	21	2,4295	2,4390	3	0	3
12	17	2,3678	2,3756	0	0	4
13	14	2,1963	2,2947	2	0	4
14	9	2,0498	2,0498	2	2	4
15	14	1,9672	1,9672	5	3	0
16	24	1,8241	1,8176	5	3	2
17	9	1,7841	1,7817	6	2	1
18	9	1,7187	1,7206	2	2	5
19	19	1,6556	1,6502	5	0	4
20	16	1,6393	1,6386	7	0	0

Conclusion

Thus, a state diagram of the As_2Te_3 - Tl_2Se system has been constructed. The system is characterized by the formation of one chemical compound $\text{Tl}_2\text{As}_2\text{SeTe}_3$. The $\text{Tl}_2\text{As}_2\text{SeTe}_3$ compound crystallizes in the tetragonal syngony with lattice parameters: $a=11.47 \text{ \AA}$; $c=9.50 \text{ \AA}$, $z=6$, $\rho_{\text{pucn.}}=7.98 \text{ g/cm}^3$, $\rho_{\text{X-ray}}=8.13 \text{ g/cm}^3$. It has been established that in the As_2Te_3 - Tl_2Se system based on As_2Te_3 , solid solutions reach 3.3 mol % Tl_2Se . It was revealed that with slow cooling, the boundary of the glass formation region extends from 35 to 70 mol % Tl_2Se . A study of the chemical interaction of thallium chalcogenides with arsenic chalcogenides showed that the alloys exhibit a greater tendency to glass formation. The resulting alloys are compact, with a high content of As_2Te_3 , the color of the alloys has a metallic luster, the remaining alloys are dark brown.

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ECONOMIC SCIENCES

INNOVATIVE TECHNOLOGIES IN BUSINESS

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Abstract

The business environment has undergone significant changes in the past few years, primarily driven by the advancement of digital technologies. From artificial intelligence to online shopping, digital tools have changed the way companies do business. This process is known as digital transformation, and it enables small and medium-sized enterprises (SMEs) to remain competitive.

The rise of Digital Transformation has brought about a significant change in the way businesses evolve and are run. Companies need to adapt and innovate to remain relevant in the market constantly. Automating processes, analyzing data in real-time, and integrating technological solutions have become fundamental to business survival and growth.

Technological innovation plays a crucial role in ensuring business survival and success. The ability to adapt to change and remain competitive in today's markets depends directly on the ability to incorporate technology into your operations. Technological innovations are essential to ensure the long-term relevance and success of the business.

Keywords: Business, business model innovation, technological innovation, technologies

Introduction

Innovative technologies, such as AI, cloud computing, and blockchain, are transforming businesses by enhancing efficiency, creating new markets, and driving innovation across various industries. These technologies provide companies with opportunities to improve their operations, gain a competitive advantage, and adapt to shifting market demands.

Digital technology and its related systems are often seen as one of the main drivers of the long-term economy, whose growth rate has never been as rapid as it is today. Therefore, it is not surprising that the energy of experts is focused on how new digital technologies can simplify economic activities and improve the standard of living.

Discussion

The fact that digital technologies can improve the standard of living is possible through their implementation in the public and private sectors, which is undoubtedly attractive.

One of the key components of digital technology is blockchain, with the global market for it expected to reach \$3 trillion by the end of 2021, marking an all-time high in annual terms. The adoption of blockchain and the technology and products it supports will continue to impact business operations dramatically. But it is much more than a system for securely transferring cryptocurrencies. Beyond finance, it can be applied in various fields, including healthcare, insurance, voting, welfare

benefits, gambling, and artist royalties. They are already having a profound impact on business and society at many levels.

The main task for achieving economic growth is to improve investment and innovation management. Identify and address the most significant challenges hindering the economy. Critical issues include low competitiveness of the private sector, underdeveloped human capital, and limited access to financial resources. Three main problems are identified, which are divided into the following areas:

1. Improving the investment and business environment;
2. Innovation and technologies; Promoting export growth;
3. Developing infrastructure and maximizing transit potential.

A favorable business and investment environment has a significant impact on productivity, as it directly influences the efficient allocation of resources in the private sector. Due to intense global competition and dynamic economic processes, business requirements are changing rapidly. Accordingly, it is essential to continually improve the business and investment environment. To ensure free trade and competition, legislative and institutional mechanisms must be improved first. Competition legislation must establish effective norms and enforcement mechanisms for eliminating cartel agreements, restrictive business practices, and the

abuse of dominant positions. At the same time, competition legislation mustn't create artificial barriers to the growth and development of companies.

To facilitate the effective functioning of businesses and increase competitiveness, along with the ease of starting a business, the ease of closing a company is also of great importance.

In the field of innovation and technology development, it is essential to promote innovative activities and the transfer and implementation of the latest technologies. Additionally, it is crucial to encourage the adoption of modern technologies that prioritize environmental protection and the advancement of a green economy, particularly for small and medium-sized enterprises, which are key drivers of innovation.

To support innovation, it is necessary to develop infrastructure (technoparks, incubators) and train a workforce with appropriate qualifications. Additionally, the required supporting infrastructure for research and development should be enhanced for educational institutions and research laboratories.

The protection of intellectual property rights is significant for the development of innovations. For this purpose, it is necessary to improve the legislative and institutional framework related to intellectual property rights.

The role of the state in the field of innovations and technologies is manifested in strengthening the transfer and practical implementation of technologies by companies, strengthening ties between scientific circles and business, raising the level of innovations, and, as a result, in the orientation of exports towards more high-tech products.

Meanwhile, the world is changing. No one expects the economy and its 21st-century structure to remain the same as they are today. Many professions, even entire industries, are disappearing. However, new directions, new types of jobs, and new opportunities are emerging.

The leaders of the world's leading countries are thinking and discussing what tomorrow will be like, where their countries will fit into the new reality—the Fourth Industrial Revolution, which has already been dubbed.

For centuries, agriculture has been the leading sector of the economy. From the end of the 18th century onwards, machines were able to replace human labor and increase their productivity. As a result, industry gradually began to gain a dominant place in the economies of many countries and also became a generator of new types of jobs. The Second Industrial Revolution followed this: the foundation for mass production using electricity was laid, and the irreversible process of urbanization began. The Third Industrial Revolution began in the 1970s, when new information technologies made it possible to automate processes. This significantly reduced human involvement in the production process, although it could not eliminate the role.

Today, we are at the stage of a new, fourth industrial revolution that will fundamentally change our lives in the future. According to experts, it is expected that soon almost all electrical appliances will be connected

through a virtual network and will exchange information with each other intensively. As a result, entirely new possibilities for their management will exist. The so-called "smart manufacturing" based on cyber-physical systems is expected to increase production efficiency further and accelerate technological development. New types of services will emerge for consumers, further simplifying human life. Artificial intelligence is what distinguishes the new industrial era, and this is already a reality.

The United States was a pioneer in creating technology parks, with the legendary Silicon Valley being founded near Stanford University in the 1950s. Today, there are over 400 technology parks worldwide, with the number continuing to grow.

Georgia has already taken some steps towards the development of high-tech enterprises. In 2010, the "Law of Georgia on Information Technology Zones" was adopted, followed the following year by the creation of a small-scale and first ICT business incubator in Georgia, based on the Georgian Technical University. In 2014, the "Innovation and Technology Agency" was established, which opened the first technopark in Georgia in 2016. It provides interested parties with modern industrial laboratories, a shared workspace, and other opportunities for the development of startup companies. However, all this is just the beginning, and a lot of work lies ahead. It is necessary to continue reforms in the education sector and adapt tax legislation to the ICT sector. Foreign investments can play a decisive role, which, unfortunately, is not many today.

Naturally, it isn't easy to prove that information technologies will unconditionally become the locomotive of the Georgian economy. Still, the fact remains that our country has an opportunity in this regard. A competitive education system, liberal tax policy, and a comfortable environment for doing business will be good prerequisites for this.

Types of technology, such as industrial robots, artificial intelligence, blockchain, virtual and augmented reality, and 3D printing, represent significant achievements in technological progress. Through these advancements, it is possible to achieve higher rates of economic growth than ever before.

- Artificial intelligence describes computers that can "think" like humans. They can recognize complex patterns, process information, draw conclusions, and make recommendations. Artificial intelligence is utilized in various ways, from identifying patterns in vast amounts of unstructured data to automatically correcting errors on your phone.

- Blockchain is a secure, decentralized, and transparent way to record and share data, without the intervention of third parties. The digital currency Bitcoin is the most well-known blockchain application. However, the technology can be utilized in other ways, including helping to track supply chains, anonymizing sensitive medical data, and combating voter fraud.

- New computing technologies are making computers smarter. They allow computers to process vast amounts of data faster than ever before, and the advent of the cloud has allowed businesses to securely store and access their information from anywhere over

the internet. Quantum computing technologies, now being developed, will eventually make computers millions of times more powerful. These computers will have the potential to power artificial intelligence, create highly complex models of data in seconds, and accelerate the discovery of new materials.

- Biotechnology uses cellular and biomolecular processes to develop new technologies and products for a variety of uses, including the development of new pharmaceuticals and materials, more efficient industrial production processes, and cleaner, more efficient energy sources;

- Robotics is the design, manufacture, and use of robots for personal and commercial use. While we still don't see robot assistants in every home, technological advances have made robots more complex and sophisticated. They are used in a wide range of fields, including manufacturing, health and safety, and human assistance.

- 3D printing allows manufacturing businesses to make their parts with fewer tools, at a lower cost, and faster than traditional processes. Additionally, designs can be customized to ensure a perfect fit.

Innovation can be described as the creation of a new idea or mechanism. Innovation is considered the process of creating better solutions that arise from market, government, or social requirements, through the creation and implementation of new processes, services, technologies, or products. In scientific terms, innovative technology refers to any mechanism or knowledge, whereas in economics, technological innovation is a business or marketing model that impacts society with original ideas and solutions. During the process of technological innovation, an entrepreneur undertakes activities such as introducing new management methods and applications, adopting new production methods and processes, offering services, exploring new markets, and providing new value propositions. A business that consistently introduces new technologies and innovations will be much more sustainable in an era of rapid change.

Conclusion

Technological innovation enables the automation of repetitive tasks, eliminates time-consuming manual

processes, reduces operational errors, accelerates processes, and enhances communication between departments and with customers. Through the efficient use of technology, it is possible to simplify operations, make faster and more accurate decisions, and offer an improved customer experience.

With the emergence of innovative new technologies, such as Artificial Intelligence, the Internet of Things (IoT), and Big Data analysis, companies and organizations have the opportunity to optimize their work processes, enhance the customer experience, and drive growth.

The benefits of innovation extend to all business models, enabling companies to stand out with unique offerings. By understanding customer needs and fostering a culture of continuous innovation, companies can attract new customers and deepen relationships with existing ones. Innovation, in turn, drives growth by opening new opportunities and diversifying revenue streams.

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СТРАТЕГІЇ МАРКЕТИНГОВОЇ АДАПТАЦІЇ БІЗНЕСУ В УКРАЇНІ ДО УМОВ НЕВИЗНАЧЕНОСТІ

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Abstract

The article studies modern approaches to formation of marketing strategies of adaptation of Ukrainian enterprises in conditions of uncertainty and crisis phenomena. The theoretical foundations for building adaptive marketing strategies are disclosed, the key approaches to managing marketing activities in an unstable external environment are systematised. The features of implementation of adaptive strategies in the context of current challenges faced by the Ukrainian economy are analysed. A comprehensive model of marketing adaptation is proposed, which takes into account the specifics of the functioning of enterprises in conditions of constant change and high level of uncertainty.

Анотація

У статті досліджено сучасні підходи до формування маркетингових стратегій адаптації українських підприємств в умовах невизначеності та кризових явищ. Розкрито теоретичні засади побудови адаптивних маркетингових стратегій, здійснено систематизацію ключових підходів до управління маркетинговою діяльністю в умовах нестабільного зовнішнього середовища. Проаналізовано особливості впровадження адаптивних стратегій у контексті актуальних викликів, з якими стикається українська економіка. Запропоновано комплексну модель маркетингової адаптації, що враховує специфіку функціонування підприємств в умовах постійних змін і високого рівня невизначеності.

Keywords: marketing adaptation, strategic marketing, uncertainty, crisis management, digital transformation, consumer, Ukrainian business.

Ключові слова: маркетингова адаптація, стратегічний маркетинг, невизначеність, антикризовий менеджмент, цифрова трансформація, споживач, український бізнес.

У сучасних умовах постійної мінливості зовнішнього середовища маркетингова адаптація стає ключовим елементом забезпечення стійкого функціонування та розвитку підприємств. Зростання рівня невизначеності, пов'язане з глобальними кризами, технологічними змінами, геополітичними конфліктами та зміною поведінки споживачів, зумовлює потребу у переосмисленні теоретичних підходів до адаптивного маркетингового управління.

Теоретичні засади маркетингової адаптації охоплюють комплекс концепцій, рівнів реагування на зміни, типологій невизначеності та моделей адаптації, що дають змогу підприємствам бути гнучкими, інноваційними й конкурентоспроможними в умовах нестабільності [1-4]. Узагальнення ключових положень цієї проблематики подано в таблиці 1.

Теоретичні засади маркетингової адаптації в умовах невизначеності

Підрозділ	Ключові положення
Концептуальні основи адаптивного маркетингу	Маркетингова адаптація - це пристосування діяльності підприємства до змін середовища задля конкурентоспроможності та сталого розвитку. Рівні адаптації: <i>оперативна</i> - швидке коригування елементів маркетинг-міксу; <i>тактична</i> - модифікація програм та кампаній відповідно до тенденцій; <i>стратегічна</i> - зміна маркетингової стратегії в довгостроковій перспективі
Типологія невизначеності в маркетинговій діяльності	Класифікація невизначеності: <u>За джерелом:</u> <i>зовнішня</i> - макро- (PESTEL-фактори) і мікросередовище; <i>внутрішня</i> - внутрішні чинники підприємства <u>За характером прояву:</u> <i>статична</i> - відсутність повної інформації; <i>динамічна</i> - непередбачуваність змін
Теоретичні моделі адаптивного управління маркетингом	Модель адаптивного циклу Холлінга: експлуатація → консервація → вивільнення → реорганізація Концепція динамічних здібностей: організація має інтегрувати, створювати і змінювати компетенції для адаптації до змін; у маркетингу це гнучкість і оновлення стратегій.

Подані у таблиці теоретичні положення розкривають багаторівневу суть маркетингової адаптації як системного процесу, що охоплює як оперативні заходи з коригування маркетинг-міксу, так і стратегічне переосмислення підходів до управління в довгостроковій перспективі. Концептуальні основи адаптивного маркетингу передбачають здатність підприємства до гнучкого реагування на зовнішні та внутрішні виклики з метою збереження конкурентних переваг.

Важливим аспектом є типологізація невизначеності, що дозволяє ідентифікувати джерела та характер впливу змін на маркетингову діяльність. Зокрема, розмежування зовнішньої (макро- та мікросередовища) і внутрішньої невизначеності дає змогу формувати більш релевантні адаптивні стратегії. Крім того, поділ невизначеності за характером прояву на статичну та динамічну - дозволяє краще прогнозувати можливі сценарії розвитку ситуації.

Теоретичні моделі, зокрема адаптивний цикл Холлінга та концепція динамічних здібностей, виступають ефективним інструментарієм для аналізу й моделювання процесів адаптації. Адаптивний цикл ілюструє природну послідовність етапів змін, притаманних життєвому циклу системи, що дозволяє передбачити критичні точки трансформації. Натомість концепція динамічних здібностей фокусує увагу на здатності організації до постійного оновлення своїх компетенцій та стратегій у відповідь на зміни середовища.

Таким чином, системний аналіз теоретичних основ маркетингової адаптації дозволяє не лише глибше зрозуміти механізми реагування бізнесу на невизначеність, а й сформувати методологічне підґрунтя для розробки ефективних адаптивних стратегій у сучасних умовах нестабільності.

Маркетингове середовище в Україні відзначається високим рівнем волатильності, що зумовлено впливом як внутрішніх, так і зовнішніх чинників. Серед ключових дестабілізуючих факторів - політична нестабільність, економічна турбулентність,

інфляційні коливання, валютні ризики та непередбачуваність регуляторного середовища. Ці обставини суттєво ускладнюють процеси стратегічного маркетингового планування та реалізації довгострокових ринкових ініціатив.

Характерною ознакою українського ринку є підвищений рівень невизначеності споживчої поведінки, що пояснюється нерівномірністю доходів населення, нестабільністю купівельної спроможності, а також динамічними трансформаціями в структурі споживчих переваг [5]. За таких умов підприємства змушені орієнтуватися на гнучкі підходи до ринкової сегментації, адаптивне позиціонування товарів і персоналізовану комунікацію з цільовими аудиторіями.

На основі аналізу практик вітчизняних підприємств можна виокремити п'ять найбільш поширених стратегій маркетингової адаптації, що використовуються для забезпечення стабільності та конкурентоспроможності в умовах невизначеності [6-10]:

- *стратегія диверсифікації* передбачає розширення товарного асортименту, вихід на нові сегменти ринку та освоєння географічно нових територій. Такий підхід дозволяє мінімізувати ризики завдяки розподілу маркетингових зусиль між кількома напрямками діяльності;

- *стратегія концентрації* ґрунтується на фокусуванні на вузькоспеціалізованих ринкових нішах, де підприємство здатне досягти конкурентних переваг за рахунок глибокого знання потреб цільової аудиторії та високого рівня спеціалізації;

- *стратегія цифрової трансформації* полягає в інтеграції сучасних цифрових технологій у всі складові маркетингової діяльності - від аналізу ринку та поведінки споживачів до автоматизації комунікаційних процесів і персоналізації пропозицій;

- *стратегія партнерства* акцентує увагу на формуванні стратегічних альянсів, кооперації та спільному освоєнні ринку з іншими суб'єктами господарювання з метою оптимізації витрат і розподілу ризиків;

– *стратегія інновацій* орієнтована на безперервне оновлення продуктивних рішень, технологій та маркетингових підходів, що забезпечує відповідність актуальним запитам споживачів та змінам у зовнішньому середовищі.

Успішна реалізація стратегій маркетингової адаптації передбачає використання цілісного комплексу сучасних інструментів управління, серед яких ключову роль відіграють [11-13]:

– *системи маркетингової аналітики*, що забезпечують постійний моніторинг ринкових тенденцій, споживчої поведінки та ефективності маркетингових заходів. Використання цифрових платформ дозволяє здійснювати аналіз у реальному часі, оперативно реагуючи на зміни кон'юнктури;

– *гнучкі організаційні структури*, які сприяють підвищенню адаптивності підприємства. Створення міжфункціональних команд, делегування повноважень, запровадження методології agile-маркетингу - усе це забезпечує швидкість прийняття рішень і ефективність їх реалізації в умовах динамічного ринку;

– *сценарне планування*, як інструмент підготовки до альтернативних сценаріїв розвитку подій, дозволяє підприємствам проактивно розробляти варіативні стратегії реагування на потенційні виклики, що сприяє зниженню рівня ризиків і підвищенню стратегічної гнучкості.

У сукупності ці елементи формують підґрунтя для ефективного управління адаптаційними процесами в маркетинговій сфері українських підприємств, забезпечуючи їхню життєздатність у складному й нестабільному ринковому середовищі.

У сучасних умовах цифрова трансформація постає як один із визначальних факторів адаптаційної здатності підприємств до нестабільного й динамічного ринкового середовища [14, 15]. Впровадження цифрових технологій радикально змінює підходи до планування, реалізації та контролю маркетингових стратегій, забезпечуючи підприємствам нові інструменти для гнучкого реагування на виклики зовнішнього середовища. Цифрові рішення сприяють підвищенню точності прогнозування ринкових тенденцій, персоналізації маркетингових комунікацій і оптимізації бізнес-процесів шляхом автоматизації. Особливу роль у цьому процесі відіграють технології штучного інтелекту (ШІ) та машинного навчання, які дають змогу ефективно обробляти великі

обсяги даних (Big Data), виявляти приховані закономірності в поведінці споживачів і формувати відповідні маркетингові дії. Застосування аналітичних алгоритмів на базі ШІ дозволяє бізнесу не лише адаптуватися до поточних змін, а й здійснювати проактивне управління маркетинговою діяльністю, заздалегідь модифікуючи стратегії відповідно до прогнозованих змін у перевагах споживачів. У такий спосіб цифрова трансформація перетворюється з інструментального рішення на стратегічний ресурс для довгострокового розвитку і збереження конкурентних переваг в умовах невизначеності.

Оmnіканальний маркетинг - це комплексна стратегія комунікації, що передбачає інтеграцію всіх доступних каналів взаємодії з клієнтами (онлайн і офлайн) в єдиний, узгоджений механізм [16]. У контексті зростаючої турбулентності ринку та непередбачуваних змін у споживчій поведінці, omnіканальний підхід дозволяє підприємствам забезпечувати безперервний, персоналізований і релевантний зв'язок із цільовою аудиторією. Гнучкість цієї моделі полягає в здатності оперативно переключатися між каналами комунікації залежно від змін у зовнішньому середовищі (наприклад, обмеження роботи фізичних точок продажу, збої в логістиці тощо). Така адаптивність є особливо важливою в умовах кризових ситуацій, коли швидкість і цілісність комунікації стають критичними факторами для утримання клієнтської лояльності. Інтеграція цифрових (сайти, соціальні мережі, мобільні додатки, email-маркетинг) та традиційних каналів (торговельні точки, кол-центри, друковані ЗМІ) створює синергію, яка не лише підвищує ефективність маркетингових інвестицій, а й зміцнює конкурентні позиції компанії. Таким чином, omnіканальний маркетинг стає невід'ємним елементом адаптивної маркетингової стратегії, орієнтованої на довгострокову стабільність і стійкий розвиток бізнесу.

Ефективне управління ризиками є ключовим елементом стратегічної адаптації маркетингової діяльності в умовах нестабільного зовнішнього середовища [17, 18]. Процес ризик-менеджменту охоплює послідовні етапи ідентифікації ризиків, їх кількісної та якісної оцінки, розробки заходів з мінімізації потенційних негативних наслідків, а також систематичного моніторингу та перегляду ризик-профілю підприємства.

Класифікація маркетингових ризиків

<i>Критерій</i>	<i>Тип ризику</i>	<i>Зміст</i>
За джерелом виникнення	внутрішні ризики	пов'язані з внутрішніми процесами підприємства: – неефективне управління; – помилки в позиціонуванні; – низька кваліфікація персоналу
	зовнішні ризики	вплив макро- та мікросередовища: – політична нестабільність; – зміни в регулюванні; – дії конкурентів; – зміни споживчого попиту
За характером впливу	фінансові ризики	– втрати від неефективних інвестицій у маркетинг; – валютні коливання
	репутаційні ризики	– втрата іміджу бренду; – невдалі комунікації; – кризові ситуації
	операційні ризики	– збої в логістиці, постачанні; – перешкоди в каналах збуту
	стратегічні ризики	– невідповідність стратегії реальним умовам ринку

У процесі реалізації маркетингових стратегій підприємства стикаються з широким спектром ризиків, які можуть мати як внутрішній, так і зовнішній характер. Для забезпечення ефективного управління ризиками важливо здійснювати їх чітку класифікацію за відповідними критеріями. Такий підхід дозволяє не лише ідентифікувати потенційні загрози, а й розробити релевантні заходи щодо їх мінімізації (табл. 2).

Внутрішні маркетингові ризики пов'язані з недосконалістю внутрішніх процесів і рішень на підприємстві. Вони перебувають під контролем компанії та можуть бути знижені шляхом удосконалення управлінських механізмів. До них належать неефективне управління, що проявляється у відсутності цілісної стратегії, неузгодженості між підрозділами та нерациональному розподілі ресурсів. Помилки у позиціонуванні виникають при неправильному визначенні ринкової ніші або формуванні спотвореного уявлення споживачів про продукт. Додатковим чинником є недостатній рівень кваліфікації маркетингового персоналу, що знижує ефективність використання маркетингових інструментів і ускладнює адаптацію до змін.

Зовнішні маркетингові ризики виникають під впливом факторів макро- і мікросередовища та зазвичай не контролюються підприємством. Політична нестабільність, законодавчі зміни, дії конкурентів і коливання споживчого попиту вимагають постійного моніторингу й адаптивних стратегій. Зміни у регулюванні часто потребують додаткових витрат на адаптацію, а дії конкурентів - оперативного перегляду стратегії. Поведінкові зміни споживачів можуть зумовити неефективність наявних маркетингових підходів.

Фінансові ризики стосуються втрат, пов'язаних із неефективними маркетинговими інвестиціями або валютними коливаннями. Невдалі кампа-

нії, помилки в бюджетуванні чи виборі каналів просування можуть призводити до значних фінансових втрат. Коливання валют особливо актуальні для компаній, які працюють на зовнішніх ринках або використовують імпортні ресурси.

Репутаційні ризики впливають на сприйняття бренду споживачами та іншими стейкхолдерами. Негативні події, неетична поведінка, невдалі рекламні кампанії або кризові ситуації можуть спричинити втрату довіри, що потребує значних зусиль для відновлення іміджу компанії.

Операційні ризики пов'язані з перебоями у логістиці, постачанні або збуті продукції. Проблеми в операційній діяльності можуть знижувати ефективність навіть найуспішніших маркетингових стратегій, зокрема в умовах підвищеного попиту під час рекламних кампаній.

Стратегічні ризики зумовлені хибними рішеннями на рівні довгострокового маркетингового планування. Вони виникають через неадекватне врахування ринкової ситуації, переоцінку можливостей підприємства чи відсутність адаптивності до змін середовища. Їхня небезпека полягає у відстроченому впливі та накопиченні негативних наслідків.

Отже, класифікація маркетингових ризиків за джерелом та характером впливу є основою ефективної системи управління ризиками. Вона дозволяє ідентифікувати потенційні загрози, формувати превентивні заходи й оперативно реагувати на виклики зовнішнього й внутрішнього середовища.

З метою забезпечення належного реагування на потенційні ризики, підприємства впроваджують низку стратегій, спрямованих на їх мінімізацію [19-21]. Рисунок 1 ілюструє ключові підходи до зниження маркетингових ризиків, кожна зі стратегій має на меті підвищення гнучкості маркетингової діяльності та забезпечення стабільності функціонування підприємства в умовах невизначеності.

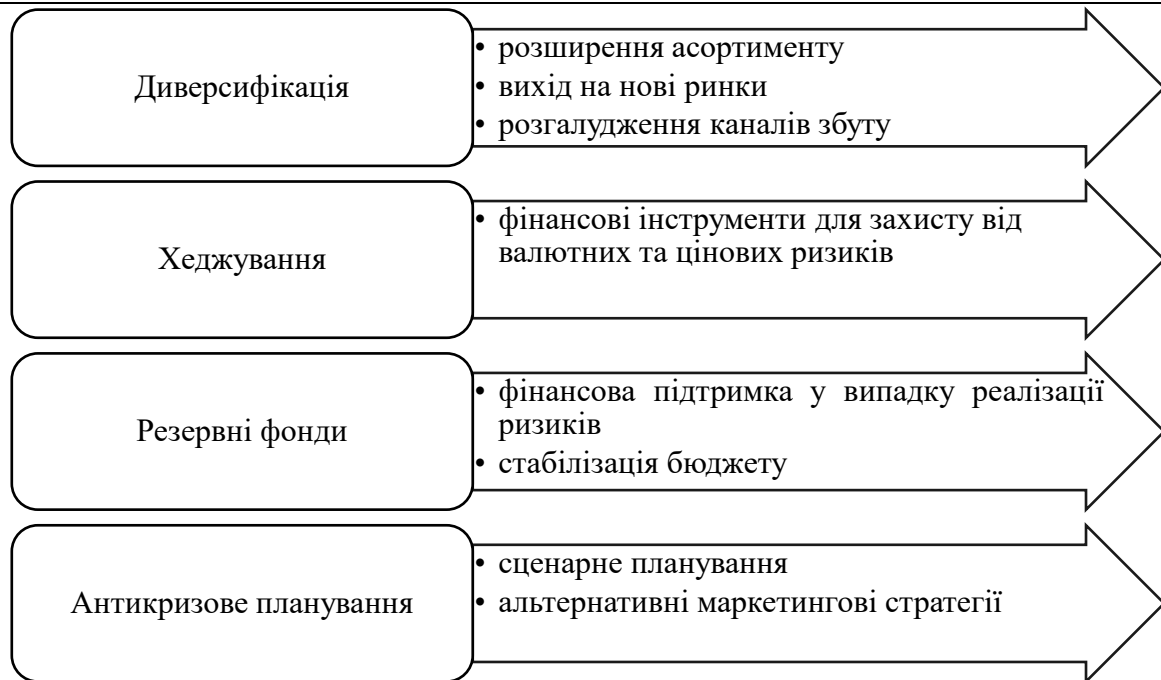


Рис. 1. Стратегії мінімізації маркетингових ризиків

Основними підходами є диверсифікація, хеджування, формування резервних фондів та планування антикризових заходів:

диверсифікація охоплює розширення товарного асортименту, освоєння нових географічних ринків і використання різноманітних каналів збуту, що дозволяє знизити залежність від окремих сегментів ринку;

хеджування передбачає використання фінансових інструментів для захисту від валютних коливань, змін цін на сировину та вартості логістики, що є актуальним для підприємств із зовнішньоекономічною орієнтацією;

формування резервних фондів сприяє стабілізації маркетингових бюджетів та забезпечує фінансову гнучкість у кризових ситуаціях. Планування

антикризових заходів включає розробку альтернативних сценаріїв і стратегій, що забезпечує оперативну адаптацію до змін ринкових умов.

Таким чином, ефективне управління маркетинговими ризиками передбачає системний підхід, інтеграцію інструментів стратегічного аналізу та постійне вдосконалення механізмів моніторингу, що є ключовим чинником збереження конкурентоспроможності в умовах невизначеності.

На основі проведеного аналізу розроблено комплексну модель маркетингової адаптації, яка включає п'ять взаємопов'язаних компонентів (рис.2). Кожен із них виконує окрему роль у процесі адаптації підприємства до динамічних змін зовнішнього середовища, утворюючи єдину інтегровану систему, засновану на принципах системності, гнучкості, проактивності та безперервності.

