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Section 1. Agriculture

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COMPARATIVE ASSESSMENT OF EIGHT BARLEY GENOTYPES FOR PRODUCTIVITY IN RAINFED CONDITIONS OF UZBEKISTAN

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Abstract

Barley production in rainfed areas faces challenges from climate variability, with severe hot winds and high temperatures during grain filling which are causing yield declines in Uzbekistan. This study evaluated the agronomic performance and yield stability of eight barley varieties and accessions under rainfed conditions during 2022–2023 growing seasons. Field germination increased from 29.2–36.5% in 2022 to 57.8–75.5% in 2023 due to better moisture availability. Plant height ranged from 57–75 cm, while tillering capacity varied from 1.6–2.8 tillers per plant. Grain yield improved dramatically from 0.3–0.5 t/ha in 2022 to 1.8–2.8 t/ha in 2023. Variety Ang'iz demonstrated superior performance with the highest yield (2.8 t/ha), followed by HM-12–20 and KP-24 (DNS-4) with 2.4–2.5 t/ha. The results revealed significant genotype × environment interactions affecting all agronomic traits, highlighting Ang'iz as a promising candidate for rainfed production systems and breeding programs.

Keywords: *barley, rainfed conditions, agronomic traits, yield components, genotype × environment interaction, drought tolerance*

Introduction

Barley is the most important forage crop in Uzbekistan, mainly cultivated under rainfed conditions. Although existing varieties are adapted to local soil and climatic conditions, recent global climate changes have exposed their insufficient resistance to environ-

mental stresses. In rainfed areas and regions with limited water supply, severe hot winds (*garmsel*) and high temperatures during grain filling cause sharp yield declines and deterioration of nutritional quality (Mamatkulov et al., 2025). Winter barley generally shows higher yield potential than spring

barley (Bisharev et al., 2017), as they develop strong root systems which gives drought tolerant during the plant growth and development. Therefore, targeted breeding research for varieties combining drought tolerance and stable productivity remains essential for sustainable crop production in these challenging environments.

Materials and Methods

A competitive trial nursery was conducted at the experimental farm of the Scientific Research Institute of Rainfed Agriculture, Gallaorol district, Jizzakh province, Uzbekistan during the 2022–2023 growing seasons. Eight genotypes including the local check variety ‘Lalmikor’ were evaluated using a randomized complete block design (RCBD) with three replications.

Measurements included field germination, plant survival, morphological traits

(plant height, tillering capacity, spike length), yield components (spike weight, thousand kernel weight, test weight), and grain yield productivity. Analysis of variance (ANOVA) was performed using GenStat 18th Edition software, with mean separations conducted using LSD test at the 5% significance level ($P \leq 0.05$).

Climatic Conditions

The two growing seasons exhibited contrasting weather patterns. Precipitation in 2023 was substantially higher than in 2022, particularly during critical growth stages (Figures 1–3). Air temperatures fluctuated between 5–25 °C, with 2023 providing more favorable growing conditions as this positively affected barley grain yield. The marked differences in air humidity patterns between years significantly affected plant development and grain filling processes.

Figure 1. Precipitation rate in Gallaorol, mm (2022–2023)

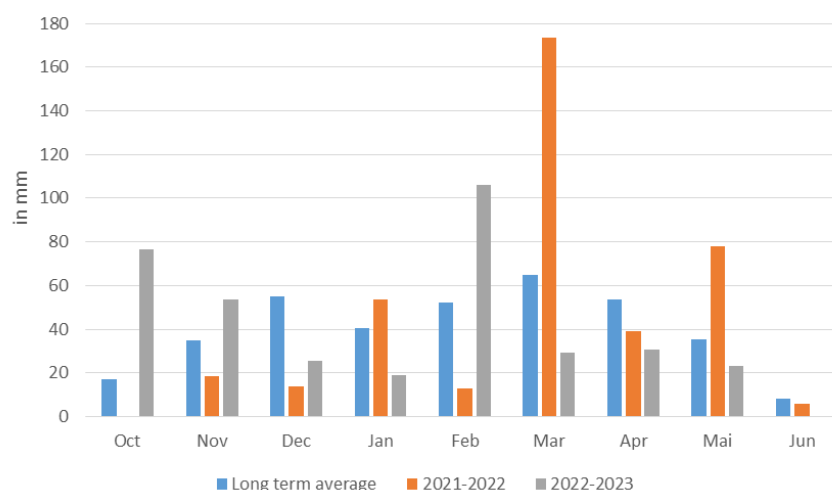


Figure 2. Air temperature in Gallaorol, C (2022–2023)

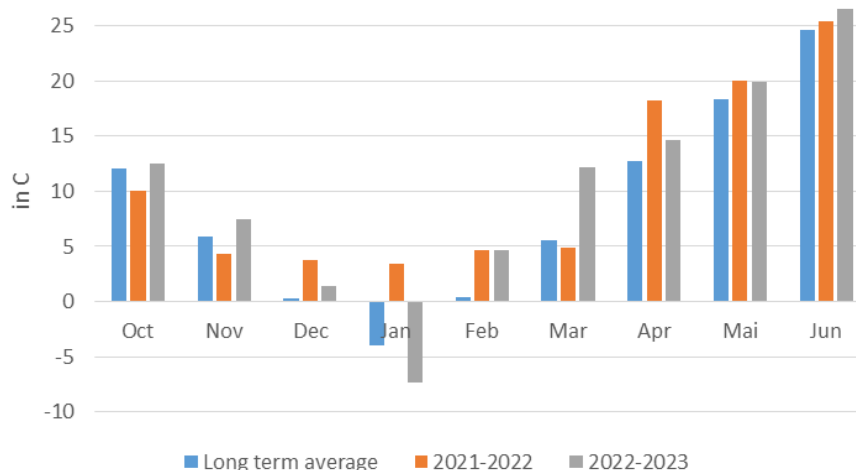
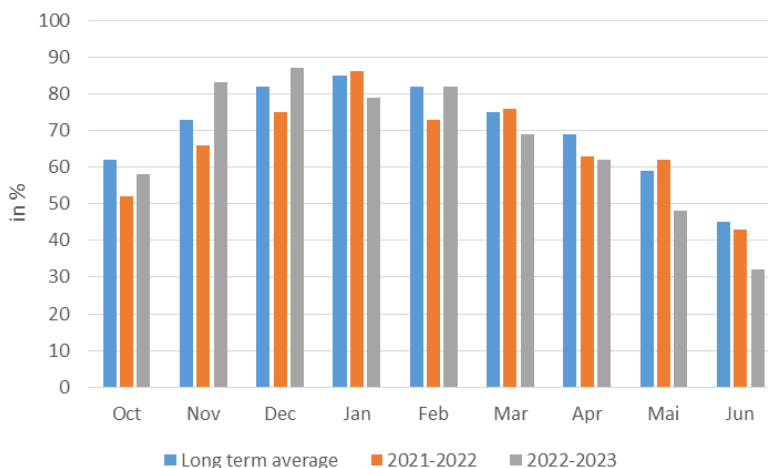


Figure 3. Air humidity in Gallaorol, mm (2022–2023)

Results and Discussion

Germination and Plant Establishment

Field germination varied considerably between varieties and years (Table 1). In 2022, germination ranged from 29.2% (Adir) to 36.5% (KP-24), while 2023 showed substantially improved performance from

57.8% to 75.5%. This improvement reflects more favorable moisture conditions during early growth. Variety Dunyo M achieved the highest germination rate (75.5%) in 2023 while maintaining acceptable performance (33.2%) during the drier 2022 season.

Table 1. Important agronomic traits of barley varieties and accessions in competitive trial nursery (2022–2023)

Variety and accessions	Field germination, %		Germinated plants, unit		Number of plants remained till harvest, unit		Plant height, cm		Tillering capacity, unit	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
Lalmikor, check	33.8	65.5	102	197	88	165	59	75	2.2	2.4
Adir	29.2	61.5	88	185	77	159	58	70	2.4	2.5
Bahorikor	34.7	68.8	104	207	92	172	64	62	2.8	2.5
Sharof 100	35.9	71.1	108	213	97	175	57	59	1.8	2.2
Dunyo M	33.2	75.5	100	227	85	184	59	71	2.4	2.6
Ang'iz	35.4	70.5	106	212	99	176	60	65	1.6	2.7
HM-12–20	36.4	69.0	109	207	92	170	59	75	2.6	2.6
KP-24 (DNS-4)	36.5	57.8	107	174	95	160	61	75	2.7	2.8
LSD 05	1.2	1.7	3.5	5.4	2.3	4.1	1.3	2.2	0.11	0.10

Plant survival from germination to harvest remained significantly higher across varieties and accessions, averaging 85–92% in 2022 and 81–86% in 2023. This stability demonstrates good adaptation to local environmental conditions.

Morphological Characteristics

Plant height showed moderate variation, ranging from 57–64 cm in 2022 and 59–75 cm in 2023. Previous research by Paramonov (2010) established that plants with stem lengths between 64–74 cm combined with short, dense spikes of 7–8 cm produce

the highest yields, with plant height and spike length showing a moderately positive correlation ($r = 0.44$). In our trial, Lalmikor and HM-12–20 reached 75 cm in 2023, approaching the upper optimal range, while Sharof 100 (59 cm) and Ang'iz (65 cm) maintained moderate plant height suitable for rainfed conditions where lodging resistance is crucial.

Tillering capacity ranged from 1.6–2.8 tillers per plant in 2022 and 2.2–2.8 in 2023. Bahorikor showed the highest tillering (2.8) in 2022, though this trait decreased to 2.5 in 2023. As noted by Kostylev (2017), produc-

tive tillering is a quantitative trait with polygenic inheritance, and its expression depends significantly on environmental conditions and genotype-environment interactions.

Spike Characteristics and Yield Components

Main spike length varied from 6.6–8.8 cm in 2022 and 7.6–10.2 cm in 2023 (Table 2), with the longer spikes in 2023 reflecting improved growing conditions. KP-24 (DNS-4) produced the longest spikes (10.2 cm) in 2023, while Ang'iz maintained relatively shorter, denser spikes consistent with optimal productivity parameters.

Table 2. Yield components of barley varieties and accessions in Competitive trial nursery (Gallaorol 2022–2023)

Variety and accessions	Main spike length, cm		Spike weight, g		TKW, g		Test weight, g/l	
	2022	2023	2022	2023	2022	2023	2022	2023
Lalmikor, check	8.2	9.8	1.1	1.2	58.0	52.0	655	672
Adir	7.6	7.8	1.2	1.2	54.8	52.0	666	677
Bahorikor	8.8	8.8	1.2	1.3	59.0	52.5	659	669
Sharof 100	7.4	7.6	1.1	1.1	60.0	46.5	657	676
Dunyo M	8.2	8.0	1.2	1.2	47.8	42.5	650	660
Ang'iz	6.8	9.0	1.1	1.3	51.4	44.0	661	694
HM-12–20	6.6	9.0	1.1	1.4	60.0	50.4	659	669
KP-24 (DNS-4)	6.8	10.2	1.1	1.3	55.7	53.2	665	679
LSD 05	0.28	0.47	–	–	2.2	2.0	–	–

Spike weight ranged from 1.1–1.2 g in 2022 and 1.1–1.4 g in 2023. HM-12–20 and KP-24 showed notable increases in spike weight in 2023 (1.4 and 1.3 g respectively), indicating good responsiveness to favorable conditions.

Thousand kernel weight (TKW) is particularly important under drought stress (Kincharov et al., 2020). In our study, TKW ranged from 47.8–60.0 g in 2022 but declined to 42.5–53.2 g in 2023 across most varieties. Sharof 100 and HM-12–20 maintained the highest TKW (60.0 g) in 2022. The reduction in 2023 despite better moisture may reflect trade-offs between grain number and grain size, or heat stress during grain filling.

Test weight, indicating grain density and quality, remained relatively stable at 650–666 g/l in 2022 and 660–694 g/l in

2023, with Ang'iz achieving the highest value (694 g/l) in 2023.

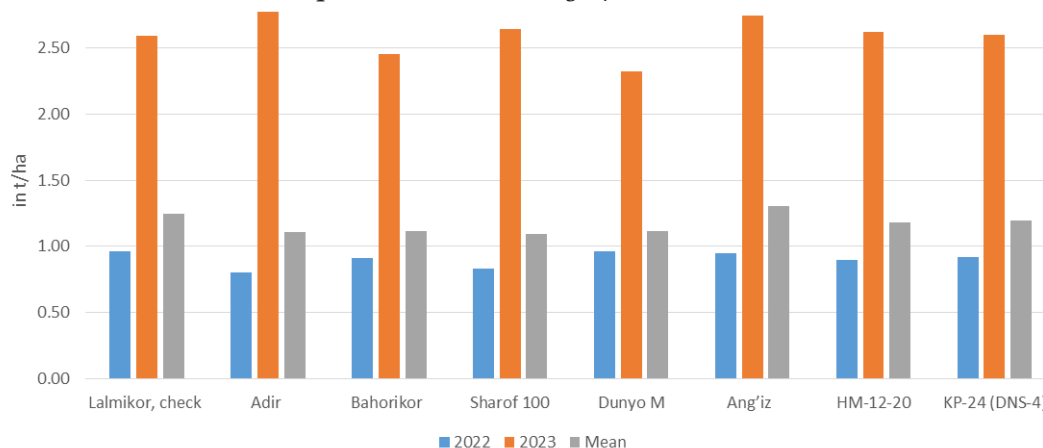
Yield Performance

Grain yield showed a significant difference between the 2022 and 2023 growing seasons (Figure 4). In 2022, yields were extremely low, ranging from 0.80 to 2.77 tons per hectare, primarily attributed to limited precipitation coupled with slightly higher temperatures and air humidity. In contrast, the 2023 season, benefiting from substantially better moisture availability, resulted in significantly higher overall yields, ranging from 2.32 to 2.77 tons per hectare. Furthermore, the mean yield over the two years indicates that the Ang'iz variety provided a higher yield compared to other varieties and accessions in the competitive

trial nursery (Figure 4). This early-ripening variety's success aligns with research emphasizing that early maturity and high yield rates are crucial breeding criteria from both economic and social perspectives (Mamatkulov

et al., 2025). The check variety Lalmikor produced approximately 2.0 t/ha in 2023, while HM-12-20 and KP-24 (DNS-4) showed competitive performance at 2.4–2.5 t/ha.

Figure 4. Yield productivity of barley varieties and accessions in complete trial nursery, t/ha (2022–2023)



Genotype × Environment Interactions

The contrasting performance between years underscores the importance of trait stability under variable conditions. As highlighted by Kholdorov and Do'squlov (2024), in rainfed areas where yield depends heavily on climatic conditions, accessions with low trait variability under environmental influence are particularly valuable for breeding programs. Stolpivskaya (2020) emphasized that when selecting accessions for breeding, using material well-adapted to target cultivation conditions is essential for developing successful varieties.

Conclusions

This two-year study resulted three key findings. First, environmental conditions, particularly precipitation, dramatically affected all agronomic traits and productivity of barley varieties and accessions. Second, Ang'iz

showed superior yield and stability, making it highly promising for rainfed systems. Third, significant genotype × environment interactions affected all measured parameters.

Moving forward, breeding programs should prioritize the selection of varieties that maintain high yields consistently across different environmental conditions, including years with drought or high precipitation. This selection strategy should also focus on incorporating resilient genotypes such as 'Ang'iz'. As Kholdorov (2019) noted, evaluating tolerance and involving resistant genotypes serves as the foundation for creating varieties that produce stable yields under variable climatic conditions. The identification of varieties combining early maturity, stable yield components, and environmental resilience will be crucial for sustainable barley production in Uzbekistan's rainfed areas.

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Section 2. Biology

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STUDY OF GENETIC ASSOCIATION BETWEEN the rs1799817 POLYMORPHISM OF THE INSULIN RECEPTOR GENE and THE DEVELOPMENT OF TYPE 2 DIABETES MELLITUS

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Abstract

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease characterized by elevated blood glucose levels due to defects in insulin secretion or its signaling pathway. This disease develops as a result of the complex interaction between genetic, metabolic, and environmental factors. In this study, we investigated the association between the rs1799817 (C>T) polymorphism in exon 17 of the insulin receptor (INSR) gene and the risk of T2DM. A total of 144 participants were included in the study, with 66 diagnosed with T2DM and 78 healthy individuals as controls. Genetic analysis was performed by isolating DNA from peripheral blood samples and detecting the rs1799817 polymorphism using PCR and PmlI restriction enzyme digestion. Genotyping results showed no deviation from Hardy-Weinberg equilibrium in both groups. Although the overall genotype distribution did not reach statistical significance ($\chi^2 = 5.35$, $p = 0.069$), allelic analysis revealed a significant association. The C allele was less frequent in T2DM patients (54.5%) compared to controls (67.3%), while the T allele was more frequent in T2DM patients (45.5% vs 32.7%, $p = 0.028$). The C allele was associated with a protective effect against T2DM (OR = 0.58, 95% CI: 0.36–0.94). Further analysis using dominant and recessive models showed a trend toward reduced disease risk in carriers of the CC genotype (OR = 0.53, 95% CI: 0.28–1.00, $p = 0.05$), whereas the TT genotype did not show a significant association (OR = 1.69, 95% CI: 0.71–3.99, $p > 0.05$). These findings suggest that the rs1799817 polymorphism may influence susceptibility to T2DM, with the C allele potentially offering a protective effect. Further studies with larger sample sizes and mechanistic investigations are needed to validate these results and explore the biological mechanisms underlying this association.

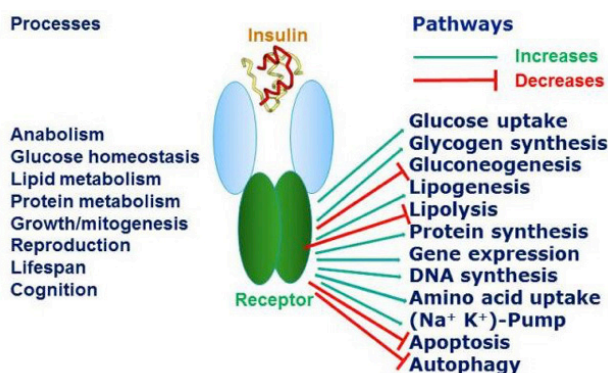
Keywords: *type 2 diabetes mellitus, single nucleotide polymorphisms, genetic association, insulin receptor gene, Uzbek population*

Introduction

Type 2 diabetes mellitus (T2DM) is a complex metabolic disease characterized by chronic hyperglycemia and impaired carbohydrate metabolism (Khokhar, P. B., Pentangelo, V., Palomba, F., Gravino, C., 2025). The pathogenesis of the disease is based on insulin resistance resulting from a deficiency in insulin secretion or a decrease in the sensitivity of peripheral tissues to insulin (Khokhar, P. B., Pentangelo, V., Palomba, F., Gravino, C., 2025; Młynarska, E., Czarnik, W., Dzieża, N., Jędraszak, W., Majchrowicz, G., Prusinowski, F., Franczyk, B., 2025). The main function of the hormone insulin is to exert its effects through

the insulin receptor located in the liver, muscle, and adipose tissue. In particular, in liver cells, it increases the conversion of glucose to glycogen and reduces glucose excretion, and in muscle and adipose tissue, it increases glucose uptake via the GLUT4 transport protein. The insulin receptor belongs to the tyrosine kinase superfamily and becomes activated by autophosphorylation upon insulin binding. The activated receptor induces the IRS and PI3K/Akt signaling pathways (Figure 1). These mechanisms cause metabolic, mitogenic, and pleiotropic effects (Khokhar, P. B., Pentangelo, V., Palomba, F., Gravino, C., 2025; De Meyts P., 2016).

Figure 1. *Pleiotropic effects of insulin and its receptor*



Notes: *Insulin regulates multiple physiological processes through its receptor (center), increasing (green lines) or decreasing (red lines) the activity of various intracellular metabolic pathways. These include glucose and lipid metabolism, protein synthesis, gene expression, cell growth, and cell-survival mechanisms (De Meyts P., 2016)*

In recent years, growing attention has been directed toward the genetic predisposition to T2DM. The rs1799817 polymorphism located in exon 17 of the insulin receptor (INSR) gene, lies within the tyrosine kinase domain, structural alterations in this region may impair insulin signaling efficiency and increase T2DM risk (Gao, W., Deng, Z., Gong, Z., Jiang, Z., & Ma, L., 2025; Mekuria, A. N., Ayele, Y., Tola, A., & Mishore, K. M., 2019; Irgam, K., Reddy, B. S., Hari, S. G., Banapuram, S., Reddy, B. M., 2021). The INSR gene is located on the short (p) arm of chromosome 19 and consists of 22 exons and 21 introns. Exons 17–22 of the gene encode the tyrosine kinase domain, which is crucial for receptor function. Mutations within this domain can

disrupt insulin signaling system (Figure 1), potentially leading to insulin resistance and compensatory hyperinsulinemia (Park, M., Kim, J. S., Park, Y. A., Lee, D. H., Choi, S. A., Chang, Y., Yee, J., 2025; Hubbard S. R., 2013; Feng, C., Lv, P. P., Yu, T. T., Jin, M., Shen, J. M., Wang, X., Jiang, S. W., 2013; Chandrasekaran, P., Weiskirchen, R., 2024).

The aim of the study: To investigate the genetic association between the rs1799817 polymorphism of the insulin receptor gene and the development of T2DM in individuals of Uzbek ethnicity.

Materials and Methods

A total of 144 participants were included in the study, comprising both individuals diag-

nosed with T2DM and healthy controls without symptoms characteristic of the disease. Of these, 66 individuals with clinically confirmed T2DM formed the main study group, while 78 healthy individuals served as the control group. Participants in the main group were selected from patients undergoing inpatient treatment at the Republican Specialized Scientific and Practical Medical Center of Endocrinology named after Academician Y. Kh. Turaqulov.

To ensure a comprehensive evaluation, a genealogical questionnaire was administered, and clinical indicators, medical history, and relevant biochemical analyses were assessed. For genetic analysis, DNA was isolated from peripheral blood samples, and the rs1799817 polymorphism of the INSR gene was detected using polymerase chain reaction (PCR) followed by restriction fragment length analysis.

Extraction of genomic DNA from peripheral blood

Genomic DNA was isolated from peripheral blood leukocytes using a salt-based precipitation method. To ensure high analytical accuracy and reproducibility, all procedures were conducted with the *DNeasy Blood & Tissue Kit* (QIAGEN, Germany) according

to the manufacturer's protocol. The concentration and purity of the extracted DNA were assessed using a *NanoOne Ultra Micro* spectrophotometer (China). Absorbance measurements were recorded at 260 nm and 280 nm in TE buffer (Tris–EDTA), and samples with an A260/A280 ratio between 1.8 and 1.9 were considered of high purity. The integrity of each DNA sample was further confirmed by visualizing aliquots on agarose gel electrophoresis. All DNA samples were stored at –25 °C until further analysis to maintain molecular stability and prevent degradation.

PCR protocol for detection of the rs1799817 polymorphism of the insulin receptor gene

Detection of the rs1799817 (C>T) single nucleotide polymorphism (SNP) in the insulin receptor (INSR) gene was performed using a targeted polymerase chain reaction (PCR) assay. Primers specific to exon 17 of the INSR gene were designed by laboratory specialists using the reference genomic sequence to ensure optimal specificity and amplification efficiency (Table 1). Oligonucleotides were synthesized by Integrated DNA Technologies (IDT, USA) and validated for concentration and purity prior to use.

Table 1. PCR mixture composition and the sequences of used oligonucleotide primers

Reagents	Volume	Note
HiGenoMB PCR TaqMixture (2×)	15 µL	
HiGenoMB Taq-polymerase (5 U/µl)	0.3 µL	
dNTPs (10 mM)	0.6 µL	HiGenoMB PCR TaqMixture – Specific PCR mixture, dNTPs – Nucleoside triphosphate mixture, HiGenoMB Taq-polymerase – Specific Taq-polymerase)
Forward primer (For p INSR1)	0.65 µL (15 pmol);	
Reverse primer (Rev p INSR2)	0.65 µL (15 pmol);	
Deionized water	9.8 µL	
DNA matrix	3 µL	
Total volume	30 µL	
Forward primer (For p INSR1)	5'- TCAGGAAAGCCAGCCCATGTC –3'	
Reverse primer (Rev p INSR2)	5'- CCAAGGATGCTGTGTAGATAA –3'	

PCR amplification was carried out on a StepOne Real-Time PCR System (Applied Biosystems, USA) under optimized thermal cycling conditions. Reaction mixtures contained genomic DNA template, forward and reverse primers, dNTPs, MgCl₂, and Taq DNA polymerase in volumes prepared ac-

cording to standardized laboratory protocols. Amplification success was verified through electrophoretic separation of PCR products on agarose gel. The resulting amplicons were subsequently subjected to restriction fragment length polymorphism (RFLP) analysis for genotype determination.