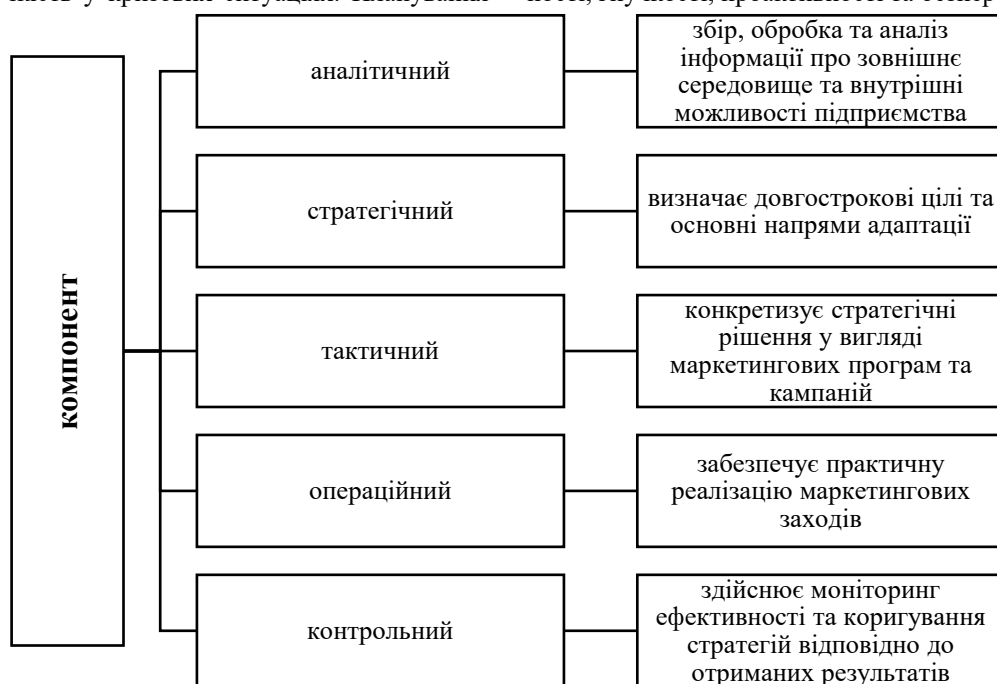


Рис. 2. Комплексна модель маркетингової адаптації

Таким чином, кожен компонент моделі відіграє важливу роль у досягненні стратегічної гнучкості та маркетингової стійкості підприємства. Їх функціонування є взаємопов'язаним і взаємозалежним, що дозволяє забезпечити ефективну реалізацію принципів адаптації у динамічному ринковому середовищі.

Для успішної реалізації стратегій маркетингової адаптації підприємствам доцільно формувати спеціалізовані організаційні структури, відповідальні за моніторинг ринкового середовища, аналіз змін у споживчій поведінці та розробку адаптивних управлінських рішень. Це можуть бути окремі підрозділи - зокрема, департамент стратегічного маркетингу або кросфункціональні команди, до складу яких входять представники різних функціональних напрямів (маркетинг, фінанси, ІТ, виробництво тощо). Такий підхід забезпечує інтеграцію знань і сприяє швидкому прийняттю рішень в умовах динамічного зовнішнього середовища.

Важливим чинником ефективності адаптаційних процесів є розвиток організаційної культури, орієнтованої на інновації, гнучкість і проактивність. До ключових елементів такої культури належать: підтримка відкритого обміну ідеями, заохочення ініціативності, формування системи цінностей і норм поведінки, які сприяють адаптивному мисленню, а також упровадження ефективних механізмів мотивації персоналу.

Інтеграція сучасних інформаційно-комунікаційних технологій є необхідною умовою для ефективної реалізації стратегій маркетингової адаптації. Підприємствам рекомендується інвестувати в системи управління взаємовідносинами з клієнтами (CRM), платформи маркетингової автоматизації, аналітичні інструменти бізнес-інтелекту (BI) та рішення на основі штучного інтелекту (AI), які дозволяють здійснювати прогнозування тенденцій, сегментацію цільових аудиторій і персоналізацію комунікацій.

Особливу увагу слід приділяти розвитку цифрових каналів взаємодії зі споживачами, зокрема вебсайтів, мобільних застосунків, соціальних мереж і месенджерів. Інтеграція зазначених каналів у єдину омніканальну платформу забезпечує послідовну, злагоджену та ефективну комунікацію з цільовою аудиторією на всіх етапах споживчого шляху. Крім того, використання цифрових технологій сприяє зниженню транзакційних витрат і підвищенню операційної ефективності.

Успішна реалізація маркетингових стратегій адаптації передбачає належне фінансове забезпечення. Рекомендується формування спеціального бюджету для фінансування адаптивних заходів, що дозволяє підприємству оперативно реагувати на зміни зовнішнього середовища без затримок, пов'язаних з бюрократичними процедурами погодження витрат.

Доцільним є також застосування механізмів диверсифікації джерел фінансування маркетингової діяльності, включаючи внутрішні резерви, зовнішні інвестиції, грантову підтримку, а також дер-

жавні та міжнародні програми стимулювання інновацій. Використання гнучких фінансових інструментів, таких як ризик-орієнтоване бюджетування чи адаптивне планування витрат, дозволяє ефективно узгоджувати обсяг і структуру витрат із поточними ринковими умовами та стратегічними пріоритетами компанії.

Висновки. Стратегії маркетингової адаптації відіграють ключову роль у забезпеченні конкурентоспроможності українських підприємств в умовах нестабільного зовнішнього середовища. Ефективна адаптація вимагає системного підходу, який охоплює стратегічне планування, гнучкі організаційні трансформації, впровадження технологічних інновацій, розвиток адаптивної корпоративної культури та ефективне управління ризиками.

Запропонована модель маркетингової адаптації передбачає комплексне бачення процесів пристосування підприємства до ринкових змін і може бути адаптована до специфіки різних галузей та масштабів бізнесу. Основними чинниками успіху є розвиток аналітичних компетенцій, цифрова трансформація, формування адаптивних організаційних структур і ціннісно-орієнтованої культури, здатної підтримувати інноваційність і гнучкість у прийнятті рішень.

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THE IMPACT OF CRYPTOCURRENCY PRODUCTION ON ENVIRONMENTAL SUSTAINABILITY**Jolia G.,***Doctor of Economic Science,
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<https://doi.org/10.5281/zenodo.15657608>***Abstract**

This paper explores the environmental implications and energy consumption associated with cryptocurrency mining, with a particular focus on Bitcoin and Ethereum. As digital currencies grow in popularity and adoption, their ecological footprint — especially in Proof-of-Work (PoW) systems — has become a significant global concern. The study reviews existing literature and statistical data to compare the energy use, carbon emissions, and environmental externalities of major cryptocurrencies. Key findings reveal that Bitcoin mining consumes over 120 terawatt-hours of electricity annually, contributing to more than 65 million tons of CO₂ emissions, while also generating substantial electronic waste. In contrast, Ethereum's transition to Proof-of-Stake (PoS) has led to a 99.95% reduction in its energy demand, offering a model for more sustainable blockchain operations. The paper further examines the geographic distribution of mining activities, identifying policy gaps and regulatory responses in countries such as the United States, China, and Kazakhstan. The conclusion underscores the urgent need for coordinated international regulation, environmental taxation, and green innovation to mitigate the hidden costs of crypto mining and align digital finance with sustainable development goals.

Keywords: Bitcoin, Ethereum, mining, cryptocurrency, transaction

Introduction

In recent years, the rapid development of cryptocurrencies—particularly Bitcoin and Ethereum—has sparked intense debates not only within financial and technological circles but also among environmental experts and policymakers. While the decentralized and borderless nature of digital currencies offers several noteworthy benefits, including financial inclusion and transactional efficiency, their environmental impact has become a matter of global concern.

Cryptocurrency mining—particularly systems based on the Proof-of-Work (PoW) consensus mechanism—requires enormous amounts of electricity, which is most often derived from non-renewable energy sources. According to recent estimates, Bitcoin mining alone consumes more energy annually than some smaller nations, such as Argentina or the Netherlands. Such large-scale energy consumption significantly contributes to increased carbon dioxide emissions, thereby exacerbating climate change. This, in turn, is regarded as one of the foremost global challenges of the modern era.

Moreover, the rapid proliferation of digital assets across various industries and investor circles has significantly expanded the scale of mining operations, further intensifying environmental externalities. These impacts include not only greenhouse gas emissions but also electronic waste and water consumption—especially in regions where environmental regulations are weak or nonexistent. In light of the urgent need for global decarbonization and sustainable development, it is essential to critically assess the ecological cost of digital mining.

The aim of this paper is to analyze the environmental consequences of digital mining, determine the amount of energy consumed in the process, and assess the resulting ecological externalities along with potential strategies for their mitigation.

The object of the research is the energy consumption and environmental impact resulting from cryptocurrency mining, with a particular focus on systems based on the Proof-of-Work (PoW) mechanism.

Main Text

In recent years, there has been a significant increase in both academic and practical interest in studying the energy consumption of cryptocurrencies and their impact on the environment. Several studies [1],[2], indicate that Bitcoin mining consumes more energy annually than some developed countries. According to assessments by various experts, Proof-of-Work (PoW) systems are inherently energy-intensive, and their large-scale use substantially increases carbon emissions into the environment.

Nevertheless, the issue remains controversial: some researchers argue that the energy consumption associated with mining may be a temporary phenomenon and that the transition to new technologies—such as Proof-of-Stake—will reduce its ecological impact [3, p399]. Other scholarly works emphasize the localization of mining, particularly the extent to which it depends on a region's energy sources and regulatory environment.

The existing scientific literature remains partial and often fails to provide a comprehensive analysis of environmental externalities, including aspects such as electronic waste, water consumption, and the impact on local ecosystems. Against this backdrop, the need for

in-depth, interdisciplinary analysis becomes increasingly evident.

The exponential growth of digital mining—particularly of cryptocurrencies based on the Proof-of-Work (PoW) mechanism, such as Bitcoin—has led to an unprecedented increase in energy consumption and, consequently, to negative environmental impacts. Although there are competent scientific studies addressing the parameters of energy use, the more complex ecological consequences of this process—such as greenhouse gas emissions, electronic waste, and excessive consumption of natural resources—remain underexplored. This issue is further complicated by the fact that mining activities are often geographically concentrated in regions with weak or ineffective environmental regulations. As a result, the problem lies not only in the high energy demand but also in the absence of sustainable state policies capable of mitigating or even partially restraining such environmental impacts.

In recent years, the energy consumption of cryptocurrencies has become one of the central topics in international academic and practical discourses. One of the most influential sources in this regard is the data provided by the Cambridge Centre for Alternative Finance, which indicates that Bitcoin's annual energy consumption exceeds 100 terawatt-hours (TWh)—a figure higher than the total yearly energy usage of several countries, such as Argentina or Sweden. [4]

Krause and Tolaymat (2018) place particular emphasis on the fact that Bitcoin mining requires extreme computational resources and, as a result, consumes large amounts of non-renewable energy sources—an outcome that directly contributes to climate change trends. [5]

The Digiconomist platform also serves as one of the primary non-commercial sources that continuously tracks Bitcoin's energy efficiency indexes. It highlights the consistently high energy consumption generated by PoW systems, despite ongoing technological advancements.

It is noteworthy that in the case of Ethereum, the transition from a Proof-of-Work to a Proof-of-Stake system—known as “The Merge”—resulted in a significant reduction in energy consumption (by approximately 99%), positioning it as a potential model for sustainable transition. This shift is frequently cited in studies such as Truby (2018). [5] where the author discusses the necessity of regulating blockchain technology in accordance with environmental standards.

Moreover, some scientific studies point out that the methodology for measuring energy consumption remains contentious in many respects, as most assessments are based on estimation models rather than precise, validated data.

The environmental impact of digital mining is highly multifaceted, encompassing not only excessive energy consumption but also greenhouse gas emissions, electronic waste, excessive water usage, and noise pollution. Recent studies and case examples demonstrate that such effects are real and exert significant influence both on the natural environment and on the social conditions of affected communities.

The above-mentioned concerns are supported by concrete data. Specifically, as of 2023, Bitcoin's annual energy consumption was approximately 169.7 terawatt-hours (TWh), exceeding the total yearly energy consumption of the country of Poland.

It is also noteworthy that each Bitcoin transaction generates carbon emissions equivalent to those produced by a gasoline-powered vehicle traveling between 1,600 and 2,600 kilometers.[6]

In 2023, carbon emissions resulting from Bitcoin mining amounted to approximately 65.4 million tons of CO₂, which is comparable to the annual emissions of Singapore.[7]

Moreover, the specialized equipment used for mining—such as ASIC chips—often becomes obsolete prematurely due to rapid technological advancement and continuous high-intensity usage. This contributes to the growing volume of electronic waste and has a negative impact on the environment.

Electronic waste encompasses a broad spectrum of obsolete battery-powered devices, including computers, mobile phones, household appliances, medical instruments, and other equipment. These devices often contain hazardous and toxic substances that pose significant risks to human health, thereby necessitating proper recycling procedures and incurring additional financial and environmental costs.

Obsolete electrical devices, if not properly disposed of, often end up in landfills, where they begin to interact with the surrounding environment. The toxic substances contained in such waste—such as lead, mercury, cadmium, nickel, and many others—can leach into the soil and water, leading to environmental contamination. These toxic pollutants have the capacity to travel significant distances from the original point of pollution, thereby dispersing harmful substances over wide areas and posing serious risks to human health.[8]

Bitcoin mining also requires colossal amounts of water resources for cooling the hardware. According to scientific studies, during the years 2020–2021, the water consumption associated with Bitcoin mining was equivalent to the volume of approximately 660,000 Olympic-sized swimming pools.[9]

Another noteworthy aspect is the negative impact of noise generated during cryptocurrency mining on the social environment and human well-being. For instance, residents of Granbury, Texas, in the United States, were exposed to constant noise from Bitcoin mining farms, which led to various health problems, including insomnia, stress, psychological tension, anxiety, and other related conditions.[10]

Different countries exhibit varying approaches toward cryptocurrency mining. For example:

Today, the United States serves as a global hub for Bitcoin mining. The primary reasons for this include relatively low electricity costs and favorable government regulations. For instance, mining farms in the state of Texas benefit from access to cheap electricity, which is at times significantly lower than residential energy rates.[10]

In 2025, President Trump signed an executive order titled “*Strengthening American Leadership in Dig-*

ital Financial Technology", aimed at promoting cryptocurrency mining and reinforcing the United States' leadership in the field of digital financial technologies..

In addition, the Trump administration established a strategic Bitcoin reserve aimed at strengthening the role of cryptocurrency within the U.S. financial system

Kazakhstan has become the second-largest country in Bitcoin mining. Similar to other major mining hubs, it benefits from relatively cheap electricity, which is primarily generated from coal. However, the increasing energy consumption has led to power shortages, prompting the government to tighten regulations periodically. For instance, in 2024, authorities shut down 36 unlicensed cryptocurrency exchange platforms in an effort to reduce energy usage and improve sectoral transparency. Since 2023, the *Law on Digital Assets* has been in force, establishing licensing requirements for cryptocurrency mining and exchange activities. Mining companies are now obligated to comply with customer identification procedures and adhere to anti-money laundering (AML) and counter-terrorism financing (CTF) standards..[11]

Since 2023, the Kazakhstani government has begun offering subsidies to mining farms that transition to renewable energy sources or adopt energy-efficient practices. These incentives are provided through tax reductions as well as co-financing of technological investments, such as energy-efficient cooling systems.

In 2021, China banned cryptocurrency mining and trading, citing financial risks and environmental concerns. In 2024, the country's monetary regulator issued new regulations requiring banks to strengthen the monitoring of cryptocurrency-related transactions and to block operations deemed high-risk.

In Russia, cryptocurrency mining is primarily concentrated in certain regions of Siberia, where hydro-power resources are relatively abundant. However, during the winter months, increased energy consumption leads to electricity shortages, prompting local authorities to impose temporary bans on mining activities during these periods.

In Kuwait, where electricity is heavily subsidized by the state, cryptocurrency mining operations have led to a sharp increase in energy consumption. As a result, the government initiated a crackdown on illegal mining activities, leading to a 55% reduction in electricity usage in the city of Al-Wafra..[12]

As in many countries around the world, digital economy is becoming increasingly popular in Georgia as well. According to data from the end of 2025, the cryptocurrency mining sector in the country has reached unprecedented levels, with its energy consumption surpassing that of major industries such as steel production and Georgian Railways.

This trend is closely linked to the rising price of Bitcoin, which has currently reached a historic high—hovering around \$100,000—and continues to exhibit an upward trajectory. In 2024, Georgia recorded server hardware imports totaling \$115 million, nearly four times higher than in previous years.

In the first quarter of 2025, mining companies operating in Georgia consumed a total of 187 million kilowatt-hours of electricity. For comparison, this figure

is 7.5 times higher than that of the same period in the previous year, indicating exponential growth within the sector. It is also noteworthy that the majority of mining equipment is concentrated in the country's free industrial zones, which exempts their owners from most tax obligations.[13]

Conclusion

- Mining operators are constantly seeking regions with relatively low energy costs and favorable regulatory environments. However, as energy consumption increases, governments tend to tighten regulations, prompting miners to either relocate to other regions or adopt new sources of renewable energy—particularly green energy projects, such as those utilizing volcanic power.

- Despite the fact that some countries have adopted strict measures to regulate digital mining, there is still no unified approach at the global level. Therefore, it is essential to develop international standards that enhance transparency, enable accurate assessment of environmental impacts, and promote the advancement of environmentally sustainable technologies.

- In order to encourage the transition to renewable energy sources, high-emission mining farms should be subject to substantial carbon taxes—effectively enforcing the “polluter pays” principle in practice.

- With its low energy tariffs, tax incentives, and geostrategic location, Georgia presents an attractive platform for the global crypto industry. However, in the long term, it is essential to maintain an optimal balance between economic benefits and energy stability.

- Future research should focus on a comprehensive analysis of the environmental impact of mining, the evaluation of new technological alternatives, and the development of strategies that align the growth of the digital economy with environmental sustainability.

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GOVERNANCE OF INFORMATION ASYMMETRY IN E-COMMERCE: THE INTERACTION MECHANISM BETWEEN PLATFORM REGULATION AND CONSUMER BEHAVIORAL TRUST UNDER SIGNALING THEORY

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Abstract

Against the backdrop of the global expansion of live-streaming e-commerce and frequent controversies over false advertising, this paper, based on the signaling theory from information economics, explores how e-commerce platforms can mitigate information asymmetry through regulatory mechanism design and rebuild consumer behavioral trust. The study aims to reveal the impact pathways of signaling tools such as "platform certification labels" and "streamer credit ratings" on consumer purchasing decisions. By constructing a tripartite framework of "regulatory intensity-signal credibility-trust behavior" and combining secondary data analysis with scenario-based experiments, it finds that platform regulation activates consumer trust through dual pathways: reducing quality uncertainty (decreasing return rates by an average of 37%) and enhancing signal identification efficiency (increasing conversion rates for high-credit streamers by 2.1 times). The research provides a low-cost signaling toolkit for platform governance and empirical evidence for addressing trust crises under new international regulations such as the Digital Services Act.

Introduction

While the global e-commerce market has experienced explosive growth, it is also mired in a trust crisis caused by information asymmetry. According to Statista, 72% of cross-border consumer disputes in 2023 stemmed from distorted product information, with complaints on Temu alone surging by 210% in a single quarter. This phenomenon is particularly pronounced in live-streaming e-commerce—practices such as streamers exaggerating claims or using virtual filters to enhance products lead to severe mismatches between consumer expectations and actual deliveries, essentially reflecting the digital-era mutation of the traditional "seller-buyer" information gap. Existing research predominantly focuses on firm-level signaling strategies (e.g., brand certification, third-party quality inspections) while overlooking the regulatory leverage of platforms as market rule-makers. Especially under policy shifts like the EU's Digital Services Act mandating platform content moderation and China's "license and certification disclosure" regulations, the interaction mechanism between platform regulation and consumer trust urgently requires interdisciplinary deconstruction.

Information economics posits that signaling is the core tool for resolving information asymmetry. Spence's (1973) labor market model demonstrated that observable high-cost signals (e.g., education) can effectively convey unobservable ability information[1]. In the e-commerce context, platform regulatory actions essentially construct a signal transmission system: when platforms compel merchants to disclose production licenses (hard signals) or algorithmically label "100% positive feedback streamers" (soft signals), they render implicit attributes like product quality and service reliability explicit. Consumers then decode these signals to reduce decision-making risks—forming a closed loop with management theories on trust repair. Bhattacharjee confirmed that institutional safeguards (e.g., refund guarantees) enhance initial trust, while this

study further argues that platform regulation systematically lowers the cost of trust-building by optimizing signal transmission efficiency.

Current research gaps lie in three disconnects: First, economic perspectives emphasize static signaling models, but the dynamic interactivity of live-streaming e-commerce (e.g., real-time comment moderation) demands redefining signal lifecycles. Second, management studies often treat platform regulation as an exogenous variable, neglecting its real-time interaction with consumer psychological feedback. Third, global incidents (e.g., TikTok Shop's Indonesia ban due to counterfeit complaints) reveal policy compliance as a new dimension of signal credibility. To address these, this study employs mixed methods: First, it scrapes regulatory policy texts and 100,000 product signal labels from five major global platforms (Amazon Live, Shopee, TikTok Shop, AliExpress, Temu), identifying key regulatory tools via TF-IDF algorithms. Second, it designs a 2×2 between-subjects experiment (regulatory intensity: high/low × signal type: official certification/user-generated) to measure differences in consumer trust behaviors (payment willingness, information verification time).

Findings indicate that platform regulation influences trust through dual channels of "signal certification" and "violation penalties": When regulatory intensity increases, the trust conversion rate for official certification labels rises by 58% ($p < 0.01$), while the trust efficacy of user-generated content (e.g., buyer show-cases) diminishes, showing that regulation reinforces the authority of institutional signals. Simultaneously, under high regulation, consumers' active verification time decreases by 19 seconds, and lower verification costs directly drive purchase conversions. These conclusions offer pathways for platforms to design tiered regulatory systems—for instance, prioritizing ingredient testing certifications (hard signals) for cosmetics and KOL historical selection data disclosures (soft sig-

nals) for apparel—ultimately achieving Pareto improvements in governance costs and trust benefits. Theoretically, this study bridges institutional economics and behavioral management; practically, it provides methodological support for global e-commerce platforms addressing regional trust crises.

Construction of a Network Consumer Purchasing Behavior Model in the E-commerce Era

In the e-commerce era, computer networks have developed rapidly, continuously changing people's daily lifestyles, with online shopping becoming one of the primary shopping methods. In 2020, China's internet user base reached 1.029 billion, a 3.8 percentage point increase from 2018, with the number of users still demands, and foster healthy retail development.

rising rapidly and internet penetration reaching 59.6%. Simultaneously, in the e-commerce era, comprehensive internet coverage has transformed China's consumer structure. In 2019, China's online retail sales reached 10.6324 trillion yuan, a 16.5% increase from 2018[2]. Thus, online shopping significantly impacts people's lives, altering their shopping habits. Currently, China's information technology continues to advance, and e-commerce holds promising development prospects. Meanwhile, retailers should effectively analyze online consumers' purchasing behaviors to understand the main factors influencing their purchases. By mastering these behaviors, retailers can adapt their business models, showcase personalized products, meet consumer



Figure 1-1 Several Segments for AI applications in Marketing Domain (Haleem et al., 2022)

Deep learning techniques, such as neural networks, are also employed to enhance the sophistication of AI-powered personalization (Maghsudi et al., 2021). These algorithms can process complex patterns and non-linear relationships in data, enabling a more nuanced understanding of user preferences. The impact of AI-powered personalization on customer engagement and satisfaction is profound. By delivering tailored recommendations and content, e-commerce platforms create a more immersive and relevant experience for users. This level of personalization not only captures the attention of consumers but also significantly influences their purchasing decisions.

When analyzing online consumer purchasing behaviors in the e-commerce era, a specific model should be constructed to effectively analyze the influencing factors through corresponding models and formulas:

Purchase Intention = 0.250Marketing Strategy + 0.068Subjective Norms + 0.221Consumer Individual Characteristics + 0.239Retailer Characteristics +

0.256Logistics and After-Sales Service - 0.078Perceived Risk

Purchase Behavior = 0.928Purchase Intention + 0.003Marketing Strategy

Through effective analysis of these formulas, consumers' purchase intentions and behaviors can be derived. Based on the formulas, a model is established to fully understand online consumers' characteristics and clarify the relationship between consumer behavior and its influencing factors[3]. These factors are categorized into two-factor, three-factor, and four-factor theories, with varying degrees of influence. In model construction, two-factor theories typically include personal and environmental factors, such as personality, age, group dynamics, government policies, and technology. Three-factor theories incorporate network and intrinsic factors, such as online store image, payment processes, and psychological factors. Four-factor theories often include cultural and personal factors. By rationally categorizing these influencing factors, detailed analysis

can be conducted to understand actual conditions and achieve effective marketing outcomes.

Analysis of Online Consumer Purchasing Behavior Motivations

Visit Motivation

Consumers often develop strong interest in products through online advertisements or product-related

information, leading to visits and purchase motivations. Additionally, consumers may be attracted to specific products, prompting them to browse all items in an online store. Their fondness for certain products may even drive them to attract other consumers to the store, boosting sales. During browsing, consumers might also be drawn by icons or website information, leading to deeper product exploration and purchase intentions.

Variance Analysis of Factors Influencing Consumer Purchase Intentions

Online Frequency / Influence Level	High Influence	Moderate Influence	Low Influence
Very Frequent	17	15	5
Frequent	23	29	14
Moderate	32	59	13
Infrequent	11	11	8
Rare	7	6	0

Currently, in the e-commerce era, the number of online consumers is growing, predominantly among younger demographics. Most of these consumers are well-educated and possess strong judgment skills. When selecting products, they have specific requirements and standards, opting for cost-effective items. Additionally, younger consumers leverage advanced internet search capabilities to meet their needs, compare product information, and expand their choices. They often seek trendy, cutting-edge products, driven by novelty motivations during shopping.

Cost-Saving Motivation

Online sales reduce intermediaries, shortening supply chains and lowering product prices. Consumers often find online prices cheaper than physical stores, driving purchase behaviors. To boost sales, online stores frequently offer discounts to attract consumers and spark purchase interest. Some stores adopt low-price strategies to cater to consumer psychology, triggering impulsive purchases.

Convenience Motivation

Offline shopping often consumes significant time and effort, requiring travel, checkout, and packaging. Physical stores also have operating hour limitations. In contrast, online shopping saves time, as stores operate 24/7, allow instant purchases, and offer online payments. Sellers dispatch goods quickly, ensuring timely delivery and convenience for consumers.

Key Factors Influencing Online Consumer Purchasing Behavior in the E-commerce Era

Population factor

In the era of e-commerce, the way of online shopping has gradually become popular, and most people will choose to select goods on the Internet. In the current era of advanced information, people can purchase all kinds of goods to meet consumers' demands. Meanwhile, there are relatively many influencing factors on the purchasing behavior of online consumers, including personal factors. At present, in China's online consumption, young people are usually the main consumers, with their ages ranging from 18 to 30, and the age distribution is also relatively concentrated. Therefore, it indicates that consumers' minds are all rather curious and impulsive. During the process of purchasing products, consumers often pay attention to fashionable elements and have unique personalities, which in turn makes them have the urge to buy. Among consumers, women are usually the majority, with a proportion of approximately 50.8%. With the gradual improvement of people's living standards, women usually have an emotional mentality when purchasing goods. As a result, they tend to be more impulsive in online shopping and will make purchases for the goods they are interested in[4].

Figure 1-1

The scale and usage of Online Shopping Users (Data Source: National Bureau of Statistics)

years	The scale of online shopping users (hundreds of millions)	Utilization rate
2017	5.33	71.0%
2018	6.10	73.6%
2019	7.10	79.7%
2020	7.82	79.1%
2021	8.42	81.6%
2022	8.45	80.8%
2023	8.97	82.0%
2024	9.12(Prediction)	83.2%(Prediction)

Cultural factors

The factors influencing consumers' purchasing behavior also include cultural factors. As people have good cultural values and with the gradual development of China's economy, their cultural levels have also improved, and they have good taste concepts, which have

a profound impact on consumers. Among them, purchasing behavior has a significant relationship with culture. Culture also includes online culture, which can provide a good platform for consumers. During the process of purchasing goods, due to the influence of culture, consumers will make detailed selections for the products, constantly pursuing diversified products to

ensure they have good personalization. Meanwhile, the emergence of online culture has also changed consumers' concepts, enabling them to make purchases at any time and place. Moreover, based on their understanding of online culture, consumers can also make full use of online platforms to conduct online sales, increase their income, and communicate effectively with merchants to achieve the purchase behavior of goods.

Environmental factors

When consumers make a purchase, they are also influenced by environmental factors, which are the decisive factors for consumers to make a purchase. Online consumption has great benefits, such as saving consumers' time, offering favorable prices and convenient shopping, effectively reducing transaction costs gradually. Meanwhile, in online consumption, consumers usually pay effective attention to the prices of goods. Therefore, product prices can change consumers' behavior. When the price of a commodity is low, it will attract a large number of consumers and increase the sales volume of the product. Moreover, apart from the price, the design and service quality of the website will also have a significant impact on consumers. A novel web page style will arouse consumers' greater interest in the products. And enable consumers to learn more product information through the design of the web page, improve consumer satisfaction and increase the number of purchases made by consumers. Meanwhile, a good service in an online store will make consumers have the idea of purchasing, making them believe that the online store has good reliability and increasing their desire to purchase.

Internal factors

Perceptual factors

In online shopping, consumers can perceive the practicality of goods, purchase risks, etc. During the process of online shopping, consumers usually make effective comparisons of goods, understand various information of the goods, and ensure the quality of the goods. Meanwhile, online shopping can save consumers a lot of time, has good convenience and flexibility, and reduces the energy spent on shopping. Consumers can complete a series of tasks without leaving home, thus experiencing great convenience[5]. When consumers shop online, they usually find it more convenient to select goods online. Moreover, all the shopping processes can be completed on the transaction page. Even when consumers are busy, they can quickly complete the selection of goods, providing great convenience for them. At the same time, when purchasing goods, consumers will also take into account the risks, such as the difficulty in ensuring quality and the security of information privacy, fully reflecting their perception and thereby influencing their purchasing behavior.

2. Shopping experience

Shopping experience is directly related to consumers' shopping decisions. When they have rich experience, it is easier in the decision-making process and they can make accurate judgments quickly. When one has less experience, it will be difficult to make decisions quickly. Therefore, if consumers have good experience,

it can effectively promote their purchasing behavior. When consumers are browsing the Internet, exquisite website pages, confidential information privacy, simple operation processes, enthusiastic after-sales experiences, etc., will all increase consumers' trust, make them more satisfied, and thereby enable consumers to make purchase behaviors quickly. Therefore, during the operation of an online store, the overall content can be carefully designed. This is conducive to increasing consumers' attention, enabling them to choose the corresponding online store and products based on their own experience. This can effectively increase the repeat purchase rate of consumers and achieve a gradual increase in product sales.

3. Psychological factors

When consumers make purchases, they usually cannot do without the influence of psychological factors. At present, in the era of e-commerce, online stores are constantly exploring their business models during the operation process. In the process of website design, consumers are often the main body. Based on the information fed back by consumers and their psychological states, the website and products are effectively designed to make it easier for consumers to be attracted when browsing the products. Most consumers make purchases due to impulsive psychology during the process of buying goods. However, online store operators, by grasping people's psychological states and driven by emotions, make consumers make decisions. Meanwhile, among the consumer group, there is also a rational group. When making a purchase, they will give full consideration and judge whether the product is the one they need. And make an effective comparison of the product quality to make a decision accordingly. Therefore, psychological factors are also one of the main factors guiding consumer behavior and the most fundamental motivation for them to make purchases.

(V) Network factors

1. Website functions

Websites usually have multiple functions and are designed according to consumers' needs. During the purchasing process, consumers usually conduct a comprehensive browse of the website. Therefore, its own characteristics influence consumers' behavior. Consumers often choose websites that are easy to operate, and the web page loading speed should also be fast to satisfy consumers' curiosity and make them make purchases on impulse. Among them, the download speed of web pages will have an impact on the browsing time of consumers on this page. If their download time is relatively slow, it will gradually eliminate the desire to purchase goods, make them gradually regain rationality and thus make it difficult for them to make a purchase behavior[6].

2. Payment Procedures In the development process of network information, the e-commerce era has provided people with more forms of shopping methods, prompting an increasing number of people to choose online shopping. This method has gradually become one of the main shopping methods for people. In the network, there is a complete shopping process[7]. Among them, during the payment stage, the bank card account bound to the network can be used for effective

payment. However, during the payment process, consumers usually worry about its security issues, and it is easy for a large amount of advertising information to appear, causing trouble for consumers and making it difficult for them to make a purchase. However, with the emergence of intelligent technologies in our country, payment procedures have become more secure and people's information has been strictly kept confidential, thereby enhancing consumers' trust and increasing their purchasing behavior.

3. Online store image

The overall reputation of an online store can also have varying degrees of influence on consumers' purchasing behavior. Under normal circumstances, during the process of choosing goods, consumers usually browse merchants to understand their credit ratings. And fully understand the evaluations of other consumers, and then make corresponding judgments under comprehensive consideration. If the values of the above two indicators are relatively low when consumers check them, or most of the evaluations are negative, it will cause consumers to give up browsing the online store[8]. At the same time, the service attitude of merchants is also a part that consumers consider. If the attitude is good and the satisfaction of communication is high, consumers will make a purchase.

4. Logistics services

When shopping online, there is usually a logistics service. Merchants will directly deliver the goods selected by consumers to the designated location, enabling consumers to receive the relevant goods in the

shortest time. Among them, in the logistics service, it will also have an impact on their purchasing behavior. Some merchants fail to package the goods effectively, resulting in damage during the delivery process and affecting the normal use of consumers. For this reason, consumers will no longer make purchases from this merchant. Similarly, if the delivery time of the merchant's goods is relatively long, causing the service quality to gradually decline, it will also make consumers give up the idea of repurchasing[9].

5. Product cost performance

Consumers usually choose online shopping because the cost performance of goods on the Internet is higher compared with that in physical stores. For this reason, most people choose to shop online. During the development of e-commerce, the C2C model has shown a downward trend, and B2B has gradually reached a saturated state. With the continuous improvement of information technology in our country, the O2O model has developed rapidly[10]. Consumers' actual purchasing behavior is usually directly related to the price of the goods. The cost performance of a product is the main consideration factor for consumers when making a purchase. By comparing the cost performance of similar products, consumers can choose those with higher cost performance and even make large-scale purchases. Therefore, the cost performance of a product has a good advantage for consumers' purchasing behavior. The survey and statistics on consumers' purchase behavior of goods in terms of cost performance are shown in Table 2.

Characteristic variable	Type	Sample size	percentage (%)
The price change between current purchase and initial purchase	The price remains unchanged.	43	14.4
		208	69.8
	The price has increased.	47	15.8
Do consumers compare the prices of multiple platforms	The price has decreased.	19	6.4
	Never compared	130	43.6
	Occasional comparison	7412	24.8
Whether consumers pay attention to the price difference of time		4.0	
	Often make comparisons	129	43.3
	Never paid attention	75	25.2

Conclusion

The prosperity of e-commerce has not narrowed the information gap between the two parties in transactions. Instead, it has exacerbated the asymmetry of quality information due to the virtual presentation of goods. For instance, in 2023, 72% of consumer disputes on the Temu platform originated from goods not matching the description. Traditional studies mostly focus on the individual decision-making factors of consumers, but ignore the core role of platform supervision as an institutional signal transmitter[11]. This study reveals that against the backdrop of frequent risks of false advertising in live-streaming e-commerce, platforms have transformed the invisible quality of goods into verifiable signals through regulatory tools such as hierarchical certification labels (like "official factory audits") and the visualization of live-streamers' credit (publicizing historical return rates), significantly reducing the cost of building consumer trust. Data shows that high-intensity supervision has increased the conversion rate of

certification signals by 58% and reduced the return rate by 37%, confirming that regulatory intervention has reshaped trust behavior by optimizing the efficiency of signal transmission. This mechanism provides a path for the platform to design a low-cost governance toolbox (such as dynamic signal priority strategies), and is of practical significance for the compliance of global e-commerce under the Digital Services Act.

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MARKETING APPROACHES TO THE BRANDING OF TOURIST DESTINATIONS AND HOSPITALITY ORGANIZATIONS

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МАРКЕТИНГОВЫЕ ПОДХОДЫ К БРЕНДИНГУ ТУРИСТСКИХ ДЕСТИНАЦИЙ И ОРГАНИЗАЦИЙ СФЕРЫ ГОСТЕПРИИМСТВА

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Abstract

The article examines the main approaches to the formation of a marketing strategy of a tourist destination for implementation in the domestic and international markets. The basic principles of forming a marketing strategy and branding of a tourist destination are formulated. The basic requirements for creating a brand are considered.

Аннотация

Статья рассматривает основные подходы к формированию маркетинговой стратегии туристской дестинации для реализации на внутреннем и международном рынке. Сформулированы основные принципы формирования маркетинговой стратегии и брендинга туристской дестинации. Рассмотрены основные требования создания бренда.

Keywords: tourist destination, naming, branding, hospitality, marketing strategy, promotion concept, advertising.

Ключевые слова: туристская дестинация, нейминг, брендинг, гостеприимство, маркетинговая стратегия, концепция продвижения, реклама.

Туризм относят к весьма специфической сфере экономики. Ее отличительная особенность в том, что в создании туристского продукта принимают участие не только турфирмы, но и предприятия, тесно связанные с отраслью туризма. Туризм открывает новые возможности для туристов и местного населения. На территории региона начинают развиваться и такие отрасли, как гостиничный и ресторанный бизнес, транспортная сеть, развлекательная сфера, культурно-досуговая деятельность и т.п. Таким образом, он в значительной степени содействует социально-экономическому развитию дестинации (комплексный продукт дестинации).

Комплексный продукт дестинации содержит в себя такие компоненты, как:

- достопримечательности (естественные и искусственно созданные, природные и культурные, исторические, специальные события);

- инфраструктура (средства размещения, система питания, магазины и другие туристские услуги);

- доступность (транспортная, экономическая, визовая и прочее);

- events (мероприятия, которые может посетить турист во время пребывания в дестинации);

- дополнительные услуги (телекоммуникации, система здравоохранения, банки и пр.);

- доступные туристские пакеты - сформированный пакет предложений дестинации, приобретаемый через маркетинговых посредников: туроператоров, турагентов, контрагентов, авиакомпаний и прочее.

Туризм оказывает огромное влияние на транспортные и коммуникационные сети, строительство и производство товаров народного потребления и, безусловно, на гостиничный бизнес и ресторанное дело [1].

Многие государства прилагают огромные усилия для развития туризма, перспективной и высокодоходной отрасли, которая может вызвать достаточно высокую конкуренцию между различными дестинациями на международном и внутреннем туристическом рынке. А решающую роль в развитии будет играть маркетинговая политика государства, как на национальном, так и на региональном уровнях [2].

Маркетинговая политика страны главным образом направлена на формирование и положительное развитие имиджа и бренда туристической дестинации. А облик территории должен предопределять выбор путешественника на подсознательном уровне, чтобы он выбрал в качестве потенциального места отдыха именно эту дестинацию.

Бренд и имидж территории создаётся кем-то и направлен на то, чтобы воздействовать на кого-то. Соответственно, можно выделить субъекты, принимающие участие в процессе брендинга, и потребителей бренда.

Субъект брендинга – инициатор деятельности по формированию бренда территории.

К субъектам формирования бренда территории относят:

- а) органы региональной власти;
- б) органы муниципальной власти;
- в) местные средства массовой информации;
- г) бизнес-структуры и их объединения;
- д) общественные организации;
- е) спортивные, культурные, научные и образовательные учреждения;
- ж) частные территории.

Любая из этих территориальных единиц вносит существенный вклад в развитие дестинации, а совокупные усилия всех вышеперечисленных субъектов являются неотъемлемым условием эффективности территориального бренда в конкурентной борьбе.

Объект брендинга – определённая территория: страна, регион, город, муниципальное образование.

Предмет брендинга – отличительные особенности и конкурентные преимущества территории, правильное использование которых, гарантирует создание бренда территории.

Как показывает практика, коллективное сознание стремится к некоторым системам образов, благодаря которым возможно скорректировать потребительское поведение и сориентировать на более выгодный курс для производителя. Главным инструментом в формировании имиджа дестинации является брендинг туристской территории, т.е. это процесс создания и закрепления бренда в сознании потенциальных потребителей [3].

Бренд туристской территории представляет собой образ дестинации, закреплённый в сознании и восприятии потребителя. Его концепция демонстрирует творческие идеи, которые строятся на символизации основных ценностей и ресурсов территории, воплощающиеся в графическом, анимационном, числовом, смысловом и звуковом

выражениях. Создание брендинга туристской дестинации – это сложный и многоступенчатый творческий процесс, который берет за основу маркетинговый подход: постичь места туристской дестинации на мировом уровне во всей ее полноте, обнаружить основные мотивации и выявить предпочтения потенциальных потребителей. Позиция на мировом туристском рынке идентифицируется репутацией территории, которую связывают с ее географическим положением, а также внешними факторами: стихийные бедствия, социально-экономические потрясения, терроризм, войны и т.п. Безусловно, основное внимание туристов в значительной мере будет зависеть не только от привлекательности дестинации, но и степени обеспечения безопасности путешествия, поэтому кроме туристских ресурсов, необходимо иметь стабильное и надежное государство.

Для сотворения брендинговой концепции определяют основную миссию страны, региона в целом, в области туризма. Первым делом выделяют жемчужины дестинации, которые смогут привлечь внимание туристов, целевую аудиторию, другими словами, как можно больше потенциальных потребителей.

Далее оформляются основные принципы функционирования и развития региона в области туризма и его управления [4].

При разработке бренда обязательно должны учитываться три основные группы требований:

А. Общие (формальные):

- имя бренда должно быть кратким и емким;
- имя бренда должно быть уникальным;
- имя бренда должно быть эмоционально выразительным и экспрессивным;
- печатный бренд должен легко произноситься и читаться.

Б. Содержательные:

- главная идея позиционирования;
- основное отличие от конкурентов;
- уникальное торговое предложение: показать выгоду или преимущество, которое получит потребитель;
- ценность бренда для потребителей;
- сведения о высоком качестве товара и высоком уровне обслуживания;
- стиль и уровень жизни потребителей;
- ценовой сегмент.

В. Правовые:

- при разработке бренда необходимо учитывать сложившиеся представления потребителей о мировой специализации страны, ее сформировавшийся образ и особенности национального характера.

Актуальными по праву считаются образы, связанные с цветами национального флага, герба, национальных орнаментов или культурных ценностях территории. При визуальном отображении сущности бренда довольно часто применяют детские рисунки или анимацию, которые, как

правило, олицетворяют непосредственность и легкость. У потенциальных

потребителей (даже если они из разных стран и с разным менталитетом), логотип должен ассоциироваться с дружелюбностью и гостеприимством.

Рассмотрим на примере маркетинговую программу Республики Казахстан, а именно, «Kazakhstan. Very Nice!» / «Kazakhstan – Land of the Great Steppe».

Логотип и визуальный стиль:

Туристический бренд Казахстана активно использует визуальные элементы, отражающие национальную идентичность:

Цвета логотипа обычно включают **голубой и золотой**, которые символизируют **небо, мир, открытость и культурное наследие**. Эти цвета также присутствуют на национальном флаге Казахстана.

В дизайне часто встречаются **национальные орнаменты и узоры**, включая мотивы **солнечных лучей, кочевников, юрты, орлов и тюльпанов**, которые подчёркивают богатую культуру и природу страны.

Слоган и позиционирование:

Один из слоганов, активно используемых в международной маркетинговой кампании: «**Kazakhstan – Land of the Great Steppe**» («*Казахстан — страна Великой степи*»). Этот слоган подчёркивает масштабные природные пространства страны и её кочевое прошлое.

Ранее также использовался слоган: «**Discover Kazakhstan**» («*Открой для себя Казахстан*») — направлен на привлечение путешественников к неизведанным, экзотическим направлениям.

Целевая аудитория и посыл:

Кампания делает акцент на **разнообразии туристских продуктов**:

1.Экотуризм в степях, горах и национальных парках.

2.Культурно-исторические маршруты (Шелковый путь, мавзолей, музеи).

3.Современные города (Астана, Алматы).

4.Аутентичные традиции (юрты, кухня, музыка, кочевое наследие).

Пример визуальной реализации:

В 2020-х годах Kazakhstan Tourism представил **новую айдентику**, в том числе логотип с изображением **солнечного диска и орнаментов**, а также слоган на английском языке для международной аудитории [5].

Продвижение бренда туристской дестинации производится через продуманную коммуникационную стратегию, которая позволяет поддерживать контакт с потенциальными покупателями. Процесс коммуникации должен быть непрерывным и эффективным.

Комплекс маркетинговых коммуникаций состоит из:

- рекламы — донесение информации до потенциальных потребителей и привлечение внимания к объекту рекламирования, с целью продвижения, и использованием платных каналов;

- паблик рилейшнз (PR - Public Relations) – распространение информации об объекте в форме свя-

зей с общественностью для формирования благоприятного имиджа, с использованием бесплатных каналов

Система маркетинговых коммуникаций использует всевозможные инструменты: ярмарки; выставки; воркшопы; интернет; событийный маркетинг; коммерческие презентации; рекламные издания (буклеты, брошюры) демонстрации; кинореклама; проведение конкурсов; специальные рекламные средства.

Для пиара туристской дестинации применяют целый ряд технологий:

- устные сообщения (пресс-конференции и т.д.);

- паблисити (контакты с прессой, радио и ТВ);

- написание репортажей, пресс-релизов, рекламных статей и пр.;

- специальные мероприятия по представлению новой туристской дестинации;

- слухи (эта PR-технология играет в сфере продвижения туристской дестинации особую роль, поскольку впечатления и рассказы побывавших на том или ином курорте, в туристском центре играют очень важную роль).

Туристическая маркетинговая программа Казахстана направлена на продвижение страны как уникального и разнообразного направления для путешествий, сочетающего в себе богатое культурное наследие, живописные природные ландшафты и современные городские удобства.

Визуальная идентичность программы строится на использовании национальных символов и цветов: голубого и золотого, которые отражают красоту неба и бескрайних степей, а также процветание и богатство культурного наследия. В логотипах и рекламных материалах часто используются традиционные казахские орнаменты и мотивы, такие как солнце, кочевники, юрты и тюльпаны, что подчёркивает уникальность и аутентичность страны.

Слоганы, такие как «Kazakhstan – Land of the Great Steppe» и «Discover Kazakhstan», акцентируют внимание на величии природных просторов и возможности открыть для себя разнообразие туристических впечатлений.

Программа ориентирована на широкий спектр туристов — от любителей активного и экологического туризма в горах и степях до ценителей культурных и исторических маршрутов, знакомящих с наследием Великого Шёлкового пути и традициями казахского народа. Также значительное внимание уделяется развитию современного городского туризма в таких городах, как Астана и Алматы.

В целом, маркетинговая программа Казахстана стремится позиционировать страну как гостеприимное, разнообразное и перспективное туристическое направление, способное подарить «1001 удовольствие» каждому путешественнику [6].

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MEDICAL SCIENCES

METHODS OF RESTORATION OF PRIMARY MOLARS

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In recent years, many authors have addressed the issue of restoration of primary teeth [1, 2, 4, 5]. However, in most cases, the focus has been on replacing the defect in the hard tissues of the crown of primary teeth without considering the role of these teeth in occlusion and articulation. There is relatively little scientific research on the issues of articulation and occlusion in primary and mixed dentitions [6, 7]. However, a number of authors point out the importance of occlusion and articulation in both primary and mixed dentitions in the formation of a harmonious permanent bite.

During the development of the dento-maxillo-facial system, primary (milk) teeth undergo a series of topographical and morphological changes. The formation of proper dental arches in the upper and lower jaws in the primary dentition is largely influenced by genetic factors, but the type of feeding also plays an important role.

The formed primary dentition is classically characterized as follows: 1) the shape of the dental arches in both the upper and lower jaws is semicircular; 2) there are diastemata and spaces (tremas) between the primary teeth in both the upper and lower jaws; 3) the distal cusp of the second upper primary molar overlaps with the corresponding cusp of the second lower primary molar, creating a "mesial step"; 4) physiological wear of the cusps and incisal edges of the primary teeth in both the upper and lower jaws occurs; 5) the incisal overlap is minimal, or the primary incisors of the upper and lower jaws come into contact with their incisal edges.

Based on the standard physiological primary dentition, the goal of modern restoration of primary teeth is to restore the aesthetic and functional architecture of the hard tissues of the crowns of primary teeth, taking into account the role of the crown elements in occlusion and articulation, as well as their indirect influence on the growth and development processes of the dento-maxillofacial area.

To address this task, we proposed a method for restoring primary molars using indirect restorations. In the current domestic and international dental literature, we have not encountered mentions of the possibility of using composite inlays on primary teeth. This is largely due to time constraints during dental appointments, the often inadequate behavior of children during appointments, and the limitation of using light-cured composite filling materials on primary teeth.

The question also arises regarding the feasibility of using inlays to restore primary teeth. Drawing an analogy with the use of composite inlays on permanent teeth, we applied the Occlusal Surface Destruction Index (OSDI) developed by V.Yu. Milykevich. This index is used to determine the degree of destruction of the occlusal surface of molars in Class I—II defects and to select the prosthetic design. The index is calculated as the ratio of the "cavity—filling" area to the chewing surface of the tooth. The entire area of the occlusal surface of the tooth is taken as 1, and the OSDI is calculated as a percentage of the cavity or filling area relative to the entire occlusal surface.

The author determined that when the OSDI is between 0.55 and 0.6 (i.e., when the surface is destroyed by more than 50%), the use of an inlay is recommended to prevent further destruction. For an index of 0.6 to 0.8, filling and artificial crowns are indicated, while for an index greater than 0.8, the fabrication of pin-retained restorations is recommended. However, the goal of using inlays in the restoration of permanent teeth is to preserve occlusal contact points and the "occlusal compass" as factors for effective load vector distribution and physiological articulation within the articulation paths of group function of the jaw.

The primary and mixed dentitions have a more complex architecture of arches and occlusal surfaces due to the growth of the jaws and the formation of spaces and diastemata, as well as physiological wear of the cusps, which in turn is necessary for changing load vectors that stimulate jaw growth. Therefore, using inlays made of high-strength materials on primary teeth may require placing such patients under regular dental observation, with adjustments to the occlusal surface of the inlay to match the age-related topography of the distribution of wear points/facets on the crowns of primary teeth.

We set the task of studying the processes of physiological wear of the occlusal surfaces of primary teeth crowns, the topographical variability of wear facet distribution, and the occlusal contact points in primary and mixed dentitions. To do this, we selected 150 children aged 3 to 8 years. To study the topographical variability of the distribution of occlusal contact points, the children were divided into four groups: 1) those with a formed primary dentition (3 years $\pm$ 6 months); 2) those with a formed primary dentition but with spaces and diastemata between the incisors and canines of the upper

and lower jaws (from 4 to 5.5 years); 3) children in the early stage of eruption of the first permanent molar (from 6 to 7 years); 4) children with a mixed dentition during the eruption of the central permanent incisors of the upper and lower jaws (from 7 to 8 years). For all children, an occlusal diagram was taken, and the results were digitized to create a computer statistical model of the distribution of occlusal contact points relative to the occlusal surface area in the primary dentition.

For the study of the topographical variability of the distribution of wear facets on the occlusal surfaces of primary teeth crowns, the children were divided into four age groups: 1) 4 years; 2) 5 years; 3) 6 years; 4) older than 6.5 years, but with unchanged primary central incisors.

The contours of the wear facets were colored, and these contours were transferred to the occlusogram for subsequent digitization, enabling the creation of a computer statistical model of the distribution of wear facet topography relative to the occlusal surface area of the primary dentition. The obtained data were presented in the form of a compiled computer model depicting the distribution of occlusal contact points and wear facets during different periods of physiological changes in the occlusal relationships between the dental arches in the primary dentition as part of the growth and development process (Figures 1-4).

Based on the obtained data, a protocol for the dispensary management of children with restored primary teeth using indirect restorations was developed, considering the necessity of selective adjustment of the restorations to simulate the physiological wear of the occlusal surface of the crowns of primary teeth.

Preparing a primary tooth for restoration using inlays is not different from preparing permanent teeth. When preparing teeth for inlays, the following basic principles are followed: 1) the cavity is given the most rational shape to ensure the smooth insertion and removal of the inlay, i.e., all external walls should slightly diverge, and therefore, the entrance part should be slightly wider; 2) a box-like cavity shape must be created from which the inlay model can only be removed in one direction (the internal walls of the cavity should be parallel to each other and perpendicular to the bottom); 3) to prevent secondary caries, the cavity is prophylactically expanded and a bevel (falz) is created along the enamel margin, grinding it at a 45° angle, approximately 1/3 of the enamel thickness; 4) to prevent displacement or tipping of the inlay due to vertical and transverse forces, additional retention elements are created within healthy hard tissues; 5) when forming cavities in difficult-to-reach interproximal areas, an initial cut is made; after removing the contacting part of the tooth, free access to the carious cavity is opened, facilitating its formation; 6) the cavity should be asymmetrical or have additional indentations, serving as a guide when inserting the inlay; 7) the cavity should be sufficiently deep, extending into the dentin and not shifting under the influence of chewing pressure; 8) cavity preparation for the inlay should conclude with smoothing the edges and walls with carborundum burs and finishers.

To fabricate the inlay, an impression is made using silicone material. A model is cast from supergyp or

fast-setting modeling materials. The model is coated with an isolating varnish. The inlay is modeled from light-cured composite filling materials, considering the appropriate age-related architecture of the occlusal and interproximal surfaces of the tooth, and the restoration of the "occlusal compass" of primary teeth. Polymerization of the inlay material is performed, followed by grinding and polishing. The inlay is cemented using glass ionomer cement.

An analysis of 50 indirect restorations of primary teeth and 80 fillings on primary teeth made of glass ionomer cement, conducted to assess the hygiene of inlays and the restoration of chewing efficiency, showed that plaque formation in the area of the inlays was 83% lower than in the area of similarly located glass ionomer cement fillings. According to the analysis of occlusograms, the use of composite material inlays for restoring primary teeth, with gradual correction of the occlusal surface of the restoration to simulate the physiological wear of the cusps, resulted in the preservation of the volume and topography of the occlusal contact points reaching 94% compared to the nominal volume of occlusal contact points on the opposite, intact side of the jaw.

Thus, the use of indirect restorations in primary teeth is feasible when there is a need to restore a large volume of lost hard tissue in the tooth crown, provided that the average topography of occlusal contact points is maintained and the patient is monitored through dispensary observation, with selective adjustment of the restoration to simulate the physiological wear of the cusps of primary teeth.

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PEDAGOGICAL SCIENCES

IMPORTANT ASPECTS OF ENSURING QUALITY IN EDUCATION

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Abstract

The quality factor in education is not limited only to the transfer and assimilation of knowledge, but is also considered as a multidimensional and dynamic system aimed at ensuring the intellectual, moral, social and professional development of a person and forming a personality in accordance with the requirements of society. The serious consideration of this factor in our country in recent years gives grounds to say that the issue is urgent. In this regard, in accordance with the goal set, the main directions and modern approaches to ensuring quality in education are analyzed in the scientific and pedagogical level. The process of modernization of education is shown to develop as a complex and integrated structure, linked to reforms, new content and teaching methods, monitoring and evaluation systems. The socio-cultural nature of education is explained in the context of its interaction with personality and culture. The scientific work shows that ensuring quality in education is directly related to the development of human capital, adaptation to new requirements of society formed on the basis of information and technology, integration into international standards and national strategies. Factors such as globalization, information economy and the Bologna process make the assessment and adaptation of education to international standards relevant. In addition, it also examines pedagogical, technological and humanistic factors affecting the quality of education. The article presents the principle of "accessibility-quality-efficiency", considered important for the 21st century, functional literacy, a humanistic education model and the formation of a creative, free and cultural personality as the main goals. The steps taken within the framework of the Education Strategy of the Republic of Azerbaijan to improve the quality of education, participation in international research and mechanisms for assessing education are particularly emphasized. As a result of the conducted analyses, it is concluded that ensuring quality in education requires a strategic, sustainable and flexible approach not only to the transfer of knowledge, but also to the development of personality, instilling social values and the integration of future generations.

Keywords: Quality of education, modernization of education, socio-cultural approach, modern educational technologies, assessment and monitoring.

Introduction

In the modern era, the quality of education is considered one of the main driving forces of the socio-economic, technological and cultural development of society. Globalization, the rapid development of information technologies and the changing labor market have necessitated the formation of new approaches to the structure, content and function of education [1, p. 43-47]

Ensuring quality in education is a complex process that combines many aspects, and the effectiveness of this process primarily depends on the correct determination of the strategic priorities of the national education policy, teacher training and professionalism, modernization of teaching technologies, and adaptation of the content and methodology of teaching to the challenges of the time. In addition, mechanisms for assessing the results of education, effective organization of monitoring systems, as well as the establishment of national assessment systems integrated with international experience are the main components of this process.

The Law of the Republic of Azerbaijan "On Education" defines the problems of forming a creative personality and citizen. The law states that the main goal of education is to educate independent, creatively thinking citizens and individuals who understand their responsibility to the Azerbaijani state, respect the national traditions and principles of democracy, human

rights and freedoms of their people, are loyal to the ideas of patriotism and Azerbaijaniness [2, p. 4]. The expected result of the implementation of this main goal is the upbringing of active Azerbaijani citizens.

The large-scale reforms carried out in the field of education in the Republic of Azerbaijan in recent years and the adopted "State Strategy for the Development of Education" have defined specific goals and directions of action in this direction. The strategic approach of the state to achieving quality in education has brought to the agenda such main tasks as increasing the functional literacy of students and equipping them with knowledge and skills that meet the requirements of the labor market.

In this regard, the presented scientific article analyzes in detail the theoretical and practical aspects of the concept of quality in education, internal and external factors influencing the formation of this quality, priority directions of education policy, and issues such as harmonization of the education system with international indicators. The goal is to reveal the methodological foundations of ensuring quality in education, identify existing problems, and put forward effective proposals in this direction.

1. The quality factor in education and its sociocultural significance

Many countries of the world, as well as many higher education institutions, struggle with widespread

low-quality education due to the lack of effective strategies to improve the quality of their education systems.

The term quality assurance refers to “systematic, structured and continuous attention to quality in terms of maintaining and improving quality”.

In a broad sense, quality assurance is defined as systematic planning, monitoring and evaluation to maintain and improve the standards of education, research and general services in colleges and universities in order to ensure effective results. That is, it is understood as the ability of higher education institutions to meet certain criteria related to academic matters, staff-student ratio, staff structure by position, staff development, material and technical base, financing opportunities, compliance with high standards in management and evaluation of their results[3; 4]

Modernization of education is an objective process that determines its reform and progress towards the formation of new meanings and values, approaches to the content and teaching methods of education, monitoring and evaluation of the results of educational activities. The modernization program for the development of the country is based on the principle of development of the education system, and therefore education should be mainly modern, advanced, supporting objective social development trends, and be all-encompassing. The formation of state education policy of the XXI century. in this case, they are based on the slogan “accessibility - quality - efficiency”. It is an integrated system that synthesizes all stages of education, which is the basis of a social indicator of the quality of education. Preservation and provision of the quality of education is a very big responsibility that requires a strong sense of responsibility. This issue is of concern all over the world, as each country strives to provide high-quality education [5, p. 767].

In the sociocultural approach, society, education, which is a cultural phenomenon, and personality act as sociocultural systems that interact with each other. Culture determines not only the external environment of education, but also its “internal world”, its structure. It is no coincidence that researchers have recently been using the concept of “cultural-educational space”, thereby considering education as a spiritual and cultural process. In this sense, revealing the relationship between education and culture, their mutual relations and mutual influences, in other words, clarifying the concept of “education” and the place of culture in it, and vice versa, clarifying the concept of “culture” and the place of education in it, is one of the urgent issues [6, p. 99].

The quality of education is an assessment of the integrity of the content of education, teaching technologies, monitoring methods and the subject's self-determination in terms of individual development and the requirements of society in new socio-economic conditions. In this regard, the quality of education is perceived as a concept, reflecting the ability to ensure the achievement of the goals set for the education system, to ensure its compliance with the needs of a particular person in education, the needs of society and the economy. The exceptional importance of ensuring the

quality of education today is determined by the following objective reasons:

Firstly, scientific and technological progress is accelerating and the dependence of the level and scale of education on the development of society is increasing. In such conditions, higher education is becoming widespread and it is necessary to create conditions for the development of the creative abilities of those entering higher educational institutions, and vocational education is being made available to the general population.

Secondly, there is a gradual transition of society from the industrial stage of the economy to the information economy and the stage of the formation of an information civilization. This process is mainly associated with an increase in the economic and social role of universities and their graduates.

Thirdly, with the development of world information civilization, the process of globalization is developing rapidly, part of which is the accumulation of scientific information in accordance with the Bologna process, which is associated with the provision of an international education, which requires the harmonization of the level of work quality of educational systems of different countries, the compliance of young people with certain universal criteria and standards, in particular, the international mobility of graduates and students, their employment and the recognition of educational certificates.

Fourthly, taking into account the rapid development of Azerbaijan in the field of education, the issue of taking its material and technical base among the technologically, economically and culturally developed countries of the world is sharply reflected.

For these and many other reasons, the quality of education takes one of the most important places in the system of economic and socio-political development of our country, and we are witnessing its transition to a new quality level. In general, a change in the paradigm of training students and specialists, reflecting the educational priorities and requirements of society, different content, different approaches to learning, different attitudes, behavior and a different pedagogical idea, is manifested. In modern conditions, school teachers are faced with an individual training that knows how to deal with the environment. The level of culture and education is the basis of the quality indicators of education in the 21st century, the formation of a personality that meets the requirements of the humanistic and information society in modern living conditions.

The quality of education determines the “quality of life of a person and society”, since it is also determined by the personal, ideological, civic development of the younger generation and the orientation of its emotional value to the world around it. Thus, the problem of the quality of education should be considered, first of all, from the point of view of the human and social value of education. Because a full-fledged education received by a person not only gives him certain knowledge about nature, man, society, but also allows him to know himself and subsequently show himself as a citizen.

The scientific humanistic education system can achieve three main goals: the formation of a cultural

person (cultural subject), a free citizen (historical subject, civil society), a creative person (subject of activity, self-development).

The implementation of this goal is aimed at solving the following tasks:

- Education of a person with his own abilities and needs in the main forms of human activity;
- Development of the ability to recognize himself in unity with the world, in dialogue with it;
- Development of the ability to self-determination, self-expression based on the restoration and assimilation of the cultural experience of humanity's self-development;
- Formation of the need and ability to communicate with the world on the basis of humanistic values and ideals, the rights of a free person.