Restriction Enzyme and Reagents for Polymorphism Identification

The hydrolysis of amplified DNA fragments was conducted in accordance with the manufacturer's guidelines (New England Biolabs, NEB, USA). Specifically, PCR products were subjected to digestion using the PmlI restriction enzyme (Eco72I, 10 U/ μ L, NEB, USA) in conjunction with 10 $\times$ Tango buffer. The digestion reaction was performed in a total volume of 15 μ L and incubated at 37 °C for 4 hours to facilitate endonuclease hydrolysis. The 10 $\times$ Tango buffer utilized for the PmlI enzyme comprised 33 mM Tris-acetate (pH 7.9), 10 mM magnesium acetate, 66 mM potassium acetate, and 0.1 mg/mL Bovine Serum Albumin (BSA).

Visualization of PCR Products

To visualize the PCR results and assess the efficacy of the restriction analysis, gel electrophoresis was performed on a 2.5% agarose gel. The electrophoresis was conducted at a voltage of 150 V for a duration of 25 minutes. Prior to loading the PCR products onto the gel, bromophenol blue and glycerol were incorporated into the samples to facilitate well deposition and to monitor the progress

of the electrophoresis. A 1 $\times$ TBE buffer solution (pH 8.0) was employed during the electrophoresis process. For DNA fragment visualization, the gel was stained with Ethidium Bromide (EtBr). Following electrophoresis, DNA fragments were visualized using a UV transilluminator (Life Technologies E-Gel Imager, USA), and their sizes were estimated in comparison to a 50 bp DNA ladder.

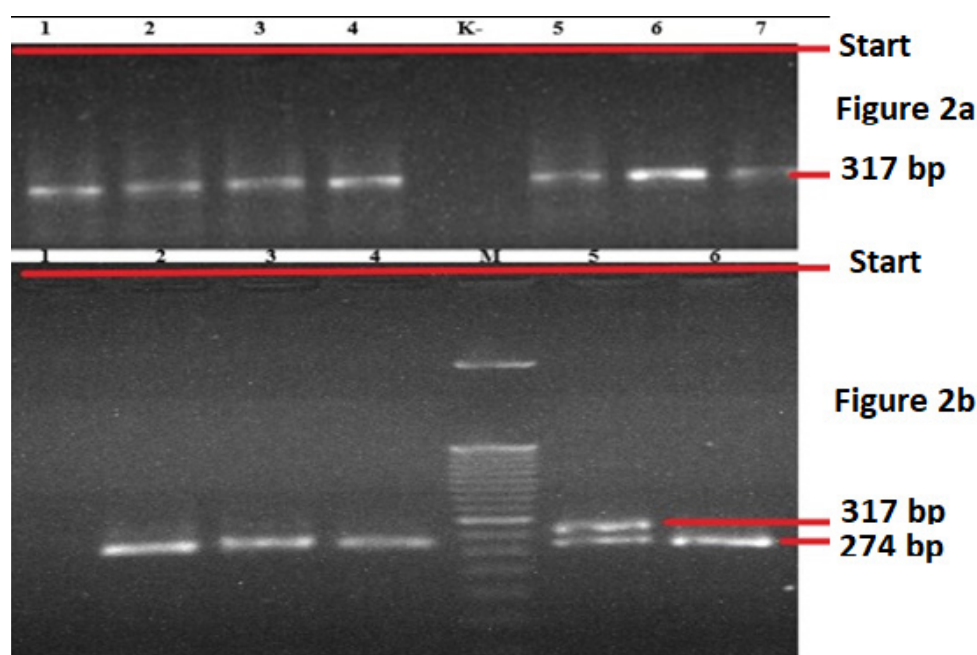
Statistical Analysis of Results

Statistical analyses of the obtained data were performed using the statistical software packages "WINPEPI 2016 (Version 11.65)" and "Doctor Stat 2013 (Version 1.9)." To evaluate the population characteristics regarding the distribution of genotypes and alleles of the studied polymorphism, statistical analyses were based on the criteria of Hardy-Weinberg equilibrium (HWE).

Results: Familial Predisposition and PCR Specificity

Genealogical analyses indicated that 71.2% of patients with Type 2 Diabetes Mellitus (T2DM) reported a familial predisposition to the disease.

Figure 2. Visualization of the rs1799817 polymorphism of the INSR gene after PCR analysis and endonuclease hydrolysis



Regarding the standard PCR results for the rs1799817 polymorphism in the insulin receptor (IR) gene, a single distinct DNA frag-

ment of 317 bp was clearly visualized, with no evidence of non-specific amplification or primer-dimer formation. This observation

confirms both the specificity of the primers for the targeted genetic locus and the successful execution of the PCR reaction (Figure 2a).

Figure 2.

(a) PCR amplification showing a specific 317 bp product in samples 1–7, with no band in the negative control (K-).

(b) PCR products reflect the results after restriction enzyme digestion (RFLP – Restriction Fragment Length Polymorphism). M – DNA marker 50 bp; lane 1 – negative control; lanes 2,3,4,6- samples with a 274 bp fragment, homozygous TT genotype of mutant type; 5 – sample with a heterozygous CT genotype, with a combination of 317 bp and 274 bp fragments.

Results of Restriction Fragment Length Polymorphism (RFLP) Analysis

The outcomes of the RFLP analysis, illustrated in Figure 2b, revealed distinct patterns among the samples based on the selective cleavage of the amplified DNA fragments.

The intact 317 bp fragment corresponds to the homozygous reference genotype (CC). In contrast, the presence of both the 317 bp and 274 bp fragments indicates the heterozygous genotype (CT), while the exclusive appearance of the 274 bp fragment signifies the homozygous mutant genotype (TT).

Assessment of Hardy-Weinberg Equilibrium for Genotypes and Alleles

To evaluate the population equilibrium of the genotypes and alleles under investigation, we employed the chi-square (χ^2) test to assess Hardy-Weinberg equilibrium (HWE). The distribution of genotypes for the rs1799817 (C>T) polymorphism in the insulin receptor (INSR) gene was analyzed in both Type 2 Diabetes Mellitus (T2DM) patients and control subjects. Within the T2DM cohort (CC = 19, CT = 34, TT = 13; n = 66), the observed genotype frequencies conformed to Hardy-Weinberg expectations, yielding $\chi^2 = 0.10$ with a p-value of 0.75.

Table 2. Genotype and allele frequencies of polymorphism rs1799817 gene INSR in T2DM patients and controls

Group	Genotyp	Observed	Expected	χ^2	p-value
T2DM (n=66)	CC	19	19.4	0.10	0.75
	CT	34	33.2		
	TT	13	13.4		
Controls (n=78)	CC	37	36.7	0.74	0.39
	CT	31	32.6		
	TT	10	8.7		

Assessment of Hardy-Weinberg Equilibrium in Control Group

In the control group (CC = 37, CT = 31, TT = 10; n = 78), we observed no significant deviation from Hardy-Weinberg equilibrium ($\chi^2 = 0.74$, p = 0.39). These findings suggest that both studied populations are in genetic equilibrium, with no evidence indicating genotyping errors or population stratification.

Evaluation of the Association Between the rs1799817 Polymorphism in the INSR Gene and Type 2 Diabetes Mellitus

This study investigated the association between the rs1799817 (C>T) polymorphism

in the insulin receptor (INSR) gene and the risk of Type 2 Diabetes Mellitus (T2DM). Genotyping results for the T2DM group (CC = 19, CT = 34, TT = 13; n = 66) and the normoglycemic control group (CC = 37, CT = 31, TT = 10; n = 78) demonstrated adherence to Hardy-Weinberg equilibrium (T2DM: $\chi^2 = 0.10$, p = 0.75; controls: $\chi^2 = 0.74$, p = 0.39), confirming appropriate sample distribution (Table 2).

While the overall genotype distribution did not reach statistical significance ($\chi^2 = 5.35$, df = 2, p = 0.069), allelic analysis revealed a significant association. The frequency of the C allele was notably lower in T2DM patients (54.5%) compared to controls

(67.3%), whereas the frequency of the T allele was higher among cases (45.5% vs. 32.7%). The allelic chi-square test confirmed this difference as statistically significant ($\chi^2 = 4.78$,

$df = 1$, $p = 0.028$), with an odds ratio of 0.58 (95% CI: 0.36–0.94). This suggests a potential protective effect of the C allele against the development of T2DM.

Table 3. Association analysis of rs1799817 genotypes and alleles with T2DM

Comparison	Model	χ^2 (df)	p-value	OR (95% CI)	Interpretation
C vs T allele	Allelic	4.78 (1)	0.028	0.58 (0.36–0.94)	C allele protective
Genotype (CC vs CT vs TT)	Codominant	5.35 (2)	0.069	–	No significant association
TT+CT vs CC	Dominant (T carrier)	–	> 0.05	1.90 (0.99–3.64)	Borderline ten- dency
TT vs CC+CT	Recessive (T risk)	–	> 0.05	1.69 (0.71–3.99)	Not significant

Further Analysis of the rs1799817 Polymorphism under Dominant and Recessive Models

Subsequent analyses utilizing dominant and recessive genetic models revealed that individuals carrying the CC genotype exhibited a trend toward reduced susceptibility to Type 2 Diabetes Mellitus (T2DM) (OR = 0.53, 95% CI: 0.28–1.00, $p = 0.05$). Conversely, the recessive TT model did not demonstrate a statistically significant association (OR = 1.69, 95% CI: 0.71–3.99, $p > 0.05$). Collectively, these findings suggest that the rs1799817 polymorphism in the insulin receptor (INSR) gene may modulate T2DM susceptibility at the allelic level, despite the genotypic distribution failing to reach a statistically significant threshold. The observed protective effect of the C allele underscores potential functional implications for the regulation of insulin receptor signaling, thereby necessitating further investigation in larger cohorts and mechanistic studies to elucidate its biological role in T2DM pathogenesis.

This study provides preliminary scientific evidence that contributes to the expansion of the ethnic and geographic spectrum of genetic association studies related to T2DM.

Discussion

This investigation focused on the genetic association between the rs1799817 polymorphism of the INSR gene and T2DM development among individuals of Uzbek ethnicity. The INSR gene, located on chro-

mosome 19, encodes the insulin receptor protein, composed of two subunits, α and β . The principal function of this receptor is to bind insulin and initiate a cascade of intracellular signaling pathways that facilitate glucose uptake by cells, thereby lowering blood glucose levels (Zerón H. M., Maldonado A. N., Sánchez M. M., 2025). Disruptions in insulin receptor functionality due to mutations or polymorphisms can lead to insulin resistance, a critical factor in the onset of diabetes and other metabolic disorders. Such disruptions adversely affect normal insulin signaling, diminishing the body's capacity to effectively regulate blood sugar levels.

The polymorphism examined herein plays a pivotal role in modulating both transcriptional and translational efficiency of the INSR gene, thereby influencing the overall expression of the insulin receptor protein. While this nucleotide change may not alter protein conformation, it can significantly affect transcription and translation processes, potentially reducing protein synthesis levels. This reduction may disrupt the activation of signaling cascades associated with the insulin receptor.

The frequency of the rs1799817 polymorphism exhibits variation across different ethnic groups. In European populations, the prevalence of the T allele ranges from 30% to 35%, whereas in East Asian populations, it is notably higher, reaching 40% to 45%. Conversely, African populations typically exhibit lower prevalence rates for the T allele, generally ranging

from 20% to 25% (Adam, A. R., Ozbakir, B., Ozay, A. C., Tulay, P., 2022). These disparities may be attributed to genetic heterogeneity and variations in the prevalence of metabolic diseases among different ethnic groups, consequently impacting susceptibility to insulin resistance and diabetes-related complications.

Previous studies conducted among Japanese populations have indicated that carriers of the T allele face a heightened risk of insulin resistance and an increased likelihood of developing T2DM compared to carriers of the C allele. This association has been corroborated in various Asian and European populations (<https://www.snpedia.com/index.php/Rs1799817>). Our findings suggest that this polymorphism exerts a similar effect within the Uzbek population.

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Legal and Ethical Standards: The study received approval from the Ethics Committee of the Republican Specialized Scientific and Practical Medical Center of Endocrinology named after Academician Y. Kh. Turaqulov under the Ministry of Health of the Republic of Uzbekistan, as well as from the Institute of Biophysics and Biochemistry at the National University of Uzbekistan named after Mirzo Ulugbek. The research was conducted in accordance with the principles outlined in the Declaration of Helsinki (revised in 2018).

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Section 3. Economic and Management

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TRADE STRATEGY: TYPES, FORMATION, AND IMPLEMENTATION

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Abstract

Trade strategy plays a central role in shaping a country's economic development, competitiveness, and integration into the global economy. In an era of globalization, digitalization, and geopolitical uncertainty, well-designed trade strategies have become a critical policy instrument for both developed and developing economies. This article provides a comprehensive analytical overview of trade strategy, focusing on its main types, formation mechanisms, and implementation processes.

Keywords: *trade strategy, international trade policy, export promotion, trade liberalization, economic development, competitiveness*

Introduction

International trade has long been recognized as a driving force of economic growth, structural transformation, and technological progress. Countries participate in global trade not randomly but through deliberate strategic choices that reflect their economic structure, development objectives, and institutional capabilities. These choices are commonly embodied in a national trade strategy.

A trade strategy defines the long-term vision and priorities of a country's engagement in international trade. It determines how a country promotes exports, regulates imports, negotiates trade agreements, and positions itself within global value chains. In recent decades, trade strategies have evolved significantly due to globalization, regional

integration, digital trade expansion, and increasing trade tensions.

The relevance of trade strategy has increased particularly for developing and transition economies, which face the dual challenge of expanding market access while protecting domestic industries and ensuring inclusive growth. This article aims to analyze the concept of trade strategy, classify its main types, examine the process of its formation, and explore key mechanisms for its effective implementation.

Concept and Theoretical Foundations of Trade Strategy

Trade strategy can be defined as a coherent set of policy objectives, principles, and instruments designed to guide a country's

participation in international trade over the medium and long term. It is rooted in classical and modern trade theories, including comparative advantage, factor endowment theory, new trade theory, and strategic trade theory.

Classical theories emphasize specialization and free trade as sources of welfare gains, while modern approaches highlight the role of economies of scale, imperfect competition, and state intervention. Strategic trade theory, in particular, justifies targeted government support for key industries in order to enhance national competitiveness in global markets.

From a policy perspective, trade strategy serves as a bridge between macroeconomic goals (economic growth, employment, balance of payments stability) and microeconomic outcomes (firm competitiveness, productivity, innovation).

Literature Review

The concept of trade strategy has been widely discussed in economic literature, particularly within the fields of international trade theory, development economics, and public policy. Scholars generally agree that trade strategy is not limited to tariff policy but encompasses a broader framework of institutional arrangements, export promotion measures, and integration mechanisms shaping a country's engagement in the global economy.

The emergence of new trade theory, notably developed by Krugman (1980), shifted the focus toward economies of scale, imperfect competition, and product differentiation. This framework provided theoretical justification for strategic government involvement in trade and industrial policy. Building on this, strategic trade theory (Brander & Spencer, 1985) argued that selective state intervention could improve national welfare in industries characterized by oligopolistic competition. These theoretical advances laid the groundwork for modern interpretations of trade strategy as an active policy instrument rather than a passive outcome of market forces.

From a development perspective, scholars such as Rodrik (2004) and Chang (2002) emphasized the role of institutions, learning, and policy sequencing in shaping successful trade strategies. Their work highlighted that late-industrializing countries often adopted non-lin-

ear paths combining protection, export promotion, and gradual liberalization. This view is supported by empirical studies on East Asian economies, which demonstrate that export-oriented trade strategies, when combined with strong state capacity and performance-based incentives, can drive rapid industrialization and structural transformation.

In contrast, the literature on import substitution industrialization (ISI)—notably analyzed by Hirschman (1958) and Prebisch – presents mixed conclusions. While ISI strategies helped some countries establish basic industrial capacity, long-term empirical evidence points to declining efficiency, limited export competitiveness, and fiscal distortions when protectionist measures were prolonged without clear transition mechanisms. Subsequent liberalization experiences in Latin America reinforced the argument that trade strategies must be dynamic and adaptive rather than static.

More recent studies focus on trade strategy within the context of global value chains (GVCs) and digital trade. Gereffi et al. (2005) argue that participation in GVCs requires targeted trade and industrial policies aimed at upgrading, logistics development, and standards compliance. Similarly, Baldwin (2016) emphasizes that modern trade strategies increasingly revolve around services, data flows, and regulatory cooperation rather than traditional tariff barriers alone.

Overall, the literature suggests that trade strategy is a multidimensional and evolving concept. There is broad consensus that no single model fits all countries; instead, successful trade strategies reflect national conditions, development stages, and global economic dynamics. This article builds on existing theoretical and empirical insights by integrating classical trade theory, modern strategic approaches, and practical case studies to provide a comprehensive analytical framework for understanding trade strategy formation and implementation.

Types of Trade Strategies

Trade strategies can be classified according to their objectives, degree of openness, and policy orientation.

An export-oriented strategy focuses on expanding domestic production for external

markets. It prioritizes export promotion, diversification, and integration into global value chains. Countries pursuing this strategy typically invest in infrastructure, logistics, human capital, and export-support institutions. East Asian economies provide classic examples of successful export-oriented strategies.

Import substitution aims to reduce dependence on foreign goods by developing domestic industries. This strategy often relies on tariff protection, quotas, and subsidies. While it can support early industrialization, long-term reliance on import substitution may lead to inefficiencies and reduced competitiveness if not combined with gradual liberalization.

Trade liberalization emphasizes the reduction of tariffs and non-tariff barriers to promote competition and efficiency. It is often associated with accession to international trade organizations and regional trade agreements. Liberalization strategies seek to enhance consumer welfare and attract foreign investment, though they require strong adjustment mechanisms.

Strategic and Selective Trade Strategy combines openness with targeted state intervention. Governments selectively support priority sectors with high export potential, technological spillovers, or employment effects. Such strategies require strong institutional capacity and clear performance criteria to avoid distortions.

The formation of a trade strategy is a complex, multi-stage process influenced by both internal and external factors.

Internally, economic structure, resource endowment, level of industrial development, and institutional quality shape strategic choices. Externally, global market trends, trade partner dynamics, international agreements, and geopolitical considerations play a decisive role.

The strategy formation process typically includes situation analysis, stakeholder consultation, priority setting, and policy coordination. Empirical data analysis, sectoral diagnostics, and competitiveness assessments are essential tools at this stage. A well-formulated trade strategy aligns trade objectives with broader national development plans and industrial policies.

The success of a trade strategy depends largely on effective implementation. Key im-

plementation mechanisms include regulatory instruments, institutional frameworks, and support measures.

Trade policy instruments such as tariffs, export incentives, customs facilitation, and technical standards directly influence trade flows. Institutional mechanisms involve specialized trade ministries, export promotion agencies, and inter-agency coordination platforms. In addition, public–private dialogue plays a crucial role in aligning policy measures with business needs.

Modern trade strategies increasingly rely on digital tools, trade facilitation reforms, and logistics modernization. Capacity building for exporters, access to trade finance, and information support further enhance implementation effectiveness.

Despite their importance, trade strategies face numerous challenges. These include policy inconsistency, limited institutional capacity, external shocks, and global trade volatility. Measuring the effectiveness of trade strategies requires comprehensive evaluation frameworks based on export growth, diversification, value addition, and resilience indicators.

Case Study 1: Export-Oriented Trade Strategy in South Korea

South Korea is widely recognized as a benchmark case of a successful export-oriented trade strategy. In the 1960s–1980s, the government deliberately shifted from import substitution toward aggressive export promotion. The strategy focused on identifying priority industries (electronics, shipbuilding, automobiles), providing targeted incentives, and integrating domestic firms into global markets.

Key implementation instruments included export subsidies, preferential credit, duty-free import of intermediate goods, and the establishment of strong export promotion institutions such as KOTRA. As a result, South Korea's exports increased from less than USD1 billion in the early 1960s to over USD600 billion by the late 2010s, while the export structure shifted toward high-value manufactured goods.

This case demonstrates that export-oriented strategies can be highly effective when combined with strong state

coordination, performance-based support, and gradual exposure to international competition.

Case Study 2: Import Substitution and Trade Liberalization in Latin America

Several Latin American countries, including Brazil and Argentina, pursued import substitution industrialization (ISI) strategies during the mid-20th century. The objective was to reduce dependence on imported manufactured goods by protecting domestic industries through high tariffs and quotas.

While ISI initially stimulated industrial growth, over time it led to structural inefficiencies, low productivity, and limited export competitiveness. By the late 1980s and 1990s, many countries shifted toward trade liberalization, reducing tariffs and opening markets.

This experience highlights that import substitution strategies may support early-stage industrialization but require a clear exit strategy and integration with export promotion to avoid long-term stagnation.

Case Study 3: Strategic Trade Policy and Global Value Chains in China

China's trade strategy represents a hybrid model combining openness with selective state intervention. Since the late 1970s, China has gradually liberalized trade while simultaneously supporting strategic sectors through industrial policy, special economic zones (SEZs), and export-oriented manufacturing clusters.

China's accession to the World Trade Organization in 2001 accelerated its integration into global value chains. The government used targeted incentives, infrastructure investment, and technology transfer requirements to move from low-value assembly to higher value-added production. Today, Chi-

na is the world's largest exporter and a key player in high-tech and digital trade.

This case illustrates how a strategic trade strategy can evolve over time, adapting to changing domestic capabilities and global market conditions.

Case Study 4: Trade Strategy and Regional Integration in the European Union

The European Union represents a unique case of trade strategy implemented through deep regional integration. The EU's trade strategy emphasizes market integration, regulatory harmonization, and common external trade policy. Through free trade agreements and a unified customs union, the EU has enhanced internal trade efficiency and strengthened its bargaining power globally.

The EU experience shows that regional integration can serve as a powerful trade strategy, particularly for small and medium-sized economies seeking scale, market access, and regulatory stability.

Conclusion

Trade strategy remains a fundamental instrument of economic policy in an increasingly complex global environment. This article demonstrates that there is no universal trade strategy applicable to all countries. Instead, effective strategies are context-specific and evolve over time.

Policymakers should focus on designing flexible trade strategies that balance openness with strategic support, integrate trade policy with industrial and innovation policies, and prioritize implementation capacity. For developing economies, trade strategies can serve as a powerful tool for economic diversification, competitiveness enhancement, and sustainable growth when supported by strong institutions and evidence-based decision-making.

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INTELLECTUAL PROPERTY IN THE CYBERSECURITY STRUCTURE OF A GEORGIAN PUBLIC COMPANY. REGIMES, PRACTICES AND STRATEGIES FOR PROTECTING INTELLECTUAL PROPERTY FROM CYBER THREATS (Part 1)

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Abstract.

The institution of intellectual property occupies one of the most important places in Georgian legislation. The results of intellectual activity, goods, works, services and means of individualization of legal entities of public law, which are granted legal protection by law and which are defined as intellectual property according to the Civil Code of Georgia and special laws, are intangible assets with material, commodity value.

Patents issued for inventions, utility models, industrial designs, as well as trademarks, computer programs and copyrighted works, production secrets (know-how) and other intellectual intangible assets - which contain innovative technical and humanitarian knowledge and skills - acquire special value for public companies that own their rights in the context of global market relations.

Keywords: *intellectual property, public company, cyber threat, intellectual property protection*

Introduction

For public companies, information (data) about the nature and content of innovative achievements is extremely important in today's highly competitive environment. This is essential regardless of whether the content of such intangible assets is accessible to an unlimited number of persons (for example, a description of an invention in a patent application, a conditional designation of a trademark, a published work of the author, etc.), or information about advanced devel-

opment technologies is “covered” by commercial secrets (know-how) or protected by state secrets. Georgian legislation ensures the protection of rights to such intangible assets in favor of their rights holders. (Challenges IP in Global Market, 2024).

The use of patents, trademarks, computer programs and other intellectual property objects in civil circulation and commodity circulation is allowed subject to the exclusive right of their legal owner. The forms of such use are very diverse and include both direct

use and the use of the results of intellectual activity and means of individualization in goods in civil circulation and placed on the market.