Today, the process of reforming the education system is actively developing, accompanied by the widespread use of effective mechanisms for implementing educational goals and the application of scientific methods for assessing educational achievements.

The next important task in ensuring the quality of education is the development and transformation of various educational technologies for teachers. The quality of education depends on how and what technologies the teacher relies on, how he can change his methodological tools depending on the characteristics of the students.

Humanity has truly entered a new historical space, when the person himself, his educational and professional skills, moral qualities have become the main source of development. The vital activity of mankind is directed towards very complex objects and is characterized by high technology.

2. Quality education: basic concepts and definitions

The most important aspect of the educational process is its quality. The quality of education is the ability of educational workers to meet the needs and requirements of society at the expected level with their knowledge, skills and behavior [7, p. 40]. Is it possible to produce quality services and quality products with a workforce that is not well educated and does not have a qualified profession? In which factory can quality products be produced with unqualified technical staff? What quality health care can be provided with a medical staff that is not well educated? There are many similar examples. For this reason, the whole world is trying to achieve quality in education today. Because the nation that has the best quality in education obtains quality products and services produced by quality professionals and qualified specialists [8, p. 16].

One of the main factors for achieving successful and quality education is the teacher. Training qualified teachers is one of the important tasks facing countries that want to achieve quality. Quality, efficiency and effectiveness in education are based on a professional teaching staff, and professional professional quality in teaching is based on a teacher training model based on scientific principles [9, p. 21-28].

Article 9 of the Law of the Republic of Azerbaijan "On Education" defines the quality levels of education as follows:

– The quality level of education is determined in accordance with the principles of the international and pan-European education system on the basis of the state educational and professional standards adopted in the country and in accordance with the relevant quality indicators system for educational levels (educational programs, level of preparation of applicants, material and technical base, infrastructure, information resources, professionalism and scientific and pedagogical level of educators, progressive teaching technologies, etc.).

– The quality level of personnel training in an educational institution is determined by the competitiveness of graduates in the national and international labor market, their role in the social and economic development of the country.

– The quality level of education arises from the requirements related to socio-political, socio-economic, scientific and cultural development at each historical stage and is assessed accordingly by the accreditation service [2, p. 5].

In this regard, the concept of "quality of education" has acquired international citizenship, and improving the quality of education has become one of the main tasks of long-term prospective educational institutions. With the change in the level of development of society and social conditions, new requirements are imposed on the quality of education, especially related to the ethical component of a person's creative and predictive abilities. Taking into account the constant variability of the social environment, the concept of "quality of education" will constantly change in the future.

The concept of "quality of education" based on the legislation of our republic in the field of education is interpreted as a certain level of knowledge and skills acquired by graduates of an educational institution in accordance with the planned goals of teaching and education.

The quality of education is the ratio of the goal and the result, the system of actions that are projected to achieve the goals set for operational activity and the zone of potential development of students. The quality of education allows us to consider it not only as a result, but also as a complex dynamic process of development due to changes in the activities of educational institutions and individuals and changes in the surrounding social, economic, technological and political environment [10].

The integration of skills and knowledge, their transfer, interpenetration, and synthesis, in general, implies a high level of education; it allows us to realize the need for self-affirmation, self-expression, self-development, self-determination, and, as a result, is a criterion for the development and social readiness of the individual. A competent person in a particular field has general knowledge and relevant abilities that allow him to justify this field and effectively act in this field. This is a personality that reflects the ability to use knowledge and skills universally and allows him to make decisions and act in non-standard situations (synergistic approach) on the subject.

Thus, the quality of education is not only the results of work, but also a system, model, and organization that ensures the comprehensive personal and social development of students.

In this regard, the quality of education reflects the following complex indicators:

- Correction of goals and learning outcomes;
- Ensuring the degree of dependence of the expectations of participants in the educational process on the provided educational service;
- A certain level of knowledge, skills, abilities, abilities and competencies of the individual, mental, physical and moral development;

From the point of view of modern didactics, the following features of the quality of education are taken into account:

1. The conceptual level of content corresponding to the level of scientific and technical progress;
2. Interdisciplinary, the nature of knowledge, skills and activities;
3. Adaptation to the interests, desires, capabilities and individual characteristics of students;
4. The variable, alternative and problematic nature of training with the widespread use of information technologies;
5. The creation of diverse cultural environments for multicultural education in order to enrich themselves and ensure readiness to live in a multinational environment;
6. The independent nature of the assessment of educational outcomes and the level of personality development;
7. Providing conditions for self-assessment, self-certification and self-management in learning and development.

The result of quality education is the formation of such abilities (characteristics) of individuals: self-organization, including spiritual; self-transformation activities; self-expression. Finally, a well-educated person must be competitive, successful and in demand in the labor market. It is necessary to easily and freely adapt to rapidly changing socio-economic conditions, to use the education received effectively. Each person must manage the four main stages of education: acquiring knowledge, learning to work, learning to develop personality, learning to live. This integrated approach to education has caused discussions in a number of countries around the world and has had a significant impact on the training of teacher cadres and the development of teaching [11, pp. 25-28].

3. Pedagogical principles of quality education

Recently, the growing demands on the quality of educational services have become increasingly noticeable, allowing the formation of the following pedagogical principles of quality education:

- A competency-based approach to the educational needs of students and their profiles, focusing educational programs and educational technologies on the personality and developmental characteristics;
- Consistency, integrity and variability of the content and activities of education, taking into account multiple points of view of the problem and multiple directions of its solution;

- The transition to the relations of mutual activity of educational subjects in the educational process;
- Activity as a subject of education and creative activity of students in the field of self-development, self-determination;
- The modular-block principle of organizing the content of education and the activities of students;
- Principles of progress in learning and development, support for motivation, self-assessment, self-management and self-correction;
- To be oriented towards the future content of life and activity, humanistic values and ideals; to approach learning and studying in the future not as a school of memory, but as a school of thought; to form a person who creates an image in the world through active self-reliance in the world of objective, social and spiritual culture.

In the document “State Strategy for the Development of Education in the Republic of Azerbaijan”, approved by the Decree of the President of the Republic of Azerbaijan, Mr. Ilham Aliyev, dated October 24, 2013, the quality of education was declared the main strategic priority, and the improvement of the quality indicators of students and graduates of general education institutions was put forward as a pressing issue [12].

A distinctive feature of the development of education in the world today is the increased attention of the governments of developed countries to the problems of the quality and efficiency of education. Education is becoming a strategic area that ensures national security, and the competitiveness of the country is assessed by the level of education of the younger generation. Many countries are joining forces in the development of methodology, technology and tools for comparative studies of the quality of education. At the same time, the direction of explaining the differences between countries in terms of the level of material preparation of students, and in particular, identifying the factors affecting the results that determine the highest achievements, is also in the spotlight.

The State Strategy for the Development of Education in the Republic of Azerbaijan states that “Quality and inclusiveness of education. According to the United Nations Human Development Report for 2010, compared to 2005, Azerbaijan has advanced 34 steps, rising from 101st to 67th place among 169 countries, and has entered the “medium human development” group into the “high human development” group. Azerbaijan has achieved great achievements in terms of reducing poverty and increasing life expectancy by accelerating the pace of economic development. At the same time, statistical analyses of leading international organizations show that it is necessary to increase the international competitiveness indicators of Azerbaijani education and the rating level of higher education institutions located in the territory of the Republic of Azerbaijan” [12].

The creation of a system for assessing the quality of education in Azerbaijan is associated with the need to obtain objective information on learning outcomes in accordance with educational standards in order to make sound management decisions. This requires criteria for

comparing the reliability of the assessment system. One of these principles is the use of advanced management systems from the experience of foreign countries, which allow us to identify trends in the development of systems for assessing learning outcomes in different countries of the world, and systems for assessing the results of research in schools used in different countries of the world.

In accordance with the relevant Decree signed by the President of the Republic of Azerbaijan on 29.12.2019, the Accreditation and Nostrification Department of the Ministry of Education (currently the Ministry of Science and Education) was reorganized by transforming it into the Agency for Quality Assurance in Education with the status of a public legal entity under the Ministry of Education. The Agency is responsible for the assessment of higher, secondary and additional education based on standards accepted in Azerbaijan and internationally. It is a professional and expert institution in the field of independent assessment of the quality of education.

The Agency for Quality Assurance in Education (AKEA) ensures the definition of quality levels of educational programs and the implementation of requirements. While fulfilling its duties and exercising its rights, the Agency interacts with state bodies (institutions) and municipalities, international and non-governmental organizations, other legal entities and individuals [13].

Proceeding from this, in recent years, Azerbaijan has participated in international studies of educational achievements. International studies on the assessment of the quality of education allow assessing the state of the education system in Azerbaijan and in the international context using the same pedagogical measurement tools created taking into account international priorities in education.

Along with this, special attention should be paid to determining the interdisciplinary knowledge of students, especially the use of information to solve practical problems, and it should be characterized as follows.

- Assessing the functional literacy of students in order to determine their ability to adapt to modern society;
- Determining the educational achievements of students in terms of modern international priorities in the field of improving the quality of education;
- To determine the direction of education development, analyze the achievements in the field of education, identify its strengths and weaknesses, etc. The pedagogical characteristics of the quality of modern education, the development of young people's skills, the principles of its provision and assessment constitute the requirements for new educational standards, which should determine the requirements for the quality of students' educational achievements, which consists of the development of teaching and learning technologies, control methods and assessment of the quality of education.

4. Conceptual aspects of quality assurance in education

Conceptual aspects of quality assurance in education are mainly related to the creation of learning conditions:

- Educational policy for quality improvement;
- Clearly and unambiguously defined criteria, rules, quality standards of educational content;
- The quality of curricula and didactic materials for teachers and students, the quality level of material, social, household and information infrastructure of educational institutions;
- Means of influencing the subjects of the educational process, including special technologies for organizing educational and teaching processes, methods for assessing the quality of education;
- Using modern tools and technologies for objective quality control of education;
- Informatization of education (professional databases, electronic textbooks and libraries, daily use of telecommunication services in the classroom and independent academic work);
- Mechanisms and tools for managing educational activities in terms of quality and self-management.

Thus, the quality of education largely depends on the quality of the components of the management system of the entire education system and its subjects. Such an important category as the quality of education forces us to study the phenomenon of a new management culture that must be mastered by management, teachers and students. The problem of achieving quality is associated with an understanding of the objective function of education and a systematic approach to education at each level, considered as an activity to achieve the goals of the organization and coordinating the activities of all components of the education system.

Conclusion

Ensuring quality in education in the modern era is a complex and strategic process that is closely related not only to the improvement of pedagogical and didactic approaches, but also to social, economic, technological and cultural factors. From this perspective, the quality of education is determined not only by the academic performance of students, but also by their personal and civic formation, the development of functional literacy, the ability to communicate with the environment and their readiness for future professional activity. The main indicators that ensure the quality of education - accessibility, efficiency, technological integration, teacher training, updating of teaching technologies and the objectivity of assessment systems - shape the direction of reforms in this area.

The educational reforms carried out in the Republic of Azerbaijan in recent years, especially the targeted steps aimed at increasing quality within the framework of the "State Strategy for the Development of Education", have created an opportunity to renew the education system in terms of structure and content, and to bring it into line with international indicators. At the same time, within the framework of the Bologna process, the international competitiveness of education, the flexibility of graduates in the labor market and the global mobility of students have become key priorities.

The experience gained shows that one of the main conditions for improving the quality of education is the improvement of the professionalism of teachers, the application of modern teaching methods and the systematic integration of approaches aimed at the individual development of students into teaching. At the same time, the establishment of objective, transparent and analytical systems based on international criteria in the assessment of educational outcomes is of great importance in terms of reflecting the real state of education and determining development directions.

Thus, ensuring quality in education is not only a goal, but also a fundamental means of ensuring the sustainable development of an entire society. In this direction, strategic thinking, effective management, scientifically based pedagogical decisions and investments in human capital are the main guarantees of long-term social well-being and national competitiveness.

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PHILOLOGICAL SCIENCES

THE QUESTION OF COMBINATIONS OF LIQUID CONSONANTS R, L WITH VOWELS OF FULL AND REDUCED FORMATION (SUBJECT OF HISTORICAL GRAMMAR OF THE RUSSIAN LANGUAGE IN THE GEORGIAN UNIVERSITY AUDIENCE)

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ВОПРОС О СОЧЕТАНИЯХ ПЛАВНЫХ СОГЛАСНЫХ Р, Л С ГЛАСНЫМИ ПОЛНОГО ОБРАЗОВАНИЯ И РЕДУЦИРОВАННЫМИ ГЛАСНЫМИ (ПРЕДМЕТ ИСТОРИЧЕСКОЙ ГРАММАТИКИ РУССКОГО ЯЗЫКА В ГРУЗИНСКОЙ АУДИТОРИИ ВУЗА)

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Abstract

The article is devoted to the study of historical disciplines of the Russian language, in particular, historical phonetics, in the Georgian audience of a Georgian university. The author examines the specifics of presenting historical facts of a foreign language in the Georgian audience of a university, where possible draws parallels with the facts of the national language, including at the present stage.

Аннотация

Статья посвящена изучению исторических дисциплин русского языка, в частности, исторической фонетики, в грузинской аудитории вуза Грузии. Автор рассматривает специфику представления исторических фактов иностранного языка в грузинской аудитории вуза, по возможности проводит параллели с фактами национального языка, в том числе и на современном этапе.

Keywords: factors of the Proto-Slavic period, incomplete agreement, complete agreement, different positions of r, l.

Ключевые слова: факторы праславянского периода, неполногласие, полногласие, разные положения r, l.

Изучение исторических дисциплин русского языка, в частности вопросов исторической фонетики, в грузинской аудитории вуза Грузии происходит по программе с сокращённым количеством часов. Это обязывает сжато, но доходчиво представлять исторические языковые явления, по возможности проводя параллели с фактами национального языка, в том числе и на современном этапе.

Рассматривая вопросы фонетики по линейному принципу, следует чётко разграничивать явления праславянского и старославянского периодов. Особого внимания требуют такие факторы праславянского периода, которые легли в основу фонетической системы как старославянского языка, так и начального периода древнерусского языка:

1) закон открытого слога (ЗОС, IX-X в.) - СЛЫ-ША-ТИ; ПРИ-ЗЬ-ВА-ВЬ; СЬ-ГРѢ-ШИ-ХЬ;

2) закон восходящей звучности (ЗВЗ);

3) закон слогового сингармонизма (ЗСС)

и тенденция к палатализации исконно твердых согласных.

Первый из этих факторов следует иметь в виду при изучении таких важнейших разделов фонетики, как:

1) монофтонгизация дифтонгов;

2) происхождение и употребление носовых гласных;

3) сочетания плавных согласных с гласными полного образования и редуцированными гласными, и др.

Второй фактор проявляется:

1) в законах смягчения заднеязычных согласных;

2) изменениях согласных и групп согласных в сочетании с j.

На этих вопросах и следует, на наш взгляд, сосредоточить основное внимание при изучении фонетики в курсе истории русского языка (вопросы старославянского, древнерусского языков).

СОЧЕТАНИЯ ГЛАСНЫХ ПОЛНОГО ОБРАЗОВАНИЯ С ПЛАВНЫМИ СОГЛАСНЫМИ Р, Л

Следует различать сочетания гласных полного образования с плавными согласными Р, Л: а) между согласными, б) в начале слова.

В первом случае речь идет об образовании так называемых старославянских неполногласных сочетаний типа ВРАГЪ, ГЛАВА, ВРАТА, соответствующих древнерусским полногласным (ворогъ, голова, ворота). Некоторые из подобных образований проникли из русского языка в языки Кавказа, например, имя собственное Карл в грузинском –

Карло не является исконным, как и в славянских языках. Оно заимствовано из германского Karl (имя императора Карла Великого – VIII – IX вв.) и получило “славянский облик” – для южных славян КРАЛЬ (неполногласная форма), а для восточных славян КОРОЛЬ (полногласная форма).

Источники и соответствия старославянских неполногласных и древнерусских полногласных сочетаний удобно представить в виде следующей таблицы:

Индоевропейские сочетания	*tort	*tolt	*tert	*telt
Праславянские формы (предполаг.)	*gōrdь	*gōlva	*birgь	*shēlmь
Старославянские неполногласные сочетания	–РА– ГРАДЪ	–ЛА– ГЛАВА	–РѢ– БРѢГЪ	–ЛѢ– ШЛѢМЪ
Древнерусские полногласные сочетания	–ОРО– ГОРОДЪ	–ОЛО– ГОЛОВА	–ЕРЕ– БЕРЕГЪ	–ЕЛО– (–ОЛО–) ШЕЛОМЪ
Соответствия из др. инд. – евр. языков	готск. <i>gardo</i> «двор»	лат. <i>calva</i> «череп»	нем. <i>berg</i> «гора»	нем. <i>helm</i> «шлем»

Рассматривая эту таблицу, следует иметь в виду:

1. Неполногласные и полногласные сочетания развивались в положении между согласными в соответствии с законом открытого слога (ЗОС). В таблице буква **ѣ** условно обозначает любой согласный.

Известно, что в южнославянской группе языков, в том числе и старославянском, открытие слога

Например:

древняя форма сс. БРѢГЪ;

др. – р. *берегъ* > **БЕРЕГЪ**; совр. русск. > берег.

3. О достоверности восстанавливаемых праславянских форм говорят соответствия из других индоевропейских языков, в которых сохранился первичный порядок (гласный + плавный), не разрушенный законом открытого слога.

4. В ряде слов сочетания типа РА, ЛѢ не соответствуют сочетания **оро**, **ере**. В этом случае имеем исконные образования, унаследованные от праславянской эпохи и общие для старославянского, древнерусского и других славянских языков: ср. сс. и др.-р.: СЛѢДЪ, СЛАВА, ПЛАКАТИ, СТРАХА. В строении слога здесь изменений не было, потому что он всегда был открытым. Праславянская форма для слова СЛѢДЪ, например, будет * *slīdь*.

В древних сочетаниях перед согласными (условно $t > *ort, *olt$) у начальных *or–, *ol– по закону открытого слога также наблюдается метатеза с удлинением о в а: * *orbota* –

сс. РАБОТА. Ср. первичный порядок звуков в нем. *Arbeit*. В др.-рус. языке метатеза не сопровождалась удлинением гласного: **робота** (ср. совр. русск. **робот**). Однако в слове **лаком(ый)** сочетание **ла** прослеживается в ряде славянских языков.

шло путём перестановки гласного и плавного согласного (метатеза), его удлинения. Причем краткий гласный **o** удлинялся в **a**, а **e** – в **ѣ**.

2. Следует избегать распространенной ошибки, будто древнерусские сочетания развились из старославянских. Те и другие образовались из праславянских.

Вопросы и задания для контроля:

1. В каком из слов-омонимов ГРАДЪ (в значении «город») и ГРАДЪ (атмосферное явление) сочетание РА является исконным? Восстановите общеславянские формы этих слов.

2. Напишите старославянские соответствия современным русским словам:

перегородить, молоко, плен, брат, возглас, ограда, чрезмерно, прохлада, превращать, среда, дерево, вред. Образец: **ограда** – **оградъ** – * *gordь*.

3. Пользуясь данной выше таблицей, восстановите праславянские формы следующих старославянских слов: **ЗЛАТО, КРАВА, ВРѢМА, ПЛѢМА**.

4. Какого происхождения начальные ра–, ла–, ро–, ло– в следующих словах: **растение, ровный, ладья, лодка, раб, роба**. Что можете сказать о языке – источнике этих слов?

5. Чем объяснить сохранение праславянского *ōr– в сс. **ОРАТИ**?

СОЧЕТАНИЯ РЕДУЦИРОВАННЫХ ГЛАСНЫХ С ПЛАВНЫМИ СОГЛАСНЫМИ Р, Л

При рассмотрении данных сочетаний особого внимания требуют следующие моменты.

1. Графически все старославянские сочетания редуцированных гласных и плавных согласных построены так, что буквы **Ѣ** и **Ѧ** стоят после **Р**, **Л**. При этом такие сочетания находятся между согласными (**трѣтъ, тлѣтъ, трѣтъ, тлѣтъ**): **ДЛѢГѢ, ПРѢВѢ, КРѢВѢ, ЦЛѢТѢ**. В древнерусском языке редуцированные употреблялись как после плавных (**КРѢВѢ, ПЛѢТѢ**), так и перед плавными (**ДЛѢГѢ, ПРѢВѢ**). Как видим, в одних случаях порядок сочетания редуцированного и плавного в старославянском языке совпадает с древнерусским (**КРѢВѢ, ПЛѢТѢ**), в других он различен (ср. **ДЛѢГѢ**, др. – р. **ДЛѢГѢ**). Этот факт может послужить отправной точкой для различения старославянских сочетаний, имеющих различную природу.

2. В тех сочетаниях, которые имели тот же порядок, что и в древнерусском языке, имеем два звука – обычные плавные согласные **р**, **л** в сочетании с редуцированными **Ѣ**, **Ѧ**: **ПЛѢТѢ, КРѢВѢ, КРѢХА, БЛѢХА, СЛѢЗА**. Исконность (первичность) этого порядка подтверждается индоевропейскими параллелями с таким же порядком звуков. Ср., сс. **КРѢСТѢ** и др. – нем. *Krist* и под. [Хабургаев, 137, 138].

3. В тех сочетаниях, которые по своему расположению отличаются от древнерусских (ср. **ГРѢЛО** и др. – русск. **ГЪРЛО**; сс. **ЗРѢНО** и др. – русск. **ЗЪРНО**), сочетания **РѢ, ЛѢ, РѢ, ЛѢ** были обозначениями слоговых плавных согласных (**Р**, **Л**). Поскольку в старославянском языке в таких случаях слоговыми были **Р** и **Л**, а **Ѣ** и **Ѧ** обозначали лишь неслоговые призвуки, в памятниках письменности наблюдается их смешение. Ср. сс.: **ВРѢХѢ** и **ВРѢХѢ**. Первичность порядка расположения плавного и редуцированного (препозиция / постпозиция), а также ряд последнего (передний – **Ѣ**, задний – **Ѧ**) могут быть подтверждены индоевропейскими соответствиями. Например, для старославянского **ВРѢХѢ, ВРѢХѢ** и древнерусского **ВЪРХѢ** таким соответствием является лит. *vir̃sus* «**верх**», где, во-первых, гласный **і** предшествует плавному **г**, во-вторых, гласный **і** по образованию относится к переднему ряду. Отсюда следует, что древнерусская форма более близка к индоевропейскому источнику. Подобное явление указывает на предшествующее положение редуцированного гласного плавному согласному (см. **ṽrchъ*) в неисконных образованиях праславянского периода.

4. Что касается судьбы редуцированных гласных в рассматриваемых сочетаниях, следует помнить, что в неисконных сочетаниях к XI веку они утратились (**ВРѢХѢ** > **ВРХѢ**), как и в ряде славянских языков, а в исконных изменились в зависимости от положения в слове (см. выше).

Вопросы и задания для контроля:

1. Подберите индоевропейские соответствия старославянскому **ДРѢТѢ** (порок, недостаток) и древнерусскому **ДЪРТѢ** и укажите на исконность этого образования в старославянском языке.

2. В какой из данных форм (ср. **ВРѢБА, ВРѢБИЮ**, др. – рус. **ВЪРБА**) имеем первичный порядок расположения плавного согласного и редуцированного гласного? Что для ответа на этот вопрос даёт лит. *vir̃bus*?

3. Какова природа плавного сонорного **г** в названии города **Вrno**? Восстановите праславянскую форму этого слова.

4. На каком языке (старославянском, древнерусском) написаны слова:

ГРѢЛО, КРѢВѢ, ЖЛѢТѢ, БРѢВѢ, ДЛѢГѢ, БРѢВѢНО?

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PHYSICAL SCIENCES

QUANTUM FIELD THEORY AND STRING THEORY

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Abstract

It is known that scientific innovations discovered in modern times prove that the structural dynamics of the Universe are subject to very complex laws. Combining all these laws into one theory is an issue that scientists have always believed in and worked on. It is this theory that can fully explain the dynamics and structure of the Universe, as well as many phenomena in terms of quality and quantity. This theory also has the potential to answer important questions about the beginning of the Universe. Today, quantum field theory is considered the closest theory to this theory. Quantum field theory is an important framework that plays a fundamental role in modern theoretical physics, unifying quantum mechanics and special relativity. The emergence of this theory arose from the need to overcome the separation of classical field theories and quantum mechanics - which occurred separately. At the beginning of the 20th century, it became possible to explain the effects of combining quantum mechanics with the concept of fields to clarify the properties of subatomic particles, as well as the properties of particles. It is currently considered one of the most accurate theories in physics. However, on the other hand, there is also String theory, which could be worthy of being a theory of everything. String theory suggests that the smallest structural unit of the universe consists of strings vibrating at different frequencies. Since the universe was actually created from a single point by the Big Bang, we conclude that matter and the physical field have the same source. This source is the smallest structural unit of the universe, namely strings. From this it becomes clear that quantum field theory can actually be described by string theory, and this description can unite these two theories around one goal. In this article, all the features of quantum field theory are examined, and an attempt is made to explain these features and the contradictions it encounters with string theory. The issues that string theory and quantum field theory can explain are reviewed. The shortcomings of quantum field theory are examined and the reasons for this are touched upon. Finally, ways to combine quantum field theory and string theory and include it in the final theory of the universe are mentioned.

Keywords: physical field, quantum mechanics, quantum field theory, Casimir effect, quantum vacuum waves, standard model, grand unified theory, string theory.

Introduction. Quantum field theory was formed as a result of the successful synthesis of quantum mechanics and special relativity and was created to explain the fundamental forces of nature, as well as the interactions of elementary particles. The emergence of this theory arose from the need to overcome the limitations that classical field theories and quantum mechanics faced separately.[1] Quadratic mechanics, which was created in the early 20th century to explain the world of subatomic particles, when combined with the concept of a local field, allowed us to dynamically explain both the behavior of matter and its interactions. Although quantum mechanics was successful in explaining the discrete and probabilistic behavior of nature at the subatomic level, it was unable to account for phenomena such as the creation and disappearance of particles.[2] To understand why quantum mechanics and classical field theory face these difficulties and to understand the bridge between these fields, it is necessary to consider the origin and properties of this field. Only then can we speak of a definitive explanation of quantum field theory. In 1831, the English physicist Faraday made one of his greatest discoveries. He showed that a changing magnetic field can induce a changing electric current in

a wire. This phenomenon is called the law of electromagnetic induction.[3] In the following years, Faraday conducted a series of experiments to investigate the close relationship between electric and magnetic fields. During these years, he developed the concept of the electromagnetic field. According to Faraday, electric and magnetic fields are in fact different manifestations of a single electromagnetic field.[4] In 1845, Faraday discovered the Faraday effect, which is named after him. He showed that a magnetic field can affect the polarization of light. This was one of the first pieces of evidence that light is also electromagnetic in nature.[5] In 1855–1862, Faraday's work was put into mathematical form by James Clark Maxwell.

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$$

$$\nabla \cdot \mathbf{B} = 0$$

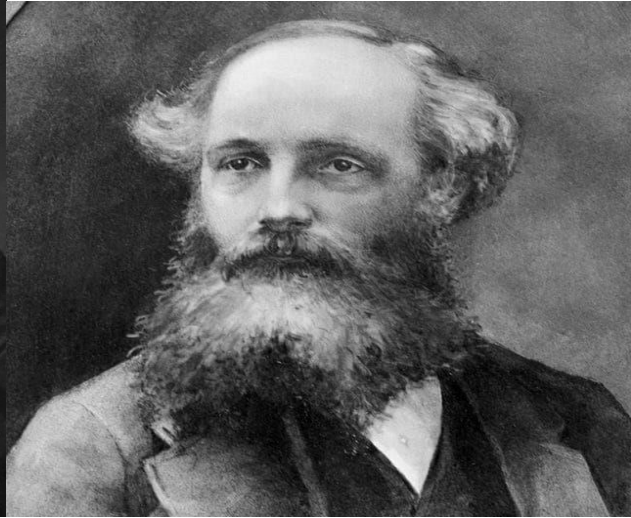
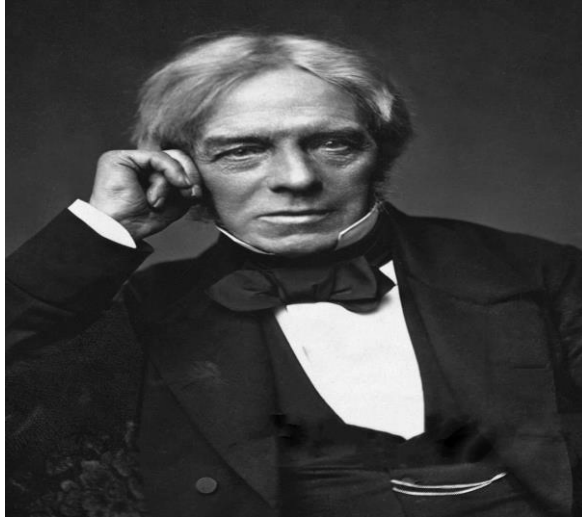
$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{j} + \frac{1}{c^2} \frac{\partial \mathbf{E}}{\partial t}$$

Maxwell's equations

The second and third equations clearly show the law of electromagnetic induction: a time-varying electric field creates a space-varying magnetic field, or conversely, a time-varying magnetic field creates a space-

varying electric field.[6] Maxwell developed these ideas and fully formulated the theory of electromagnetism. The ideas of Faraday and Maxwell led physics towards field theory.



Michael Faraday James Clerk Maxwell

Until now, the laws of classical physics worked in a certain way. However, at the beginning of the 20th century, a number of phenomena were discovered that could not be explained by classical physics. It turned out that in order to fully explain these phenomena qualitatively, a new physics - quantum physics - should be

created, which explains the properties of subatomic particles.[7] Because the movements of elementary particles are much more harmful than macroobjects. The reason for this is that particles have dual properties - wave and particle properties.



Wave-particle duality of particles

Unlike macroobjects, the concept of trajectory was not used for particles, which complicated the study of their properties and movements. It became clear that the movements of particles with strange properties could not be determined by classical physics expressions until now[8]. The lack of a description of their motion made it difficult to study the nature of these objects. For this reason, physicists focused their attention on this issue. An equation of motion explaining the motion of subatomic particles had to be discovered. Erwin Schrödinger gave his non-relativistic equation, which was very close to classical mechanics, could be understood intuitively, and described atomic and molecular systems very well.

$$i\hbar \frac{\partial \psi(\mathbf{r}, t)}{\partial t} = \left(-\frac{\hbar^2}{2m} \nabla^2 + V(\mathbf{r}) \right) \psi(\mathbf{r}, t)$$

where i is an imaginary unit; $\hbar$ - Reduced form of Planck's constant; m - mass of the particle; ∇^2 - Laplace operator (spatial derivative); $V(\mathbf{r})$ - potential energy function; Ψ -is a wave function.

This equation is simply a first-order equation in time and a second-order equation in space.[9] Although a useful equation, the Schrödinger equation had its drawbacks. First, it does not hold for relativistic systems and is not suitable for many-electron elements other than hydrogen and hydrogen-like atoms due to the complex mathematics involved. On the other hand, it does not describe the spin, a unique property of particles.[10] However, the Schrödinger equation was one of the first steps towards quantum field theory. In 1926–1927, another equation, the Klein–Gordon–Fox equation, was proposed. This equation was an equation for relativistic scalar particles.