Main text

1. What is cybersecurity intellectual property and why is it important in the public sector?

Cybersecurity intellectual property is used to describe valuable and unique information, ideas, inventions, and innovations created, owned, or used by individuals or organizations involved in cybersecurity. Cybersecurity intellectual property may include software code, algorithms, patents, trade secrets, designs, methods, processes, data, and know-how related to the creators and owners of cybersecurity intellectual property, its detection, or response. (IP in Cyberspace, 2025).

For state-owned companies, intellectual property in the field of cybersecurity is important for several reasons: 1) it provides a competitive advantage to creators and owners of intellectual property in the field of cybersecurity; 2) it helps differentiate the products, services and solutions offered by companies, researchers and professionals operating in the field of cybersecurity from their competitors; 3) it can attract customers, investors and partners who value the quality, reliability and innovation of intellectual property in the field of cybersecurity; 4) it promotes the creation and development of new and improved intellectual property in the field of cybersecurity; 5) it can be a source of income, recognition and rewards for creators and owners of such property; 6) It may also encourage them to attract and invest more time, money and other necessary resources in the development and improvement of cybersecurity intellectual property, which will benefit the cybersecurity industry and society as a whole; 7) Protects the rights and interests of creators and owners of cybersecurity intellectual property; 8) Can help prevent unauthorized use, disclosure, copying, modification or theft of intellectual property protected by the cybersecurity regime by others who may attempt to exploit, damage or otherwise impair the cybersecurity intellectual property or its creators and owners;

9) Can help ensure that users and intellectual property licensees fulfill their legal, contractual obligations and responsibilities in the field of cybersecurity. (legal advantage, 2025; Domination of Cybersecurity, 2023).

2. Cyber threats and intellectual property rights. Violations of intellectual property rights in Georgian public companies

In relation to intellectual property, cyber threats are associated with the risk of infringement of intellectual rights to the relevant objects. Risk, – as a certain probability of negative consequences, – in relation to intellectual property is expressed in the possibility of infringement of intellectual rights (primarily, special / exclusive rights) with varying degrees of probability. Infringement of intellectual property rights implies the illegal use of the result of intellectual activity or means of individualization, which leads to damage to the public company holding the copyright in the form of lost / unearned income or damage to its reputation (image).

In a public company, infringement of intellectual property rights recorded on its balance sheet can be expressed, for example: 1) by infringement of patented technical solutions, – on the basis of its direct use by third parties, – in the production of a product; 2) It may be associated with the illegal use of a patented method. Indirect infringement of intellectual property rights occurs when counterfeit products (goods) are released into civil circulation or otherwise introduced there. The effectiveness of intellectual property rights protection in the digital space of the Internet is determined by the ability to resist such violations and the threats arising from them. Threats of infringement of intellectual property rights in cyberspace (cyber threats) are associated with certain risks and may affect the physical existence of the object containing the relevant rights. In particular, as a result of cyber attacks, certain databases containing commercially valuable information may be modified or completely lost, or information containing trade secrets may be disclosed, which leads to the loss of confidentiality and the termination of rights to production secrets (know-how), in accordance with the established procedure. (What is IP Infringement?, 2023).

Violations of intellectual property rights in the digital space of the Internet as a result of cyberattacks / cyberthreats have their own specifics. In particular, the types of violations of intellectual property rights in cyberspace – using electronic and digital means – may include: 1) illegal access to information containing commercial secrets (know-how), official or state secrets, their unauthorized receipt and disclosure, including actions with prior intent (“hacking attacks”); 2) unauthorized intervention in databases, creation and use of computer software to change information in databases or block it and replace it with other digital information (data); 3) dissemination of false (inaccurate) information about a natural or legal person on the Internet, or other violation of the right to privacy, or damage to business reputation; 4) violation of these rights in cyberspace, on works protected by copyright and related rights; 5) illegal use of a trademark, the name of a legal entity and other means of individualization, including the illegal use of designations in domain names or in the content of web pages; 6) intentional illegal use of means of individualization (commercial designation, company name, trademark, geographical indication) with the aim of causing direct or indirect harm to the copyright holder. (I.Sopilko and others, 2023; D.Bennet & Ludwig, 2024).

It should be noted that, in accordance with the legislation in force in the country, the owner of patents, trademarks, know-how, integrated circuit topologies, computer programs, copyrighted works and other relevant objects of intellectual property can be both a private individual and an organization, as well as the state and its entities. In this regard, the protection of intellectual property from cyber threats, as a rule, is ensured not only in relation to copyright holders with different legal statuses, but is also divided according to the levels of protection.

Conclusions

1) Intellectual property in the field of cybersecurity is important for Georgian state-owned companies for several reasons: it pro-

vides a competitive advantage to creators of intellectual property in the field of cybersecurity and its owners; it helps to differentiate the offered products, services and solutions from competitors; Can attract users, investors and partners who value the quality, reliability and innovation of cybersecurity intellectual property; Promotes the creation and development of cybersecurity intellectual property and can be a source of revenue, recognition and reward, as well as a source of protection and encouragement for relevant individuals; Can help prevent unauthorized use, disclosure, copying, modification or theft of cybersecurity-protected intellectual property by others; Can help ensure that users and intellectual property licensees comply with their legal, contractual and responsibilities in cybersecurity.

2) In a public company, the risk in relation to intellectual property is expressed in the possibility of violation of intellectual rights (primarily special / exclusive rights) with varying degrees of probability. Violation of intellectual property rights implies the illegal use of the result of intellectual activity or means of individualization, which causes damage to the public company holding the copyright in the form of lost / unearned income or damage to its reputation (image).

In a public company, violation of intellectual property rights recorded on its balance sheet may be expressed, for example: a) in violation of the law of patented technical solutions, – on the basis of its direct use by third parties, – in the production of a product; b) it may be associated with the illegal use of a patented method. Indirect infringement of intellectual property rights occurs when counterfeit products (goods) are released into civil circulation or otherwise introduced into it. As a result of cyberattacks, certain databases containing commercially valuable information may be modified or completely lost, or information containing trade secrets may be disclosed, which leads to the loss of confidentiality and the termination of rights to production secrets (know-how), in accordance with the established procedure.

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SUSTAINABLE EDUCATIONAL AND CONSULTING ECOSYSTEMS AS A DRIVING FORCE FOR MARKET TRANSFORMATION AND PUBLIC ADMINISTRATION

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Abstract

This paper considers sustainable educational and consulting ecosystems as the most important elements of the transformation of market mechanisms and public administration systems. Special attention is paid to the structural components of such ecosystems, including digital platforms, network forms of interaction, institutional mechanisms and models of distributed responsibility. The article examines in detail how the ecosystem approach helps to increase market flexibility, develop new skills, accelerate innovation and improve the quality of management decisions in the public sector. Sustainable educational and consulting ecosystems create favorable conditions for the formation and development of human capital, as well as for the formation of a culture of data use. This, in turn, leads to increased transparency and management efficiency. It has been proven that cooperation between educational institutions, consulting companies, business and the government contributes to a more efficient transition of the economy to sustainable development and ensures competitiveness in the face of rapid changes.

Keywords: *educational ecosystems, consulting ecosystems, public administration, digital transformation, sustainable development, human capital, network models of interaction, innovative infrastructure, platform solutions, market adaptability*

Relevance of the study

Sustainable educational and consulting ecosystems are becoming a key tool that allows the economy and public administration to successfully adapt to modern challenges. The rapid development of digital technologies, the increasing complexity of market processes, the increasing importance of data and the need for constant updating of competencies require the creation of new organizational forms that could ensure continuous

learning, innovation and the provision of high-quality expertise.

The ecosystem approach helps strengthen ties between business, government, educational institutions, and the expert community. It creates a flexible infrastructure for developing human capital and improving the effectiveness of management decisions.

The relevance is also related to the fact that sustainable ecosystems help the state to respond more quickly to socio-economic chang-

es. They improve the quality of public services and reduce administrative costs by combining knowledge, technology, and networking.

The purpose of the study

The purpose of this study is to explore the role and opportunities of sustainable educational and consulting ecosystems in the transformation of market processes and public administration systems. We intend to understand how they affect the effectiveness of decision-making, the level of innovation and the sustainability of development, as well as to propose a conceptual model for their integration into socio-economic management.

Materials and research methods

The research is based on modern theories on the formation of educational and consulting ecosystems. We also studied the analytical reports of international organizations and the scientific works of domestic and foreign authors in the field of digital transformation, knowledge management, organizational development and public administration. The study used data on the work of existing educational platforms, expert networks, consulting centers and public-private partnerships.

The methodological base of the research includes system and institutional analysis, comparative research methods, analysis of specific situations (cases), elements of net-

work theory and the concept of knowledge management. In the course of the work, methods of content analysis, expert assessment and modeling of interactions within ecosystems are used. Such an integrated approach allows for a deeper understanding of how ecosystems maintain their stability, how they develop, how they create value, and how they influence the processes of market modernization and public administration.

The results of the study

The history of the development of consulting ecosystems, which play an important role in the transformation of the market and public administration, is a gradual process. They have evolved from simple, independent organizations into complex, interconnected intellectual and digital platforms capable of having a significant impact on the economy, personnel policy, and government decision-making.

The first beginnings of ecosystems emerged in the middle of the XX century, when classical schools of business and management consulting began to form. These schools defined management standards, trained qualified personnel, and provided expert research for government agencies without being integrated into a single structure. Their influence was limited, but they laid the foundation for further systematization of knowledge and the formation of stable professional communities (Table 1).

Table 1. *The specifics of educational ecosystems: a review of research*

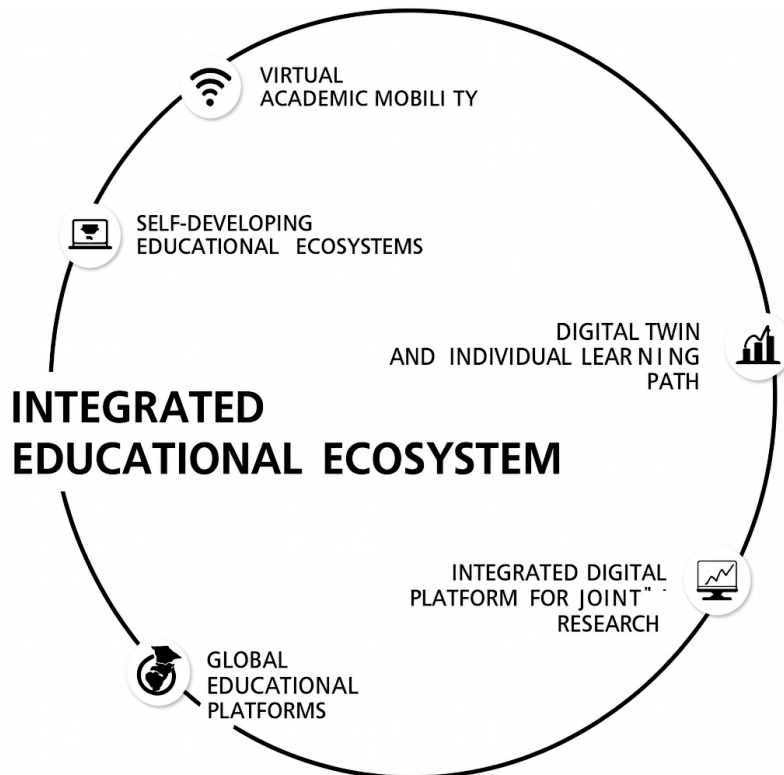
The specifics of educational ecosystems	Authors
A large number of stakeholders is an important prerequisite for the success of educational innovations. For innovations to be successful, it is necessary to reach agreement between representatives of the various sectors of society involved in the process.	M. A. De Souza Rodriguez and others (De Souza Rodriguez M. A., Chimenti P., Nogueira A. R., 2021)
The product, created as part of a public-private partnership, is aimed at meeting the needs of consumers, including parents and teachers.	M. Abdul-Jabbar, B. L. Kurshan (Abdul-Jabbar M., Kurshan B. L., 2015)
Various educational institutions offer a variety of forms of education: schools, professional educational organizations, classical and corporate universities, state and non-state educational institutions, additional education organizations, as well as non-formal and informative learning projects. Thanks to this, people have new opportunities for development. These educational institutions are not limited by geographical location and can use global educational resources.	V. V. Timchenko (Timchenko V. V., 2019)

The specifics of educational ecosystems	Authors
The focus is on the joint activities of the subjects to create networked, human-centered educational systems that maintain harmony with the environment.	O.V. Zinevich, E. A. Milekhina (Zinevich O. V., Melekhina E. A., 2023)
They are based on the principles of network interaction between educational institutions and students, which are aimed at forming a harmonious personality, as well as at developing the professional skills of each person and group of people throughout their lives.	E.N. Prokofiev (Prokofieva E. N., 2021)
With the development of the Internet in the 1990s and early 2000s, educational and consulting services began to move into the online space. The first major online platforms, distance learning programs, and digital knowledge libraries appeared which significantly expanded educational and analytical opportunities.	The massive introduction of online learning, the rapid growth of EdTech companies, the development ecosystems. These ecosystems not only facilitate knowledge transfer, but also provide forecasting, project support, human resource development, and automation of management decisions. At this time, sustainability began to be seen as the ability of systems to maintain high quality and adapt to uncertainty, achieved through the integration of data, technology, and human skills.
This period was a turning point, as the institutions were no longer isolated from each other. Networking between universities, companies, think tanks, and government agencies began to form. States have become more active in attracting foreign and local consultants to modernize administrative systems, and businesses to restructure their models. At this stage, there is an objective need for a more comprehensive and sustainable knowledge infrastructure.	At the present stage, sustainable educational and consulting ecosystems have become the most important factor determining the development of markets and public administration (Fig. 1). They contribute to the formation of personnel models, the creation of tools for analysis and monitoring, provide the state and business with objective data and forecasts, and help to build long-term trajectories for the development of territories and organizations. Ecosystems have gone beyond a simple addition to the management infrastructure and have become a key element influencing the competitiveness of the economy, the effectiveness of institutions and the depth of social transformation.
In the 2010s, the ecosystem approach began to flourish. Educational platforms have moved from traditional to more complex models that connect participants with different functions: students, experts, employers, and technology developers. Large consulting companies have begun actively creating research laboratories, data centers, predictive models, and digital decision-making tools. At the same time, public administration faced growing challenges and began to use a wide range of external analytical partners.	It is important to note that modern educational and consulting ecosystems are complex systems that combine training, analytics, data management, and expert support. Their main task is the formation of competencies, solutions and management models capable of transforming the market and improving the quality of public administration. The following are examples of such ecosystems and the technologies they are based on.
The ecosystems of the period under review demonstrated key signs of sustainability, including the ability to continuously update content, adapt to economic changes, and integrate artificial intelligence into educational and expert processes.	Major educational platforms such as Coursera, edX, FutureLearn, and Udacity are creating unique ecosystems that connect universities, technology companies, govern-

ment agencies, and millions of users. These platforms not only offer access to mass education, but are also becoming important tools for training qualified personnel for the digital economy. They influence the structure of demand; contribute to the emergence of new professions and the formation of internation-

al standards of education. Such ecosystems are actively implementing adaptive learning technologies, recommendation mechanisms, and automated analytics. This makes them effective tools for transforming HR systems in both the private and public sectors.

Figure 1. *Unified educational ecosystem*



The consulting ecosystems of the world's leading companies such as McKinsey, BCG, Deloitte and PwC are actively developing, becoming centers of expertise and innovative technologies. They create their own digital platforms designed for processing big data, analyzing trends, modeling socio-economic processes, and evaluating the effectiveness of government programs. They integrate machine learning; build predictive models, and use cloud services and end-to-end analytical tools in their ecosystems. This allows them not only to provide consultations, but also to actively participate in the development of territorial development strategies, public administration reform, and optimization of budget processes and assessment of the quality of public services.

The examples that we can observe in Russia demonstrate the process of ecosys-

tem formation around national projects and digital platforms. The SberObrazovanie ecosystem is a complex of services, including Skillbox, Netology, and Agi.ru, which create sustainable educational environments. These platforms combine training, career paths, digital analytics, as well as platform-based methodologies and tools for mass competency assessment. Platforms such as Gosudarstvo, Gostech, and Sotsgarant are actively developing in the field of public administration. They are being updated with new consulting and analytical modules, from comprehensive regional assessment to automated decision support systems. Scientific and educational centers and competence centers are being formed based on universities, which combine personnel training, scientific research and high-tech consulting with government customers.

The main technologies that make these ecosystems resilient and transformative include:

- Artificial intelligence, which helps to individualize learning, predict results, and automate analytical processes.
- Big data used to monitor markets, assess regional development, and analyze the effectiveness of government programs.
- Platform architectures that integrate participants, data, and services into a single environment.
- Cloud infrastructure that ensures ecosystem scalability.
- Knowledge management systems that create intelligent databases of cases, practices, and research.
- Digital twins of organizations and territories used for modeling management decisions.
- Competence assessment and career navigation tools that influence the formation of personnel systems.

The combination of these examples and technologies transforms educational and consulting ecosystems not just into services, but also into strategic tools for market transformation and public administration. They train personnel for the digital economy, create intelligent tools for analysis and decision-making, provide government and business with reliable expert advice, and support the long-term development of territories and industries.

It should be noted that modern educational and consulting ecosystems, despite their enormous potential in market transformation and public administration, face serious systemic difficulties that hinder their expansion and sustainable development.

One of the main problems is the fragmentation of data and the lack of uniform standards for their exchange. This significantly limits the integration of platforms, analytical tools, and management services, which in turn reduces the effectiveness of interagency and intersectoral collaboration.

There is also a gap between rapidly developing digital technologies and the regulatory framework, which is adapting rather slowly. This hinders the introduction of end-to-end

analytics, artificial intelligence, and automated decision support systems into public administration.

There is also a shortage of specialists with skills in digital management, working with big data and creating platform solutions. Because of this, organizations are forced to rely on external contractors, which makes it difficult to develop sustainable internal competencies.

In modern educational systems, problems related to the quality of content, the lack of reliability of competence assessment systems and the discrepancy between educational trajectories and the real needs of the labor market are particularly acute. This leads to a decrease in efficiency in training personnel for the economy.

Consulting ecosystems are experiencing significant limitations due to the unavailability of public sector data, which negatively affects the quality of modeling and forecasting. Their work is further complicated by the insufficient maturity of management processes, which often lack a culture of analytical justification of decisions.

Digital inequality between regions remains a significant problem. This leads to uneven access to modern educational and analytical services, which exacerbates the imbalances in regional development. In addition, many ecosystems are developing as commercial or departmental products. This creates risks of excessive competition, infrastructure incompatibility, and data closure. However, effective transformation of public administration requires open standards and coordination at the State level.

These problems require a comprehensive approach to their solution. It should include developing the skills and abilities of employees, improving the digital infrastructure, improving the regulatory framework, and creating mechanisms that will combine different platforms. This is the only way educational and consulting ecosystems can become a driving force for the transformation of the market and the public administration system.

In our opinion, to solve the problems that arise in the process of ecosystem development, it is necessary to apply an integrated

approach that includes technological, organizational and regulatory measures.

A key focus is the creation of a unified data infrastructure that will be based on national standards for storing, exchanging, and processing information. This will ensure the compatibility of different platforms, increase the accuracy of analytics and accelerate the process of introducing digital services into management processes.

At the same time, it is necessary to make changes to the regulatory framework. This includes simplifying procedures for integrating digital solutions, introducing so-called regulatory sandboxes, and developing models for the ethical use of artificial intelligence. All this will make ecosystems more flexible and innovative.

An important aspect is the development of human resources. Modern retraining programs, the integration of educational trajectories with the real needs of the market, as well as the formation of a culture of working with data and project management contribute to the sustainable growth of the competence of specialists both in the public sector and in business.

In order for educational systems to become better, it is necessary to introduce adaptive digital platforms, develop objective competence assessment systems, create mechanisms for independent content review, and establish close communication with employers. All this will help to reduce the gap between training and real tasks at work.

Consulting ecosystems will develop more efficiently if we expand access to government data, create interagency analytical centers, and standardize forecasting methodologies. This will improve the quality of recommendations and make them more reasonable.

To eliminate digital inequality in the regions, it is necessary to invest in the development of communication infrastructure, support local innovation centers and encourage the use of domestic platforms. This will ensure equal access to modern development tools for all.

Conclusions

The formation of educational and consulting ecosystems, which play a key role in the transformation of the market and the public administration system, is becoming an essential condition for successful digital transformation. Their impact can be seen in accelerating knowledge sharing, developing flexible skills, improving the quality of management decisions, and creating a sustainable data infrastructure that will support innovation over time. One of the main results of this process is the strengthening of ties between the state, business and society. This makes it possible to more accurately predict development, respond quickly to challenges, and create an open and effectively managed environment.

Comprehensive modernization of the legislative framework, technological infrastructure and human resources makes it possible to achieve a synergistic effect. As a result, ecosystems do not just become tools, but become the driving force of structural change. The integration of educational and consulting ecosystems creates the basis for sustainable and innovative development, which contributes to improving the competitiveness of the economy and the effectiveness of public administration in the context of the increasing complexity of modern processes.

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THE IMPACT OF GREEN FINANCE ON BUSINESS SUSTAINABILITY

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Abstract

Nowadays, green finance is a valuable instrument for achieving the long-term sustainability and competitiveness of a business. Green finance encompasses various types of financial instruments, such as: green loans, green bonds, and green investments. These financial instruments are used to finance business activities that offer environmental benefits. For small and medium-sized enterprises (SMEs) that are already adapting to climate change, the real value lies not only in the accessibility of green finance but also in the creation of sustainable business models that link to their financial viability and the achievement of environmental benefits. The purpose of this study is to determine the advantages and prospects of using green finance in the field of business sustainability

Keywords: *Green Finance, Green Loans, Green Bonds, Business Sustainability*

Introduction

Green Finance refers to a comprehensive suite of financial instruments and services specifically designed to support projects that generate positive environmental impacts and foster sustainable development. Among the most prevalent forms of green finance are: Green Bonds; Green Loans (including Green Mortgages); Green Investment Funds.

A fundamental component of green finance is the integration of ESG criteria (Environmental, Social, and Governance). This framework ensures that investors evaluate not only financial returns but also a company's environmental stewardship, social responsibility, and corporate governance transparency.

Research method

In the research process, we consider materials about Sustainable and Green finance published by Georgian and foreign scientists in local and international scientific journals, the results of research from international rating organizations, and statistical data. The study is based on the processing of secondary analytical materials derived from open sources. The methods of analysis and synthesis, deduction and induction are used as the research methodology.

Results analysis

When we use the term 'sustainable business' (or 'green business'), we generally refer

to businesses that prioritize not only profit in their operations but also uphold environmental and social responsibility. Green finance has become a highly topical issue globally in recent decades. It is linked to the goals of the Paris Climate Agreement (reducing greenhouse gas emissions in the atmosphere), as well as the UN Sustainable Development Goals (SDGs). For financing to be considered “green”, the project must meet certain criteria. The concept of sustainable finance has evolved as part of the broader notion of business sustainability over the last decades (Dirk Schoenmaker, 2019).

These criteria contribute to guaranteeing that the investment is truly allocated to fund environmental initiatives. By implementing a social standard, a company publicly declares its commitment to environmental protection, minimizes harmful impacts on the environment, ensures the creation of a safe environment for future generations and promotes sustainable development (Mzevinar Nozadze, 2025).

Green finance and sustainable business create a synergy, where businesses integrate environmental, social, and governance (ESG) principles into their long-term perspective. The evolution of business social responsibility reflects the relationship between the success of business entities and social benefits, which leads to an integrated approach to the field of business social responsibility (Mzevinar Nozadze T. B., 2024). While green finance provides investments through innovative financial instruments (green bonds and green loans) for projects that reduce harmful environmental impact.

This was a truly unprecedented event in the history of financial markets, which to a certain extent contributed to the spread of the mentioned financial instrument and the growth of its popularity (Rusudan Kutateladze, 2025). Furthermore, business sustainability requires specific investments, the financing of which is only possible through the joint participation of the public and private sectors.

To increase the scale of green finance, significant government intervention is required, which involves defining norms, rules, and strategies for the creators of green financial instruments. Business entities must clearly understand which financial products,

activities, or technologies can be classified as green. In the process of issuing and circulating green bonds, companies take into account the Green Bond Principles, developed by the International Capital Markets Association (Nino Makatsaria, 2025).

Among the wide range of green finance instruments (loans, credits, emission permits, green procurement mechanisms, etc.), the fastest growth has been observed in the field of green bonds. The cumulative amount of green, social, sustainability, sustainability-linked, and transition (labeled sustainable) bonds issued in the market. Green bond issuances represented the largest share of the labeled sustainable bond market, representing 53.2% of the overall issuances in Q1 2025, with a significant rise in sustainability issuances (Labeled Sustainable Bonds).

“Green Projects should provide clear environmental benefits, which will be assessed and, where feasible, quantified by the issuer” (Green Bond Principles, June 2025). The financing of environmental concerns, such as: the mitigation of greenhouse gas emissions, the management of natural resources, the protection of biodiversity, and energy efficiency, falls into the category of “green finance” and is encompassed by the “environmental finance” umbrella, which allocates funds for financing projects and initiatives designated with a green label. What impact does green finance have on business sustainability?

Green finance not only ensures the creation of safe environmental conditions for future generations but also allows businesses to gain the following advantages:

- **Attracting Investments.** Investors are increasingly interested in “green” projects. Companies that demonstrate a commitment to sustainable development become more attractive for investment.

- **Access to Concessional Financing.** “Green” loans, bonds, and other instruments are often offered under more favorable terms compared to traditional ones. This financial assistance, in the form of subsidies, stimulates the development of the recycling industry and promotes the more efficient use of resources.

- **Improving the Company’s Image.** The involvement of a business in green projects positively affects the company’s im-

age, increases the loyalty of customers and employees, and strengthens its reputation as a socially responsible business.

— **Gaining a Competitive Advantage.** Consumers are increasingly choosing environmentally friendly products and services. Companies implementing green technologies gain a competitive advantage and strengthen their reputation.

Currently, business entities, including small and medium-sized enterprises (SMEs), corporations, and commercial banks, are actively adopting and implementing the globally recognized ESG principles. One prominent example of successful green financing is the Spanish utility company Iberdrola, which is a world leader in issuing green bonds to finance significant investments in renewable energy projects. Iberdrola has issued €1 billion in green hybrid bonds, becoming the first company to align this class of instrument with the European Union Green Bond Standard (EUGBS). The issuance, eight times oversubscribed with over €8 billion in demand, drew participation from more than 400 institutional investors globally (Iberdrola Raises €1B in First EU Green Hybrid Bond After Strong Investor Demand).

Regarding green finance and its impact on business sustainability, we can state that this type of financing and its financial instruments are gradually gaining more popularity in developing countries, including Georgia. In a country, especially in a developing country, it is quite difficult, long and time-consuming way to form and develop the business environment (Mzevinar Nozadze N. C., April 2024).

The Sustainable Finance Taxonomy was developed by the National Bank of Georgia in collaboration with local and international experts and stakeholders. Taxonomy categories and corresponding technical criteria are developed in accordance with the best international practice, while the characteristics

of the Georgian economy are also well-integrated. Nevertheless, the universally adopted definitions and sustainable development reporting frameworks exhibit cross-country variations, and efforts are being made toward their gradual harmonization.

In the practice of some countries, the issuers of “green” bonds have a greater guarantee of receiving benefits, in which the support and financial benefits provided to them by the state play a big role (Mzevinar Nozadze N. S., 2025). Georgia’s economic policy aims to support the private sector, particularly small and medium-sized enterprises (SMEs), and to create a favorable business environment (Tea Kasradze).

Georgian businesses have access to green finance to assist investments in resource efficiency, energy and green supply chains. Only in 2024, \$300 millionworth of green bonds were issued by a Georgian companies (Green Finance Landscape in Georgia and Regional Best Practices, December, 2024). However, credit lines provided by international financial institutions (IFIs) and disbursed through local banks are the primary source of longterm funding for green developments in Georgia.

Conclusion

Access to green finance stimulates the development and implementation of innovative solutions that can become a source of competitive advantage and facilitate business growth.

The integration of the ESG approach into business sustainability requires the transformation of a company’s business model by incorporating sustainable development goals and utilizing relevant instruments, including green finance tools.

It is crucial to increase the accessibility of green finance for entities involved in business, as this represents a prerequisite for ensuring the sustainability of the economy and society as a whole.

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ADVANCED NEGOTIATION STRATEGY FOR HIGH-STAKES INTERNATIONAL BUSINESS: MANAGING POWER, RISK, AND COMPLEXITY IN GLOBAL CORPORATE DEAL-MAKING

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Abstract

The article discusses an in-depth negotiation strategy that makes it possible to successfully conclude international corporate transactions in conditions of “expensive capital”, increased volatility and a complicated regulatory environment. The article emphasizes that the rising cost of borrowed resources and stricter requirements of investors and creditors are changing the logic of negotiations. Now, the key factors are not only the price and timing, but also the distribution of financial, legal and operational risks, the establishment of liability limits, termination conditions, performance guarantees and mechanisms for adapting the transaction to changes in external conditions. In addition, the multilevel nature of global transactions increases information asymmetry, increases the likelihood of delays, and requires management of an “operational closure model.” Based on the generalization of modern approaches to the theory of negotiations, the article systematizes the instruments of contractual risk consolidation. This makes the outcome of the transaction more predictable and increases the stability of its legal structure. The study drew important conclusions that in order to increase the effectiveness of negotiations and reduce the likelihood of transaction disruption, it is necessary to conduct risk-based training, standardize disclosures, and manage the approval process.

Keywords: *international negotiations, corporate transactions, cross-border transactions, negotiation strategy, risk management, contractual mechanisms, compliance, interest rates, transaction structure, complexity management*

Relevance of the study

The importance of this topic is due to the fact that today international corporate transactions are concluded in conditions of high capital costs, unstable markets and a complicated regulatory environment. The increase in the cost of borrowed resources and the tightening of the requirements of investors

and creditors are changing the approach to negotiations. It becomes critically important for the parties to not only agree on the price and timing, but also to allocate financial, legal and operational risks, set limits of liability, determine the terms of termination, provide performance guarantees and provide mechanisms for adapting the transaction to

changes in external conditions. As a result, negotiations go beyond tactical techniques and become a strategic management tool that directly affects the sustainability of corporate decisions and the economic impact of transformations.

Global transactions in the modern world are becoming more complex and multilevel. They involve several jurisdictions, regulators, stakeholders, as well as professional intermediaries and consultants. Because of this, it is becoming increasingly difficult to coordinate positions, and the information asymmetry is becoming more obvious. This increases the risk of delays or disruption of the transaction.

In such circumstances, a carefully developed negotiation strategy is of particular importance. It helps to control the positions of the parties, create coalitions of stakeholders, reduce transaction costs and find a balance between the speed of decision-making and the quality of legal and financial protection. Thus, the appeal to strategic negotiation management when concluding global corporate transactions is relevant and practice-oriented. It responds to the business's demand for reproducible methods that will help reduce uncertainty, protect the interests of the parties, and increase the predictability of results in an environment of high stakes, increased risks, and an increasingly complex architecture of international agreements.

The purpose of the study

The purpose of this study is to understand how the rising cost of capital and the increasing complexity of the institutional and regulatory environment affect the strategy of international corporate negotiations. We strive to systematize effective methods of managing conflicting interests of the parties, risks and multilevel complexity that arise when concluding large international transactions.

Materials and research methods

In the course of the research, we relied on modern negotiation theories, corporate risk management concepts, and generally accepted risk allocation tools within contracts, as well as open methodological and analytical materials that describe the practice of structuring transactions and decision-making in conditions of high uncertainty.

In the course of our work, we used various methods: theoretical analysis and generalization, comparative analysis of negotiation strategies, systematization of risks, as well as logical and structural analysis of multilevel factors and their impact on the negotiation process and the completion of the transaction.

The results of the study

In international business, negotiations are a complex process in which the parties seek to agree on the terms of the exchange, the distribution of risks and responsibilities. The success of these negotiations depends not only on the "price offer", but also on many other factors: the structure of the participants' interests, their alternatives, the institutional environment, cultural differences and dispute resolution procedures. The methodology of negotiation analysis in international business usually includes a combination of behavioral models that explain how parties make decisions and respond to pressure, economic and organizational approaches that describe the formation of a "pie of value" and its division, as well as legal frameworks that define the available enforcement and protection mechanisms in cross-border transactions.

In modern negotiation theory, it is customary to distinguish two strategies: "distributive" and "integrative". The first strategy focuses on the allocation of a fixed resource and the pursuit of one-sided gain, while the second is aimed at a joint search for options that will increase overall benefits and allow for better alignment of interests. The textbooks describe these strategies as two different sets of tactics and attitudes that affect the behavior of participants (for example, rigidity of positions, information exchange, attitudes towards trust and the duration of relationships) and the type of outcome (competitive "win-loss" or cooperative "win-win") (Negotiation web).

An important part of the negotiation methodology is working with alternatives and the so-called "zone of possible agreement". This approach, which has become widespread in business practice and academic education, emphasizes that before starting negotiations, the best alternative to the BATNA agreement must be determined. It will become the minimum basis for decision-

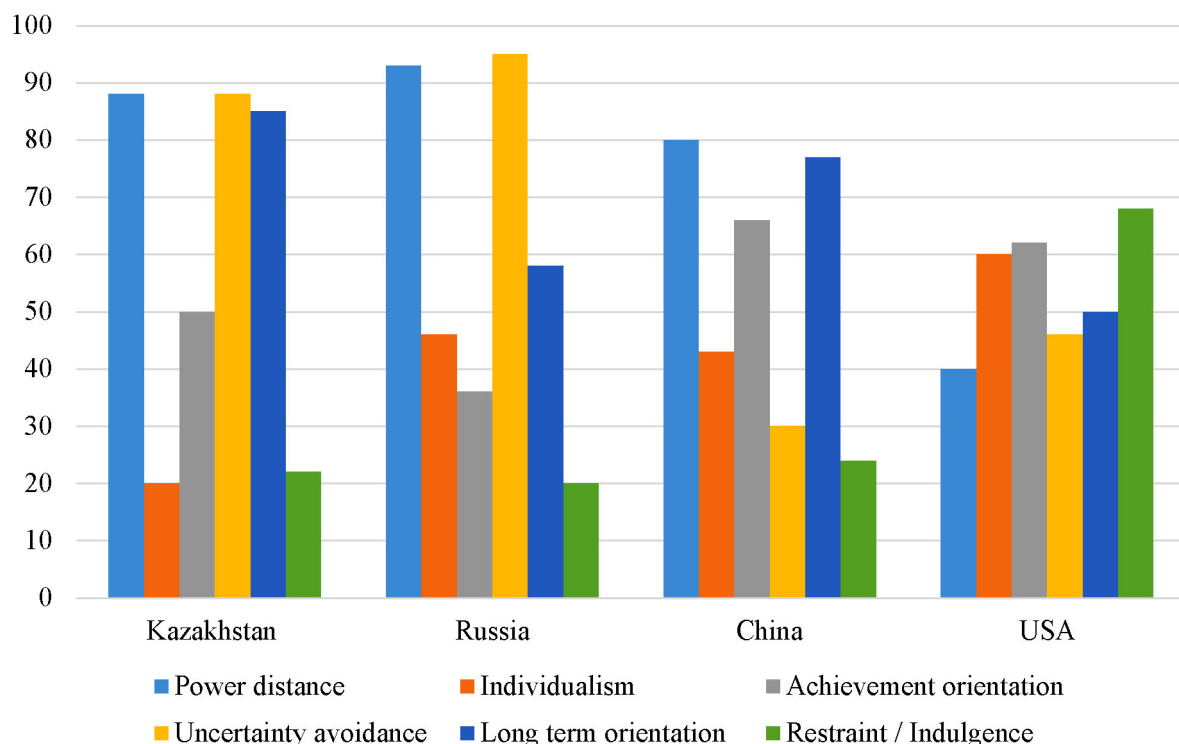
making. In addition, it is necessary to evaluate the ranges of possible concessions and their intersection (ZOPA). This will help you understand whether it is possible to reach a workable agreement and what conditions are within a reasonable compromise. The practical significance of these categories lies in the fact that they allow us to separate the “desirable” from the “acceptable”. This reduces the risk of unfavorable concessions under pressure and allows you to more clearly justify your position in conditions where the stakes are high (Sucuri WebSite Firewall – Access Denied).

The model of “principled negotiations” occupies a special place in the negotiation process. It is based on separating people and problems, as well as focusing on interests rather than positions. Within the framework of this model, participants generate solu-

tions and choose the best one based on objective criteria. This approach was described in a classic negotiation source and is widely used as a basic learning standard. It serves as a basis for discussing the terms of the deal, reducing the risk of mutual pressure and personal confrontation.

A special place in theory is occupied by cross-cultural approaches. This is due to the fact that international transactions take place in conditions of different approaches to hierarchy, individualism, uncertainty and long-term planning. Comparative cultural studies often use special measurements that make it possible to compare the “deep motives” of business behavior in different countries. Table 1 shows data on six such measurements for several countries. These data can be used as an empirical basis to explain differences in the negotiating style and expectations of the parties.

Figure 1. Comparative indicators of cultural measurements according to the Hofstede model for individual countries (Country comparison tool)



These indicators are not a direct prediction of the outcome of negotiations and cannot replace a detailed analysis of a specific transaction. However, they can be useful for forming hypotheses about possible preferences of the parties. For example, one can assume how natural rigid hierarchical communication will be, how directness will be

perceived, how important formal procedures and detailed preparation are, as well as how orientation towards short-term results and willingness to invest in long-term relationships correlate.

In international negotiations, high interest rates are important not only as part of the overall macroeconomic context, but also as

a factor that directly affects the cost of capital, yield requirements, and allowable debt burden. This, in turn, narrows or expands the possibilities for compromise on key terms of the deal. In a high-stakes environment, the parties re-evaluate time as a resource, distribute risks between price and contractual terms, and more closely link the outcome of negotiations with the availability of financing and the requirements of external participants such as banks, investors, and regulators. The policies of the largest central banks indicate that global markets are still operating in an environment of significant interest rates.

During the negotiation process, special attention is paid to reviewing the value of assets and changing the arguments related to the price. The expensive cost of capital makes cash flow forecasts more vulnerable to errors, so it is critically important to verify financial assumptions (through sensitivity analysis and stress scenarios). Negotiations are becoming contractual: the focus is shifting from general statements about future benefits to specific legal mechanisms that distribute risks and protect the parties in the event of a deterioration in external conditions. Analyzing the transaction market, it can be seen that in conditions of unstable inflation and interest rates, participants are more likely

to adjust the structure of transactions and increase the requirements for legal certainty and risk management.

Another way to influence negotiations is through changes in the financing discussion. As debt, servicing becomes more expensive, the importance of conditions related to debt obligations, covenants, and “financing as a condition for closing a deal” increases. This leads to a redistribution of forces: a party that controls access to capital or is able to close a deal without expensive debt gets more opportunities to set its own terms. And a party that depends on external financing is forced to compensate for the risks of the other party, with either price, guarantees, or a payment structure.

Due to the high cost of capital, negotiations are increasingly shifting the focus from discussing a single price to discussing how to distribute uncertainty over time. In practice, this is reflected in the increased use of deferred payments and conditional price elements, such as earn-out, as well as in the growing interest in instruments that partially replace external debt, such as vendor loans. Industry reviews of the terms of transactions directly indicate an increase in the use of earn-out and more frequent access to vendor loans against the background of the high cost of external debt financing (Table 1).

Table 1. *Changes in the applied pricing and financing mechanisms in M&A transactions in conditions of high debt cost*

Mechanism	Why is it becoming more in demand at high rates	A typical negotiation conflict over the mechanism
Earn-out	Reduces the risk of overpayment in the absence of accurate forecasts and transfers part of the cost for the period after closing.	Metrics and calculation period; post-closure management control; acceleration/early payment rules.
Vendor loan	Partially compensates for expensive external debt and helps to eliminate the difference between the expected and actual cost.	Percentage/ collateral/ subordination; default triggers; priority of requirements.
Deferred payment	Provides the customer with liquidity and strengthens the financial structure.	Guarantees and collateral; conditions of early recovery; connection with violation of the terms.
Enhanced guarantees and assurances	They help to compensate for the increased likelihood of negative scenarios and increase confidence in the deal.	Limits of liability; disclosures; exclusions; duration and procedure for filing claims.

A source: author's development based on (Deal Terms Report 2025: European Market)

In conclusion, in a high-stakes environment, time and regulatory predictability are of particular importance. This leads to the fact that in negotiations it becomes increasingly important to agree on conditions that allow you to control the process: deadlines, closing conditions, grounds for termination of the transaction, as well as the distribution of regulatory and possible delays. According to M&A market experts, in light of changes in the macroeconomic environment and the regulatory agenda, companies and investors are paying more and more attention to the legal conditions and structure that ensure the successful completion of the transaction and allow effective risk management.

In international corporate negotiations, risk management is carried out in accordance with the approaches adopted in the field of management and audit. In these disciplines, risk is seen as an integral part of strategy, closely related to business goals. It affects decision-making, control over their execution, and the quality of information disclosure to management. Negotiations in this

context turn into a process of transforming identified risks into legally established mechanisms. What cannot be reliably reduced through organizational measures is fixed in the transaction structure, closing conditions, allocation of responsibilities, and dispute resolution procedures.

In real practice, risk-based negotiations begin by dividing a transaction into separate verifiable blocks. These blocks include commercial assumptions, the legal status of assets, regulatory restrictions, sanctions and compliance factors, as well as operational dependencies and execution risks. Then the parties agree on which risks are critical for closing the transaction, and which can be compensated or taken into account in control procedures. In conditions of uncertainty, the unified clauses on force majeure and significant change of circumstances developed by the International Chamber of Commerce (ICC) are of particular importance. These clauses increase legal certainty and determine in advance the consequences of obstacles or changes in the terms of the contract.

Table 2. *Contractual risk management tools in an international transaction and their purpose*

Instrument	What risk do we exclude	What exactly is agreed upon in the negotiations
Representations, Warranties, and Disclosures	There is a risk of receiving false information about the purpose of the transaction and assets.	The scope of guarantees provided, exceptions to them, standards of knowledge, the procedure and format of information disclosure.
Closing Conditions and Preliminary Covenants	There is a risk that the company will not be able to complete its operations due to regulatory requirements, lack of financing, or the need to obtain corporate permits.	A list of conditions, the procedure for their fulfillment, deadlines and possible consequences of non-compliance.
Limitation of Liability and Indemnification Procedures	The risk of unforeseen financial losses.	Limits, deductibles, time limits for filing a claim, and the procedure for calculating damages.
Retentions/Securities of Performance (Including through Escrow)	There is a risk that the obligations will not be fulfilled after the closure.	The amount of the deduction; the events that serve as the basis for the write-off; the procedure for resolving possible disagreements.
Force Majeure and Hardship Clauses (ICC)	The risk of non-fulfillment of obligations or significant changes in the situation.	Criteria for the event, notification, consequences, possibility of revision or termination.

A source: author's development based on (Icc Force Majeure and Hardship Clauses)

To demonstrate how risks are transformed into contractual decisions, table 2 below shows the main risk management tools in an international transaction and their purpose.

Global corporate transactions are a complex process that includes several aspects: commercial, financial, legal and regulatory. Even if the parties reach an agreement on the price and the basic ownership structure, the result depends on external control procedures, which have their own deadlines, criteria and disclosure requirements. Complexity management in the negotiation process implies control over a multi-level system of approvals and the creation of a contractual structure that will be feasible and economically justified, despite possible delays, regulatory conditions and the need for adjustments.

The main reason for the multilevel is related to antitrust control and inspections of foreign investments for national security, especially when it comes to cross-border transactions. These regimes significantly expand the agenda of negotiations: the parties need to agree in advance on a list of permits and notifications, assign responsibilities for the preparation of materials, and determine the consequences of possible delays, terms of closing the transaction and rules of conduct in case of conditional approval or requirements of the regulatory authority (Regulation (Eu) 2019/452 of The European Parliament and of The Council).

As a result, the “operational closure model” becomes the main tool that allows you to manage the complexity of the process. It determines who interacts with regulators and how, what risks are considered critical, what measures are acceptable to obtain approval, how costs and responsibilities are distributed, and what exit rights are provided in case of an adverse development. The multi-stakeholder composition of the process, including creditors, consultants, auditors, and other stakeholders, further complicates the situation. That is why a single communication channel, data discipline, and consistent document control and disclosure procedures are critically important.

The development of a deep negotiation strategy in international corporate transactions implies a transition from situational decisions to a well-thought-out model in which

economic conditions, legal mechanisms and the management process are interconnected. Efficiency is achieved through a clear statement of goals and constraints at the preparation stage. The subject of negotiations usually includes not only the price, but also the procedure for closing the transaction, the distribution of risks, requirements for compliance with legislation and the consequences of possible adverse events. The strategy should take into account the interests of the parties and acceptable concessions, as well as include specific contractual instruments. This will minimize the likelihood of future disputes.

The effectiveness of negotiations increases due to the fact that the information preparation and management process is standardized. This implies the use of uniform source data, clear rules for information disclosure, as well as the establishment of an agreed communication channel and version control of documents. A risk-based approach is an important aspect of negotiations. It involves ranking risks according to their degree of criticality and consolidating them through closing conditions, obligations of the parties, limitations of liability and dispute resolution procedures. In addition, the effectiveness of negotiations is significantly improved due to a clear distribution of roles in the team, the discipline of agreeing on concessions and the predictability of interaction. These factors contribute to building trust between the parties and speeding up the process of reaching an agreement.

Conclusions

Thus, in conditions of high capital costs and a volatile external environment, international corporate transactions become a strategic management tool. The key factors in such negotiations are the distribution of risks and the legal certainty of the terms. The effectiveness of negotiations is significantly enhanced by a risk-based approach. It involves dividing the transaction into verifiable blocks, identifying critical risks for its completion and consolidating them in the form of representations and guarantees, closing conditions, limitations of liability, security mechanisms and agreed procedures in case of obstacles or significant changes in circumstances. The multilevel nature of global transactions requires a managed “operation-

al closure model” and coordination with regulators and other stakeholders. Standardization of training, information management, and decision-making discipline reduce transaction costs, build trust, and increase the predictability of negotiation outcomes.

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Section 4. Engineering sciences in general

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HIGH-THERMAL AND HIGH-ELECTRICAL-CONDUCTIVITY COMPOSITE WITH A THREE-DIMENSIONAL NANOCAPSULE STRUCTURE FOR SMART HOME SYSTEMS

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Abstract

An innovative composite material characterized by the combination of high thermal conductivity, electrical conductivity, and mechanical strength is presented. The material is based on a three-dimensional structure composed of nanoscale multilayer spherical capsules forming a pseudo-spongy volume with uniform distribution of thermal and electrical flows. The composite demonstrates stable performance under high thermal loads and pulsed energy conditions, which makes it suitable for miniature high-energy electronic components and smart home infrastructure. The structure, fabrication principles, and key performance advantages of the material are examined.

Keywords: Composite material; pseudo-spongy composite; pseudo-porous composite; nanoscale capsules; three-dimensional composite structure; mechanical strength; thermal conductivity; electrical conductivity; 3D lattice; microspheres; dielectric spheres; high-energy systems

Introduction

The development of smart home technologies and compact high-energy electronic systems is accompanied by increasing demands for materials capable of providing both efficient heat dissipation and electrical conductivity. Traditional metal composites – such as copper–tungsten, copper–molybdenum, or diamond–copper materials – remain limited in their ability to dissipate thermal

and electrical energy under high power density conditions.

The proposed composite material addresses these limitations through a three-dimensional nanocapsule architecture that enables uniform heat and current distribution within a pseudo-spongy structural volume.

Structure of the Innovative Composite 1) Nanocapsule Architecture

The material is formed from a multitude of identical nanoscale multilayer spherical capsules. Each capsule consists of:

- a **solid spherical core** made from a material featuring minimal thermal expansion, such as synthetic diamond;
- **plastic metal shells**, composed of highly conductive materials such as copper or silver.

This combination ensures a balanced set of properties: high structural rigidity due to the core and excellent conductivity and plasticity due to the metallic shells.

2) Formation of the Three-Dimensional Structure

The capsules assemble into a regular three-dimensional lattice in which each element has an equivalent system of contacts. This provides:

- stable geometric configuration;
- absence of internal deformation;
- precise calibration of structural parameters.

Physical and Technical Properties

1) Thermal and Electrical Conductivity

The pseudo-spongy organization of the composite ensures:

- uniform heat spreading;
- reduction of localized overheating zones;
- high-speed current transfer throughout the volume.

The nanoscale capsule architecture contributes to enhanced thermal and electrical conductivity.

2) Mechanical Strength and Stability

The combination of a solid core and plastic shells provides:

- resistance to mechanical impact and thermal shock;
- minimization of internal stresses;
- preservation of geometry under high pressures.

3) Resistance to Pulsed Loads

The material can efficiently absorb high-amplitude energy pulses while maintaining stable performance in rapidly changing operating modes, which is essential for miniature electronic components.