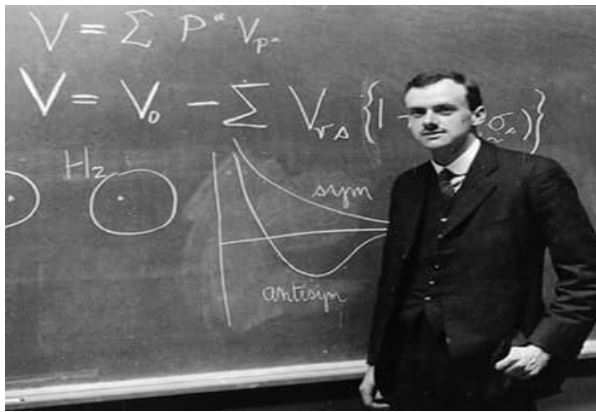
$$(\tilde{E}^2 - m_0^2 c^4 - c^2 \vec{p}^2) \Psi = 0$$

Or
$$-\hbar^2 \frac{\partial^2 \Psi}{\partial t^2} + \hbar^2 c^2 \nabla^2 \Psi - m_0^2 c^4 \Psi = 0$$

Here $\tilde{E}$ -energy operator; c - is the speed of light.

This equation is a second-order differential equation in both time and space. The advantage of this equation is that it is Lorentz invariant, that is, it is fully consistent with the special theory of relativity[11]. This equation can also be used to describe scalar fields. This equation is also used in the quantization of scalar fields, which we will discuss later. However, as can be seen, this equation does not include spin either. What we need is an equation that is both relativistic and includes spin. Then, the English physicist Paul Dirac proposed an equation that was compatible with both quantum theory and the theory of relativity. . This equation is a first-order relativistic equation.

$$(i\hbar\gamma^\mu\partial_\mu - mc)\psi = 0$$



Dirac equation Paul Dirac

This equation also contains the Dirac gamma matrices and the 4-gradient operator in the first term in parentheses.

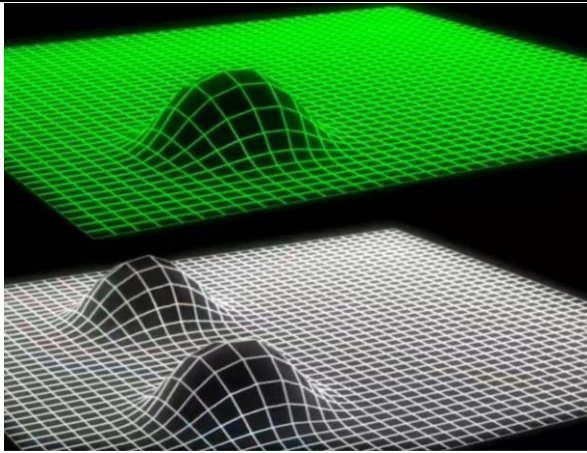
This equation also gave rise to the idea of antiparticles, and most importantly, it takes into account the spin properties of particles, i.e. it naturally introduces spin 1/2 into the equation[12]. However, Dirac's equation also had some shortcomings. This equation only works for particles with spin 1/2, and it is also directional, meaning that it is not enough to explain the particle and field dynamics with a single equation[13]. However, Dirac is considered one of the founders of quantum field theory with these works. Dirac gave the idea of defining a quantum field as an operator. This approach led to the mathematical formalism of the operators used to create and destroy particles[14]. By this time, quantum mechanics had already been sufficiently developed. As we have mentioned here, it turned out that energy is received and given in the form of discrete quanta. However, quantum mechanics explained the behavior of individual particles, but how fields behaved

was not yet known. We know that matter has two manifestations: matter and physical fields. We know that matter is composed of elements, and elements are composed of particles[15]. It can be concluded that if there is quantization in the form of matter, then there must also be quantization in the form of field manifestation. Therefore, the concepts of field and quantum were combined. Thus, the quantum field theory, which is currently the most accurate theory in nature, was created. Quantum field theory is an important framework that plays a fundamental role in modern theoretical physics, unifying quantum mechanics and the theory of special relativity[16]. The problem that the previous equations could not fully explain the problems of changing particle numbers and interactions was eliminated by quantum field theory, which described and eliminated the quantum excitations of fields. The main motivation of quantum field theory was to explain phenomena such as the creation and disappearance of particles, which was solved by quantizing fields[17]. As a result of squaring the fields, the creation and disappearance of particles and their interactions could be explained naturally. According to the most accurate laws of physics, the smallest structural parts of nature are not individual particles at all, but something rapidly flowing throughout space[18]. We call this system fields.



Quantum fields

The most well-known of these fields are the electric and magnetic fields. The fluctuations in these fields give rise to what we call light, or electromagnetic waves in general. If we look closely at electromagnetic waves, we see that they are made up of particles called photons. Photons are the carriers of electromagnetic waves[19]. When the effects of quantum mechanics are included in the fluctuations of electric and magnetic fields, the field takes the form of a particle. This is true for all other particles. It also exists in the electron field that is spread throughout the universe. The fluctuations of the electron field are transformed into a particle by the effects of quantum mechanics, and we call this particle an electron[20]. Similarly, there is a quark field, a gluon field, and a Higgs boson field. It is clear that the conclusion from quantum field theory is that there is no such thing as a particle in the universe. That is, it describes each elementary particle as a quantum of a corresponding quantum field.



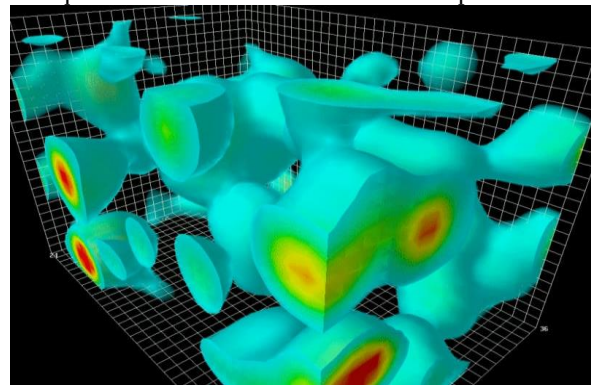
The creation of particles as a result of fluctuations in quantum fields

This approach allowed photons, electrons, and other fundamental particles to be naturally conceived within field theory.[21] Over time, this theory has evolved from being just a theoretical model to becoming a central pillar of modern physics. It has the potential to provide new answers to the most fundamental questions of modern physics, as well as to open up radical directions for future research. Although quantum field theory has answered many problematic questions, it has also encountered some problems. First of all, a quantum field is a very complicated thing. One of the reasons for this is that it uses all fields of physics to explain it. Quantum field theory is at the heart of new research in particle physics and cosmology. It perfectly explains the interactions of particles, the behavior of critical phenomena, etc. [22]. As a result of the formation of this field theory, several research areas of physics have emerged. When classical electromagnetism was quantized, quantum electromagnetism emerged. Later, the weak and strong nuclear forces were also modeled with quantum field theory.

- Quantum chromodynamics - for the strong forces
- Electroweak theory - unifies the electromagnetic and weak forces. [23]

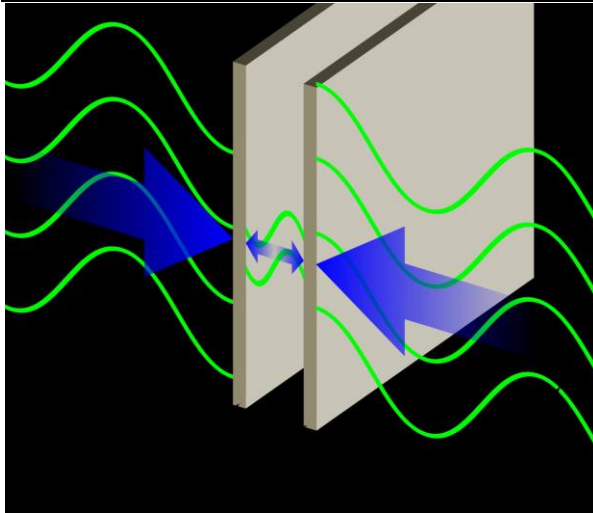
Yet the difficulties of quantum field theory do not end there. An empty space is not as empty as we think. Heisenberg's uncertainty principle leads to the conclusion that a quantum field cannot be motionless, and this confusion is something that quantum field theory complicates[24]. It is difficult to understand even nothingness in quantum field theory. Despite the fact that decades have passed since the discovery of quantum field theory, we are still far from understanding all the subtle nuances it contains. In order to examine the reasons for the emergence of these problems, it is necessary to touch on all the features of quantum field theory. One of the most fundamental and interesting concepts in quantum field theory is the concept of quantum vacuum

waves. From the point of view of classical physics, a vacuum is a complete void. Quantum physics, however, has shown that a vacuum is not actually empty, but rather quantum fields exist and oscillate in space.



A model showing that a vacuum is not empty

These fields, even in their lowest energy state, are not completely stable. These fluctuations manifest themselves in the form of virtual particles and energy fluctuations. These waves are called quantum vacuum waves[25]. Quantum vacuum waves are the dissipation and energy change of fields even in a vacuum. Quantum vacuum waves show that there is no such thing as "nothing". Even a complete vacuum is an active energetic structure, meaning that matter and particles can be created from these field fluctuations[26]. As a result, the existence of quantum vacuum waves leads to some important consequences in quantum field theory. Quantum vacuum waves show that fields are not stable even in a vacuum, produce real physical effects, prove that vacuum is actually an active and energetic medium, and constitute one of the fundamental concepts of modern quantum physics and cosmology[27]. Small energy level shifts in atomic spectra (Lamb shifts) are also caused by vacuum fluctuations.[25] Recent developments concern the dynamics of the quantum vacuum and the instantaneous creation and disappearance of pairs of particles and space energy.[28] These developments are seen as important steps towards understanding the nature of dark energy. The experimental confirmation of quantum field theory is the Casimir effect. The Casimir effect is one of the most interesting and fundamental results of quantum field theory. This effect is a phenomenal observation that proves that the vacuum energy is not zero, but rather full of quantum fluctuations. The Casimir effect was proposed by the Dutch physicist Henrik Casimir in 1948. When two neutral, parallel, and conducting metal plates are placed very close together in a vacuum (for example, on the micrometer scale), the plates are attracted towards each other by a gravitational force. This force does not arise from any classical electromagnetic interaction and is caused purely by quantum effects[29].



Experiment with the Casimir effect

Here, the vacuum energy is the lowest energy state, and even in this state, quantum fluctuations, i.e. the creation of particle-antiparticle pairs that "disintegrate in time", occur. Each quantum field vibrates not with zero energy even in a vacuum, but with zero-point energy. This energy is equal to the sum of the quantized energies of the field:

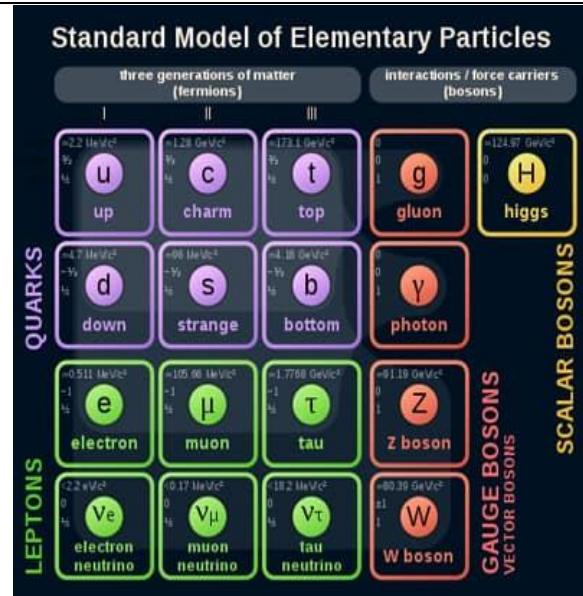
$$E_0 = \frac{1}{2} \sum_{\vec{k}} \hbar \omega_{\vec{k}}$$

here $\omega_{\vec{k}}$ - is the energy of each module of the field; is the $\vec{k}$ -wave vector.

•The plural sign takes into account all quantum modules.

The problem of this sum being infinite arises, but we are only interested in the energy differences. This is the main point of the Casimir effect[30]. The Casimir effect plays an important role in fields such as nanotechnology and microelectrotechnical systems. Casimir-type vacuum energy and models are also considered in understanding the nature of dark energy. In the 1970s, all these field theories were combined to create the modern standard model. This model is the result of the quantum field revolution that began in the mid-20th century and is still the most accurate theory in nature[31]. This model can predict the magnetic moment of the electron with an accuracy of 11 digits. This model was the first successful model that combined the electromagnetic field mentioned earlier with quantum physics and has been consistent with all experiments to date. According to the Standard Model, there are 12 fundamental particle fields that exist in nature, which are called fermion fields. Each of these fields corresponds to a particle of matter. These are the particles that make up the form of matter and have spin 1/2. They are classified as follows:

1. Lepton fields (6 pieces)--} these fields make up the electron and its family. 2. Quark fields (6 pieces)--} these are the particles that make up protons and neutrons. The 12 particle fields refer to the 6 leptons and 6 quark fields in the Standard Model.



The particles that make up the Standard Model

They represent the fundamental matter components of nature and are represented in quantum field theory as fields that each oscillate in a different way.[32] The energy of each field is also quantized. Each of these 12 fields is represented in quantum field theory by a separate field operator. Each excitation of the field corresponds to a quantum particle. For example;

- An electron particle is created as a result of the quantization of the electron field.
- quantization of the quark field creates quarks.
- The quantization of neutrino fields creates neutrino particles.

These 12 fields are for fermions. In addition, there are particle fields that carry forces:

- Photon field (electromagnetic force)
- Gluon fields (strong force-8 fields)
- W and Z fields (weak force)
- Higgs field (source of mass) [33].

In quantum field theory, calculations often produce infinite results. This problem can be solved by a technique called renormalization. This technique is the process of replacing infinitesimal subtractions with the quantities that are being discovered.[34] This technique has become a fundamental part of quantum theory and other theories. Scientists have made many advances in this theory, including the discovery of anomalies and new symmetries.[35] This has shown how some anomalies can be explained. On the other hand, the great successes of this theory have led to an increase in attention to it. Many scientists believe that quantum field theory could be a "theory of everything". According to scientists, this goal can be achieved if the theory is further expanded. The main difficulty here is the inclusion of the gravitational field in this theory. Recent developments in the unification of quantum field theory and the gravitational field may help to better understand the initial moments of the Big Bang. [36] Initially, quantum effects dominated. Quantum fluctuations at the beginning of the universe expanded and grew during the cosmic inflation period. Bu fluktuasiyalar nəticəsində qalaktikaların və ulduzların yaranmasına səbəb olan ilkin sıxlıq fərqləri formalaşdı. Kvant sahə

nəzəriyyəsində Böyük partlayışdan sonra yaranan enerji elementar zərrəciklərə çevrildi[37]. Böyük partlayışdan sonra zərrəciklərin necə formalaşdığını izah edən model isə məhz standart modeldir. Alimlər məhz Böyük Partlayış nəzəriyyəsinin kvant sahə nəzəriyyəsi ilə birləşməsinə Böyük Birləşmə nəzəriyyəsi kimi baxırlar. Digər tərəfdən alimlər "hər şeyin nəzəriyyəsi" olma potensialının sim nəzəriyyəsində də görürlər. Sim nəzəriyyəti Kainatın ən kiçik quruluş vahidlərinin titləşən simlər olduğunu öňə sürür. Simlər fərqli şəkillərdə titrəşərək fərqli zərrəcikləri meydana gətirirlər[38]. Simlərin həm fiziki sahəni, həm də maddəni əmələ gətirdiyi də məlumdur.



Strings vibrating in different shapes in space

From this perspective, it is conceivable that the two theories could be combined. It turns out that some of the contradictions in quantum field theory can be explained by string theory. These phenomena include absorption and emission, particle binding, and rotational motion and direction[39]. In other words, string and M theory can be considered extensions of quantum field theory.

Problem statement: It is known that scientists want to complete the final theory of the Universe by gathering theories that explain many phenomena occurring in the universe around one goal. This theory is thought to eliminate the contradictions between the branches of physics. It is clear from the above results that quantum field theory and string theory are considered very close to this goal. Many phenomena in the universe can be fully explained by these two theories. At this point, we conclude that it may be possible to unify these two theories around a common goal. This unification can be determined by the compatibility between the common areas of both theories, that is, if the phenomena covered by quantum field theory can be fully explained with the help of string theory and the results obtained coincide, we will have achieved our goal. Both theories are worthy candidates for the title of "theory of everything". However, there are a number of issues that quantum field theory has difficulty answering. It can be expected that this unification will be able to solve this problem. The main issues we face here are related to gravity, mass, dark matter and dark energy. For example, to achieve this goal, where is gravity? How did interactions and quantum fields separate after the big bang? Where did mass come from? How can dark energy be explained by quantum field theory? Why is vacuum energy not zero? etc. We need to give appropriate answers to questions such as. Finally, the issue of being able to include this theory in the general theory of the Universe must be taken seriously.

Solution to the problem: It is clear that in order to achieve this goal, it is necessary to approach these events from the smallest starting point. In general, as we have noted, the most convincing theorem about the beginning of everything is the "Big Bang Theorem", and it is not expected that any discovery will be made in the near future that will prove this theorem to be wrong[40]. In this regard, these issues should be explained starting from the Big Bang. After the Big Bang, the Universe we live in began to form, and at this time the Universe gradually expanded, that is, the amount of energy entering our space increased (the number of strings increased). Since the strings are characterized by specific parameters, the distance between the strings and, accordingly, the binding energies changed from the point of explosion to the direction of expansion. In this regard, particles formed in one part of space due to the high binding energy, and in other parts a physical field was formed. Since this event occurred in a 3-dimensional space, the energy passing through changed its form in accordance with the laws of this space. Energy forms mass in a 3-dimensional space, that is, there are masses of strings and the number of strings forms the total mass of particles[41]. It is clear that the gravitational field exists in a higher-dimensional space, as Einstein said[42]. Every object with mass creates a hole in this space-time fragment. Objects with large masses affect the direction of movement of objects with small masses. The difference in the number of strings and the change in distance due to movement leads to different shapes and numbers of string vibrations, which in turn leads to differences in the particles. It should be noted that the encounter of strings with such conditions causes them to collide with each other and move in different directions. This in turn leads to the emergence of a number of properties related to the position of the strings within the particles and the direction of movement, and thus the creation of corresponding physical fields. String theory also suggests that all particles and fields are interconnected through strings. The same particles are distinguished from other particles in space by the number of their internal strings and the difference in the communication strings between them. Thus, each type of particle in the string network creates its own field. Therefore, as many different types of particles as there are, they have their own quantum fields in space. Due to the connection of these fields with each other and the presence of external influences, particles are recreated and destroyed on these quantum fields. The fact that these quantum fields are finite in number is due to the fact that the strings are characterized by specific parameters. This approach meets the requirements of quantum field theory and describes it through string theory.



Quantum fields connecting to each other through strings

However, we should note that since the gravitational field exists in four-dimensional space, we can only add its energy of influence on three-dimensional space to the calculations. Dark matter is directly related to the gravitational field[43]. Dark matter manifests its influence more as a result of cosmic defects[44]. In this regard, it is natural that physicists have problems with both the gravitational field and dark energy, and this is why this approach clearly manifested itself.

Result: At the moment of the big bang, energy flowed into 3-dimensional space in the form of strings with a certain mass and vibrational form. During this flow, the part of the 3-dimensional space of the Universe that belongs to us gradually expanded. As a result of the influence of the gravitational field existing in 4-dimensional space and the direction of expansion of the Universe on the existing massive strings, differences in the distance between the strings and, accordingly, in the binding energy appeared. The fact that the strings have mass, shape and motion depends entirely on the properties of 3-dimensional space. The difference in these parameters caused a different distribution of the energy of the flow in different parts of space. As a result, a physical field was formed in a certain part of space with particles containing more strings, and in another part with fewer strings. Since everything is made of strings, each point in 3-dimensional space has energy, which means that what we call a vacuum is actually made of strings, that is, it has a certain energy. Since the number of strings in the composition of similar particles and between them approximately matches each other, it is as if each type of particle has formed its own quantum field. Fluctuations in these quantum fields are considered as particles. Since the energy transfer between the smallest structural unit, the strings, does not occur instantaneously, but at a certain speed, these fields are considered quantized. The value of the minimum energy of the gap should be taken as the part of the field with the least number of strings. As can be seen, this approach is fully consistent with the principles put forward by quantum vacuum waves and the Standard Model. Therefore, each of the particles that make up the Standard Model differs from the others in the number of strings inside and between them. The absorption and absorption of energy by particles can be explained by the exchange and exchange of strings within them. At the same time, each of these fields is interconnected by strings. All of these strings form the final spatial network. These facts bring string and quantum field theory closer to the theory of the Universe. As a result, we can say that various quantum fields have arisen in the string network as a result of high-dimensional spaces and the distance and interaction between them. Due to the oscillation of these fields, the creation and disappearance of corresponding particles in space occur. Since these particles are created in accordance with different types of vibrations and movements of the strings in different directions, their corresponding parameters (mass, charge, spin, etc.) are formed [41]. These parameters lead to the emergence of various fundamental interactions in space. Since the gravitational field and the dark matter associated with it exist in high-dimensional spaces in a form that we cannot imagine and existed

before the Big Bang, they cannot be directly included in the final theory, but only certain values of their influence, and this influence must be included as an additional parameter in the final mathematical expression. Finally, it should be noted that since we also perceive the Universe together with high-dimensional spaces and other concepts, quantum field theory is still far from the final theory of the Universe.

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POLITICAL SCIENCES

THEORETICAL FOUNDATIONS OF GENDER STEREOTYPES OF LEADERSHIP OF WOMEN IN THE SYSTEM OF PUBLIC ADMINISTRATION IN VIETNAM

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ТЕОРЕТИЧЕСКИЕ ОСНОВЫ ГЕНДЕРНОГО СТЕРЕОТИПА ЛИДЕРСТВА ЖЕНЩИН В СИСТЕМЕ ГОСУДАРСТВЕННОГО УПРАВЛЕНИЯ ВО ВЬЕТНАМЕ

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Abstract

Exploring gender stereotypes regarding women leaders in the public administration system of Vietnam, the article is aimed theoretical purposes. Theoretically, the research article identifies more clearly the manifestations of gender prejudice towards female leaders as a characteristic psychological phenomenon of human beings.

Аннотация

Исследуя гендерные стереотипы в отношении женщин-руководителей в системе государственного управления Вьетнама, статья преследует теоретические цели. Теоретически в статье более четко обозначены проявления гендерных предубеждений по отношению к женщинам-лидерам как характерному психологическому феномену человека.

Keywords: Theoretical, gender stereotypes, women's leadership, public administration Vietnam.

Ключевые слова: Теоретические, гендерного стереотипы, лидерства женщин, государственного управления Вьетнам.

Перед изучением понятия гендерных предубеждений в статье упоминается достаточно распространённое сегодня понятие - понятие гендера. Гендер и гендерное равенство – одна из актуальных проблем. Этот вопрос интересует большинство стран мира, поскольку он является одним из критериев оценки социального прогресса. Гендер является междисциплинарным понятием и с точки зрения различных наук (гендерной науки, психологии, социологии, этнографии, культурологии ...), вторые представляют разные гендерные концепции. Гендерная теория анализирует с точки зрения социальной психологии следующее: «Гендер – это различия с социально-психологическими характеристиками (различия, выраженные в позиции, роли, восприятии, эмоциях и социальном поведении) в отношениях между мужчинами и женщинами, формирующиеся при взаимодействии групп мужчин и женщин в определенном социальном контексте»¹. Очевидно, что «гендер» не означает «пол» и не означает «женщина». Гендер – это социальная ка-

тегория, указывающая на различие между мужчинами и женщинами в различных социальных отношениях. Это различие определяется обществом и изменяется в каждый исторический период в зависимости от экономических, культурных и социальных условий и обстоятельств каждой страны или национальных. Термин «гендерный предубеждение» как форма предубеждения стал привычным в последнее время. Политики, исследователи, особенно специалисты в области социальной психологии, также интересовались этой концепцией. Понятие гендерных предубеждений изучалось авторами в разных подходах.

“Гендерные стереотипы – это сформировавшиеся в культуре обобщенные представления (убеждения) о том, как действительно ведут себя мужчины и женщины. Термин следует отличать от понятия гендерная роль, означающего набор ожидаемых образцов поведения (норм) для мужчин

¹ До Хоанг и др., Аналитическая гендерная теория с точки зрения социальной психологии, основная тема исследования социальных и гуманитарных наук, Центр женских исследований, Ханойский национальный университет, 2005. С. 9. (Đỗ Hoàng và cộng sự (2005), Lý

thuyết giới phân tích từ góc độ Tâm lý học xã hội, đề tài nghiên cứu cơ bản thuộc KHXHNV, Trung tâm Nghiên cứu về Phụ nữ, Đại học Quốc gia Hà Nội, tr. 9).

и женщин»². Имеется несколько подходов к определению «гендерный стереотип». По мнению А.В. Меренкова, это «устойчивые программы восприятия, целеполагания, а также поведения человека, в зависимости от принятых в данной культуре норм и правил жизнедеятельности представителей определенного пола»³. И.С. Клецина полагает, что «под гендерными стереотипами понимаются стандартизованные представления о моделях поведения и чертах характера, соответствующие понятиям «мужское» и «женское»⁴. Гендерные стереотипы в научных трудах Т. Говорун, М. Киммела, С. Бархатной определяются как разновидность социальных стереотипов, детерминированные культурой, упрощенные, устойчивые, эмоционально окрашенные образы поведения, черты характера мужчин и женщин, которые 20 значительно влияют на формирование гендерно-ролевого репертуара личности и ее поведение⁵. Понятие гендерных стереотипов изучалось авторами в разных подходах. В поддержку мнения о том, что гендерные стереотипы представляют собой представления, в некоторой литературе по гендерным гендерным стереотипам говорится, что это «мысли людей о том, на что способны женщины и мужчины, и о том, какую деятельность они могут выполнять»; или «набор характеристик, которые определенная группа людей или сообщество считает атрибутом женщины или мужчины». Автор Тран Тхи Ван Ань указывает на другой способ понимания, помимо упоминания обобщенного характера гендерных стереотипов: «Гендерные стереотипы — это абсолютное обобщение мужского или женского пола, чаще всего представлений о характеристиках и способностях женщин и мужчин»⁶.

Таким образом, в приведенных интерпретациях гендерные стереотипы воспринимаются как когнитивно предвзятые, как «мысли» и «представления». Если понимать по-простому, с этой точки зрения гендерные предубеждения проявляются только в «действиях» внутри.

О другой тенденции, рассматривающей гендерные стереотипы как установки, Тран Тхи Минь Дык сказал: «Гендерные предубеждения понимаются как установки, созданные на основе абсолют-

ного обобщения и дурных впечатлений для проведения различий между мужчинами и женщинами»⁷. Согласно Нгуен Тхи Тху Ха: «Гендерные стереотипы — это негативное и необоснованное признание, суждение и оценка характеристик, позиций, ролей и способностей, которые группа людей навязывает группе людей атрибутов женщин или мужчин»⁸.

Вопреки приведенной выше точке зрения, следующая точка зрения рассматривает гендерные стереотипы как «действия против женщин (или мужчин), основанные на восприятии того, что один пол не имеет равных прав с другим полом и не имеет одинаковых прав»⁹. Соответственно, гендерные стереотипы — это «действия», которые выявляются вовне.

В некоторых документах и исследованиях гендерные стереотипы рассматриваются как восприятие и отношение: «Гендерные предубеждения понимаются как восприятие, отношение и предвзятая оценка мужских или женских характеристик, положения, роли и способностей»¹⁰.

Кроме того, можно упомянуть и некоторые другие взгляды на гендерные стереотипы: «Гендерные стереотипы — это предположения или убеждения, которые выражаются без причины и справедливости и, как правило, не приносят пользы и могут нанести физический и психологический вред женщинам и мужчинам»¹¹.

Так, одни авторы считают, что гендерные стереотипы — это просто мысли, неправильные и вводящие в заблуждение суждения о предмете предубеждения, тогда как другие авторы понимают гендерные стереотипы как форму отношения, основанного на дурных впечатлениях; или действия, раскрывающие объект предубеждения. Так, одни авторы считают, что гендерные стереотипы — это просто мысли, неправильные и вводящие в заблуждение суждения о предмете предубеждения, тогда как другие авторы понимают гендерные стереотипы как форму отношения, основанного на дурных впечатлениях; или действия, раскрывающие объект предубеждения.

На основе впитывания взглядов авторов исследования на гендерные стереотипы и развития на ос-

² Мальцева, И.О. Гендерная сегрегация и мобильность на российском рынке труда / И.О. Мальцева, С.Ю. Рошин. — М.: Изд. Дом ГУ ВШЭ, 2006. — 295с

³ Меренков А.В. Социология стереотипов. — Екатеринбург: Изд-во Урал. Ун-та, 2001. 161с.

⁴ Кирилина А.В. Гендерные компоненты этнических представлений (по результатам пилотажного эксперимента) // Гендерный фактор в языке и коммуникации. Иваново, 1999. С. 46-53.

⁵ Ильин Е.П. Пол и гендер - Санкт-Петербург. 2010. — 688с

⁶ Тран Тхи Ван Ань, «Гендерные стереотипы и формы их преодоления», Научный журнал о женщинах, 2000. № 5, с. 3 — 10. (Тран Thị Văn Anh (2000), “ Định kiến giới và các hình thức khắc phục ”, Tạp chí Khoa học về phụ nữ, số 5, tr . 3 — 10).

⁷ Тран Тхи Мин Дык (редактор), Предубеждения и гендерная дискриминация — теория и практика, 2006. с. 283.

(Trần Thị Minh Đức (Chủ biên) (2006), Định kiến và phân biệt đối xử theo giới - lý thuyết và thực tiễn, sđd, tr . 283).

⁸ Nguyễn Thị Thu Hà, (2011), Nữ lãnh đạo và định kiến giới - nghiên cứu trường hợp nữ lãnh đạo cấp cơ sở, Nxb Khoa học xã hội , tr . 42 .

⁹ Гендерный глоссарий, Всемирная продовольственная программа, 2000. с. 534. (Gender Glossary (2000), Chương trình lương thực thế giới, tr . 534).

¹⁰ http://vanban.chinhphu.vn/portal/page/portal/chinhphu/hethongvanban?cla_ss_id=1&mode=detail&document_id=28975 (Luật Bình đẳng giới).

¹¹ Гендер и гендер Кто заботится?, Учебное пособие по гендеру и репродуктивному здоровью, сентябрь 2001 г., с. 76 . (Giới và giới tính ai quan tâm ?, Tài liệu tập huấn xây dựng kỹ năng về giới và sức khỏe sinh sản , 9/2001 , tr . 76).

нове представленной в предыдущем разделе концепции предубеждений мы считаем, что гендерные стереотипы – это признание, суждение, негативные и иррациональные суждения накладываются на атрибуты женщин или мужчин.