Composite Manufacturing Technology

The fabrication process includes several key stages:

1. Synthesis of nanoscale multilayer capsules.

2. Assembly of the capsules into a three-dimensional pseudo-spongy structure.

3. Final plastic calibration in a cold-flow regime, enabling:

- elimination of internal stresses,
- reduction of inter-capsule gaps,
- increased efficiency of heat and current dissipation.

Strict control at all stages ensures reproducibility and stability of the material's functional properties.

Applications and Prospects

The composite is particularly effective in environments with high energy concentration, such as:

- semiconductor laser packaging;
- miniature electronic modules;
- high-frequency and pulsed systems;
- smart home infrastructure components.

Example: Semiconductor Laser Package

The material:

- ensures efficient heat dissipation, stabilizing the operating temperature at 25–27 °C;
- enables reduction of device size without compromising heat dissipation performance;
- provides reliable operation in pulsed regimes with peak loads exceeding nominal values.

A distinctive advantage is the ability to combine functions of thermal and electrical conductivity within a single homogeneous structure, enabling simplified and more efficient device architectures.

Conclusion

The composite material featuring a three-dimensional nanocapsule structure presents a promising solution for high-energy electronic systems. Its key advantages include high thermal and electrical conductivity, mechanical durability, and resistance to pulsed loads.

The proposed material has strong potential for application in smart home systems, microelectronics, and modern devices re-

quiring efficient management of thermal and electrical flows.

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THE PROCEDURE OF FILING A US PATENT APPLICATION

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Abstract

The use of TRIZ and ARIZ analytical tools in US patent applications, including those involving technical systems with elements of artificial intelligence and artificial neural networks, is an optimal approach when preparing application materials for an integrative patent.

The use of modern versions and variations of TRIZ and ARIZ is only one of many possible tools when preparing a patent application. It is important to understand that the effectiveness of the process is largely determined by a set of measures, including the protection of technical solutions, building relationships with investors and strategic partners, and properly presenting the project to experts.

Relationships with investors and potential strategic partners are particularly important in the innovation process. To convince investors of the financial attractiveness of a project, it is necessary to thoroughly explain the essence of the project to experts, including all technological and innovative aspects. Serious protection of the technical solutions underlying the product is essential at all stages of the project's development.

Keywords: *Technical systems; intelligent technical systems; technical subsystems; intelligent technical subsystems; TRIZ analytical tools; ARIZ analytical tools; patent application; application of possible tools in the application; quantum computers; non-obviousness of the claimed technical solution*

Key aspects of preparing a patent application

The title of a proposed invention plays a fundamentally important role in shaping the initial conceptual assessment made by the patent examination authority. It must not only unambiguously reflect the essence of the technical solution but also provide a concise and precise commercial characterization of its potential market impact within the relevant field of application.

A key requirement is to avoid any promotional or emotionally charged language, such as “effective,” “best,” or “unique.” Such expressions are not regarded by experts as objective, and their presence may diminish the impartiality of the evaluation, complicate the demonstration of innovation and non-obviousness, and weaken the overall credibility of the application.

The choice of title should be based on a thorough analysis of market conditions,

assessment of current trends, and forecasting of potential technological and commercial developments. The title must reflect not only the current state of the industry but also the prospective applicability of the invention. Furthermore, if the applicant's goal is to attract investment or establish partnerships with technology companies, it is highly recommended that the title be aligned with the interests of potential investors and partners. This ensures strategic coherence in the application, reinforces the perceived commercial significance of the development, and increases the likelihood of a favorable expert review.

Particular attention should be given to the aspect of proving the invention's non-obviousness, which is a key factor for patent examiners, especially in the United States. The title should be formulated in such a way that it lays the groundwork for substantiating the invention's uniqueness and innovative value. It should briefly and clearly convey the distinct technical and functional characteristics that will later be elaborated upon in the application. Moreover, the title can serve as a strategic instrument for positioning the invention within the intellectual property market, ensuring a competitive advantage and facilitating the integration of the patent into commercial and scientific initiatives.

It is also important to recognize that the title forms the first impression for all parties evaluating the patent – including examiners, investors, and potential partners. It should combine technical precision with strategic informativeness, demonstrating that the invention addresses specific problems, possesses high scientific value, and holds potential for practical implementation. Overall, a carefully chosen title not only increases the chances of a successful examination but also helps present the invention as a scientifically grounded and strategically positioned development on the international stage.

Development of Quantum Technologies

The modern market for intelligent technologies is undergoing profound transformation driven by the emergence and implementation of quantum computing systems. The first practical quantum computers have opened new horizons, triggering a global

race toward achieving “quantum supremacy.” Contemporary models, including devices operating with 20 qubits, employ advanced superconducting technologies and provide computational capabilities unattainable by traditional supercomputers.

“Quantum supremacy” is defined as the ability of a quantum computer to solve problems that cannot be efficiently handled by classical systems. At present, it has been achieved only for a limited set of model problems; however, the ongoing development of quantum computing indicates a steady expansion of solvable tasks and a potential fundamental transformation of the entire computing industry. The leading countries in this domain remain the United States and China, with active research and investment also taking place in Europe, Japan, and other regions – creating a globally competitive environment.

The progress of quantum computing encompasses not only hardware development but also infrastructural solutions: providing remote access to computing power, developing specialized software, integrating quantum and classical systems, building platforms for shared use of computing resources, and forming ecosystems that connect research institutions with commercial enterprises. Investors are actively funding projects in this field, recognizing that quantum technologies represent a strategic resource not only for scientific advancement but also for national security and economic resilience.

Research laboratories and innovation centers working in quantum computing focus on developing algorithms, modeling systems, integrating with existing computational infrastructure, and adapting solutions for practical applications. International collaboration is of particular importance, enabling faster technology adoption, knowledge exchange, and the creation of a global innovation ecosystem. These processes foster both technical progress and economic returns on investment, stimulating the emergence of new industries, services, and startups based on quantum technologies.

Key developers emphasize that quantum technologies are designed to enhance human capabilities across diverse fields such as robotics, autonomous systems, cybersecurity,

artificial intelligence, modeling of complex physical processes, and business process optimization. Their integration into commercial and scientific projects accelerates innovation and enables the creation of high-value technological platforms.

The presentation of the first quantum computer marked an important milestone in the history of technological progress, demonstrating the practical application of scientific research in real-world contexts. This was not an isolated initiative but part of a broader national strategy aimed at maintaining technological leadership, stimulating economic growth, and cultivating a highly skilled scientific and technical workforce. Within this framework, special attention is devoted not only to building devices but also to developing the infrastructure required for practical use of quantum technologies, integrating them into business processes, training specialists, and fostering collaboration between scientific, educational, and commercial institutions.

The advancement of quantum technologies is becoming a key driver of the innovation economy, defining priorities in scientific research, strategic investment directions, and global competitive advantages. Their implementation not only allows for the solution of previously intractable problems but also lays the foundation for the emergence of new industries, the transformation of existing processes, and the deeper integration of intelligent systems into everyday and industrial practice.

In the process of preparing a patent application, both linguistic precision and strategic

foresight play crucial roles in determining the success of an invention's evaluation. The title, while seemingly a small element, functions as the conceptual and commercial gateway to the entire application. It shapes the examiner's perception of the invention's essence, establishes its technological relevance, and signals its potential value within the broader innovation ecosystem. A well-formulated title demonstrates not only clarity and objectivity but also an understanding of industry dynamics and market opportunities, positioning the invention as both scientifically grounded and commercially viable.

The rapid development of quantum technologies exemplifies the need for such strategic presentation. As research transitions into commercialization, inventors must articulate the novelty and applicability of their solutions within a competitive, rapidly evolving field. Properly constructed patent documentation ensures that innovative ideas are not only protected but also effectively integrated into global technological and economic frameworks.

Ultimately, the preparation of a patent application extends beyond legal compliance, it is an act of scientific communication and strategic positioning. By aligning technical accuracy with analytical depth, inventors reinforce the credibility of their work, attract potential investors, and contribute to the collective advancement of technology. In this sense, every patent application becomes part of a broader narrative of progress, bridging the gap between invention and real-world impact.

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Section 5. Medicine

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THE TECHNIQUE OF DRY AESTHETIC TREATMENT IN MANICURE AND PEDICURE: SAFE CARE THROUGH THE GENTLE REMOVAL OF KERATINIZED SKIN, WITHOUT VIOLATING THE NATURAL PROTECTIVE BARRIER

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Abstract

The article presents the technique of dry aesthetic treatment, which is a gentle method of caring for nails and foot skin. This approach allows you to selectively remove excess keratinized skin, while maintaining a natural protective barrier. The rationale for this technique is based on knowledge about the structure of the “thick skin” of the hands and feet, the physiological role of keratinization, the importance of the acid mantle and the indicators of the barrier function of the skin. By avoiding water maceration and using controlled hardware exposure, it is possible to increase the predictability of the result and reduce the risk of micro-damage. At the same time, it is important to comply with sanitary requirements and use only sterile instruments. Particular attention is paid to a risk-based approach to product processing and the use of validated sterilization modes, which ensures the safety and effectiveness of the procedure. The practical value of dry machinery lies in ensuring the safety of services for customers and reducing occupational risks for specialists. This is achieved through strict standardization of the work algorithm, hand hygiene, dust control, and workspace organization.

Keywords: *dry aesthetic treatment, manicure, pedicure, hyperkeratosis, stratum corneum, skin barrier function, acid mantle, transepidermal water loss, selective removal of keratinized skin, sterilization, disinfection, sanitary safety*

Relevance of the study

The study in question is particularly relevant because it combines both medical and practical aspects that affect the quality and safety of modern aesthetic procedures. The

skin of the hands and feet performs the most important function of protecting the body. The horny layer of the epidermis and surface lipid structures protect the body from mechanical damage, excessive moisture loss and

microbial penetration. Therefore, any procedures related to the removal of keratinized tissue require a scientifically based approach. Improper or excessive intervention can lead to microtrauma, disruption of the barrier properties of the skin, increased sensitivity and the risk of inflammatory complications.

In the field of manicure and pedicure, there is still a contradiction between the desire to achieve an impeccable appearance (smooth skin, “perfect” treatment) and the need to preserve natural protective structures. In this regard, gentle technologies based on the principle of minimal and sufficient impact are becoming increasingly relevant. One of the promising directions is dry aesthetic treatment, in which keratinized skin is selectively removed, and the depth and area of exposure are controlled. This allows you to minimize injury and at the same time maintain an aesthetic result.

The importance of this topic increases due to modern requirements for sanitary safety and quality of services. Modern standards for the organization of procedures are aimed at minimizing the risk of skin damage upon contact, strict adherence to hygiene standards and predictability of results. These requirements are directly related to the choice of processing technique and the qualification of a specialist. Under these conditions, a scientific description of the principles of dry aesthetic treatment, criteria for the safe removal of keratinized areas and methods of maintaining the protective barrier becomes necessary for the methodological support of

the training of craftsmen. This will enhance the culture of safe care and reduce the risk of complications in the nail service industry.

The purpose of the study

The purpose of this study is to show that dry aesthetic treatment of nails and feet is a safe method that allows you to gently remove excess keratinized skin without violating the natural protective barrier. We will also define the basic requirements for the procedure and evaluate its sanitary safety.

Materials and research methods

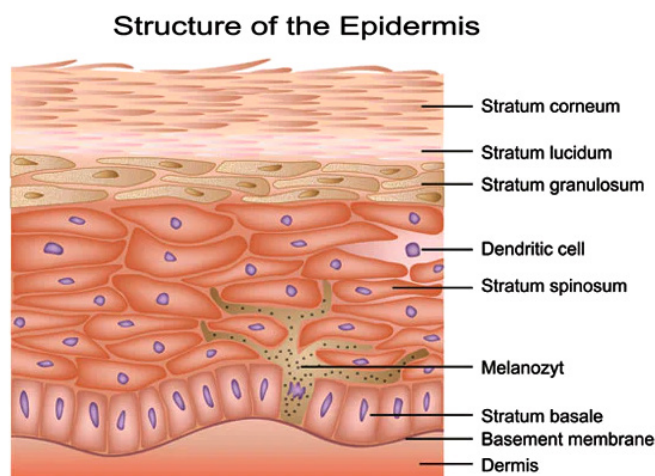
The research is based on scientific and regulatory materials devoted to the physiology and barrier function of the skin, the anatomy of the nail apparatus, as well as sanitary requirements for the provision of cosmetic services. Information on the classification of products according to the level of epidemiological risk and sterilization modes was also studied.

In the course of the work, methods of analytical literature review, comparative analysis of various approaches to skin treatment, systematization of safety requirements and generalization of practice-oriented recommendations on the organization of the procedure and processing of tools were used.

The results of the study

The theoretical foundations of dry aesthetic treatment in manicure and pedicure are based on the understanding that the skin of the hands and feet belongs to the category of “thick skin”.

Figure 1. *The structure of the epidermis (Understanding The Different Layers of Skin – Skin Kraft)*



This means that the epidermis, including the stratum corneum, is adapted to constant mechanical stress and friction. In such areas, the epidermis is well expressed, with the presence of a transparent layer, which is clearly visible in the schematic image of its layers (Figure 1).

It is important to note that the thickness of the epidermis on different parts of the body varies significantly. On average (with the exception of some special areas such as palms and soles) it is about 150 microns. This highlights the need to take into account “regional” features when choosing aesthetic processing techniques.

Physiological keratinization, or keratinization, is a natural process of maturation of keratinocytes and the formation of a stratum corneum on the surface of the skin. This layer performs several important functions at

once: it provides mechanical strength, reduces moisture loss and protects the skin from external influences. In clinical practice, indicators of transepidermal water loss (TEWL) usually assess the barrier effectiveness of the skin. TEWL is the amount of water diffusion through the stratum corneum to the surface of the skin. It is significantly higher on the palms and soles compared to other areas, which is due to the anatomical features of the “thick skin” and the influence of eccrine sweat glands. Scientific publications emphasize that TEWL is a widely used objective marker of the state of skin barrier function in research and clinical practice (Research Techniques Made Simple: Transepidermal Water Loss Measurement as a Research Tool – ScienceDirect).

Figure 2 shows a tevameter, a device for measuring transepidermal water loss.

Figure 2. *Instrument for measuring transepidermal water loss (TEWL), tevameter (Tewameter – Skin TEWL Measurement Device)*



The main component of the skin's protective barrier is an acidic reaction on its surface, known as the acid mantle. Normally, this layer has a slightly acidic pH, usually from 4.5 to 5.5. At the same time, in the deeper layers of the epidermis, the pH is closer to neutral, which creates an acidity gradient. This gradient is necessary for the proper functioning of the enzyme systems of the stratum corneum, the normal “peeling” of cells, maintaining the integrity of intercellular lipids and preventing the proliferation of pathogenic microorganisms. Theoretically, if during the aesthetic treatment of the skin one tries to completely remove the keratinized tissues, without taking into account the necessary protective layer, this can lead to functional

violations of the barrier, even if no damage is visible externally (Importance of Stratum Corneum Acidification to Restore Skin Barrier Function in Eczematous Diseases – PMC).

Special attention should be paid to the area of the nail apparatus, where aesthetic treatment affects not only the skin, but also the structures associated with the nail plate. These include the proximal nail roller, the eponychium (commonly known as the “cuticle”), the nail bed, and the matrix. These elements form an anatomical and functional complex, the main task of which is the mechanical protection of the nail growth zone and the restriction of the penetration of external agents into the proximal part of the nail apparatus. In this regard, a theoretical-

ly sound approach is to strive to preserve protective structures and minimize micro-damage. Carefully correcting the surface excess of horny masses and seals, rather than “aggressively” removing tissues in the area of the physiological barrier achieve the aesthetic result.

In the process of manicure and pedicure, dry aesthetic treatment is a procedure that is performed without pre-soaking. Instead, special hardware techniques and attachments are used for controlled exposure to keratinized skin areas and periarticular areas. This technique is based on two key princi-

ples. Firstly, wet maceration temporarily alters the mechanical properties of the stratum corneum, making it softer and more vulnerable to shearing or tearing. Secondly, properly selected modes of hardware exposure allow you to control the depth and area of contact, which makes it possible to “selectively” remove areas of hyperkeratosis.

Table 1 shows examples of measured parameters that are often found in the scientific literature to describe the barrier properties of the skin. These parameters explain why the treatment of hands and feet requires a special approach and careful monitoring.

Table 1. *Examples of physiological parameters related to the barrier function of the skin*

Indicator	Example value	Site/Condition
Skin surface pH	4.5–5.5	Normal Skin Surface pH Range
TEWL (transepidermal water loss), g/m ² · h	8.6 ± 3.9	Forearm (baseline values in the study)
TEWL (transepidermal water loss), g/m ² · h	45.8 ± 12.1	Palm (baseline values in the study)
Thickness of viable epidermis (average, excluding palms/soles)	~150 µm	Typical Body Sites (not palm/soles)

A source: author's development based on (Impacts of Skin Eccrine Glands on the Measured Values of Transepidermal Water Loss; Review of Stratum Corneum Impedance Measurement in Non-Invasive Penetration Application)

Dry technology is especially useful for hardware pedicure. It eliminates the use of water, which reduces the risk of maceration and makes the skin more vulnerable. At the same time, the requirements for workplace

equipment remain, including the presence of a sink for hand hygiene, and for the sequence of services provided if the master does both manicure and pedicure.

Table 2. *Classification of products according to Earl H. Spaulding and the required level of treatment (disinfection/sterilization) in the practice of manicure and pedicure*

Product category by risk level	A typical manicure/pedicure contact	Required processing level
Critical	They penetrate into tissues and come into contact with blood, which is unacceptable in aesthetic medicine.	Sterilization
Semicritical	Contact with mucous membranes or damaged skin (for example, using a tool that can cause micro-injuries).	It is preferable to carry out sterilization, but you can limit yourself to a high degree of disinfection. In the practice of nail service, especially when there is a risk of skin damage, they usually focus on sterility.

Product category by risk level	A typical manicure/pedicure contact	Required processing level
Uncritical	For contact with undamaged skin only (on some surfaces and equipment).	Disinfection according to the material requirements.

A source: author's development

Table 2 presents Earl H. Spaulding's classification, which allows for the classification of instruments and surfaces by epidemiological risk level. The higher the likelihood of contact with broken skin, biological fluids, or sterile tissue, the more stringent the required treatment regimen, ranging from disinfection to mandatory sterilization.

During "dry" processing, it is important to control three parameters: abrasiveness, machine speed and pressure. The coarser the abrasive and the higher the pressure, the greater the risk of overheating of the fabric, the formation of microcracks and excessive skin removal. Therefore, a safe technique is to sequentially reduce the thickness of hyperkeratosis in several passes. During the procedure, it is necessary to periodically monitor the condition of the skin and stop the treatment if signs of excessive thinning appear uneven pinkness, spot soreness or a sharp increase in sensitivity. During pedicure, it is especially important to maintain the "working" stratum corneum in the support areas. You should not strive for complete "perfect smoothness" in one visit, as this can lead to a violation of the natural barrier.

During the sterilization process, it is important to be guided not only by "traditional" values, but also by officially approved regimes. The clinical guidelines issued by the Center for Disease Control and Prevention (CDC) provide recognized minimum processing times for packaged products by steam sterilization (autoclaving). For gravity sterilizers, these periods are 30 minutes at a temperature of 121 °C, and for pre-vacuum sterilizers – 4 minutes at a temperature of 132 °C. Compliance with all process parameters is a prerequisite for achieving optimal sterilization results (Recommended Cleaning and Disinfection Procedures for Foot Spa Basins in Salons).

The practical value of dry aesthetic treatment lies primarily in improving the safety

and manageability of the result for the client. Avoiding water treatments such as maceration reduces the dependence of the treatment quality on the skin condition and allows for more accurate dosing of the effect on keratinized areas, which is especially important for people with sensitive skin and a tendency to irritation. In the field of pedicure, dry exposure also reduces the risks associated with the use of hot tubs and recirculating "foot spa". The scientific literature describes cases and investigations of outbreaks of skin infections that have been associated with these installations. Mycobacteria were found during the examination of such devices, which underlines the importance of observing strict sanitary standards or choosing technologies that do not require water procedures. If it is necessary to use basins or bathtubs, sanitary services publish detailed protocols for their cleaning and disinfection. These protocols include a requirement for mechanical cleaning and a specific "contact time" with the disinfectant. In practice, this means that the process requires additional control steps and strict rules (Steam Sterilization | Infection Control | CDC).

For a specialist, dry machinery is of great practical importance, as it allows standardizing the workflow and reducing professional risks. Dry hardware treatment fits more easily into the logged algorithm: the sequence of actions, the choice of attachments and modes, skin condition monitoring and fixation of sanitary procedures – all this is easier to bring to uniformity in the learning process and internal quality control. In addition, the importance of protection from dust and aerosols increases with hardware processing. The relevant recommendations on occupational safety and health of employees indicate that good ventilation and local exhaust in the workplace help to reduce the level of chemicals and dust in the air. These recommendations also describe practical options for local exhaust ventilation, such as work area hoods

and ventilated desks. This directly affects the maintenance of the master's working capacity and compliance with the requirements of safe work organization in the salon.

In the future, the development of dry aesthetic technologies will be associated with the further "medicalization" of safety standards. This means that more attention needs to be paid to hand hygiene and proper glove use. Gloves cannot replace hand treatment, so they need to be put on and taken off only after the hands have been thoroughly washed. This will provide more reliable protection against the cross-spread of microbes in various fields of activity, including services. Dry aesthetic treatment is gradually becoming the standard, as it not only improves the quality of service, but also supports safety requirements. This is achieved through standardization of actions, special ventilation solutions in the workplace and compliance with strict hygiene standards.

Conclusions

Thus, dry aesthetic treatment in manicure and pedicure is scientifically justified from the point of view of physiology and sanitary and hygienic standards. This technology allows you to dose the effects on hyperkeratosis and preserve important structures of the skin barrier system. To ensure the effectiveness and safety of the technique, it is necessary to observe the principle of minimal necessary intervention. It is important to pre-assess the condition of the skin and identify risk factors. When manipulating potential skin damage, only sterile instruments should be used. The level of processing of products according to the classification of Earl H. Spaulding should be selected based on a risk assessment. Only proven sterilization modes should be used. Standardization of the algorithm, hand hygiene and dust load control significantly improve the quality of services for customers and reduce professional risks for specialists.

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Section 6. Philology and linguistics

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IRISH LITERATURE AND THE WESTERN EUROPEAN TRADITION: A PERSPECTIVE FROM JAMES JOYCE'S "THE DEAD"

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Abstract

Irish literature stands among the oldest literary traditions in Western Europe, alongside Latin and Greek. Its origins trace back to the 4th and 5th centuries, during which the Ogham script a distinctive system of writing was employed from the early medieval period onward. Despite its unique linguistic and national characteristics, Irish literary production has long been intertwined with English language and culture, shaped by the phenomenon of the “dual tradition.” This entanglement often led to the assimilation of Irish authors and their works into the canon of English literature, a process further facilitated by the fact that many prominent Irish writers lived and worked in England as emigrants. Figures such as Edmund Burke, Jonathan Swift, Oliver Goldsmith, Oscar Wilde, and George Bernard Shaw were, until the early 20th century, traditionally regarded as English or British authors. However, following Ireland's partial independence and separation from England between 1920 and 1922, literary scholarship began to reclassify these writers and their works as integral to Irish cultural heritage. This shift is reflected in the emergence of the term “Anglo-Irish” literature, denoting works produced by Irish authors writing in English, often while residing in England.

From the 17th century onward, Irish society existed in a paradoxical state simultaneously colonial and nationally autonomous. This duality became a persistent source of cultural tension within Irish literature, manifesting in four central thematic concerns: land, religion, nationality, and language. The profound cultural trauma engendered by this condition gave rise to Anglo-Irish literary expression. A quintessential figure of this tradition and arguably its architect was William Butler Yeats (1865–1939), a leading voice of the Irish Literary Revival and a pivotal contributor to European literary modernism during the 1920s and 1930s. While the late 19th-century Renaissance invigorated Irish nationalism with new texts and cultural energy, Yeats aspired to forge a modern Irish literature in the English language. Until the end of his life, he produced works of profound significance, particularly in poetry, often exploring paradoxes of identity and emotion. As Yeats himself declared: “I owe my soul to Shakespeare,

to Spenser, and to Blake... and to the English language in which I think, speak and write...; my hatred tortures me with love, my love with hate.” In 1923, just one year after Ireland gained independence from England, Yeats was awarded the Nobel Prize in Literature, recognized for expressing “the soul of a whole nation” through his poetic oeuvre.

Keywords: *Irish literature; Ancient Western European literature; James Joyce; “Dubliners”; “The Dead”*

Introduction

The early twentieth century marks the emergence of a distinct literary phenomenon: the modern short story cycle. This development is exemplified by the publication of James Joyce’s *Dubliners* in 1914, which is widely regarded as a foundational work in the genre. The modernist short story cycle retained many of the characteristics previously identified in earlier narrative forms, but now rendered with greater stylistic refinement. The influence of the Renaissance is palpable, particularly in the shifting themes and motifs that distinguish these stories from their predecessors. In a 1904 letter to his schoolmate and friend Constantine P. Curran, Joyce revealed that he was composing a series of epiphanies that would soon be published under the title *Dubliners*: ‘I am writing a series of epiphanies – ten – for a paper. I have written one. I call the series *Dubliners* to betray the soul of that hemiplegia or paralysis which many consider a city.’ (Letter to Curran of early 1904, in *Letters*, I, 1966, p. 55; *Selected Letters*, 1975, p. 22.)

The narrator in each of the stories in *Dubliners* follows a consistent trajectory, tracing the stages of life from childhood and adolescence to maturity and eventual engagement with public life. It is no coincidence that *Dubliners* is often considered an archetype of the short story cycle. In such cycles, where characters inhabit the same geographic space, a pronounced sense of mutual estrangement frequently emerges. The narrative segmentation mirrors the boundaries that define their everyday existence. Characters who walk the same streets and whose stories unfold side by side remain, often unknowingly, indifferent to one another. This structural unity and the tension between individual narratives are hallmarks of the modernist approach to the short story cycle. Joyce’s influence is unmistakable in the works of later American modernist writers such as Ernest Hemingway, John Steinbeck, and William Faulkner, all of

whom adopted and adapted the short story cycle form in their own literary explorations.

The representation of Irish history and national identity stood at the forefront of twentieth-century Irish literature. The pursuit of Irish national identity has been a central objective for writers from the early Literary Revival to the era of contemporary Irish fiction. James Joyce, in his narrative approach, drew extensively upon his personal experiences in his homeland. Through a distinctive lens, he portrayed Ireland as a nation afflicted by paralysis a metaphorical condition shaped by the social, religious, and political forces that profoundly influenced the moral fabric of Irish identity and played a pivotal role in the exploration of national consciousness.

Joyce, both directly and indirectly, used his literary works to critique the Irish people’s attachment to the past and the constraints imposed upon them by religious and social conventions. His writing constitutes a form of protest against the very structures that many Irish citizens were unwilling or unable to challenge. Even in the era of a “globalized Ireland,” the nation continued to bear the weight of its oppressive historical legacy, finding itself in a world governed by submission and conformity. Through his characters, Joyce endeavored to give voice and conscience to Irish society. His artistic vision aimed at constructing an Ireland liberated from the stereotypes and limitations of traditional Irish life. Such a transformation, he believed, could only be realized if the nation itself broke free from inherited constraints and embraced a forward-looking perspective.

In James Joyce’s *Dubliners*, the short story “The Dead” offers a profound reflection on national identity through its protagonist, Gabriel Conroy. Gabriel’s rejection of various aspects of Irish heritage including its language reveals a critical stance toward his homeland. This attitude resonates in contemporary Irish fiction, where characters often live in the present

while remaining psychologically tethered to the past. Such portrayals underscore the burdensome and inhibiting nature of historical memory for individuals navigating modern life. Joyce made a significant contribution to Ireland's political and cultural discourse by crafting literary perspectives on pressing social issues that confronted the nation in the twentieth century. He believed that the complexities of Irish history, the dominance of Catholicism, and the entanglements of politics exerted a profound influence on the Irish mind and modes of thought, ultimately shaping behavior and societal norms. Through his characters, Joyce depicted segments of Irish society that, in various ways, constrained the freedom of others sometimes even within intellectual domains. This realization compelled him to use literature as a weapon to critique the lingering flaws of Ireland's past, even when such critique targeted the very foundations of national identity. Gabriel Conroy, an educated and self-possessed Irishman, serves as Joyce's voice of dissent. Disillusioned by the limitations imposed by tradition, Gabriel expresses a desire for connection with European culture, which he views as more refined and liberating than the stifling atmosphere of Dublin. As a Dubliner who sees little of value in his immediate surroundings, Gabriel chooses instead to align himself with the sophistication of continental Europe. Through Gabriel's perspective, Joyce suggests that Irish identity should not be constructed through retrospective idealization, but rather grounded in the realities of contemporary Ireland and its dynamic engagement with the present.

James Joyce's rebellious stance toward Irish society was deeply rooted in his early life experiences, shaped by family, religion, and political disillusionment. Born into a middle-class Catholic family in Dublin in 1882, Joyce was the eldest son of John and Mary Jane Joyce. His early education at Clongowes Wood College, a prestigious Jesuit school, was abruptly interrupted due to his family's financial collapse. This downturn was closely tied to his father's political support for Charles Stewart Parnell, a prominent Irish nationalist leader. After Parnell's fall from grace and subsequent death, Joyce's father lost his job as a tax collector, plunging the family into poverty. This early rupture being forced to leave school,

friends, and familiar surroundings left a lasting impression on Joyce's psyche. He began to feel alienated, a theme that would later permeate his literary work. The experience instilled in him a desire to distance himself from the oppressive structures of Irish life, particularly the authoritarian and religious constraints he associated with his family and society at large. Despite excelling academically and mastering several European languages, Joyce remained fiercely independent in thought. He viewed the rigid morality of Irish Catholic households as a form of intellectual imprisonment. In a 1904 letter to his future wife, Nora Barnacle, Joyce expressed disdain for the social and religious order of his upbringing, describing his family as bearers of "distorted middle-class habits" and victims of a system that had left its mark even on their faces. This personal history of displacement, repression, and intellectual resistance profoundly influenced Joyce's literary voice. His works often critique the paralyzing grip of tradition and advocate for a more liberated, cosmopolitan Irish identity. Through characters like Gabriel Conroy in *The Dead*, Joyce gave voice to his own frustrations and aspirations seeking not only personal freedom but a cultural awakening for Ireland. „My mind rejects the whole present social order and Christianity home, the recognized virtues, classes of life, and religious doctrines. How could I like the idea of home? My home was simply a middleclass affair ruined by spendthrift habits which I have inherited. My mother was slowly killed, I think, by my father's ill treatment, by years of trouble, and by my cynical frankness of conduct. When I looked on her face as she lay in her coffin – a face grey and wasted with cancer – I understood that I was looking on the face of a victim and I cursed the system which had made her a victim" (Letters, II: 48) (Seidel, M., 2002: 42).

From James Joyce's perspective, the Catholic Church an institution that wielded not only religious but also political authority in Ireland was a source of domination, stagnation, and disillusionment. As a young Dubliner, Joyce made deliberate efforts to distance himself from these oppressive structures and used his literary work as a form of protest. He viewed Catholicism in Ireland as a system that fostered submission, alienation, and authoritarianism, and he regarded the Church as

a major impediment to both personal and national development. Like many of his contemporaries, Joyce turned to European culture and aesthetics in search of intellectual and artistic liberation. He left Dublin and spent time in Paris, London, Zurich, and even the United States. These travels exposed him to diverse cultures, races, and individuals, deepening his sense of estrangement from his homeland and sharpening his critique of Ireland's dominant ideals and educational methods. As a result, critics often perceived Joyce as indifferent to his country and people. Having left Ireland at a young age, he positioned himself as part of the modernist avant-garde and never returned to live in his native land, identifying instead with the role of the exile. In light of this, the final story in *Dubliners*, "The Dead," is often interpreted as semi-autobiographical. The narrative touches on themes that Joyce himself experienced, particularly the complex relationship between the Irish people and their homeland. For Joyce, the essential task of the Irish writer was not to promote patriotism, but to illuminate the cultural, economic, social, and political instability of contemporary Ireland. Through his writing, Joyce renounced the Ireland of his time and sought spiritual peace beyond its borders, finding solace in literature itself.

Conclusion

As has been noted on multiple occasions, from the early 20th century onward, Irish literature began to distinctly reflect themes of significant cultural and historical relevance. These themes found expression across the

prose, fiction, and drama of the period. Central to the literary focus of 20th - century Irish writers was the depiction of Ireland's history and the articulation of national identity. Consequently, many literary figures of the time concentrated their creative efforts on exploring Ireland's historical, political, and religious issues. From the twentieth century onward, Irish literature became distinguished by its engagement with significant themes that found expression across poetry, drama, and prose fiction of the period. Irish authors increasingly focused on the historical, religious, and political dimensions of their homeland, using literature as a medium to explore and reflect upon the complexities of national identity. Ireland itself emerged as a profound source of inspiration for many writers of the time, who sought to portray their native land and foreground thematic concerns that held particular resonance in the lives of the Irish people.

The economic prosperity of Ireland's past played a pivotal role in shaping the foundation of a strong and modern Irish state. This resurgence was further reinforced by improved economic conditions and the return of emigrant populations, contributing to Ireland's re-emergence as a robust contemporary nation. However, despite these developments, nationalism continues to be one of the dominant ideologies within Irish society. As such, the concept of modern Ireland underscores the pressing need to transition from traditional nationalism to a post-nationalist framework – one that enables a dynamic reconstruction and reform of Irish culture and identity, grounded in the nation's historical legacy.

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Section 7. Political science

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DEMOCRATIC IN THE POST-SOVIET STATES FEATURES OF MODERNIZATION

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Abstract

The article is devoted to the problems of modern development of the post-Soviet states, the main trends and processes of their democratic modernization. The author analyzes the validity of the use of the term “post-Soviet space” and expresses the opinion that this space is disintegrating into various segments, including on the basis of the ethnic matrix.

Keywords: democratic modernization, national interests, transforming states, post-Soviet space

First of all, let us note that it is no secret that the hopes of the political elite and the population of many post-Soviet countries for the democratic transition that began in 1991 were greatly exaggerated. This gave rise to the question for many experts whether the theory of democratic transition is entirely unpretending. There were even discussions about abandoning the idea, since it does not really explain anything – supposedly the old communist totalitarian models have been replaced by some conservative political structures that are hardly correlated with democratic standards and practically do not evolve. To what extent is this true and to what extent is such statements an exaggeration – we do not have the task of analyzing such a thing. We will only note one fact: the textbook “What is Democracy?”, translated into more than 30 languages

of the world (What is democracy? 1991), presents the history of democratic ideas, discusses the problems of civil rights, the rule of law, elections, culture, governance, and participation in political life, but nowhere does it contain a precise definition of democracy. And this is not at all accidental. Precisely because of its universality, as American authors Matthew Handel and Chester E. Finn noted, “the demand for democracy swept the whole world, becoming an epidemic” (Handel M., Finn Ch. E., 1995, p. 17).

In practice, this “boom” has led to the fact that, according to a number of scholars (S. Huntington and others), although about 30 percent of states are real institutional democracies, almost all countries in the world are formally democratic. Edgar Morin, one of the prominent Western followers of this

problem, analyzing the fate of democracy in the “USSR-CIS” space, notes: “The peoples of the former “Soviet Union countries” are in a vortex of a triple crisis: the loss of the guarantees of the economic-bureaucratic economy has by no means been compensated by totalitarianism, contrary to political life; democratic systems that have become dilapidated and have given way to weak and, in any case, no longer having strong roots – if we take into account that legitimate patriotism is giving way to militant and backward nationalism, stimulated by the economic crisis, the crisis of democracy and, finally, the countless problems of national minorities ...” (Moren E., 1995, p. 2).

Professor Jan Egbert of the University of Mannheim goes further in his reasoning, arguing that nationalism and democracy are derivatives of the same fundamental historical idea, namely the idea of popular sovereignty. Having identified five main forms of nationalism, he makes a rather pessimistic forecast: people of the 21st century will most likely have to face four types of nationalism: established nations; macroregional, continental nationalism of European, Indian and some other sub-nationalities; microregional sub-nationalism of weak nations; and finally, the collective nationalism of scattered and isolated ethnic minorities, as well as neo-nomadic, mobile social groups from territorial nations (Egbert Ya., 1996).

Unfortunately, in modern scientific discourse, one can also find a primitive understanding of democratic transition – supposedly in most CIS countries authoritarian regimes arose as a transitional form from totalitarianism, its “soft variant”. It is difficult to agree with this, because the emergence and essence of authoritarianism does not lie in someone’s “strong will” or “powerful clans”, but in the depth of the historical reality of certain countries, in the options and methods proposed for solving the problems that arose there. For example, S. Huntington notes: authoritarian regimes can effectively govern multinational peoples; democracies are generally not very suitable for solving ethnic problems; the democratic process itself and the functioning of democracy can complicate relations between ethnic, religious and other groups in society (Huntington S., 1990).

At one point, it should be noted that the democratic transformation processes of these countries coincide with the processes of globalization. In such conditions, post-Soviet countries, which do not have sufficient potential for fundamental structural reforms, often cannot solve their problems, and their attempts at independent action are constantly faced with resistance from member states of various blocs. It is for these reasons that political transformations in some states of the post-Soviet space take on a wave character. If we also take into account the presence of numerous conflicts, then the conclusion of the Russian political scientist D. Mikhailichenko that the impact of military conflicts on the post-Soviet space significantly reduces the institutional opportunities for democratization has not lost its relevance.

As we have seen, the above material allows us to draw several general conclusions regarding the main factors and trends of democratic transition in the post-Soviet states. The following can be distinguished as the main factors that directly or indirectly affect the state, form and dynamics of democratic processes in the newly independent states:

First, the economic factor: a) low and uncompetitive initial level of socio-economic development, weak internal economic relations, mainly raw material forms of international economic specialization; b) inconsistency in the implementation of market reforms here, dangerous tendencies to create a “market” type of economy, “opacity” of emerging market relations, including nomenclature capitalism, etc. c) weak participation of post-Soviet states in the development of world integration, therefore, the dominant forms in them still remain “national integration” processes. Thus, the low level of pluralism of market systems in the transforming states of this macroregion significantly weakens the democratic foundations of the political structure, creates material.

Secondly, the political factor: a) the presence of a polyethnic structure of society in virtually all post-Soviet states, the spread of ethno-nationalism and the dominance of ethnocratic elites; 6) further formation and strengthening of the identity of post-Soviet states will be carried out, first of all, on a national basis; c) there is a combination of

market-capitalist relations and the remnants of Soviet thinking, the weakness of democratic traditions in political culture with elements of the formation of a pluralistic environment. In other words, the “blurring” and deformations in the process of democratic consolidation are decisively determined by the incompleteness of the post-communist transformation in the political, economic and socio-cultural spheres.

The “wave of democratization” in the post-Soviet states not only carried out the structuring of new institutions and technologies that to one degree or another meet the requirements of modern development, but also led to the emergence of completely new trends in their democratic evolution. First of all, we note that at least two main levels can be distinguished in the emergence of ethno-political conflicts: internal and external. The internal dimension of the problem lies in the active inclusion of ethnic actors in the political process, that is, in the emergence of an ethno-political process that acts as a process of interaction between sufficiently large groups of the population, each of which is characterized, on the one hand, by a necessarily expressed ethnic identity, and, on the other hand, by certain or de facto existing institutions.

Thus, ethno-national movements tend to sharpen the demands they put forward (from ethno-cultural to economic, from them to political, status, etc.) and, accordingly, to toughen the forms of struggle for their implementation. At the same time, a tendency can be observed: the period of pause is used not to find optimal ways out of conflicts, but to gather forces for their continuation.

The external dimension of ethno-political conflicts is manifested in the fact that in the era of globalization they increasingly take on the character of geopolitical problems (for example, the resolution of the conflicts in Kosovo, Abkhazia, South Ossetia, which have international causal significance). It is no coincidence that most governments involved in ethnic conflicts often try to explain their causes by external interference (real or imagined) in the internal affairs of these states.

Opponents of this approach, which is primarily reflected in the theory of primordialism, proceed from the fact that, in their opinion, the complex of ethnic relations,

ethnic life as a whole, with its associated features (ethnic history, psychology, mentality, etc.), a special social substance – the ethnic sphere, indisputably operates. Since here we can speak of the “real existence of an ethnic substance that is active and creates ethnically colored social phenomena”, then even primordialists in their extreme manifestations come to the conclusion that only the existence of the nation, the *ethnos*, is absolute, everything else is relative.

First, the formation of nations and nation-states is undoubtedly a historical process that goes back centuries. However, it is equally undeniable that since the beginning of the 20th century, the dynamics of state-building have been steadily accelerating. Thus, out of the nearly 200 states that exist today, there were only 15 in 1910, and each new period of geopolitical upheaval (the First and Second World Wars, the collapse of the colonial system, and world socialism) has only given this process an additional impetus.

Second, when analyzing democratic processes in the context of globalization, one cannot focus solely on conflictual factors and processes. This approach is understandable if we consider that globalization expands the communication “web” of interdependencies across existing borders and barriers between peoples, thereby uniting diverse ethnic identities into a global unity at the level of a new civilization.

Thirdly, the challenges and threats of globalization already today confront virtually all peoples (both those who created their own states and others) with a dilemma: either to preserve ethnic identity in their historical reality, or to search for a new formula for the adaptation of ethnosocial content. This means that no country in the world, especially a state with a multinational population, can ignore ethnic problems and contradictions in the context of ensuring its national security.

Fourth, the contradiction between the norms of international law that define the framework of state sovereignty and the processes of globalization that create the basis for the intervention of international and regional organizations in internal affairs, including in connection with interethnic conflicts, is deepening. This, in turn, leads to the emergence of leading world powers and in-

ternational supranational actors of neo-imperialism, the struggle for the redivision of the world, “double standards”, etc.

Thus, in political science and in the political practice of the late 20th and early 21st centuries, one can trace a certain transformation of existing ideas regarding the context of democratic transition – from simple to more complex and multi-factorial. In the era of globalization, when the cause-and-effect

foundations of conflicts shaking the world are transformed, there is a need, in essence, to change the theoretical and methodological paradigm in understanding democratic processes, and on this basis to form a multidimensional and multi-level functional system, in which the transfer of real national interests is a necessary condition for optimizing the modern process of democratization of society.

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Section 8. Psychology

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THE ROLE OF THE COLOR PALETTE IN SHAPING THE EMOTIONAL EXPRESSIVENESS OF THE FRAME

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Abstract

The article is devoted to a comprehensive study of the role of color in creating expressive and emotionally charged images in cinema, photography and digital graphics. It examines the psychological aspects of color perception, its ability to enhance drama, emphasize the character of characters, set the pace and rhythm of a scene, and attract the viewer's attention. Special attention is paid to the interaction of the color palette with composition, light, texture and space, as well as how cultural codes influence the interpretation of shades. The article describes how color helps the author to create emotional accents, convey visual symbols and reveal deeper meaning in the frame. The authors give examples of contrasting and harmonious color combinations, as well as discuss techniques for creating a color script and shaping the overall style of a film or series of photographs. They emphasize that the skillful use of color is a powerful tool of artistic expression, which directly affects the perception and emotional response of the viewer.

Keywords: *color, color palette, expressiveness of the frame, emotional mood, visual image, color perception, cinema, photography, composition, light, coloristics, visual drama*

Relevance of the study

In modern visual culture, color is the most important means of expression. It is he who determines how the viewer will perceive the meaning, atmosphere and emotional overtones of the frame.

Modern color correction tools and the growing volume of visual content require a clear understanding: how exactly the color shapes the mood of the frame and strengthens its composition.

The relevance of this research is due to the need to systematize knowledge about color as a means of artistic expression, identify patterns of its impact on perception, and develop professional techniques for applying the color palette in areas such as cinema, photography, animation, and media art.

The purpose of the study

The purpose of the study is to comprehensively study the role of color as an artis-

tic tool: to identify its importance in shaping the expressiveness and emotional tone of the frame, to analyze the mechanisms of psychological impact on the recipient, as well as to trace the influence of color solutions on the perception of plot, compositional and stylistic aspects of the image. Additionally, it is planned to study applied strategies for using color to enhance dramatic potential and create a holistic artistic image.

Materials and research methods

The materials science base of the study consists of representative visual sources: film frames photographic images, illustrative materials, as well as digital visual projects, including the results of color correction and computer graphics.

The methodological framework includes visual analysis, comparative historical method, psychophysiological and artistic-aesthetic study of color perception, as well as the analysis of professional color schemes and industrial image processing technologies.

The methodological basis of the research is formed based on a systematic understanding of the theory of color, applied aspects of coloristics, compositional principles and methods of light organization of the frame. This interdisciplinary approach provides a comprehensive assessment of the effect of the color palette on the expressive qualities and emotional saturation of the visual image.

The results of the study

The history of studying the influence of color on the expressiveness and emotional component of an image has many stages and cultural layers. Its origins can be traced back to ancient philosophy, where ideas about color harmony and the natural properties of chromatic phenomena were formed.

Already in ancient Greece, philosophers paid special attention to color, considering it as a carrier of meaning and a means of influencing human perception. During the Renaissance, interest in color reached new heights thanks to artists who actively experimented with shades and contrasts, seeking to enhance the dramatic effect and create depth of space.

In the XVIII and XIX centuries, Goethe and Chevreuil created the first scientific theories of color. Goethe studied its psychological influence, and Chevreuil studied optical patterns. Their work formed the basis for subsequent research.

Although color science, the science of the nature of color and its basic properties, originated only in the 19th century, the characteristics of the color spectrum and the patterns of its perception have been studied since ancient times. The first scientific research in this field is considered the work of Isaac Newton. He approached the study of color from the point of view of physical color science. At the same time, Johann Wolfgang von Goethe, known for his philosophical writings, for the first time tried to explain how a person perceives color and what psychological reactions it causes.

With the development of photography and the advent of cinema, color has become an important expressive element, although cinema for a long time remained black and white, which stimulated theoretical research into color perception.

In the second half of the 20th century, with the arrival of color cinema and the expansion of technical possibilities, interest in colored drama increased, and filmmakers and cinematographers began to intentionally use color palettes to manipulate the emotional tone of a scene (Goethe I. V., 2012).

Table 1. *Comparative analysis of traditional (classical) and modern (contemporary) art (Guk A. A., 2024)*

Criteria of functionality	Traditional (classical) art (painting, theater, choreography, music, etc.)	Contemporary (current) art (non-specific, non-genre)
The subject of art (the author)	An outstanding personality with a special gift and unusual abilities is a true demiurge.	The author does not exist as such. The subject of this work is a curator – interpreter with a design (technological) mindset.

Criteria of functionality	Traditional (classical) art (painting, theater, choreography, music, etc.)	Contemporary (current) art (non-specific, non-genre)
The process of artistic activity	Intuitive, irrational, carried out on a whim, illumination from above (something from nothing), emotionally costly, demonstrating mastery of representation	Logical, constructive, modeling, clearly following the set goal, rational, approving the presentation, the purpose of which is to problematize reality.
A work of art	The embodiment of value, a sacred and unique object that primarily affects human feelings.	It cannot be considered as something material, it exists only in the form of an idea, a concept.
Perception of art (process)	It happens when a person who has received a work of art tries to understand the artist's intention. As a result, he may experience a sense of relief and joy.	The viewer becomes a co-author of the project, creating his or her own aesthetic codes in the process of intellectual play.
Art object (viewer, audience)	A mass, profane, non-specialized, sensitive audience	Highly specialized, trained, reflective audience.

Since the 80s of the 20th century, photography has firmly taken its place in the context of modern art, which by that time had already clearly defined its artistic and creative principles. These principles can be clearly seen in the table in which modern art is compared with traditional (classical) art (Table 1).

In the 2000s, deep visual research based on perceptual psychology, information design, and cognitive science was conducted. These studies have made it possible to systematize knowledge about the role of color in creating mood. Today, the concept of color expressiveness is considered at the intersection of various disciplines such as art history, media studies, neuropsychology and digital technologies. This interdisciplinary approach allows us to better understand the mechanisms of color effects and use them to create a vivid visual image in the frame.

It should be noted that in modern visual culture, color has become one of the key tools for managing the emotional perception of an image. This has become possible thanks to digital technologies, fine-tuning of color correction, and the development of perceptual psychology.

In modern cinema, advertising, video games and digital photography, the choice of a color palette is carried out for a reason, but taking into account a deep understanding of how different shades affect the viewer's perception. For example, in recent years, the

cinema has often used the so-called "pastel" palette, based on the natural contrast between warm human skin and cold background shades. This approach gives the frames dynamism and visual appeal (Shalimova L. A., Nasonova L. I., 2012).

In the TV series *Gone with the Wind*, the color of the sky serves as one of the means of expressing the emotions of the main character. As the story progresses and the drama intensifies, the color of the sky reflects her feelings. In *The Joker* movie, the predominant shades of green and yellow enhance the feeling of decline and anxiety, creating an unsettling atmosphere that highlights the psychological instability of the protagonist.