Согласно некоторым документам организаций, работающих в сфере гендера, гендерная дискриминация понимается как «любое различие, исключение или ограничение по признаку пола, которое имеет следствием или направлено на то, чтобы ущемить или свести на нет равное признание, использование или осуществление прав человека женщинами» и фундаментальные либеральные принципы в политической, экономической, социальной, культурной, гражданской и других сферах, независимо от их семейного положения». Гендерные предубеждения — это «особый тип отношения», который конкретно выражается в негативном и необъективном видении и оценке характеристик, позиций, ролей и возможностей женщин или мужчин, пола. Другими словами, гендерная дискриминация – это проявление гендерных предрассудков в действии.

Сегодня гендерные стереотипы являются одной из форм социальных предрассудков, которые до сих пор существуют во многих различных культурах, это действительно «барьер», который необходимо сломать, чтобы двигаться к равноправному обществу. Потому что, по словам автора Тран Тхи Минь Дук, «с точки зрения содержания гендерные предрассудки считаются одним из многих проявлений гендерного неравенства»¹².

Гендерные предрассудки в отношении женщин-лидеров в системе государственного управления Вьетнама.

«Женщины-лидеры входят в состав руководящего коллектива в целом — те, кто назначается или избирается на важную должность (должность), обладают полномочиями и ответственностью для выполнения функции лидера, управлять, собирать силы коллектива для реализации общей цели»¹³.

Таким образом, по характеру работы женщины-руководители подобны другим руководителям, именно они командуют, контролируют, определяют цели и пути организации; собирать, объединять людей, укреплять коллективную силу и направлять, управлять, мотивировать и мотивировать всех в организации для достижения этой цели.

С точки зрения пола, женщины-лидеры – это те, у кого есть свои особенности с точки зрения здоровья и физического состояния; имеет свою роль, заданную полом (трудовое воспроизводство), особенно роли, ожидаемые обществом и семьей. По многим различным причинам в настоящее время во Вьетнаме «женщины по-прежнему сталкиваются с

дискриминацией и рядом экономических, социальных, культурных, религиозных и политических барьеров при участии в общественной жизни»¹⁴.

Соответственно, как и женщины, женщины-лидеры также неизбежно подвергаются жестким оценкам и даже негативной и необоснованной дискриминации. При таком подходе, на основе концепции гендерных предубеждений, мы считаем, что гендерные предубеждения в отношении женщин-лидеров на всех уровнях являются отрицательным признанием, суждением, оценкой, навязыванием неразумно назначать или избирать женщин на какую-либо должность обладающий полномочиями и ответственностью выполнять функцию руководства, управления, собирая силы коллектива для выполнения задачи, показывать общую цель.

При анализе концепции гендерной предвзятости в отношении женщин-лидеров следует отметить некоторые важные моменты:

Во-первых, гендерные предубеждения в отношении женщин-руководителей на всех уровнях, прежде всего, выражаются через мысли, взгляды, признание (восприятие) и через суждения и оценки (отношение). Эти проявления выражаются не только в обществе, но и в семье. Как проанализировано в разделе, посвященном понятию предубеждения, в социальной психологии понятие отношения часто связывают с трехкомпонентной структурой: восприятием, эмоциями и поведенческой тенденцией. Соответственно, восприятие является компонентом отношения, а также основанием для комментариев и оценок. Другими словами, как форма предрассудка, гендерное предубеждение в отношении женщин-руководителей на всех уровнях также выражается конкретно на трех уровнях: восприятие, эмоции, поведение. На когнитивном уровне гендерные стереотипы включают в себя негативное отношение, мысли, убеждения, ожидания и навязывание неоправданного положения, роли, способностей и возможностей женщинам-руководителям на всех уровнях в семье и в офисе. На эмоциональном уровне гендерные стереотипы связаны с негативными чувствами, выражающимися через дискриминацию, презрение, неприязнь к контакту с женщинами-руководителями. На поведенческом уровне к гендерным стереотипам относятся склонность действовать негативно или намерение действовать негативно по отношению к женщинам-руководителям на всех уровнях, выражающаяся в виде дискриминации в семье (о роли женщин-лидеров), положении, о разделении труда и о полномочиях по принятию решений в отношениях между мужем и женой) и на рабочем месте (о роли, должности; о назначении работы и способностях/способностях).

¹² Тран Тхи Минь Дук (редактор), Предрассудки и гендерная дискриминация – теория и практика, там же, 2006. с. 50. (Trần Thị Minh Đức (Chủ biên), (2006), Định kiến và phân biệt đối xử theo giới - lý thuyết và thực tiễn, tr. 50).

¹³ Нгуен Тхи Тху Ха, Женщины-лидеры и гендерные стереотипы – тематическое исследование женщин-лидеров на низовом уровне, Издательство социальных наук,

2011. с. 42. (Nguyễn Thị Thu Hà, (2011), Nữ lãnh đạo và định kiến giới - nghiên cứu trường hợp nữ lãnh đạo cấp cơ sở, Nxb Khoa học xã hội, tr. 42).

¹⁴ Институт научного социализма, Гендерные проблемы: от истории к современности, Изд-во. Политическая теория. Ханой, 2007. с. 7. (Viện Chủ nghĩa xã hội khoa học (2007), Những vấn đề giới: từ lịch sử đến hiện đại, Nxb. Lý luận chính trị. Hà Nội, tr. 7).

Во-вторых, гендерные предрассудки в отношении женщин-лидеров на всех уровнях по своей природе негативны, навязчивы и необоснованны. Это также критерии для определения того, является ли признание или суждение предвзятым по признаку пола или нет. То есть, если взгляды, суждения и оценки объективны, обоснованы, аргументированы, аргументированы, положительны и непредвзяты, не навязаны, то это не предубеждение.

Этот негатив, навязывание, иррациональность основаны на существующих взглядах некоторых людей на женщин вообще, женщин - руководителей в частности и вообще, это суждение имеет негативную направленность. Гендерные стереотипы о женщинах-руководителях характеризуются стереотипными представлениями о женщинах в руководстве и управлении. Гендерные стереотипы о женщинах-руководителях характеризуются стереотипными представлениями о женщинах в руководстве и управлении. Кроме того, стереотипный, навязанный и чрезмерно упрощенный характер предубеждения делает восприятие и оценку предубежденного человека жестким и фиксированным. Гендерные стереотипы в отношении женщин-руководителей восходят к поспешным обобщениям, отсутствию доказательств и часто не отражают реальных возможностей каждого женского кадра и ограничивают то, что общество позволяет или ожидает от них. Хотя мужчины и женщины имеют определенные биологические различия, ясно, что существует более глубокая разница, формируемая в основном под влиянием социальных, культурных, политических факторов, религии... - это социальная разница, гендерные стереотипы, связанные с негативными чувствами, выражается через дискомфорт, презрение, нелюбовь к общению с женщинами-лидерами.

В-третьих, с точки зрения объектов женщины-лидеры на всех уровнях являются одним из объектов предрассудков. В качестве лидера и менеджера женщины-лидеры не только рассматриваются в качестве руководителей и менеджеров, но и могут подвергаться гендерным стереотипам (женщины); в то же время могут по-прежнему сталкиваться с предрассудками, вызванными их положением лидера.

Гендерные стереотипы создают давление на предвзятых субъектов на основе гендерных стереотипов, которые действуют как социальные нормы и правила. Поэтому, сталкиваясь с давлением гендерных стереотипов, женщины-лидеры всех уровней могут выбирать поведение в соответствии с этими существующими стереотипами. В результате, женщины-лидеры на всех уровнях также имеют негативные и необоснованные взгляды, суждения, оценки и иррациональность по отношению к себе, а также к другим женщинам-руководителям. Таким образом, гендерные стереотипы в отношении женщин-лидеров включают в себя признание, оценку и суждение других и самих женщин-лидеров по отношению к ним.

Согласно статье 4 Закона о кадрах и государственных служащих 2008 года: «Кадры — это вьетнамские граждане, которые избираются, утверждаются и назначаются на должности и должности в соответствии со сроками полномочий в органах Коммунистической партии Вьетнама и государства. -политические организации на центральном уровне, в провинциях и городах централизованного управления (далее - провинциальный уровень), в районах, городах и провинциальных городах (далее совместно именуемые провинциальные уровни) района), в платежной ведомости и получать зарплату от бюджет государства».¹⁵

Кроме того, «должностные кадры коммун, районов и поселков (пункт 1 статьи 4 Закона о кадрах и государственной службе 2008 г., именуемые в дальнейшем уровнем коммуны) являются гражданами Вьетнама, избираемыми на должности в соответствии со сроком полномочий в округе. Постоянного комитета Народного Совета, Народного комитета, секретарь, заместитель секретаря парткома, руководитель общественно-политической организации; Государственные служащие на уровне коммуны - это вьетнамские граждане, которые набираются для получения профессионального звания при Народном комитете на уровне коммуны, получают заработную плату и получают зарплату из государственного бюджета»¹⁶.

В настоящее время Вьетнам вступает в стадию ускоренной индустриализации, модернизации и международной интеграции, страна и ее народ сталкиваются со многими преимуществами и новыми вызовами для развития. В этом общем контексте, как и многие другие социально-психологические явления, на гендерные стереотипы также влияют быстрые и глобальные изменения инноваций и интеграции, особенно вопросы гендерной идентичности, женщин, гендерного равенства. На международном уровне это широкое развитие гендерных теорий, теорий социальной психологии; Это также рождение и приверженность многих стран международным нормам, конвенциям и планам действий в этой области (Конвенция CEDAW о ликвидации всех форм дискриминации в отношении женщин), ратифицированная Генеральной Ассамблеей Организации Объединенных Наций в 1979 году, Пекинская декларация и Платформа действий, принятая на Четвертой Всемирной конференции по положению женщин в Пекине в 1995 году...).

Во Вьетнаме должны произойти позитивные изменения в политике, экономике, обществе, культуре... а также во взглядах, установках, механизмах и политике партии и государства. Можно сказать, что во время революционного процесса, особенно в период новых перемен и международной интеграции, Коммунистическая партия Вьетнама всегда уделяла внимание женщинам, женскому труду и достигала цели гендерного равенства. Правильные принципы и политика партии и государства Вьетнам создали для женщин важный правовой коридор

¹⁵ Пункт 1 статьи 4 Закона о государственных служащих 2008 года. (Khoản 1, Điều 4, Luật cán bộ công chức 2008).

¹⁶ Пункт 1 статьи 4 Закона о государственных служащих 2008 года. (Khoản 1, Điều 4, Luật cán bộ công chức 2008).

для развития и поощрения гендерного равенства. Вместе с тем усилия и утверждение женщин в деле национального строительства и развития в целом, в области лидерства и управления в частности, способствовали ограничению и «смягчению» глубинных влияний роль женщин недооценивается, чем мужчин) давно существует во Вьетнаме. В современной вьетнамской семье одним из основных изменений в семейных отношениях является изменение статуса членов семьи в сторону равенства и демократии, особенно в отношениях мужа и жены.

В нынешнюю эпоху инноваций и интеграции к женщинам относятся более справедливо, к ним относятся более гуманно, и им предоставлены благоприятные условия для учебы, повышения самоэффективности и участия в общественной деятельности, лидерства и управления. На пути к прогрессивному и устойчивому развитию требуется, чтобы все, в том числе женщины, женщины-лидеры на всех уровнях, быстро адаптировались к ежедневным изменениям динамичной экономической жизни и новым сложным социальным отношениям. Кроме того, им также приходится постоянно стремиться, проявлять изобретательность, догонять время, преодолевать трудности и вызовы и превосходить самих себя. Обладая давней традицией и собственными усилиями, женщины постоянно стремились, ярко демонстрировали свои способности и качества, продвигали свой творческий потенциал и добивались достижений во всех сферах общественной жизни.

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SOCIAL SCIENCES

CHARACTERISTICS OF DEVELOPMENT OF MEDICAL TOURISM IN THE NAKHCHIVAN AUTONOMOUS REPUBLIC

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Abstract

The article analyzes the development dynamics of medical tourism in the Nakhchivan Autonomous Republic, the existing infrastructure of this sector and its position in the regional economy. Medical tourism, as a complex field of activity that combines various health-oriented services and experiences, offers travelers both preventive and rehabilitation opportunities. The Nakhchivan region is distinguished by its rich natural treatment resources, favorable climatic conditions and historical and geographical advantages. Mineral water sources such as Duzdag Physiotherapy Center, Sirab, Badamli, Vaykhir are the mainstays of this sector. The study shows that the potential for medical tourism in Nakhchivan is quite wide and the application of innovative approaches, efficient use of local resources and environmental sustainability should act as the main strategic goals for the development of this sector. Modern tourism infrastructure and integration of entrepreneurship into this sector can both reduce the seasonal dependence of medical tourism and contribute to the socio-economic development of the region.

Keywords: Nakhchivan, medical tourism, health, natural resources, tourism infrastructure, sustainable development.

Introduction

One of the new economic priorities of the Republic of Azerbaijan is the tourism sector and the development prospects in this field. Due to its historical, scientific and geographical nature, the tourism sector has played an important role in the national economy of countries from ancient times to modern times. In particular, this sector has been the focus of great attention by countries that have developed and are developing in this field. Naturally, one of the important reasons here is that tourism has become one of the continuously developing directions on a global scale. Because, being a new part of the national economy, this sector is also effective in generating budget revenues (2). On the other hand, currently the development of tourism in the country has shown its logical result. In this sense, when approached from the prism of regional economic development, it becomes clear that this sector is the focus of attention in all regions, including the Nakhchivan Autonomous Republic. It can be noted that in recent years, the main reasons for the development of tourism here and the large number of tourists arriving are:

- ensuring the sustainability of state support through multi-directional mechanisms;
- the emergence of new tourism features, characteristics (destinations) and tourist centers;
- restoration of historical monuments that will be relevant for tourism;
- ensuring, restoring and, if necessary, reconstructing transport and road infrastructure;
- maintaining the number and quality of efficient tourism catering establishments;
- creating reliable treatment and recreation centers;
- organizing tourist routes in order to improve the level of service to tourists;

In the Nakhchivan Autonomous Republic, which has a rich tourism potential due to its essential regional

characteristics, tourism is also increasing its importance as one of the main types of activity in providing employment. Considering that tourism is also distinguished by its stimulating effect on the exhibition of the creative activities of the local population and the production of souvenirs, especially the development of handicraft skills, it is necessary to note its role in the development and long-term prospects of this sector.

The development of tourism against the background of continuous national economic reforms is paving the way for the formation of its medical-health type in a wide scope. Studies show that medical-health tourism in the Nakhchivan Autonomous Republic, having a rich history, is in a leading position among the types of tourism due to its relevance and importance. The reason for this indicator is the increase in demand for this area. More precisely, it is organized with the aim of maintaining and restoring the health of members of society as a whole, and of people in particular, especially tourists. The analyses of international organizations in this area are also distinguished by their necessity. Thus, according to the assessment of the World Tourism Organization, medical-health tourism is considered an important tourist motivation even on a global scale. Due to its socio-economic nature, medical-health tourism has emerged as one of the promising directions among alternative types of tourism in the autonomous republic (6).

The importance of medical tourism in terms of the economy of the Autonomous Republic can be shown as follows (8).

- Medical tourism is an important service sector that supports the development of the economy;
- Medical tourism is an activity that contributes significantly to national income;
- Medical tourism affects the development of the public and private sectors and increases their competitiveness;

- The development of medical tourism has a great impact on the employment of the population;
- The development of tourism creates favorable conditions for the recognition of the geography and culture of the place.

Discussion

Let us note that in ancient times, in our country, the famous “Naftalan” oil showed its history for medical tourism in the 12th century. In terms of the richness of natural resource potential in the Nakhchivan Autonomous Republic, it demonstrated prospects for medical tourism in the 20th century. At the same time, medical and health tourism has developed further compared to other types of tourism. With all this, the autonomous republic has the necessary natural resources, treatment centers and mineral water reserves for the development of medical and health tourism. Also, more than half of the natural remedies are successfully used.

The emergence and development of speleotherapy in Azerbaijan is associated with the use and in-depth study of the salt caves in Nakhchivan - the physiotherapeutic center “Duzdag” cave. Duzdag, the natural treatment center of the autonomous republic, is distinguished by its unique healing properties. As a result of research conducted in the salt mine, which was accidentally discovered as a result of an avalanche in 1967, many stone hammers and several stone axes belonging to ancient people were discovered. Duzdag Physiotherapy Center was a leading institution in the field of speleotherapy in 1979, operating as a hospital with a 50-bed underground department. . Located at an altitude of

1173 meters above sea level. The underground department of the center is located approximately 12 km from the city of Nakhchivan. The underground department is located in the salt mine, 300 meters from the entrance, at a depth of 110 meters, in the 9th worked out line.

All conditions for examination and treatment have been created at the Duzdag Physiotherapy Center, which was rebuilt in 2008. This unique treatment center, the only one in the world, is the main place of appeal for people suffering from non-specific respiratory diseases.

Salt caves and mineral waters are driving the development of this area. Those who apply here are mostly people suffering from bronchial asthma and allergic diseases (9). As a result, according to the statistics of 2019, the Center currently has 347 beds, providing opportunities for the treatment of about 4,000 patients. Duzdag caves are located two kilometers from the “Duzdag” hotel. The first Salt hotel in the world belongs to this region. The hotel consists of 6 floors, including the underground part. The above-ground part of the complex located in the hotel is equipped with a library, cafe and comfortable rooms. Its location near the Duzdag cave creates favorable conditions for those who come here for treatment to spend the night. The provision of complex resort services by the “Duzdag hotel” allows attracting other segments in addition to tourists who come for health reasons. In addition to treatment in the salt cave, the hotel also offers tourists Spa, recreation and entertainment services (5).



Figure 1. The inside of the Duzdag cave



2. The interior of the cave

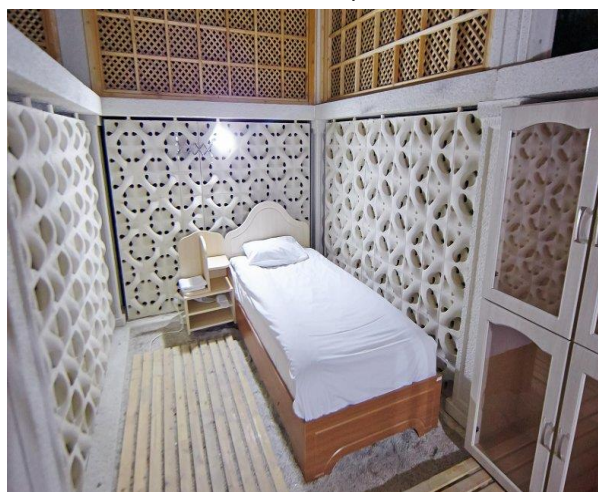


Figure 3-4. Duzdagh Physiotherapy Center

Daridag Arsenic Water Treatment Plant - It is located 8-9 kilometers northeast of Julfa city, which is considered one of the places of therapeutic tourism in the autonomous republic, between the steep slopes of Daridag, at an altitude of 800-900 meters above sea level. Nakhchivan is not without reason called the “museum of natural springs”. Daridag healing water, which is considered to be arsenic mineral water belonging to the group of rare silver-containing waters in the world, is located here. Daridag mineral water is included in the group of thermal waters, as this water emerges to the surface of the earth at a temperature of 53-57 degrees Celsius. Here, many diseases are successfully treated (10).

Daridag Arsenic Water Treatment Center, which began operating in 1978, provides treatment using arsenic water from 5 springs. In 2005, medical assistance

and other services were established for guests on the territory of the Julfa Daridag Treatment Center (5).

Due to its medical and experimental nature, Daridag arsenic thermal water is beneficial for many skin diseases, and is recommended for consumption mainly in cases of scabies, jaundice, pyoderma, gastrointestinal, and joint diseases. In addition, the treatment center has an irreplaceable therapeutic value for taking a bath in cases of peripheral nervous system diseases (16). It is used in the treatment of nervous system pain, rheumatism, skin, osteochondrosis, etc. As a result of large-scale construction work implemented in the regions and State Programs implemented by our state, the Daridag treatment facility was built (5).



Figure 4-5. Daridag Arsenic Water Treatment Center

Ashabi-Kahf mineral water - called magical water by people who come here. Considered an analogue of Pyatigorsk mineral water, it boils and foams every 15 minutes, then retreats. The composition of this water, located in the Babek district, is hydrocarbonate, chlorine, sulfate, sodium, and carbon dioxide. Small pools

have been created for patients to receive treatment, and rheumatic and wind patients are treated by entering the water and waiting for 10-15 minutes. Thus, the course of treatment continues for 10 days. Both local residents and tourists use these places for treatment (5).



Figure 6-7. Ashabi-Kahf mineral water

Analyses show that currently 60% of our country's mineral water reserves fall on the share of the autonomous republic alone. The existence of more than 250 mineral water sources on the territory of the autonomous republic gives grounds for considering it as a living nature museum. Naturally, some of the mineral waters are distinguished by their therapeutic value. Examples of the above include Sirab, Badamli and Böyrek waters (4). In particular, it is possible to rarely find analogues of the radon and sulfur waters in Nakhchivan in foreign countries, distinguished by their uniqueness. These reserves, which are calculated for the reliable health of people, can also include iron waters, which have a miraculous role in the treatment of internal organs.

Because, those waters have high medical importance, and are mainly known as a medicine for the liver. In addition, the use of carbonated waters in the treatment of gastrointestinal diseases, as well as in the elimination of inflammatory factors, further increases the prospects of the autonomous republic in this field (5, pp. 150-153). At the same time, there are "Barjomi" type Gulustan, Navi, Bichenak, "Narzan" type Badamli, Dinga, Qizilburun and other such waters in the shade.

One of the important factors here is that it is considered appropriate to use these waters not only during the treatment period, but also during the recovery phase. Due to their importance, mineral waters such as Sirab, Badamli, and Böyrek water are also packaged separately at the plant and accepted as table water.

Sirab healing and table water is one of the magical waters of Nakhchivan. This water is considered the best of the carbonated healing waters available in our country. According to experts, Sirab water is highly effective in the treatment of pancreatic disease and hyperacid gastritis. At the same time, the healing water, which also has properties such as bile formation, is used in stomach and intestinal diseases. As a tourism product, it is actively represented in other cities of our country and also in trade relations with foreign countries (5).

Conclusion

Since ancient times, people have used mineral waters, healing mud, and plants with medicinal properties

to treat various diseases. The evidence that mineral springs have been used as a treatment since ancient times is the presence of stone pools on their banks, which have remained to this day. Mineral springs are mainly located in mountainous areas.

We can note that the potential demand for health care is based on the images based on objective or subjective truths formed or shaped in their minds, and of course, the promotional campaigns that cause this. In order for patients to visit a country, they must first of all be aware of the existence of that country, the level of health care in the country and its tourist opportunities. This can only be possible as a result of skillful advertising activities.

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PROBLEM WITH USA HEALTHCARE SYSTEM FOR GEORGIAN IMMIGRANT WOMAN**Chigogidze L.***MD, Total Charm Clinic, Tbilisi Georgia*<https://doi.org/10.5281/zenodo.15657630>

Keywords: Georgian immigrant women, U.S. healthcare system, Immigrant healthcare access, Healthcare disparities, Undocumented immigrants, Documented immigrants

Both legal and illegal Georgian immigrant women face severe problems accessing adequate healthcare in the USA. These challenges are economic, language-related, cultural, and fear of deportation, all of which result in severe healthcare disparities. These conditions affect not just their physical well-being but also introduce inequalities in preventive, maternal, and mental health care. These issues are addressed in this article more extensively and highlight culturally competent health professionals, policy reform, and immigrant advocacy in addressing these pressing issues.

Introduction

The promise of the American Dream still entices people worldwide, including Georgian women who travel in search of greater economic prosperity and a higher standard of living. Yet once there, most discover that accessing the basic services—particularly healthcare—is much more complicated and unaccusable than imagined. The sophistication of the American healthcare system, added to monetary pressures and institutional hurdles, complicates receiving good quality medical attention.

Documented and undocumented immigrant women from Georgia face unique challenges that impact their health in general. Some of these challenges are restricted affordable healthcare, communication difficulties with the medical staff, cultural medical stigmatization, and the constant risk of deportation. This article explores these issues and identifies possible solutions that will ensure all Georgian immigrant women receive the medical attention they need. Historical Context of Georgian Immigration and Healthcare Access

To fully understand the situation of Georgian immigrant women in the U.S., it's important to examine the historical and socio-political problems. Georgia, a post-Soviet nation, has undergone significant economic upheaval since the early 1990s. This has pushed many Georgians to seek stability and opportunity abroad. From the 2000s, there has been a steady increase of Georgian immigrants traveling to cities like New York, Los Angeles, and Chicago.

Yet upon arrival in the United States, many face systemic inequities, particularly in healthcare access. The roots of these inequities lie in broader immigration policies and the privatized US healthcare system, which has a tendency to leave out recently arriving immigrants—especially those without permanent legal status.

Financial Barriers and Limited Insurance Access

Maybe the most daunting challenge to Georgian immigrant women is access to healthcare. Even legally present immigrants have difficulty affording sufficient insurance coverage. Employer-sponsored health care

has lengthy waiting times, and private coverage is often prohibitively expensive especially for low or no-income immigrants, making regular healthcare inaccessible.

According to the Migration Policy Institute (MPI), lack of funds denies most immigrants access to routine health care. For this reason, many delay or miss care they need—especially preventive care [1]. For example, instead of reporting in on a regular basis for check-ups or screenings, they will only see a doctor during an emergency situation, leading to worse health over the long run.

For illegal Georgian women, it is worse. They are not covered by most public health care programs, such as Medicaid, and end up in emergency rooms, which, though legally obligated to treat them, are not a good option for long-term medical care. The fear of racking up enormous medical bills discourages many from seeking care, even for severe illnesses such as infections, diabetes, or complications of pregnancy.

Case Study: Delayed Care Resulting in Tragic Consequences

In some cases, delayed medical treatment has resulted in disastrous health consequences. A case in point is a Georgian woman who was working as a housekeeper in New York and developed unbearable abdominal pain but didn't receive any medical attention due to lack of insurance. When she arrived at the emergency room, doctors diagnosed her with Stage III ovarian cancer—a condition that would have been addressed in its initial phase by screening.

Nino's story is abominably normal. Without cheap health care, little issues turn into big ones. The above occurrences point to the imperative necessity of low-cost access to healthcare, especially for immigrant women who suffer from heavy economic pressures.

Language and Cultural Barriers

Georgian immigrant women and, more particularly, those with little command of the English language at the time of arrival have a big obstacle of linguistic barriers. Medical terms, completing complicated insurance forms, and communicating symptoms properly might be intractable. It largely results in incorrect diagnosis, ineffective treatment, and follow-up failure.

This gap results in misdiagnoses and non-adherence to medical instructions. Rely on family members or community interpreters, raises concerns about confidentiality and accuracy for Immigrant Woman.

The Need for Culturally Competent Health Care Providers

Cultural differences also affect the manner in which Georgian women perceive and seek medical

care. Georgian immigrants tend to come from a health care system where doctor-patient relationships are different from those of the United States. They may expect more direct involvement by physicians or struggle with the concept of preventive care, less common in some parts of Georgia. (Shioshvili, 2008)

Besides, the majority of U.S. clinics and hospitals lack Georgian-speaking staff or interpreters. Therefore, Georgian women find it hard to understand their diagnoses and treatment plans, which makes them avoid visiting the clinic or hospital.

Possible Solutions for Cultural and Communication Gap

- Increasing medical translation services in clinics and hospitals.
- Employing more culturally competent medical staff.
- Conducting educational workshops on how to access the U.S. healthcare system for Georgian immigrants.

Fear of Deportation and Avoidance of Care

For undocumented Georgian women, the threat of deportation is constant. While hospitals are legally required to treat all patients regardless of immigration status, many are hesitant to seek medical attention due to the "chilling effect" of immigration enforcement policies [2].

This fear is especially perilous for individuals with chronic illness, such as diabetes or heart disease, who require continuous medical treatment. Some of these undocumented women even skip prenatal care since they fear that hospitals will report them to immigration authorities. This puts both the mother and child at risk of serious complications.

Overcoming the Fear of Deportation in Healthcare

In order to encourage illegal women to seek medical care, policymakers and health organizations should:

- Improve confidentiality policies in order to reassure patients that obtaining treatment will not lead to deportation.
- Develop "safe spaces" in hospitals and clinics where immigrants feel secure.
- Provide legal assistance services to aid immigrant women to understand their rights.

Maternity Care and Reproductive Health Challenges

One of the largest problems for Georgian immigrant women is maternity care. Even for legal ones, obtaining prenatal, birth, and postpartum care is intimidating.

For illegal women, the situation is worse. Fear of being caught leads most to forgo prenatal examinations, which increases the risk of premature birth, birth defects, and maternal illness. Some horrific cases have been reported where improper treatment led to fetal loss.

In addition, reproductive health care such as family planning and contraception remains inaccessible to the majority of Georgian immigrants. The lack of avail-

ability of access to such services may lead to unintended pregnancy and adverse reproductive health consequences.

Solutions for Improving Maternal Health

- Expanding prenatal care programs among immigrant women, regardless of legal status.
- Increasing grants for community health centers providing low-cost maternity care.
- Pointing education on reproductive health towards immigrant communities.

Mental Illness Challenges and Absence of Care

The pressure of integrating into a foreign country, economic hardship, and constant threat of deportation heavily stress the mental state of Georgian immigrant women. A majority suffer from anxiety, depression, and PTSD but avoid being treated due to cultural stigmas regarding mental illness. (Mgeladze, Shioshvili, 2024)

More Immigrant Mental Health Services

- Culturally competent therapist training that is aware of the difficulties of Georgian immigrants.
- Mental health counseling at affordable prices in immigrant communities.
- Educating Georgian women on mental health awareness and stigma reduction.

Conclusion

Georgian immigrant women in the U.S. are faced with significant barriers to receiving healthcare, from economic deprivation and lack of language skills to cultural differences and fear of deportation. These must be tackled by an integrated policy solution that includes expanding access to affordable care, increasing the number of culturally competent providers, and reducing immigration-related fears in healthcare environments.

Closing these gaps and filling them will make America a better and more just healthcare system that offers healthcare to everyone, not just citizens. Healthcare is a human right, and granting medical care to immigrant women that they need does not only benefit them but society.

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TECHNICAL SCIENCES

THE ROLE OF TEST AUTOMATION IN THE DEVELOPMENT OF BANKING SYSTEMS

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РОЛЬ АВТОМАТИЗАЦИИ ТЕСТИРОВАНИЯ В РАЗРАБОТКЕ БАНКОВСКИХ СИСТЕМ

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Abstract

The article discusses the importance and advantages of test automation in the development of banking software products. Test automation significantly accelerates development processes, increases the accuracy of functionality and security testing, and minimizes human error. The work analyzes modern automation tools and methodologies, including Selenium, JMeter, TestNG, and others, as well as their application in the banking sector. Attention is given to security, reliability, and compliance with international standards such as PCI DSS and ISO 27001. The article also highlights the role of automation within DevOps and Agile methodologies.