The influence of color on a person consists of physiological and culturally determined reactions. Warm shades such as red and orange activate the sympathetic nervous system, increasing arousal levels and being associated with energy, danger or passion. Cold colors, such as blue and light blue, on the contrary, reduce emotional tension, creating a feeling of distance, emptiness or calm. Green is often associated with nature, but in a certain context, it can cause a feeling of decline or anxiety (Fig. 1) (Shmakova E. Y., 2022).

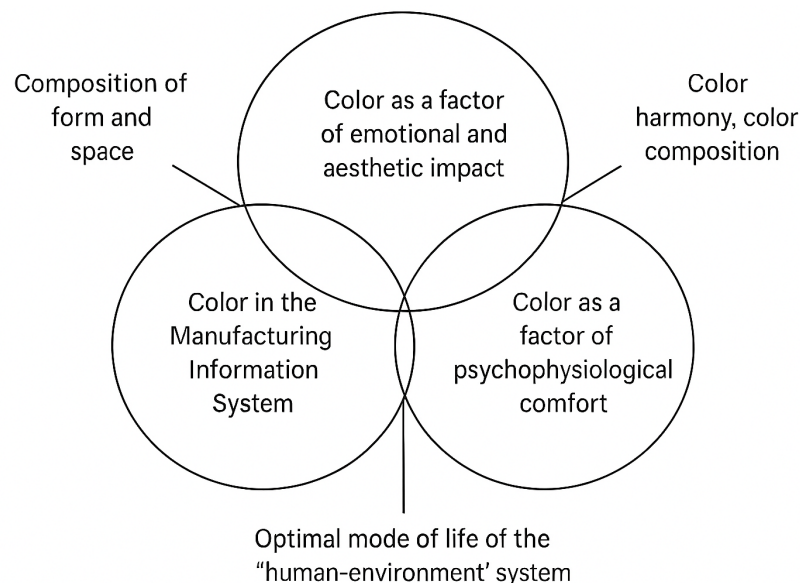
Modern color grading opens up new horizons in the art of creating an emotional atmosphere. By changing saturation, contrast, and hue, the authors can fine-tune the atmo-

sphere of a scene, creating tension, romance, alienation, or dynamics.

In video games, digital color analysis algorithms adapt the palette in real time. In

moments of danger, the picture becomes more contrasting and red, and in calm episodes, the saturation decreases, creating a soft visual field.

Figure 1. *The main tasks solved with the help of color*



Modern examples of the use of color show that it has ceased to be just an aesthetic category, but has become a powerful tool of psychological influence, subtly controlling the emotional states of the viewer. Thanks to technological development and interdisciplinary research, the mechanisms of color influence have become more precise, meaningful and flexible. This allows the authors to create deeply expressive and emotionally intense images.

There are many techniques for working with color in photography that can help achieve the desired effect:

1. Contrasting colors – is one of the simplest and most effective techniques. Contrasting colors placed opposite each other on the color wheel create bright and expressive compositions. For example, a combination of blue and orange or red and green can be very effective.
2. Monochrome palette – this technique is used to create a unified atmosphere or accentuate a certain sensuality in photography. It involves the use of different shades of the same color, which create a harmonious composition.

3. Accent color – is the use of bright colors in limited quantities against a more neutral palette. This technique allows you to draw the viewer's attention to the key elements in the photo.

4. Color filters – are special programs that allow you to change the color of a scene or object in a photo. For example, a yellow filter can create a warm atmosphere, while a blue filter can create a cool one (Profitnova D. M., 2023).

It is important to note that in the modern visual space, where digital technologies open up truly limitless horizons for working with color, the problems associated with its use to create expressiveness and mood in the frame become especially obvious.

One of the key difficulties is the excessive standardization of color solutions. The authors often follow fashionable palettes, such as the common combination of turquoise and orange. As a result, visual language loses its individuality and begins to be perceived as a template.

Another difficulty faced by filmmakers is the risk of emotional saturation of the frame. When the saturation and contrast of colors become too bright, they can tire perception and reduce the power of artistic impact.

Often, the choice of color in a frame is determined not by drama, but by the technical capabilities of color correction. Because of this, expressiveness can become artificial, and emotional meaning can become superficial.

In addition, there are cultural limitations: viewers from different regions perceive the same colors differently, which can lead to unexpected reactions and a violation of the author's intention. Problems also arise when mixing light sources with different temperatures, which complicates palette management and may compromise the integrity of the visual style. In the digital environment, another difficulty is the different color rendition of screens: shades perfectly aligned on a professional monitor can be distorted on household devices, which disrupts the intended atmosphere.

All this makes working with color a complex and multifaceted process. Lack of attention or technical limitations can easily lead to a loss of expressiveness and emotional accuracy of the frame.

In our opinion, in order to effectively use color to create expressive shots and convey mood, it is necessary to combine artistic vision and technical skills.

One of the important stages is the development of the author's color concept at the preparatory stage. The author determines in advance the emotional objectives of the work and selects a palette that will reflect the storylines, characters and atmosphere. This approach allows you to avoid standard solutions and create your own unique visual language.

To avoid emotional overload, it is important to consciously control saturation and contrast. It is necessary to find a balance between expressiveness and naturalness, as well as to take into account the dynamic perception of color by the eye.

Another important measure is following the dramatic logic. In this case, the color solutions will be justified by the internal structure of the work and will not depend on fashion trends or technical effects. To account for cultural differences in color perception, it is necessary to research the target audience first. It is important to use universal emotional codes and carefully work with symbols so as not to distort the perception of the audience.

The technical difficulties associated with the different color temperatures of light sources are solved using a well thought out lighting scheme. It is important to use light sources with the same characteristics and accurately calibrate the equipment during shooting.

To minimize color distortion on various devices, it is recommended to use professional calibrated monitors, correct color profiles, and standardized workspaces. This will keep the palette stable for subsequent playback.

All these measures are aimed at restoring color to its main function – to be an expressive, accurate and emotionally justified tool for visual storytelling.

Conclusions

To understand how color affects photos, you need to understand its basic properties. Color can be described as the ability of objects or their surfaces to reflect a certain spectrum of electromagnetic waves. In photography, color is conveyed through a combination of three primary colors: red, green, and blue. These base colors can be combined to create a wide range of shades. But even with perfect mastery of photographic technique, it is always important to take into account the aesthetic perception of the future image.

One of the ways to use color in photography is to create contrasts that help attract the viewer's attention. For example, a black-and-white photograph may include one or more color elements that emphasize a particular detail or object. Also, strong contrasts between bright and dark tones can emphasize the shapes and lines of an object.

When choosing a color for a photo, it is important to take into account not only the emotions and associations that it evokes. It is equally important to consider the combination of shades, lighting, and other factors that can affect the perception of photography. The colors have a mutual effect on each other, varying in hue, lightness and saturation.

Competent work with color requires both artistic sensitivity and technical precision. Creating a well-thought-out color concept, paying attention to saturation, contrast and the light environment, as well as taking into account the cultural and psychological characteristics of perception make it possible to avoid randomness and visual noise.

Systematic control over all processes – from preparation to post-processing – ensures stability, expressiveness and consistency with the drama of color. Due to this, color ceases

to be just a part of the image, but becomes the most important element of the semantic structure, which enhances the emotional effect and gives depth to the visual narrative.

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THE PSYCHOPHYSIOLOGICAL EFFECT OF EYEBROW SHAPE ON SOCIAL PERCEPTION: AN ANALYSIS OF THE RELATIONSHIP BETWEEN MICRO-EXPRESSIONS OF THE FACE AND GEOMETRIC FEATURES OF EYEBROWS

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Abstract

This article analyzes the psychophysiological effects of eyebrow shape on the perception of human emotions and social interaction. The article explores how the geometry of eyebrows and emerging micro-expressions affect the understanding of intentions, emotional state and personal qualities of a person. Special attention is paid to neuropsychological aspects of emotion recognition. The role of the arch, angle of elevation, density and symmetry of eyebrows in the formation of the first impression is considered. The influence of cultural and biological factors on the perception of these signals is also being investigated. The paper analyzes data on how the shape of eyebrows can change the perception of such characteristics as dominance, friendliness, reliability, anxiety, and confidence levels. The study showed that even minor changes in the micro-movement of the eyebrows activate automatic cognitive processes, which, in turn, affects social behavior and the quality of communication. This article highlights the importance of eyebrows as a key element of non-verbal expression and demonstrates that their shape has not only aesthetic, but also significant psychophysiological and communicative significance.

Keywords: *psychophysiology of emotions, eyebrow shape, micro-expressions, non-verbal communication, social perception, facial geometry, emotional expression*

Relevance of the study

The psychophysiological effects of eyebrow shape are becoming an increasingly interesting area of research, as eyebrows are an important element of non-verbal communication. Modern neuropsychological studies confirm that even small changes in the geometry of the eyebrows can activate the mechanisms of rapid recognition of emotions,

influencing the assessment of intentions, threat level, trust and emotional state of the interlocutor.

Visual communication is becoming more and more important, and digital technologies are playing an increasingly important role in our relationships and due to the proliferation of cosmetic procedures, the study of the influence of eyebrow shape and micro-

movements on social perception, interpersonal interaction and cognitive reactions is becoming particularly relevant.

The purpose of the study

The aim of the study is to understand how the shape of eyebrows and related micro-expressions affect a person's perception in society. We want to find out how the geometric parameters of eyebrows – their height, arch, angle of inclination, length, density and symmetry – affect the perception of emotions and personal characteristics. In addition, we aim to understand how these visual cues trigger automatic cognitive and neurophysiological responses.

Materials and research methods

A variety of methods are planned to be used as part of the study. Analysis of video materials on which the eyebrow parameters are fixed and changed. Using high-speed photography, you can capture micro-expressions of the face, as well as use programs for morphological analysis of the face. The psychophysiological part of the study includes recording the motor activity of facial muscles using surface electromyography, evaluates attention and emotional response using gaze tracking and galvanic skin reaction.

The results of the study

The study of the role of eyebrows in the expression of emotions and social perception has a long tradition that combines the achievements of anthropology, physiology, psychology and modern neuroscience. The first mentions of the importance of eyebrows are found in the writings of ancient philosophers and doctors. Hippocrates and Galen considered facial expressions of the forehead and eyebrows as important indicators of a person's inner state, emphasizing the close relationship between facial expression and the emotional reactions of the body.

During the Renaissance, artists, in particular Leonardo da Vinci began to study the anatomy of facial muscles in depth. They described how the shape and location of eyebrows could convey various emotions such as surprise, anger, and suffering. It was during this period that the idea arose that the geometry of the eyebrows could be an independent

visual signal that affects the perception of the face.

In the XIX century, thanks to the work of Charles Darwin, scientific interest in eyebrows increased significantly. In his book "The Expression of Emotions in Humans and Animals," he examined in detail the role of the brow ridges and forehead muscles in creating emotional expressions. Darwin was one of the first to realize that micro-eyebrow movements represent evolutionary communication mechanisms that allow us to quickly recognize threats, intentions, and the emotional state of others. His ideas formed the basis for further research on non-verbal communication.

In the XX century, the study of eyebrows became an integral part of systematic approaches to analyzing facial expressions. Paul Ekman, who developed the FACS system, a detailed description of the muscle units responsible for eyebrow position changes, made an outstanding contribution to this field. Ekman found that even the smallest micro-movements of the eyebrows, occurring in fractions of a second, can reflect hidden emotions and serve as a reliable indicator of the reliability of emotional reactions. This discovery marked a new stage in understanding how eyebrows are involved in transmitting micro-expressions that affect the perception of sincerity, threat, anxiety, or benevolence.

At the same time, research in the field of social psychology was actively developing. Scientists have found that the geometric parameters of eyebrows, such as height, arch, slope and density, play an important role in forming the first impression of a person. Experiments in the middle of the XX century have shown that low-set or angular eyebrows are most often perceived as a sign of dominance or aggression, while high or rounded eyebrows are considered an indicator of surprise, openness and friendliness. These observations formed the basis of modern models of social perception.

At the end of the XX and beginning of the XXI century, interest in studying eyebrows increased significantly, which was facilitated by the development of neuroimaging technologies. Studies using functional MRI, gaze tracking, and electromyography have shown that the shape of the eyebrows is directly

related to the activation of certain areas of the brain involved in the rapid assessment of emotions, such as the amygdala and pre-frontal cortex. In addition, it was found that eyebrows play an important role in children's and intercultural communication, as well as have a significant impact on perception in the digital environment, including photos and avatars on social networks.

The modern stage of eyebrow research is characterized by the integration of perceptual psychology, cosmetic anthropology, neuroscience, and computer modeling. Digital morphing technologies allow you to change the shape of eyebrows and analyze the reaction of observers with microsecond accuracy. This opens up new horizons in understanding the connection between eyebrow geometry, micro-expressions, and social perception.

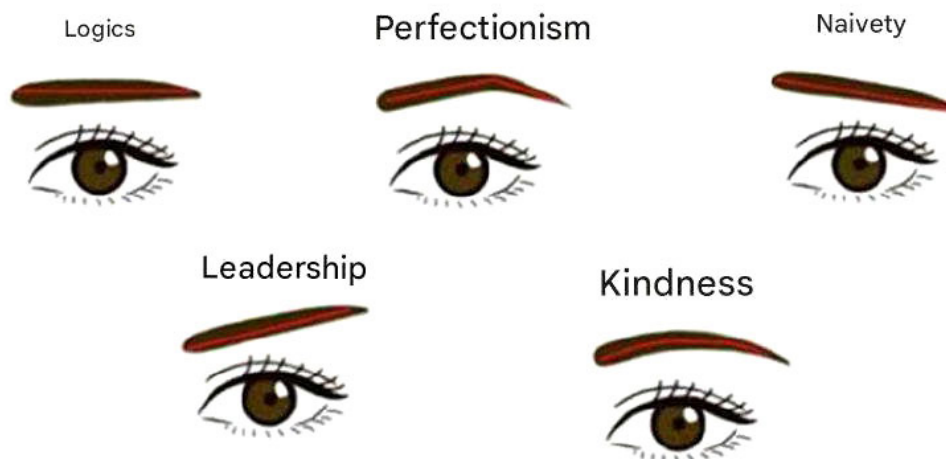
It should be noted that in recent years, research in this area has been actively conducted using neural network analysis of faces, gaze tracking and high-speed shooting of micro-expressions. For example, experiments conducted at Stanford University have

shown that angular and lowered eyebrows can automatically enhance amygdala activity, causing a sense of threat or dominance, even if a person retains a neutral facial expression. At the same time, higher and smoothly arched eyebrows, on the contrary, reduce neural reactivity and are associated with a sense of security, softness and accessibility.

Digital platforms also provide valuable information. Machine learning, analyzing millions of images from social networks, has found that symmetrical eyebrows with a slight rise in the outer part contribute to increased attractiveness and trust. This geometry enhances the signals of openness and reduces the likelihood of micro-expressions being perceived as tense.

Psychologists studying Internet avatars have found that changing the shape of eyebrows alone can dramatically change the perception of an emotion. A slight lowering of the middle part of the eyebrow makes the expression focused or angry, while a slight external rise gives it a friendly or interested expression (Fig. 1).

Figure 1. *Psychology of eyebrows*



As part of behavioral economics, experiments were conducted in which participants made decisions about collaboration by watching photographs or videos with minimal changes in the shape of their eyebrows. The results showed that eyebrows that give the impression of alertness or hidden aggression reduce the likelihood of choosing a cooperative strategy, even if the rest of the facial features remain unchanged. This confirms that eyebrows are one of the key elements

of rapid social assessment, influencing trust, risk, and behavior prediction (Lemeshevskaya Z. P., 2010).

In the field of neuroaesthetics, scientists have found that eyebrow correction style can affect the perception of emotions. For example, clearly defined graphic eyebrows make the micro-contractions of the frontal muscles more noticeable, which enhances the perception of emotions of tension and discontent. At the same time, soft, shaded eyebrows soften

harsh micro-expressions and create a more relaxed image (Anishchenko K. V., 2024).

Special attention is paid to differences between cultures. Modern research shows that in cultures with a high level of collectivism, arched eyebrows are usually perceived as a sign of benevolence and emotional expressiveness. At the same time, in individualistic cultures, straight eyebrows, which are domi-

nant, are associated with confident and competent behavior.

Despite these differences, the basic mechanism remains universal: the shape of the eyebrows directs the observer's attention and serves as a clue for interpreting micro-expressions, which, in turn, accelerates the process of emotional and social assessment of the face (see Table 1).

Table 1. *The effect of eyebrow shape on face perception (Gorbunova O. A., 2023)*

No.	Indicator	Characteristic
1.	Emotional perception	The shape of the eyebrows can dramatically change the facial expression. Raised eyebrows can express joy or surprise, while lowered eyebrows can convey sadness or anger.
2.	Symmetry and harmony	Symmetrical eyebrows are often associated with attractiveness. Uneven or asymmetrical eyebrows can distract attention and create a sense of imbalance.
3.	Age	The shape and thickness of the eyebrows can tell a lot about a person's age. Thin, high-arched eyebrows are often associated with youth, while heavier and lower-set eyebrows can give the impression of maturity.
4.	Cultural and individual preferences	Different cultures have their own ideas about the beauty of eyebrows. For example, in some cultures, thick and wide eyebrows are preferred, while in others, thin and well-defined lines are preferred.
5.	Personality	The shape of the eyebrows can also tell a lot about a person's personality. For example, straight and wide eyebrows are often associated with confidence and determination, while arched eyebrows can create the impression of a more friendly and romantic image.

It should be noted that modern research faces a number of methodological and interpretative difficulties. One of the main problems is that eyebrow geometry rarely acts in isolation. It inevitably interacts with facial expressions, the structure of the eyes, and the shape of the skull and the general proportions of the face. This makes highlighting the pure eyebrow effect difficult and requires multiple models. Another difficulty is related to the fact that micro-expressions appear within milliseconds, and their accurate registration depends on lighting, equipment quality, and subjective coding. This leads to different interpretations of the same facial signals.

Cross-cultural differences also contribute to the complexity of eyebrow research. What is perceived as friendliness in one culture may be regarded as affectation, dominance, or even aggression in another. This makes it difficult to create universal models of eyebrow perception and makes it impossible to

use research results in international projects or in computer vision systems. In addition, the impact of the cosmetics industry and digital filters on public standards is making its own adjustments. Natural eyebrows are being replaced by artificial ones, which distorts the data and complicates the study of the basic physiological response to them.

An important issue is the influence of the observer's expectations. People tend to interpret the shape of their eyebrows through their emotional and social experiences, which can reinforce stereotypes and reduce objectivity. This is especially noticeable when we evaluate reliability, aggression, or leadership qualities, where eyebrows become part of a quick but subjective "social scan." The situation is complicated by the fact that neural responses recorded using functional magnetic resonance imaging (fMRI) or electroencephalography (EEG) do not always allow us to understand whether they reflect

emotions, changes in attention, or automatic processing of a visual stimulus.

Finally, there is a risk of exaggerating the importance of eyebrows. Some studies assign them too much of a role in personality perception, without taking into account other factors such as speech, posture, general facial expression, and interaction dynamics. This leads to simplified conclusions and reduces scientific accuracy.

In our opinion, in order to overcome the identified methodological and interpretative problems, an integrated approach is needed that combines technological, theoretical and intercultural strategies. One of the key steps is to standardize incentives: using large databases of faces with carefully controlled parameters minimizes the impact of extraneous factors such as eye shape or lighting. The use of three-dimensional modeling and generative neural networks opens up new possibilities. We can change the shape of the eyebrows separately, leaving the rest of the facial features unchanged. This allows us to identify the net effect of eyebrows and micro-movements, focusing on their impact on personality perception.

To improve the accuracy of micro-expression detection, we recommend using high-frequency cameras, automatic facial recognition systems, and machine learning algorithms. These tools allow you to reduce the subjectivity of coding and capture movements that last only a few milliseconds. This makes the analysis more objective and reproducible. In addition, the inclusion of multi-channel data such as electroencephalography (EEG) in combination with eye tracking helps to separate the attention response and the emotional processing of the stimulus. This reduces the risk of misinterpretation and makes the research process more accurate.

Cross-cultural differences in research are taken into account through multicenter projects involving representatives of different ethnic groups and the use of unified protocols. Comparing data from different regions allows us to identify universal patterns that can be separated from cultural expectations. Another important aspect is the use of double-blind procedures, when neither the participants nor the researchers know what a particular stimulus is intended for. This

helps to reduce the impact of expectations and avoid confirming your own hypotheses.

To minimize the impact of social trends and cosmetic procedures, it is recommended to include both natural faces and controlled computer models without makeup in the research. This allows you to evaluate the difference between the perception of natural eyebrows and the so-called “constructed” ones.

In addition, long-term longitudinal studies provide an opportunity to understand how reactions change depending on social norms and cultural trends. This approach makes the results more stable and less susceptible to distortion caused by fashion.

Finally, the integration of data from various disciplines such as psychology, neuroscience, computer vision, and anthropology allows for a deeper and more accurate understanding of how eyebrows participate in social perception. This interdisciplinary approach helps to avoid simplifications, take into account the context and dynamics of communication, and create more informed models of emotion perception and personality traits based on eyebrow expression.

Conclusions

Psychophysiological studies on the shape of eyebrows and micro-expressions demonstrate that these seemingly insignificant details of appearance play a key role in social perception. They help create a first impression, interpret emotions, and evaluate a person's intentions.

Eyebrows are not only an important part of the facial anatomy, but they are also a powerful communication tool. They are able to influence the perception of various aspects, including emotion recognition, trust level, dominance, and social status. Micro-eyebrow movements can enhance emotional messages, appearing faster and more accurately than full facial reactions. This makes them important markers that can reveal a person's true feelings.

Modern analysis methods such as high-speed video, machine learning, and computer modeling have significantly improved the ability to capture and interpret subtle changes in facial expression. However, despite the achievements, research still faces certain methodological difficulties. The perception

of the meaning of eyebrow shape is influenced by many factors, including cultural norms and cosmetic practices. A comprehensive and interdisciplinary approach is needed to gain a deeper understanding of this topic. However, the available evidence strongly suggests that eyebrows play a key role in non-verbal communication, providing a fast and effective way to convey emotions and interpersonal messages.

Thus, further improvement of facial recognition technologies, an increase in the

number of participants from different cultures, and more precise standardization of stimuli are key areas contributing to a deeper understanding of the role of eyebrows in the process of social perception. These studies open up new horizons for psychology, neuroscience, communication system design, and even clinical diagnostics, emphasizing the importance of paying attention to the smallest details of human facial expression.

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THE LEADER OF THE XXI CENTURY: KEY COMPETENCIES SHAPING A SUCCESSFUL ENTREPRENEUR

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Abstract

This article examines the topic of leadership in entrepreneurship and identifies what qualities and skills leaders of the XXI century need to succeed in business. The paper examines the evolution of scientific approaches to leadership and their application in the context of entrepreneurship. The leader, according to the authors, plays a dual role: he not only initiates changes, but also ensures the efficient use of resources. In the context of digital transformation and high uncertainty, such competencies as cognitive-strategic, technological, and socio-managerial become especially important. These skills help an entrepreneur navigate effectively in a rapidly changing world. Special attention is paid to the mechanisms of formation and development of leadership competencies. The authors suggest using a combination of training, practice, mentoring, and systematic feedback. This allows you to consolidate skills through the cycle of “experience – reflection – reflection – experimentation”, which contributes to the continuous improvement of leadership qualities. The practical significance of the results obtained lies in the fact that the conclusions can be applied to develop programs for the development of entrepreneurial leadership and create tools for assessing competencies.

Keywords: *leadership, entrepreneurial activity, entrepreneurial leadership, leadership competencies, transformational leadership, situational approach, emotional intelligence, digital transformation, change management, learning from experience, mentoring, feedback*

Relevance of the study

In today's world, entrepreneurship faces many challenges: high uncertainty, rapid technological changes and growing competition. Digital transformation, the development of platform-based business models, remote work and the use of data as a key resource have radically changed the approach to managing companies. The speed of decision-making and the quality of strategic choice have become top

priorities for managers. In such circumstances, the role of an entrepreneur leader becomes particularly important for the sustainability of the organization. His ability to form a clear vision, manage changes, and coordinate the actions of the team depends on maintaining competitiveness and the ability of the business to adapt to external challenges.