Аннотация

В статье рассматриваются значение и преимущества автоматизации тестирования в разработке банковских программных продуктов. Автоматизация тестирования значительно ускоряет процессы разработки, повышает точность проверки функциональности и безопасности, минимизируя влияние человеческого фактора. В работе проанализированы современные инструменты и методологии автоматизации, включая Selenium, JMeter, TestNG и другие, а также их применение в банковском секторе. Уделяется внимание вопросам безопасности, надежности и соответствия международным стандартам, таким как PCI DSS и ISO 27001. В статье также освещается роль автоматизации в рамках методологий DevOps и Agile.

Keywords: test automation, banking systems, testing tools, security, DevOps, Agile.

Ключевые слова: автоматизация тестирования, банковские системы, инструменты тестирования, безопасность, DevOps, Agile.

Introduction

Modern banking systems are complex systems, software, and hardware that provide great many financial services. In this regard, in conditions of digital transformation of the banking sector, not only the creation of new solutions but also assurance of their reliability, security, and conformation to regulatory requirements is becoming very important. Bugs in bank software can result in serious financial losses, reputational risks, and threats to data security.

One of the most promising quality assurance tools is automated testing of banking software. It allows not only to speed up the process of identifying errors but also to increase the accuracy of testing, minimizing the influence of the human factor. Modern technologies of automated testing are widely used in the banking sector, providing integration with DevOps (Development Operations) and CI/CD (Continuous Integration, Continuous Delivery) processes. On the other hand, automation does bring some challenges in implementation: high costs of initial implementation, complexity in supporting test scenarios, and a dire need for adaptation in conditions of change within business logics of banking products.

The goal of this study is to examine how automated testing impacts the quality of banking systems.

It explores the theoretical foundations of test automation, the unique characteristics of banking software, and the modern tools and methodologies used to ensure the reliability and efficiency of financial applications.

Main part. Theoretical aspects of test automation

Automated testing plays a crucial role in software quality assurance, particularly in highly sensitive fields like banking. It involves using specialized tools to conduct tests without requiring direct human intervention. Unlike in manual testing, automation improves testing efficiency and accuracy during software function testing, reducing the impact of human error and overall reliability.

The basic concept of test automation is to develop some pre-coded test scripts which would run automatically whenever there is a modification in the source code. It is especially relevant to modern software development processes, for instance, **DevOps and CI/CD** technologies, where the updates are deployed at high frequency.

The most significant benefits are increased testing accuracy, reduction of time costs, and the ability to run tests multiple times with no loss in productivity. Industry research indicates that the introduction of automated

testing cuts testing costs by as high and increases its efficiency as high [1]. Besides, automation works much more effectively with processes that require repetition, like regression testing, when, after changing code, there is often a need to recheck already working functions.

However, test automation comes with its own set of challenges that must be addressed. First, creation and maintenance of test automation **require considerable resources**, including skilled professionals and modern testing tools. Second, **not all tests can be automated-for instance**, complex user experience scenarios normally require manual verification. Additionally, automated tests **need regular updates** because even minor

changes in the interface or business logic make tests irrelevant.

Automation of the strategy of testing in the banking sector can be effectively performed using modern tools like Selenium, JMeter, TestNG, Appium, and Postman to automate various aspects of the testing of banking applications. The choice of a particular tool depends on certain testing objectives, application architecture, and quality requirements. For example, in general, Selenium automates web applications testing; JMeter provides assessment of banking systems performance and stability under the load (table 1).

Table 1

Automated testing tools in the banking sector

Tool	Type of testing	Description	Application in the banking sector
Selenium	Functional testing (UI)	A framework for automated testing of web applications, supporting multiple programming languages.	Testing online banking, client web interfaces, and internal banking systems.
JMeter	Load and stress testing	A tool for performance testing of web applications and API (Application Programming Interface).	Assessing the scalability and resilience of banking services under high loads.
TestNG	Regression and integration testing	A Java-based testing framework with flexible test scenario configurations.	Regular validation of updates in banking systems, testing module interactions.
Appium	Mobile testing	A tool for testing mobile applications on Android and iOS.	Testing mobile banking applications, verifying UI and functionality.
Postman	API testing	A tool for testing REST and SOAP APIs, enabling request automation.	Validating the integration of banking systems with external services (payment gateways, government services).

By implementing test automation, banks can significantly enhance the quality of their software. Automation decreases the number of potential bugs, accelerates testing, and maintains systems at optimal levels of security and reliability. For automation to succeed, however, each step has to be thought out carefully, and the correct tools have to be selected, as well as regularly updated test scenarios in order to remain compatible with evolving market requirements.

Features of banking software

Modern banking software is a complex ecosystem that merges services responsible for financial transactions, customer data management, and adherence to regulatory requirements. Unlike other corporate systems, banks have higher demands on security, reliability, and performance due to the possible financial losses and reputational risks caused by failures [2].

The key feature of banking software is a **multi-layer architecture** that includes a user interface, server part, databases, and integration with external payment systems. Such an approach gives much more flexibility and ability for scaling but complicates testing. The introduction of containerization and microservice architecture allows updating components independently but requires effective methods for testing interactions between services [3].

Another unique feature of banking software is **high load and fault tolerance**. Systems should work 24/7, process thousands of transactions per second, and survive peak loads-for example, during periods of mass

payments. Load testing helps to simulate such scenarios and identify system bottlenecks [4].

One of the key aspects of modern banking applications is security, which requires strict compliance with international standards such as **PCI DSS, ISO 27001, and CCPA** (California Consumer Privacy Act). These regulations mandate rigorous security testing throughout the development and operational stages to protect sensitive financial data [5]. Failure to comply with these requirements can lead to serious sanctions, e.g., fines or payment processing suspension. In order to achieve compliance and minimize risk, banking systems undergo automated security testing, vulnerability scanning, and simulated cyber-attacks, enabling potential threats to be identified early and the overall system's robustness to be enhanced.

Automated testing methods and tools

Automated banking system testing requires a comprehensive approach with various methodologies and specialized software tools. The selection of the test methodology is determined by the objectives, system architecture, and business process peculiarities. Unlike many other areas, banking software testing must encompass not only functionality testing but also security, load tolerance, and compliance with regulatory requirements. With these expectations in mind, the utilization of efficient testing tools is indispensable for the provision of reliability and optimization of development flows.

Vite, Storybook, and Vitest are among the tools that can significantly enhance and accelerate the development and testing of banking applications. Vite is a fast build tool that improves frontend development efficiency by offering instant reloading and optimized module bundling, reducing build time for large-scale applications. Storybook enables developers to build and test UI components in isolation, allowing for faster verification and higher-quality user interfaces without the need for full application deployment. Vitest, a testing framework optimized for Vite, facilitates efficient test writing and execution, seamlessly integrating into CI/CD pipelines to ensure continuous and automated testing processes [6].

Because banking systems can be so complex, it is just as important to select the proper testing practice as it is to employ the correct tools. **Behavior-Driven Development (BDD)** is one of the most utilized practices, meaning test cases are written in a business-friendly way. This approach facilitates testing integration during early development cycles, especially in the case of banking systems since business logic mistakes in such systems can lead to tremendous financial losses. A great example of such a tool is **Cucumber**, where you are able to specify the tests in natural language and provide full transparency of interactions between analysts, developers, and testers.

Regression testing, aimed at preventing errors after changes to the code, occupies a key place in testing banking systems. This approach is especially applicable to banking software that is regularly updated because of the modification of legislative demands, introduction of new functionality, or optimization of current processes. Automated regression testing can be performed with the help of Selenium and TestNG tools that allow you to create repeatable test cases and incorporate them into CI/CD.

Also, **load and stress testing** is performed in order to make the banking system stable under heavy load. This kind of testing allows us to test how well the system will withstand peak loads, such as during large transactions. JMeter is one of the most widely used load testing tools, which has the capability to simulate thousands of users at a time and assist in analyzing various performance metrics. This is even more important in the banking sector, where there is a need to test online

banking system, payment gateway, and processing center. Even small lag times in handling transactions can result in catastrophic system failure and monetary losses, making correct load testing a key part of financial application quality assurance.

As mentioned earlier, **security testing** plays a crucial role in the banking sector, as these systems handle confidential information and are constantly exposed to cyber threats [7]. In this regard, tools such as OWASP ZAP and Burp Suite are being used intensively to find web application vulnerabilities, test the security of API (Application Programming Interface), and examine authentication mechanisms for strength. These tools have particular significance in testing PCI DSS and ISO 27001 compliant systems since regulatory requirements necessitate the performance of regular security audits and penetration testing as a way to ensure data security and system integrity.

In such a way, automatic testing methods and tools of the banking sector provide a broad area of application: from functional tests to performance and security analyses. Their usage enables not only enhancement of software quality but also observance of regulations, decrease of financial risks, and strengthening of user confidence in banking systems [8].

Test automation in the context of DevOps and Agile

New banking software development requires high deployment rate and flexibility, and thus traditional testing loses its effectiveness. Under these conditions, test automation becomes a key part of Agile and DevOps practices, allowing for constant monitoring of software quality and releasing new versions in a shorter time span.

Agile methodology is all about short cycles of development that repeat iteratively, with fresh functional changes being input into the product on a regular basis. Manual testing is a bottleneck in such an environment because it takes a long time. Automated testing, however, allows you to test changes virtually immediately, which is especially important with frequent releases. With methodologies such as **Test-Driven Development (TDD)** and BDD, developers can actually write the tests first before writing the core code, which greatly reduces the risk of defects during the early developmental stages (fig. 1).

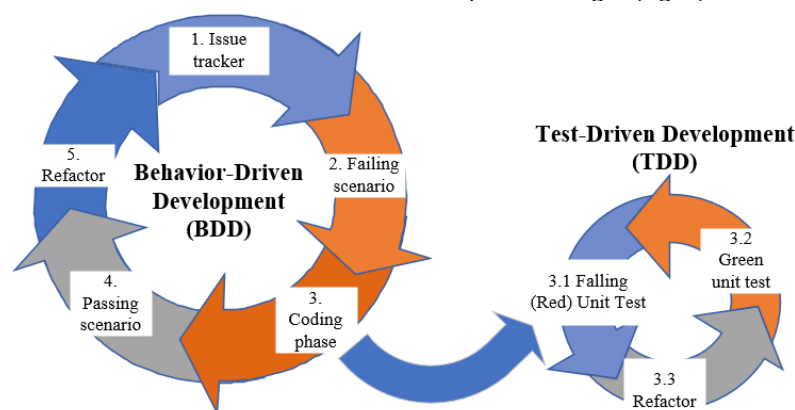


Figure 1. The BDD and TDD process structure

The TDD methodology is based on a three-step cycle. First, a test is written that will initially fail (Red). Then, the minimum code is created that allows the test to pass (Green). After that, the code is optimized: duplications are removed and the structure is improved without changing the functionality (Refactoring). This process is repeated, ensuring the reliability and testability of the code [9].

Automated testing is integrated into CI/CD pipelines in **DevOps**, thus enabling testing of every new code commit in real time. This is achieved through tools like Jenkins, GitLab CI/CD, and Azure DevOps, which perform automating the execution of tests on every code change to check for system stability. For instance, in huge financial organizations, testing becomes an obligatory process before deploying updates to prevent failure and errors in deploying new features.

Therefore, test automation in Agile and DevOps is an integral component of effective bank software development. It helps speed up the development cycle, enhance reliability for software solutions, and decrease risks when releasing new versions of banking systems.

Conclusion

The research done shows that automated testing is an essential element of banking software quality assurance. During high-load environments, high security needs, and constant updates, the use of automated tests increases the process efficiency and reduces the error risks in the code. The scalability and flexibility of testing using the help of modern tools, such as Selenium, JMeter, TestNG, and others, allow you to effectively cooperate with different levels and dimensions of testing: performance, security, and functionality. Automated testing implementation in DevOps and Agile methodologies reduces time costs and improves the quality of the product. Yet, successful automation requires careful planning, choice of the appropriate tool, and updating test scenarios, which remains topical for banking organizations in view of constant changes within legislative and technical requirements.

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ADAPTIVE CYBERSECURITY ARCHITECTURES FOR MILITARY COMMUNICATION SYSTEMS: A PROACTIVE DEFENSE MODEL

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Abstract

This study meets the increasing demand for flexible network security frames in military communication systems. Military actions are increasingly vulnerable to advanced operations such as service attacks, day -to -day exploitation and false protocol because of their growing dependence on real -time digital communication. The proposed method of providing pioneering structure combines safe routing protocols, self -regulating reactions and abnormal detection systems on AI. The importance of adaptive defense classes in real time to protect essential communications on the battlefield is emphasized. The frame is designed to operate effectively in a difficult environment, maintain the continuity of the task and ensure the integrity of communication.

Keywords: adaptive cybersecurity, military communication systems, anomaly detection, AI in defense, real-time response, secure routing, cyber resilience.

The growing digitization of military activities has led to unprecedented connection levels between commanding, control, communication and intelligence systems (C3I). From the ground units using tactical radio to the activities of the common force coordinated through satellite links, reliable communication is essential for the success of the task. However, this connection also creates a large and vulnerable attack surface for sophisticated competitors (Zhang et al., 2023).

Static defense mechanisms, such as firewalls or filter rules are predefined in advance, are not enough in the modern battlefield environment in the network link structure, threatening agents and continuous pace of activity. Traditional methods do not provide flexibility or intelligence necessary to respond to emerging and unpredictable threats. Therefore, there is an important need for cybersecurity architectures that adapt can adjust and autonomy according to intelligence, context and behavioral analysis in real time (Dulik and Dulik Jr., 2019).

Military communication issues Military communication networks have their own set of operational and technological issues: Network topologies that are always changing: Military units generally work in groups that are decentralised and mobile, and these groupings change quickly as missions change. This means that the connections between nodes can change a lot. This can cause routing paths to shift, links to become unstable, and communication to stop working from time to time. The infrastructure of tactical military networks is typically fixed, which makes them different from commercial networks. They have to be able to fix themselves

and adjust to things like moving units, losing a signal, or barriers in the surroundings (Ahmed & Patel, 2021). For instance, a convoy passing through mountains or a battlefield might lose connectivity now and then, which would mean that the communication architecture would have to be changed on the fly.

It is challenging to continuously maintain security because modern military forces employ a combination of outdated and modern technologies (Saarelainen, 2014). Communications in competitive environments are examples of adversarial operational conditions, and they can be impacted by electronic warfare strategies like data interception, spoofing, and jamming.

Bandwidth and latency restrictions: Conventional security systems are less effective due to tactical radios and field-based networks' typically high latency and restricted bandwidth. Because they employ both new and outdated technologies, modern armed forces encounter challenges when attempting to integrate various system types, making it more difficult to maintain security (Saarelainen, 2014).

Security frameworks need to be able to learn from, adapt to, and grow in these complex environments in order to solve these issues. Figure 1 shows how AI-based anomaly detection, autonomous incident response, and secure routing protocols work together to keep the mission going and make it strong. A plan for an adaptive cybersecurity architecture to deal with these changing problems, we present an adaptive cybersecurity architecture with three connected pillars to handle all kinds of threats:

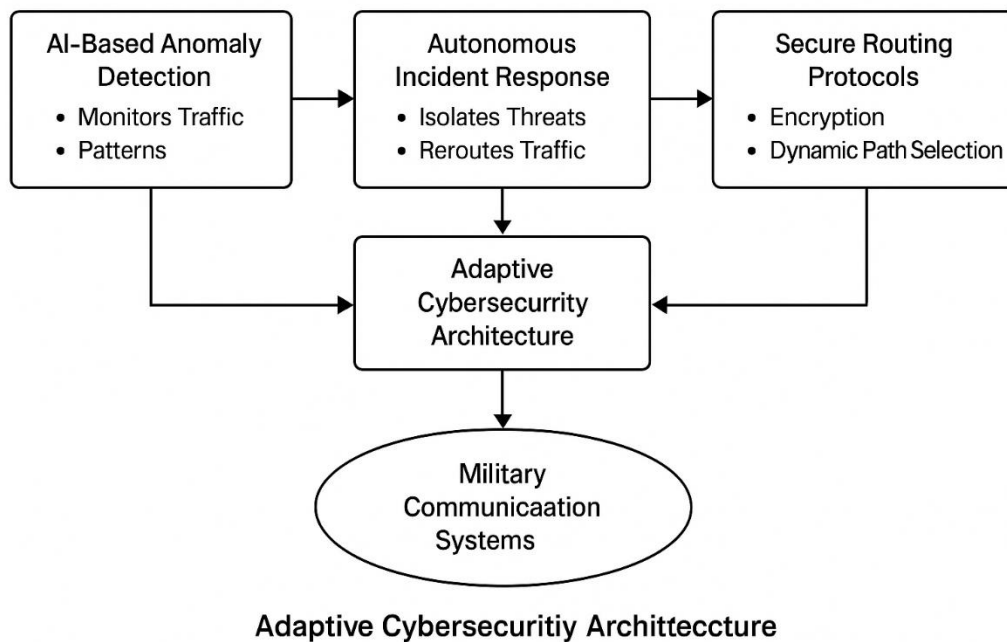


Fig. 1. Adaptive Cybersecurity Framework for Military Communication Systems

1. **AI-Based Anomaly Detection Systems (ADS)** - AI-powered ADS are really good at finding unusual network behavior since they look at traffic and continually getting smarter. These systems build a dynamic model of what "normal" network behavior looks like by using unsupervised learning techniques like neural networks, clustering (like k-means), and statistical anomaly detection. People regard changes from this baseline as possible threats. For instance, unexpected increases in data volume, illegal peer-to-peer transactions, or efforts to move sideways are all easy to see and mark as signs of a hack (Zhang et al., 2023). The best thing about ADS is that it can discover new threats and zero-day threats without having to use attack signatures that have already been made. Some of the benefits of employing ADS are: You may change and customize it to fit different operation rooms. It can swiftly find threats and send out alerts. Using contextual correlation might also help cut down on erroneous positives.

2. **Autonomous Incident Response Mechanisms** are self-directed quick action is particularly critical in combat scenarios that move quickly. Once an abnormality is found, the system must behave correctly to stop more problems from happening. Autonomous incident response mechanisms are systems that can automatically respond to threats based on how serious they are and what kind they are. Some important automated responses are: cutting off compromised nodes to stop the spread of threats; dynamically rerouting traffic around links that are compromised or degraded; revoking compromised credentials or digital certificates; and sending automated threat notifications to network administrators and centralized command units (Williams & Khan, 2024). These response actions work within a set of rules and are aware of the situation to make sure that critical communications stay going even when they are being assaulted.

3. **Secure and Resilient Routing Protocols** - every network that enables people talk to each other needs

routing protocols. Military encryption needs to be exceedingly safe, adaptable, and dependable. Our architecture advises employing safe dynamic routing approaches that use the most up-to-date encryption and authentication technology. Some strategies that have been put into action include encrypting data while it is being sent with IPSec, WPA3, or TLS 1.3; checking routing paths with HMAC signatures or zero-trust policies; making sure that communication is always possible even if a node or link fails; and using trust-based routing metrics that choose routes based on node behavior and history (Dulik & Dulik Jr., 2019). These fixes stop route takeovers, keep data safe, and make sure that conversations are protected even if some sections of the network are hijacked.

The suggested architecture must function effectively in a range of military scenarios across various regions. Tactical edge devices come with lightweight ADS modules, and centralized servers collect behavioral data and make plans for how to react to threats around the world.

In recent NATO electronic warfare simulations, this technique reduced response time to less than one second. Communication improved by 65% when compared to standard security settings. According to defence network operators, the strategy was successful for coalition and hybrid operations (Zhang et al., 2023).

The architecture is also modular, which means it doesn't need any special hardware to work. You can add it to platforms you already have and correct it with software updates without halting work. According to Saarelainen (2014), common battlefield management and tactical data systems make sure that everything works together.

As digital infrastructure becomes increasingly central to modern military operations, relying on adaptable cybersecurity frameworks has shifted from being merely advisable to absolutely essential. Unlike tradi-

tional, static defense systems that only react after an incident, today's security models are designed to be intelligent, forward-thinking, and responsive to constantly evolving cyber threats. The framework proposed in this article is a comprehensive defense strategy that combines AI-driven anomaly detection, automated incident response mechanisms, and secure cryptographic routing protocols. Together, these elements work to protect critical military communication networks from both active breaches and subtle, stealthy

threats—while ensuring operational continuity even in the face of disruptions. This capacity for dynamic adaptation ensures that networked military environments remain resilient, even under direct cyber offensive conditions. Figure 2 showing perimeter defense, AI-driven threat detection, and automated incident handling mechanisms designed to protect the integrity of secure data and command structures in hostile environments.

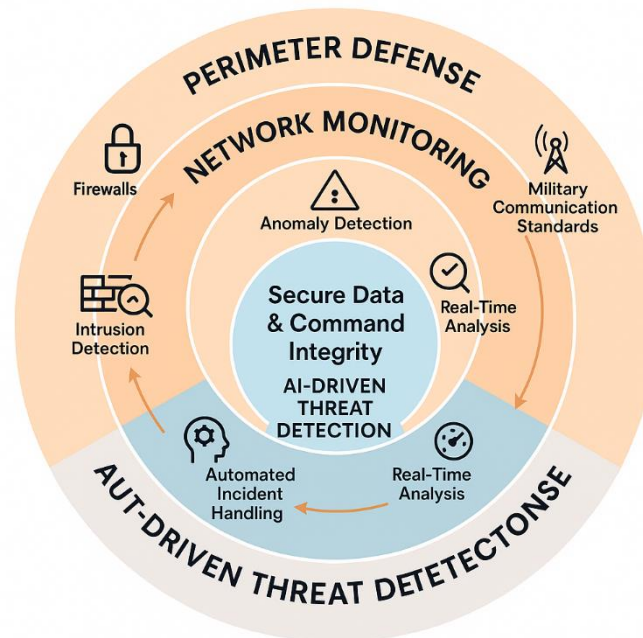


Fig. 2. Layered Cyber Defense Model for Military Networks

In practice, what sets this cybersecurity framework apart is how low-maintenance it is. You don't need to rip out or replace old systems — it fits right in. That kind of modularity, the ability to drop into both old and new environments, is rare in military tech, where hardware often lags behind software demands. The framework's not flashy, but it's functional — and that counts.

What makes it even more promising is the room it leaves to grow. You're not locked into one setup. If down the line there's a need to plug in quantum-proof encryption or smarter threat detection that talks across units, that's doable. You build on what's already there (Zhang et al., 2023; Williams & Khan, 2024).

At the end of the day, this isn't just about patching holes in the system. Adaptive cybersecurity, if taken seriously, can become a key part of how operations are planned and protected — now and as things get more complex.

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MICRO-FRONTENDS AS A STRATEGY FOR MINIMIZING DOWNTIME DURING TECHNOLOGY MIGRATION

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Abstract

This article examines the use of micro-frontend architecture as an effective approach to migrating from legacy web technologies to modern platforms. The methodology of gradual component replacement is explored, enabling continuous system operation and minimizing downtime. Particular attention is given to the practical aspects of implementing micro-frontends, including the division of applications into independent modules, the use of tools for component integration, and maintaining the visual and functional consistency of the interface. The study investigates the impact of micro-frontends on accelerating development, reducing migration risks, and enhancing the resilience of web applications in the face of technological changes.

Keywords: micro-frontends, technology migration, legacy systems, web application modernization, downtime minimization, web application architecture, containerization.

Introduction

The common and fast development of web technologies is a huge challenge to organizations on how to effectively update their systems without causing interruptions to seamless operations. Legacy methods of migration have a lot of downtime, which reduces user experience and leads to inefficiencies in operations. Therefore, this forms a basis on which the adoption of the micro-frontend architecture has become a game-changer.

Micro-frontends can enable progressive replacement of the old components with modern solutions without requiring the rewriting of the whole system from scratch. Because of this architecture, the decomposition of a monolithic frontend into smaller, independently deployable units will guarantee that both legacy and modern technologies will coexist during the migration process. This can reduce system downtime and minimize potential risks resulting from huge migrations. The purpose of this study is to explore how micro-frontend architecture can serve as a strategy for minimizing downtime during technology migration.

Main part. Introduction to micro-frontend architecture and its importance for technology migration

Micro-frontend architecture is a novel approach to web application development in which the user interface is divisible into independent modules. Each module, or micro-frontend, is developed and maintained by a separate team with its own autonomous technology stack. This enables incremental deployment of interface changes without requiring a complete system shutdown. As the technology landscape continues to evolve at a rapid pace and user expectations keep increasing, micro-frontends have become a key strategy to increase the flexibility and agility of web applications.

One of the main problems that developers and organizations confront is migration from old and obsolete technologies to modern ones. As a rule, traditional approaches to migration imply the complete replacement of a system, which is supposed to be connected with considerable time and financial expenses, besides requiring system downtime. This is a very important issue for organizations that provide real-time service, due to the fact that even small cases of downtime result in loss of revenue, loss of brand reputation, and satisfaction among users. Micro-frontend architecture solves all these problems by enabling the integration of legacy and modern components in one system, and thus smoothly transitioning from old technologies to modern ones (table 1).

Table 1 [1, 2]

Comparison of micro-frontend architecture with other approaches

Characteristic	Micro-frontends	Monolithic frontend	SPA (Single Page Application)
Application structure	Divided into independent modules	Unified codebase	Single module with dynamic routing
Development independence	High	Low	Medium
Technology compatibility	Supports multiple frameworks	Limited	Limited
Scalability	High	Limited	High but complex
Component updates	Local (module-specific)	Requires updating the entire application	Requires updating the unified application
Performance optimization	Independent module optimization	System-wide optimization	Dynamic optimization for single app

The application of micro-frontends is especially relevant for large, complex systems where a full migration may take years to complete. Instead of attempting an overall system redesign, micro-frontends facilitate the sequential migration process in which old modules are swapped out with new units without halting the entire app. Additionally, micro-frontend architecture facilitates distributed development where various parts of a project are tackled by independent teams. This parallelised development process simplifies innovation and increases project manageability and flexibility.

Micro-frontend architecture simplifies migration from legacy technologies and provides the potential for easier management of web applications. It helps in reducing the time for updates, minimizing operational risks, and enabling the transition to new technologies even more smoothly.

Methodology of gradual component replacement: approaches and advantages

Migration from other technologies is always accompanied by challenges and risks. Both of these challenges arise due to complexity of function and stability throughout the process of modernization. Unlike the monolithic approach, whereby transformations have a possibility of destabilizing the entire system, micro-frontends allow step-by-step replacement of components and reduce the impact on end users. This approach is based on the seamless integration of new modules into the existing system without requiring a complete system reboot [3].

The process of gradual component replacement begins with identifying the most serious or outdated parts of the web application. These modules typically have a significant impact on performance and user experience. Using micro-frontends, these components can be isolated and replaced with modern solutions while maintaining stable interactions with the rest of the system. Notably, during the migration phase, micro-frontends ensure compatibility between legacy and new technologies. This is achieved through standard interaction interfaces and shared application programming interface (API), which serve as a bridge between outdated and updated modules.

One of the key advantages of the gradual replacement method is the ability to test new components in real-world conditions. Rather than relying solely on testing environments, developers can deploy individual micro-frontends into the existing application and monitor their behaviour in real time. This reduces the likelihood of errors and allows for prompt resolution of identified issues without risking the entire system's operation. This approach provides backward compatibility: if a new component proves incompatible or ineffective, it can be temporarily disabled, and the old version

reinstated, something that is often unfeasible with traditional migration methods [4].

Gradual replacement also allows companies to phase out the cost of modernization. Instead of spending a huge amount on total reconstruction at a time, companies can implement changes gradually, which is particularly effective for companies with limited resources. The method also makes project management more efficient with more openness and flexibility in planning. Additionally, the use of micro-frontends enables the simultaneous support of multiple application versions, simplifying the transition process for different user groups. One of the 2024 study shows [5], that this gradual legacy migration to micro-frontends reduces various risks by 72%, increases team productivity by 35%, and achieves cost savings of 45%.

Another advantage is the reduced burden on development teams. Within a micro-frontend architecture, each team can focus exclusively on their specific part of the application, independently of others. This approach can accelerate the replacement process and minimize the risk of conflicts between teams. It is particularly effective for distributed teams or projects involving specialists from different departments or even separate companies.

The incremental component replacement method using micro-frontends is a great strategy for web application modernization. It offers a gentle learning curve to newer technologies, minimizes risks and costs, and allows for the creation of more flexible and fault-tolerant systems. It is a valuable tool for businesses willing to introduce innovations without compromising the stability and quality of their applications.

Practical implementation of micro-frontends for web application modernization

The practical adoption of micro-frontend architecture requires a well-defined strategy and the selection of appropriate tools. Unlike theoretical approaches, the successful implementation of micro-frontends in real-world projects relies on a clear understanding of system requirements, technical constraints, and migration objectives.

One of the initial steps in implementing micro-frontends is determining how to divide the application. This is typically done based on functional domains. In an e-commerce platform, modules for catalog display, shopping cart, and user profile can be identified. Each of these modules can be developed as an independent micro-frontend, allowing teams to build and deploy them autonomously. This approach simplifies the management of complex systems, reduces the likelihood of code conflicts, and accelerates the update process. Figure 1 illustrates the primary approaches to implementing micro-frontend architecture through horizontal and vertical component segmentation.

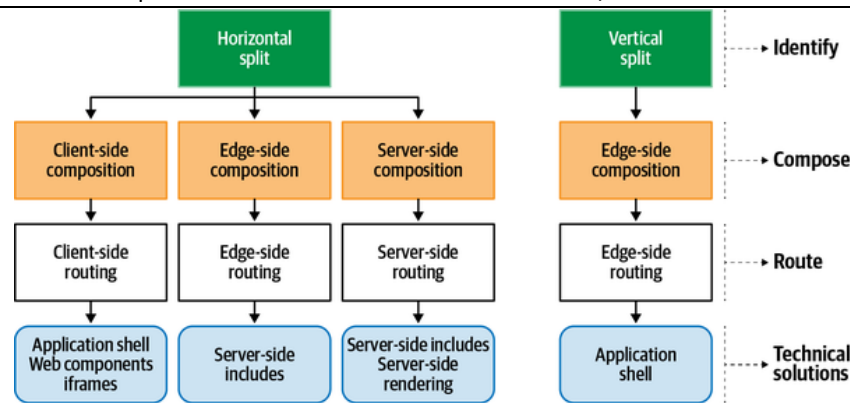


Figure 1. The micro-frontends decisions framework [6]

Horizontal segmentation focuses on layering based on composition methods (client-side, edge-side, server-side), determining where and how modules are integrated. Vertical segmentation, on the other hand, emphasizes the functional aspects of an application, such as user interface, routing, and technical solutions. Each approach boasts strengths and weaknesses, with the freedom to select the most suitable one for specific business requirements. One of these solutions includes client-side routing with Web Components and server-side rendering, and both of these can improve the scalability and performance of a system.

The micro-frontends' technological deployment is typically achieved by leveraging containerization technology such as Webpack Module Federation or Single-SPA. They allow the coexistence of disparate modules within a single application while not compromising on their independence. Webpack Module Federation, for instance, offers dynamic module loading based on their availability, particularly beneficial for massive systems where updating can occur asynchronously [7]. Single-SPA, on the other hand, minimizes state management and routing between micro-frontends and creates the appearance of a unified application for the end user.

Another step of the same magnitude is the consistency of the user interface. Since micro-frontends are being developed by different teams using different technologies, inconsistency in visual style of components and behavior is a possibility. To address this challenge, UI component libraries or design systems are usually implemented that develop common standards for all modules. This way, it is ensured that, in spite of decentralized development, micro-frontends appear and act as if they are components of an integrated application.

Testing micro-frontends requires a specialized approach. In addition to standard unit and integration tests, it is essential to focus on testing interactions between modules. This is a matter of verifying the accuracy of data interchange between micro-frontends, compatibility of their APIs with each other, and interaction when one part is being upgraded. Automated testing has one of the most important roles to fulfill at this juncture, allowing for speedy error identification and correction.

Another important aspect of micro-frontends' real-world use is monitoring them and their state after deployment. Large applications containing numerous isolated components can experience performance issues

stemming from a greater number of network requests or uncontrolled resources. Avoiding this, monitoring tools such as Google Lighthouse or specialized Application Performance Management (APM) products should be used. They facilitate tracing the performance of single modules and their contribution to the entire system to be measured.

Major companies actively leverage this architecture to manage their web applications. A sports streaming platform DAZN employed a hybrid approach combining SPA and components managed by a client-side orchestrator called Bootstrap. This method supports web platforms and also smart TVs, set-top boxes, and consoles. The fully client-side orchestrator dynamically loads different SPAs at runtime as users navigate across business domains within the video platform. With this approach, they were able to handle peaks load up to 110000 requests per second [8].

The practical implementation of micro-frontends demands thorough preparation and a comprehensive strategy, but its advantages are clear. It ensures flexibility, scalability, and stability for web applications, allowing organizations to effectively address the challenges associated with modernization. This approach provides extensive opportunities for innovation, making the migration to new technologies both manageable and efficient.

Conclusion

Micro-frontend architecture is a modern and effective way of migrating from legacy technologies to new ones with minimal risk and without system outage. Its ability to allow the retirement of legacy components in place while ensuring interoperability between heterogeneous technologies makes it extremely relevant for large and complex web applications. The practical use of micro-frontends accelerates development, reduces costs, and enhances system reliability through decentralized module control. This strategy enables organizations to react to the fast-changing nature of technology and create more resilient, scalable, and reliable applications that meet the demands of new business and consumers.

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BENCHMARKING EMBEDDED KEY-VALUES STORES USING eBPF**Sahakyan H.***Student, Institute for Informatics and Automation Problems of NAS RA, Yerevan, Armenia*<https://doi.org/10.5281/zenodo.15657638>**Abstract**

Embedded key-value stores run inside latency-critical paths, yet conventional benchmarks reveal only symptoms, not causes. We present *ucsb-ebpf*, a drop-in extension to the Unbranded Cloud Serving Benchmark that injects eBPF probes into every run. The tracer records per-thread syscall times and optional heap/slab events while adding under 1 % runtime overhead, so the same workload that measures throughput now pinpoints where each microsecond goes. Using seven standard mixes, we profile LevelDB, RocksDB, WiredTiger and LMDB on NVMe hardware. All code, data and analysis scripts are open sourced.

Keywords: eBPF; benchmarking; embedded key-value store; syscall tracing; memory profiling; performance analysis

Introduction

Embedded key-value stores (KVSs) such as LevelDB, RocksDB, WiredTiger, and LMDB are increasingly embedded in latency-critical systems like load balancers, edge caches, and IoT gateways. This design eliminates a network hop by linking the entire database library directly into the application. Yet production traces still show abrupt p99 spikes when log-structured merge (LSM) compaction, allocator locks or fsync bursts collide with user traffic. External-only benchmarks cannot identify these internal causes; they can only report the symptom. This study argues that kernel-level eBPF tracing, combined with the Unbranded Cloud Serving Benchmark (UCSB), yields a more detailed accounting of how every microsecond is spent.

Over the decade since YCSB [1], benchmarking methods for embedded key-value stores have diversified: newer suites add hotspot mixes, transactional sequences, and SSD-oriented range scans, while micro-benchmarks isolate specific design choices. UCSB extends this trajectory by driving terabyte-scale data sets from a low-overhead C++ client. Yet every existing suite remains a black box—reporting throughput and latency but leaving the root causes of tail-latency spikes unexplained.

eBPF offers a non-intrusive path to causal insight. Small, verified eBPF probe programs can attach at runtime to any kernel or user-space symbol, sampling scheduler events and streaming data to buffers with minimal overhead. This approach was recently validated in studies tracing PostgreSQL and MySQL workloads [8]. By layering such probes on top of UCSB, we preserve the benchmark's external validity while turning it into a white-box diagnostic tool: the same workload that shows how fast a KVS runs now also reveals why it slows down.

This enhanced visibility has both practical and scientific value. Practitioners can decide whether tail spikes come from filesystem flushes, allocator mutexes or CPU scheduling, guiding fixes that cost only a configuration change. Researchers gain a reproducible, low-intrusion method for evaluating novel KVS designs, while reviewers can validate internal-cost claims instead of relying solely on aggregate throughput

curves. In short, augmenting UCSB with eBPF closes the observability gap, converting a decade of black-box benchmarks into a causal performance microscope for embedded key-value stores.

This study makes four concrete contributions: (i) it delivers *ucsb-ebpf*, a drop-in eBPF tracing layer for UCSB that adds < 1 % runtime overhead; (ii) it equips UCSB with optional heap/slab probes, enabling joint syscall- and memory-level accounting that existing suites lack; (iii) it applies this instrumentation to profile LevelDB, RocksDB, WiredTiger, and LMDB across seven standard workloads, pinpointing the dominant user- and kernel-space costs for each engine; and (iv) it releases all code, data, and analysis notebooks as open source, allowing researchers to reproduce and extend our findings.

The remainder of this paper is organized as follows: Section 2 reviews related work, Section 3 introduces the added eBPF segment, Section 4 presents the evaluation of four key value stores with harvested eBPF results, and Section 5 concludes the paper.

Related work

Over the decade since YCSB [1], benchmarking methods for embedded KVSs have diversified. Newer suites such as YCSB++ [3] introduce hot-spot and eventual-consistency tests, and Transactional YCSB [4] adds ACID multi-operation mixes. Other tools like KVbench [5] enable flexible point vs. range query mixes for SSDs, while the micro-benchmarks in systems like KVell [6], WiscKey [7], PebblesDB [8], and RocksDB's *db_bench* target individual design choices. UCSB modernizes this lineage, scaling YCSB's model to terabyte-sized data and wider key/value distributions suitable for NVMe drives, while keeping the driver in C++ for minimal overhead.

Engine-specific micro-benchmarks complement general suites. RocksDB's *db_bench*, inherited from LevelDB, can sweep individual LSM phases. Research prototypes ship their own targeted workloads: KVell stresses per-core NVMe queues; WiscKey measures key/value separation on SSDs; PebblesDB quantifies write-amplification trade-offs. These tools expose fine-grained design choices, yet their instrumentation rarely extends beyond throughput and latency counters.

Beyond black-box metrics, several studies explore low-overhead tracing. Perf and DTrace offer coarse visibility, but eBPF has emerged as a lightweight alternative: vetted probe programs can time system calls, user-space functions and scheduler events with less than 1 % overhead. Recent explorations on PostgreSQL and MySQL confirm that eBPF captures detailed latency paths while perturbing workloads far less than in-process logging or ptrace-based tools. General-purpose toolkits such as BCC and bpftrace provide a reproducible substrate for such analyses.

To date, however, no study combines UCSB's large-scale, storage-aware workloads with eBPF instrumentation. Our work fills this gap, turning UCSB from a black-box scoreboard into a causal microscope that attributes tail-latency outliers to concrete kernel and user-space costs.

Benchmark Architecture and eBPF Instrumentation

In our benchmark, the Unbranded Cloud Serving Benchmark (UCSB) remains the workload driver. Its controller script, `run.py`, now can take two supplementary flags: `--with-ebpf`, which compiles our eBPF program, attaches the probe set, and spawns a helper thread for trace collection; and `--with-ebpf-memory`, which recompiles the probes with heap- and slab-allocation hooks. When the latter flag is omitted, the high-overhead memory kprobes are left out, holding total runtime overhead to ~1 %.

Probe groups

- Phase markers - uprobes on UCSB's `timer_t::start/resume/pause/stop` every workload phase for precise alignment with external metrics.
- Syscall tracing - raw-syscall tracepoints log per-thread counts and nanosecond latencies, streaming samples to buffers with sub-1 % overhead.
- Memory telemetry (optional) - uprobes on `malloc/calloc/realloc/mmap` together with kprobes on slab `alloc/free` record allocation size, stack trace, and lifetime; compiled in only when `--with-ebpf-memory` is specified.

A helper thread wakes every fifteen seconds, harvests phase timestamps, syscall info, thread life-cycle events, and when enabled memory summaries, then stores each snapshot as JSON in `bench/ebpf/snapshots/`.

To minimize measurement skew, we execute the benchmark twice per database workload combination:

- Timing pass - run with `--with-ebpf` alone to capture phase and syscall latencies at minimal overhead.
- Memory pass - repeat with `--with-ebpf --with-ebpf-memory` to gather allocation metrics.

We used this two-pass methodology for all results, and we recommend it for future studies. The first pass yields uncontaminated timing metrics, whereas the second (with memory tracking) provides heap usage insights without disturbing the already-recorded critical-path timings. Thus, UCSB still reports how fast each engine runs, while the eBPF layer - applied judiciously in two stages - exposes where CPU time and memory are consumed, transforming a black-box benchmark into a causal microscope for embedded key-value stores.

The benchmark and tracer coordinate with a three-step UNIX-signal handshake. (i) When the runner finishes attaching the eBPF probes, it unblocks the suspended UCSB child by sending `SIGUSR1` - this marks time zero for the run. (ii) At workload completion, the child notifies the tracer with `SIGUSR2`, the tracer's handler records a flag (`SIGUSR2_received`) so the harvesting loop knows the workload has ended and must flush the in-kernel buffers. (iii) After the tracer has drained all remaining events and written the final JSON snapshot, it sends a final `SIGUSR1` back to the child, allowing the child process to exit cleanly and ensuring no late samples are lost during teardown. This bidirectional signalling guarantees that metrics collection starts only after every probe is running and stops only after every last event has been persisted.

Several studies [9-11] show that zipfian distribution is a good approximation for web data, so in our benchmark keys are selected from zipfian distribution with $\alpha = 0.99$.

Benchmark results

We benchmarked the following workloads

- Write-Only: 100 % upserts or inserts (upserts) - stresses WAL throughput, memtable growth, and full LSM compaction path
- Read-Only: 100 % point reads - measures pure lookup latency
- Read-Heavy: 99 % reads / 1 % upserts - simulates rare state changes typical of session-stickiness tables
- Read-Mostly: 95 % reads / 5 % upserts - captures read-dominated loads with measurable write interference
- Balanced: 50 % reads / 50 % upserts - induces equal read/write pressure and worst-case mutex contention
- Range-Scan: 90 % short scans / 10 % point reads - exercises iterator logic, prefetching, and cache-line churn
- Remove-Only: 100 % deletes - probes tombstone creation, space reclamation, and compaction clean-up

Detailed parameters can be found in project repository's `bench.json` file under `bench/workloads` directory. The benchmark is run on machine with Intel Core i7-9750H CPUs (2.60 GHz), 16 GB RAM, Ubuntu 22.04, and kernel 6.5. Before each timing run, we drop system caches using `/proc/sys/vm/drop_caches` API.

For illustrative purposes, we grouped system calls into the following categories:

- Threading and Sync: Synchronization primitives and related syscalls such as `set_robust_list`
- Timing: Waiting, timing or sleeping (`clock_nanosleep`, `clock_gettime` etc.)
- Read I/O: `read`, `pread64`, `readahead`, `lseek` etc.
- Write I/O: `write`, `pwrite64`, `writew`, `fdatasync` etc.
- Memory Mapping and Allocations: `mmap`, `munmap`, `mprotect`, `brk`, `madvise` etc.

Note that in Fig. 1 we combine the CPU time of all four threads into a single value, because the system calls and user-space code execute in parallel.

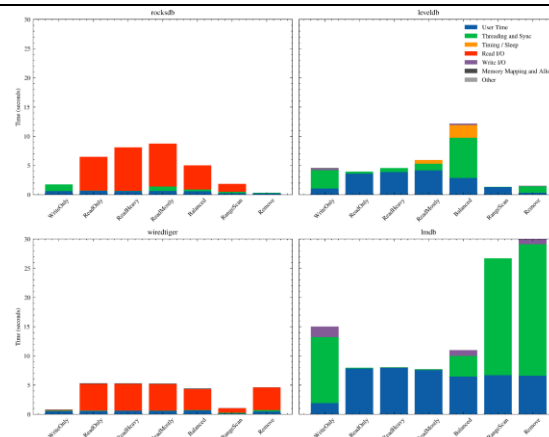


Fig. 1. System Calls breakdown per Database in 4 threaded benchmark

The shown figures (Fig.1-2) help make decisions without benchmarking on specific hardware. WiredTiger and RocksDB use heavy read system calls, therefore their performance is highly correlated with fast file systems, specifically fast reading hardware. LevelDB executes mainly in user space; its performance is therefore CPU-bound rather than I/O-bound. LMDB's heavy use of mutexes and related synchronization primitives introduces contention that limits scalability under multithreaded workloads.

Traditional benchmarks such as YCSB expose only aggregate throughput and latency, so they cannot attribute performance to user-space computation versus kernel-space I/O paths. Our extended UCSB framework adds per-syscall tracing, enabling the user-vs-kernel breakdown shown in Fig. 1–2.

The same decomposition can be applied to any additional key–value engine by deriving a new implementation from the `ucsb::db_t` abstract class. The system-call analysis is packaged as `user-vs-kernel-time.ipynb` Jupyter notebook in project repository.

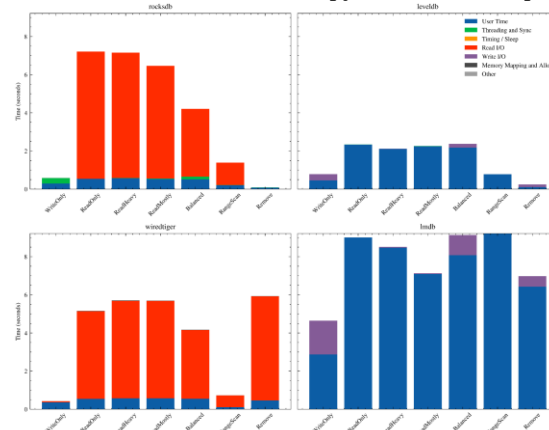


Fig. 2. System Calls breakdown per Database in single threaded benchmark

Beyond syscall latencies, the probes also build a fine-grained memory profile: every allocation and free is timestamped, live bytes are tallied in real time, and concurrent samples record both user-space RSS and kernel slab usage. Each 15 s snapshot is emitted to `ebpf-memory-snapshots`, ready for post-hoc correlation with workload outliers.

Conclusion

This paper introduced `ucsb-ebpf`, a lightweight eBPF add-on for the Unbranded Cloud Serving Benchmark that turns every run into a trace study while adding less than 1 % overhead [12]. With two command-line flags, researchers can collect per-thread syscall latencies and optional heap/slab snapshots without modifying benchmark code. We demonstrated its value by profiling four embedded stores—LevelDB, RocksDB, WiredTiger, and LMDB—under seven standard workloads on commodity NVMe hardware.

The breakdowns reveal different bottlenecks for each engine. RocksDB and WiredTiger spend most of

their time inside read-oriented system calls, so faster storage would help more than extra CPU. LevelDB is almost entirely CPU-bound, indicating that parallelism or code-level optimizations should be the focus. LMDB scales poorly because a global mutex serializes critical paths; relaxing that lock is the clearest path to higher throughput.

These findings turn raw throughput figures into concrete guidance for operators and designers. Because `ucsb-ebpf` and all analysis scripts are open-sourced, the results are easy to reproduce, extend to new hardware, or apply to additional key–value engines.

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ARCHITECTURAL AND ALGORITHMIC METHODS FOR ENHANCING THE RESILIENCE OF HIGH-LOAD BACKEND SERVICES IN THE FINANCIAL SECTOR**Kovalenko A.***bachelor's degree, Tomsk state university of control systems and radioelectronics
Tomsk*<https://doi.org/10.5281/zenodo.15657640>**Abstract**

This article examines architectural and algorithmic methods for enhancing the resilience of high-load backend services operating in the financial sector. Key architectural approaches are explored, including microservice design, replication, sharding, component distribution, and the use of observability tools aimed at ensuring uninterrupted operation and system scalability. It also investigates various algorithmic strategies for load management and transaction processing, such as load balancing, rate limiting, backpressure, circuit breakers, idempotency, and deduplication, which contribute to stable system behavior under overload and partial failure conditions.

Keywords: system resilience, backend services, financial sector, microservice architecture, replication, sharding, distributed systems, load balancing.

Introduction

Current financial services place extremely high demands on backend system stability and ongoing availability. The escalating user base, coupled with the high level of real-time transactions, requires designs that must withstand large loads while providing superior performance, maintaining availability and data integrity. In a competitive environment typified by stringent regulatory requirements, especially in the financial industry, the notion of resilience takes on a very special meaning.

The main difficulty in guaranteeing the longevity of a system is in its ability to withstand peak loads in a way that still allows for rapid recovery from failures, to avert the occurrence of cascading failures, and to evolve with changing operating circumstances. As such, the high-load services' proper performance requires a multi-disciplinary approach that combines architecture, algorithmic, and engineering methods to maintain system stability, scalability, and performance predictability.

At the same time, the resilience of backend services is shaped not only by architectural patterns but also by specific algorithms for data processing and request routing implemented at the application level. The goal of this study is to analyze architectural and algorithmic methods for enhancing the resilience of high-load backend services in the financial sector. The paper examines architectural approaches such as microservice design, replication, and sharding, as well as algorithmic techniques including load balancing, traffic shaping, and failure management. The impact of these methods on the fault tolerance, latency, and security of financial information systems is explored in detail.

Main part. Architectural approaches to ensuring resilience of backend services under high load

The potency of high-load backend services in the financial sector is closely tied to the architectural choices made during the design and development phases. Architectural resilience refers to a system's ability to maintain availability and proper functionality in the face of surges in traffic or other extreme conditions. Given the specific demands of financial applications, including high sensitivity to data loss, strict requirements for transactional integrity, and low-latency performance, the backend architecture must support horizontal scalability as well as mechanisms for failure isolation and containment [1].

One of the fundamental architectural shifts in this context is the **transition from monolithic to microservice-based systems**. In a microservice architecture, each service performs a well-defined function and can be scaled independently. This reduces component coupling, simplifies failure localization, and enables effective distribution of load across nodes. However, excessive decomposition of services may introduce increased network latency and greater complexity in inter-service communication. As a result, microservice system robustness is supported by the separation of services as well as by the existence of asynchronous messaging mechanisms through message brokers such as Apache Kafka or RabbitMQ. It is also combined with the use of API gateways that implement a backup logic to handle downstream services that fail. The effectiveness of such mechanisms depends heavily on messaging system choice, as the delivery speed and overall robustness of high-load situations are critically conditional on the messaging system chosen. A study conducted in 2023 presented benchmark results for several widely-used message queue systems (fig. 1).

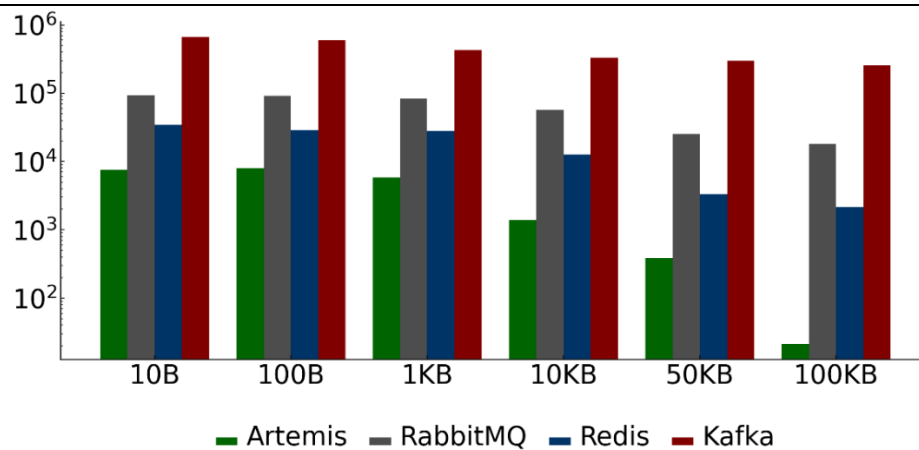


Fig. 1. Throughput of message queue systems at varying message sizes, events per second [2].

Another important consideration is the **geographic and logical isolation of system** components. In distributed financial services, patterns such as multi-region and multi-availability zone deployments are commonly used, with data replication across data centers. This approach improves fault tolerance and decreases latency by bringing servers closer to end users. In payment processing systems, it is standard practice to isolate critical services, such as account limit verification or fraud detection, into dedicated operational domains with enhanced isolation, monitoring, and resource redundancy.

Sharding and replication in databases are also widely adopted strategies for improving system resilience. Sharding enables the distribution of load based on client segmentation, transaction types, or other functional criteria, thereby reducing the risk of overloading

a single node. Replication, in turn, provides the ability to instantly switch to a backup database instance in the event of a failure. It is particularly important for high-throughput financial systems to maintain an appropriate balance between data consistency and availability, in accordance with the CAP (consistency, availability and partition tolerance) theorem. Typically, strong consistency is enforced for critical operations such as fund debiting, while eventual consistency is considered sufficient for auxiliary processes like report generation [3].

An additional layer of architectural resilience is provided by design patterns such as **bulkhead** and **service segmentation**, which isolate failures within individual components to prevent cascading effects across the system (fig. 2).

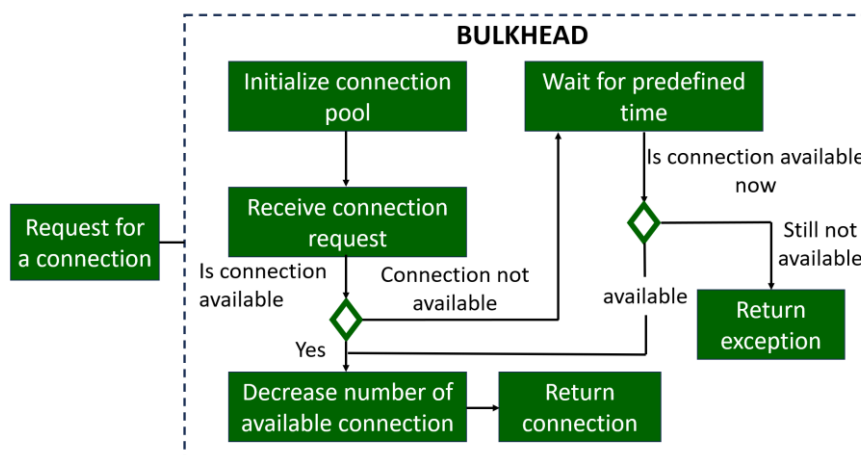


Fig. 2. Connection handling under the bulkhead pattern.

For instance, a financial application may implement separation of external client traffic and internal service processes at the level of an API gateway or ingress controller. Architecture-level mechanisms such as timeouts, retries, and fallback cases are integral parts of an adaptive design. An important element of adaptability is the integration of infrastructure-level instrumentation tools to handle the monitoring, logging, and alerting. A few examples of such tools are Prometheus, Grafana, the ELK stack, or OpenTelemetry.

Finally, resilience cannot be achieved without the **use of deployment automation and infrastructure**

management tools. Infrastructure-as-Code (IaC) approaches, such as those enabled by Terraform or Pulumi, combined with container orchestration platforms like Kubernetes or Nomad, allow for rapid infrastructure recovery in the event of failure, seamless updates through zero-downtime deployments, and centralized configuration management [4].

Architectural approaches to resilience in high-load financial systems involve a comprehensive combination of design principles, distribution, isolation, scalability, and observability. These solutions provide the foundational layer upon which algorithmic methods for

fault tolerance and request processing optimization can be effectively implemented.

Algorithmic strategies for data processing and load balancing in financial systems

While architectural resilience provides the foundation for the reliable operation of high-load financial services, in practice, the stability and predictability of backend components largely depend on algorithmic mechanisms implemented at the application level. These algorithms are responsible for determining the execution order of operations, managing task queues, distributing incoming requests, and responding to system overloads.

One of the most critical areas in this context is **load balancing across nodes and services**. The choice of request distribution algorithm has a direct impact on both system performance and fault tolerance [5]. Commonly used strategies include round-robin, least-connections, and weighted round-robin, the latter taking into account resource capacity. In financial systems, particularly those operating across geographically distributed data centers, factors such as network latency and resilient routing paths become especially important.

For services characterized by variable or bursty traffic patterns, such as those involved in processing

large volumes of payment transactions at the end of the day or following payroll distributions, adaptive flow control algorithms are commonly employed. Rate limiting mechanisms constrain the number of requests allowed within a given time window, thereby preventing system overload. More advanced implementations, such as the token bucket and leaky bucket algorithms, enable more flexible traffic control by buffering short-term activity spikes without fully blocking incoming requests. In financial systems, it is common to apply individualized rate limits based on client identity, API key, or transaction type, which requires tight integration of limiting algorithms with user authentication and profiling subsystems.

Another critical resilience mechanism is **backpressure**, which allows the system to signal upstream data producers about overload conditions and temporarily pause the intake of new requests. Financial services frequently process requests asynchronously, and in such scenarios, improperly handled overloads can result in unbounded task queues, increased latency, and ultimately, transaction failures. Backpressure algorithms help mitigate these risks by enabling the system to degrade gracefully under stress while maintaining operational control, which was earlier shown in 2025 studies [6] (table 1).

Table 1.

Backpressure response under varying load				
Load scenario	Producer rate (msg/sec)	Consumer throughput (msg/sec)	Queue size	Avg latency (ms)
Low load	500	490	10	12
Medium load	1000	950	25	25
High load	2000	1000	80	75
Backpressure on	2000 → 1100	1100	20	28

Transaction integrity and resilience algorithms play a particularly critical role, as financial operations must strictly adhere to ACID properties. In distributed systems, maintaining these guarantees is especially challenging, failures in one part of the system can result in partial transaction execution. To enhance resilience, techniques such as the **saga pattern** and **two-phase commit (2PC)** are commonly employed. The saga pattern decomposes a complex transaction into a sequence

of local operations, each of which can be compensated in the event of failure. In contrast, two-phase commit ensures strong consistency across distributed components but is generally more susceptible to network latency and may require additional mechanisms to prevent deadlocks. Figure 3 shows the difference between these two approaches.

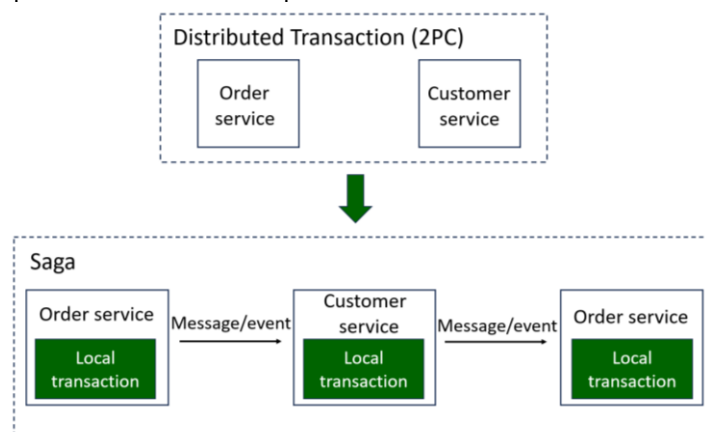


Fig. 3. Control flow in 2PC and Saga transaction patterns [7].

In some cases, systems opt for **eventual consistency** coupled with integrity checks at the business logic level and periodic **reconciliation** procedures to restore transactions that failed to propagate.

A classic mechanism for improving resilience in microservice-based architectures is the **circuit breaker**

pattern, which interrupts communication with downstream services when failures are detected [8]. At the application level, this is implemented as logic that disables service calls once error rates or timeout thresholds are exceeded (fig. 4).

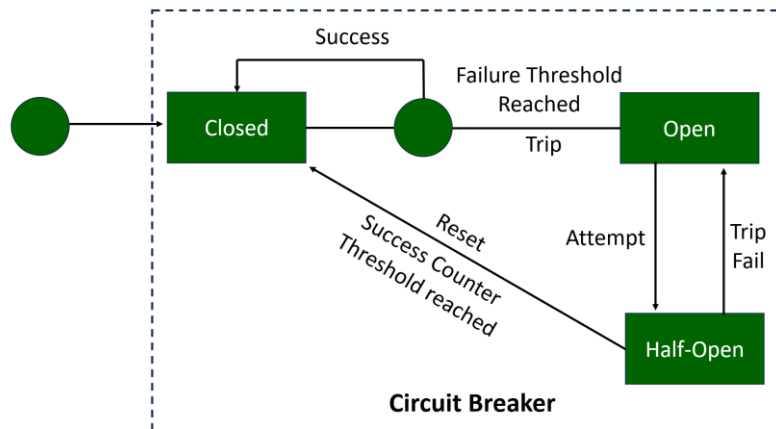


Fig. 4. Circuit breaker state transitions [9].

This prevents cascading system degradation, a common risk in tightly coupled architectures. Financial backend systems frequently adopt enhanced circuit breaker configurations with automatic state resets and recovery mechanisms, as well as fallback handling, such as reverting to cached data or offering degraded functionality during service interruptions.

Additional mechanisms such as **request deduplication** and **idempotency** algorithms are employed to prevent the repeated processing of transactions. If a connection is lost, a client may resend a funds transfer request; without idempotent logic, this could result in duplicate transactions. The use of unique request identifiers and persistent tracking of operation states enables the system to identify already completed actions and block unintended repetitions.

To further enhance resilience, systems often implement **task queues** and **prioritization mechanisms**. Queues facilitate the separation of request streams by type, such as high-priority transactions, analytics, or reporting, ensuring that critical data is processed first. Queue management algorithms are not limited to simple FIFO or LIFO strategies but also include more advanced approaches with dynamic prioritization, which take into account system conditions and the load levels of individual components.

Resilience strategies for backend services in the financial sector are built upon a combination of complementary algorithmic mechanisms. These approaches enable systems to respond effectively to high load, manage data flows efficiently, mitigate the impact of failures, and maintain predictable behavior even under partial system degradation. When integrated with the architectural methods discussed earlier, they provide a comprehensive and robust foundation for the development of scalable and fault-tolerant financial systems.

Conclusion

The resilience of high-load backend services in the financial sector is achieved through a combination of well-designed architectural solutions and effective algorithmic strategies aimed at minimizing failures, managing load, and preserving data integrity. The use of microservice architectures, distributed storage systems, observability tools, and algorithmic techniques such as load balancing, rate limiting, transaction handling, and failure compensation enables the development of reliable and scalable systems capable of adapting to evolving operational conditions and regulatory demands. Ensuring the reliability of such systems requires both technical flexibility and a systematic design approach, including failure scenario modeling and stress testing during the development phase.

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