This topic is becoming even more relevant in light of the changing set of skills

needed to run a successful business. Previously, the key factors were managerial experience and knowledge of the industry, but today skills of working in a VUCA environment, which is characterized by variability, uncertainty, complexity and ambiguity, are of particular importance. Developed emotional intelligence, the ability to communicate and negotiate effectively, as well as the ability to innovative thinking and risk management become important. At the same time, the importance of the value-ethical aspect of leadership is increasing. Society, partners, and consumers place higher demands on social responsibility, transparency, and business sustainability.

Thus, the study of the competencies of a leader of the XXI century is an important aspect both for the theoretical understanding of modern concepts of entrepreneurial leadership and for practical application. It is necessary to create effective educational programs, as well as tools for assessing and developing entrepreneurial skills, which in turn contributes to increasing the viability and efficiency of a business.

The purpose of the study

The purpose of this study is to provide a theoretical and methodological justification of leadership in entrepreneurial activity. We will identify the key competencies of a XXI century leader that influence business success, as well as analyze how these competencies can be formed and developed in modern conditions.

Materials and research methods

The research used scientific publications and publicly available analytical and methodological materials on various leadership theories, in particular, entrepreneurial leadership, as well as competence models and practices for developing leadership skills.

In the course of the work, methods of theoretical analysis and synthesis were applied, as well as comparative analysis of various approaches to leadership. The results were systematized and summarized. In addition, a classification method was used to group competencies and identify mechanisms for their development.

The results of the study

Leadership as a scientific concept covers a wide range of disciplines such as psychology, sociology and management. In the context of entrepreneurial activity, leadership is considered not as a “character trait in itself,” but as a complex set of influences, interactions, and management practices that manifest themselves in specific organizational and market conditions. Research interest in leadership has undergone significant changes throughout history. Early ideas about “leaders” and the dominance of personal qualities were replaced by behavioral patterns. This was followed by situational and integrative theories in which leadership effectiveness is explained by the leader’s style matching tasks, work structure, and group relationships. In entrepreneurship, this transition is particularly noticeable, since the entrepreneur simultaneously acts as an initiator of change and as a manager who is forced to organize people and resources in conditions of lack of time and information.

The classic source in this area is the review by R. Stogdill, which summarizes many studies conducted in the middle of the XX century. In his review, he concludes that there is no single “universal set” of traits that would guarantee leadership in any environment. R. Stogdill notes that personality traits are important, but their influence is manifested through a specific situation and role requirements. This conclusion is especially relevant for entrepreneurship, as entrepreneurial roles, industries, and stages of business development can vary greatly. Therefore, the “successful leadership formula” cannot be the same for an early-stage startup and, for example, for a mature company with formalized processes (Personal factors associated with leadership; a survey of the literature).

The next major section is behavioral approaches, which shift the focus from “how a leader is born” to “what a leader does.” In this tradition, experiments devoted to the study of social climates and management styles (authoritarian, democratic, and permissive) are often mentioned. The behavioral approach is valuable for entrepreneurial practice because it allows us to describe leadership as a set of observable managerial actions. These actions include the distribution

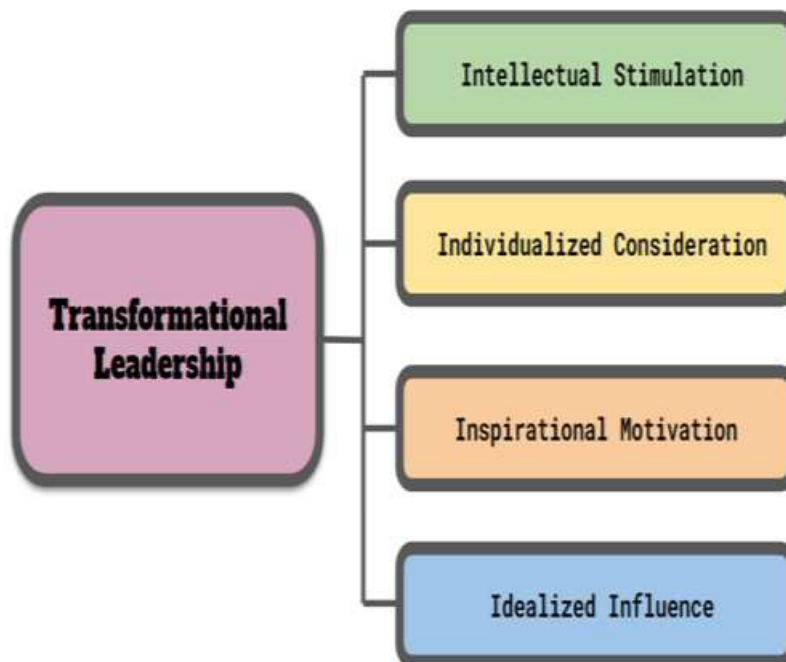
of authority, team participation in decision-making, monitoring, and feedback. These actions can be developed, evaluated, and compared (The Lewin, Lippitt and White study of leadership and “social climates” revisited).

However, despite the significant contribution of behavioral theory to the understanding of leadership, it turned out to be insufficient. A situational approach has emerged in management, according to which the effectiveness of leadership depends on how well the style of the leader corresponds to a particular situation. One of the most famous examples of the situational approach is the model F. Fiedler’s. In this model, leadership effectiveness is determined by a combination of three factors: the relationship between the leader and the group members, the structuring of the task, and the leader’s positional authority. The Least preferred colleague (LPC) scale is used in the model to measure the orientation of the supervisor. This approach is especially important for entrepreneurship, since in small business-

es, positional power is often inferior to formal corporate power. Tasks may be less structured, and team relationships may be closer and more informal. As a result, the same management style can produce different results depending on the stage of the company’s development and the degree of certainty of roles and processes (Fiedler contingency model).

At the end of the XX century, as organizational changes became more complex, transformational leadership concepts gained popularity. Within the framework of these concepts, leadership is considered as a process of changing the motivation and behavior of followers through the establishment of common values, the search for meaning, trust and support for development. Transformational leadership is characterized by four main elements known as the “four I’s”: idealized influence, inspirational motivation, intellectual stimulation, and individualized attention. A visual model of these components is shown in Figure 1.

Figure 1. *The model of the components of transformational leadership (Model of Transformational Leadership (Bass, 1985). | Download Scientific Diagram)*



In modern scientific circles, when it comes to entrepreneurship, “entrepreneurial leadership” is often mentioned. This is a special type of leadership that aims to form a common vision and mobilize a team to find and realize value creation opportunities. Entrepreneurial leadership is considered as

a concept applicable in different cultures, and its features are discussed through the prism of “roles” and “challenges of implementation.” This allows us to distinguish it from traditional managerial leadership and analyze its effectiveness in different countries and organizational cultures. This clar-

ification has important methodological significance: entrepreneurial leadership is not limited to “charisma”, but is a measurable management practice that is closely related to innovation and value creation (Entrepre-

neurial leadership: developing and measuring a cross-cultural construct).

The table below presents verifiable statements regarding the main approaches to leadership and their methodological foundations.

Table 1. *The main theoretical approaches to the study of leadership and their applicability in entrepreneurial activity*

An approach to leadership	Which explains (in theory)	Typical methodological tools/sources	Applicability to entrepreneurship
Damn it	The role of personal qualities in the leadership process. The lack of universal traits that would be equally important for all leaders	Reviews and meta-generalizations of literature	It is useful for understanding individual characteristics, but requires consideration of context and role
Behavioral	The leader’s styles and actions as visible behavior	Experimental studies of stylistic differences	It helps to describe an entrepreneur’s management practices as a set of skills that can be mastered
Situational/contingent	Effectiveness is the result of choosing the right style according to the situation	Fiedler’s contingent model; LPC measurement and situational factor analysis	This issue is especially acute for startups and small companies, as their operating conditions can change quite often
Transformational	Changing the motivation and value system of followers; growth and inspiration	The Bass and Avoglio model; measurement through MLQ (full range of leadership)	It is important for innovation and change, which is a distinctive feature of entrepreneurial projects

A source: author’s development based on (Fiedler contingency model; Leadership development: An evidence review; Multifactor leadership questionnaire)

In the XXI century, success in entrepreneurship directly depends on the key competencies of a leader. This is due to the fact that the business is developing in an environment of rapid technological change and high competition. In open international sources, in particular, in the analytical materials of the World Economic Forum on future skills, it is noted that one of the main obstacles to the development and transformation of companies is a lack of skills. Therefore, an entrepreneurial leader must not only generate ideas, but also have the skills to quickly form a team, develop employee competencies, and make decisions based on data.

The competencies of a successful business leader can be roughly divided into three interrelated blocks.

1. Cognitive and strategic competencies – include analytical thinking, the ability to see opportunities, evaluate ideas, and plan your actions. These skills determine the quality of market, product, and strategy choices, and allow for timely course adjustments when external conditions change.
2. Technological competencies – include technological literacy, understanding the role of data and modern digital tools, as well as the ability to manage technology adoption and risks.
3. Social and managerial competencies – include leadership and influence, communication, the ability to work with people, develop a team, and maintain customer focus. This block ensures the coherence of the team’s actions, trust

in partnership and the sustainability of the service.

In the European Entre Comp model, entrepreneurial competence is described as a complex system that includes the skills needed to implement ideas, mobilize resources, work in an environment of uncertainty, and learn from experience. Thus, success in entrepreneurship is often determined not by one “strong feature”, but by a combination of strategic thinking, technological literacy and advanced managerial skills. These qualities allow a leader to create value and maintain the competitiveness of his business.

In the modern scientific and practical community, the formation and development of an entrepreneur’s leadership skills is considered as a continuous process that includes education, practical training, and constant feedback. This is due to the fact that an entrepreneur operates in an ever-changing world, where tasks, team requirements, and management tools are updated much faster than in traditional organizations. Therefore, for the sustainable development of competencies, it is not enough just to attend courses once. It is necessary to regularly test your skills in real conditions and constantly learn throughout your life.

Leadership development in entrepreneurship is usually carried out through a combination of three key factors contributing to the growth of competencies:

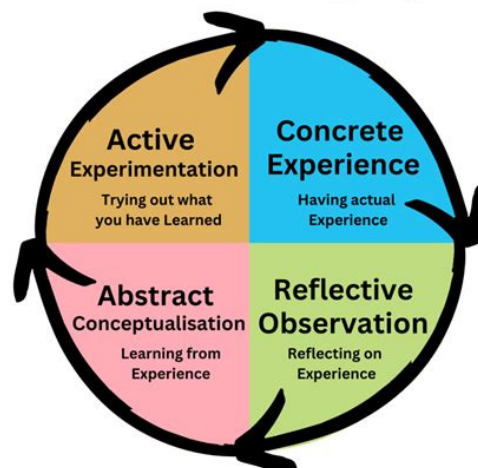
- Structured Learning – includes programs, courses, and trainings aimed at developing specific skills.
- On-the-job Development – involves completing project tasks, launching products, negotiating, and managing changes.
- Individual Support – includes mentoring, coaching, decision-making, and external expertise to help participants reach their potential.

Scientific research conducted by professional organizations shows that leadership development programs, as a rule, lead to moderate positive results in many ways. However, their effectiveness largely depends on the specifics of the program and how well the participants can put the acquired skills into practice (Leadership development: An evidence review).

David Kolb’s theory of experiential learning is often used to explain why entrepreneurial competencies develop better when learning is linked to practice. According to this theory, knowledge is formed through the transformation of experience, and the learning process is described as a cycle of four stages: experiencing experience, reflection, reflection, and active experimentation (Figure 2). In academic and university materials, this model is considered as a practical tool for constructing learning. Each stage of the cycle should be supported by certain actions: practice and cases create experience, reviews and observation diaries stimulate reflection, conceptual models and reading literature contribute to understanding, and new attempts and pilots consolidate knowledge through experimentation.

Figure 2. *The cycle of experiential learning: experiencing, reflection, comprehension, experimentation (Kolb’s Learning Styles and Experiential Learning Cycle)*

Kolb’s Learning Cycle



If we apply this methodology to entrepreneurial activity, then the development of leadership skills will become a manageable process. An entrepreneur can organize “training courses” for himself through participation in accelerators and entrepreneurial communities. He must regularly analyze his management decisions: after negotiations, hiring employees, launching a product, or conflicts in the team. It is also important to receive feedback from the team and customers. In the next cycle of tasks, the

entrepreneur can test new management approaches. Feedback tools are especially important, because without them, a leader can reinforce ineffective habits. In practice, 360 percent assessment, regular individual conversations, engagement surveys, error analysis and customer metrics of the service are used. Mentoring is an important supportive element: an entrepreneur can relate his decisions to the experience of more experienced leaders, which reduces the “cost of mistakes” in conditions of limited resources.

Since entrepreneurial skills include strategic thinking, the ability to work with people and make decisions in the face of uncertainty, the most effective development programs usually combine theory with practice. They include short theoretical blocks such as models of communication, negotiation, decision-making, and change management, which are supported by project work and follow-up. This strategy is consistent with the fact that a significant part of the adult education structure is in informal formats, such as employer-provided courses, trainings and practical exercises. Participation in such programs is significantly higher among employed people and those with a higher level of education.

Conclusions

Thus, leadership in entrepreneurial activity is a set of managerial skills and interac-

tions. The effectiveness of these practices and interactions depends not only on the personal qualities of the leader, but also on the specific situation, the stage of business development and the characteristics of the team.

In the field of entrepreneurship, combining different theoretical approaches is the most productive. So, the personal approach allows you to understand the importance of individual qualities, the behavioral approach allows you to see how people behave in management, the situational approach allows you to assess the impact of external factors on effectiveness, and the transformational approach allows you to evaluate the leader's ability to make changes and promote the development of followers. In the XXI century, an entrepreneur's success is determined by a combination of cognitive, strategic, technological, and socio-managerial skills. These include the ability to act in conditions of uncertainty and learn from their own experiences.

Developing an entrepreneur's leadership skills is an ongoing process that becomes especially effective when combined with training, practice, mentoring, and regular feedback. This approach allows you to transform the acquired knowledge into sustainable management skills, which, in turn, makes the business more flexible and adaptable to rapidly changing environmental conditions.

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Section 9. Study of art and cultural studies

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THE ROLE OF TRADITIONAL ANIMATION IN THE CONTEMPORARY MEDIA LANDSCAPE: ARTISTIC VALUE, CULTURAL RELEVANCE, AND TECHNOLOGICAL ADAPTATION

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Abstract

This article examines how traditional animation continues to exist and develop in the modern media world. The main goal of the study is to understand the current role of traditional techniques and to analyze their artistic and aesthetic value in today's visual culture. The paper gives a short historical overview of puppet, clay, hand-drawn, cutout animation and explains how these methods have been preserved, so renewed through time. Using comparative and analytical methods, the study explores how traditional animation interacts with digital technology, creating hybrid forms that combine manual creativity with modern innovation. The research also considers both European and Uzbek experiences, showing how different cultural backgrounds influence artistic style and storytelling. The findings suggest that traditional animation remains an important artistic form that connects human emotion, craft, and authenticity with the possibilities of new technology, making it relevant and meaningful even in the digital era.

Keywords: *traditional animation, artistic value, aesthetics of stop motion, cultural heritage, hybrid animation, visual art.*

Introduction

Stop-motion animation is a cinematographic technique in which physical objects, such as puppets or clay figures, are photographed frame by frame to create the illusion of movement. Each pose is adjusted by hand, and when the sequence of images is played back, the objects appear to come to life. This process gives the art form a distinctive sense of materiality and emotional depth

that separates it from computer-generated animation. As Maselli notes, the true power of stop-motion lies in the direct, tactile connection between the artist and the material – an “illusion of life” created through careful craftsmanship rather than digital programming (Maselli, 2018). The combination of precision and imperfection in this technique forms its unique artistic and aesthetic identity. The origins of traditional animation trace back to

the early 20th century, when pioneers such as Émile Cohl in France, J. Stuart Blackton in the United States, and Ladislav Starevich in Russia experimented with the illusion of movement through hand-drawn and stop-motion techniques. Cohl's *Fantasmagorie* (1908) and Starevich's *The Cameraman's Revenge* (1912) established the foundations of animation as both a technical and artistic form, blending craftsmanship with imaginative storytelling. By the 1930s, Walt Disney Studios in the United States industrialized animation production, while European and Soviet artists continued to value individuality and artistic experimentation. During the 1960s–1980s, puppet, clay, and cutout animation reached a peak of creativity in Europe, Russia, and Japan. Today, these traditional methods coexist with digital technology, as seen in Laika Studios' *Coraline* (2009), *Kubo and the Two Strings* (2016), and Tim Burton's *Corpse Bride* (2005), which preserve the emotional sincerity of handmade motion. In Uzbekistan, the art of animation emerged in the mid-1960s with the establishment of the "Animation Workshop" under "Uzbekfilm" (1964–1965). The pioneering film *"In the 6x6 Square"* (*6x6 kvadratida*, 1965) by D. Salimov and Yu. Petrov laid the foundation of the national animation tradition (Khaydarova, 2022). Since then, numerous Uzbek animators have created works using clay, puppet, and cutout techniques inspired by national folklore and poetic imagery. However, in recent years, traditional animation has been overshadowed by computer-generated production. While digital tools offer efficiency, they often lack the tactile depth and emotional warmth of handmade animation. Reviving traditional methods in contemporary practice is therefore essential not as nostalgia, but as a way to preserve artistic diversity and sustain the unique aesthetic culture of Uzbekistan within the global animation landscape.

Method

This research applies a qualitative and comparative analytical method to explore the evolution of traditional stop-motion animation and its current transformation within Uzbekistan's artistic environment. The study relies on academic publications, archival documents, and visual analysis of selected films representing both international and national

animation schools. By comparing these sources, the research identifies aesthetic, technological, and cultural principles that characterize handcrafted animation and distinguish it from computer-generated imagery.

Discussion

Despite rapid technological advancement, stop-motion animation has not disappeared. Its continued relevance lies in its aesthetic and emotional qualities rather than in technical innovation. The materiality of real objects, the visible traces of craftsmanship, and the tactile imperfection of movement give stop motion a unique expressive power that digital animation often lacks. As Henry Selick, director of *Coraline* (2009), noted in an interview: "Coming from the 2D world, I think what drew me to stop motion was the fact that you actually see this miniature world in front of you... It's one of the greatest appeals of stop motion: this feeling of real objects coming to life. I love the tactile realness of the miniature world. It's something you can never get with hand-drawn or computer animation (Lawrence, 1999)." As Langan explains, this statement captures why stop-motion continues to evolve: its materiality is not a limitation but an aesthetic language in itself (Langan, 2023). Films such as *Coraline* (2009), *The Little Prince* (2015) and *Kubo and the Two Strings* (2016) demonstrate that handmade textures and tangible worlds create emotional depth and authenticity unmatched by computer-generated imagery. Thus, stop motion endures as a form of art that unites traditional craftsmanship with modern storytelling an evolving bridge between technology and the human imagination. A similar dedication to handcrafted animation can be observed in the work of Aardman Animations, the British studio behind *Wallace and Gromit* and *Shaun the Sheep*. Unlike many contemporary studios that have fully transitioned to CGI, Aardman continues to rely on clay- technically, Plasticine- as its primary medium. This choice is not due to technological limitation but to the studio's artistic philosophy. As highlighted in the *Variety* article *At 40, Aardman Animations Stays Stubbornly Eccentric* (2016), "Working with clay- technically, Plasticine – has since become Aardman's trademark, being the medium in which Morph (their earliest stop-frame char-

acter) and later daffy inventor Wallace and his pet dog Gromit were sculpted. ‘Audiences love that sense of tangibility, the sense that it isn’t perfect, the fact that you can see the fingerprints,’ Sproxton says” (Debruge, 2016). This statement perfectly encapsulates the enduring appeal of stop-motion animation: its imperfections become its identity. Aardman’s commitment to material authenticity demonstrates how traditional techniques can coexist with modern storytelling while preserving cultural individuality. The studio’s films succeed precisely because they retain visible traces of human labor – fingerprints, smudges, and textures – which create a sense of warmth and sincerity that resonates with audiences globally. In an era dominated by digital perfection, Aardman’s Plasticine world stands as a celebration of craftsmanship, humor, and human touch. Their success confirms that the longevity of stop-motion lies not in resisting technology, but in reasserting the emotional power of the handmade image.

The historical roots of Uzbek traditional animation are closely connected with the Russian animation school, in which the name of Vladislav Starevich holds a central place. V. Starevich was one of the earliest pioneers of puppet animation, and his renowned film “The Cameraman’s Revenge” (1912) is considered a vivid example of the synthesis between technical experimentation and artistic expression. By using puppets and miniature sets, he created emotionally expressive characters and elevated animation from mechanical motion to the level of poetic storytelling. During the Soviet period, V. Starevich’s ideas and aesthetic principles had a strong influence on various animation studios across the Union, including those in Central Asia. The establishment of the “Animation Workshop” under the “Uzbekfilm” studio in 1964 was, in many ways, a continuation of this creative legacy. The first puppet animation film produced there “In the 6x6 Square” (6x6 kvadratida, 1965), directed by D. Salimov and artist Yu. Petrov reflected the artistic traditions of the Starevich school while developing a distinctly national approach to transforming simple materials into meaningful visual symbols. (Khaydarova, 2022). Following “In the 6x6 Square” (6x6 kvadratida, 1965), D. Salimov and Yu. Petrov continued to deepen their exploration of traditional techniques

and created the puppet film “*The Magic Chest*” (*Sehrli sandiq*, 1966). As Khaydarova notes, this film is based on an Uzbek folk tale and tells the story of a hardworking and kind-hearted girl and her stepmother. Through the contrast between positive and negative characters, the film reveals the eternal struggle between good and evil. The central moral idea that goodness always triumphs over wickedness, is expressed through vivid imagery and traditional narrative motifs. In *The Magic Chest*, the filmmakers successfully combined expressive puppet movement with richly textured miniature decorations to visualize moral and emotional contrasts (Khaydarova, 2019). The hand-crafted aesthetic and symbolic imagery bright costumes, tangible material environments, and ornamental details continue the artistic traditions shaped within the national cultural context of Uzbek animation. This film not only reinforced the national storytelling tradition but also established stop-motion animation in Uzbekistan as an important means of moral and aesthetic education.

With the advent of independence, Uzbek animation entered a new artistic stage. During this period, the thematic scope of films expanded, the range of characters and genres diversified, and new stylistic directions began to emerge. As Maksura Mirzamukhamedova notes in her monograph “*Uzbek Animation*”, “By the time of independence, the thematic range of Uzbek animation had expanded, and the field became enriched with new stylistic trends. The most significant creative experiments of the industry were reinterpreted in accordance with the spirit of the new era, and many new tendencies were introduced (Mirzamukhamedova, 2014).” Indeed, by the late 1990s and early 2000s, Uzbek animators began to reinterpret national values, humanistic ideas, and moral themes through a renewed artistic lens. One of the most remarkable examples is Mavzur Makhmudov’s “Nightingale” (*Bulbul*, 1999), a cut-out animation film distinguished by its refined color palette and poetic narrative. Drawing on folk motifs, the film conveys the themes of kindness and harmony in a contemporary visual style. Another notable work of the period is S. Chufarnov’s “Strike, mallet!” (*Ur, to‘qmoq*, 2006), based on Uzbek folk tales. The film employs elements of satire and humor to depict traditional

wisdom and diligence as enduring national virtues. Both films rely on handcrafted animation techniques – cut-out figures, textured materials, and rhythmic montage – to revive the distinctive aesthetics of Uzbek folklore on screen. Although the post-independence animation industry in Uzbekistan lacked the large-scale resources of Soviet studios, local artists succeeded in expressing complex ideas through symbolic and visually rich imagery. Consequently, contemporary Uzbek animation emphasizes not technical perfection, but artistic vision, national identity, and emotional sincerity, ensuring that the stop-motion and handcrafted traditions continue to evolve within the modern cultural context.

Results

Based on the conducted analysis, it can be concluded that traditional stop-motion technology holds a significant place in Uzbek animation. Its importance goes beyond technical aspects, it serves as a means of preserving national aesthetics, moral values, and artistic authenticity. In the era of digital technology, these handcrafted techniques remain relevant, as they embody cultural memory and creative individuality. Therefore, continuing and supporting traditional animation methods is essential not only for artistic innovation but also for maintaining the spiritual and cultural identity of Uzbek animation.

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Section 10. Information technology

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CONCEPTUAL EXTENSION OF THE M. FOWLER MODEL IN RELATION TO THE MIGRATION AND MODERNIZATION OF DISTRIBUTED APPLICATION INTERFACES

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Abstract

The article discusses the issue of conceptual expansion of the M. Fowler model in relation to the migration and modernization of distributed application interface systems. It is argued that the classical model of gradual replacement of outdated components needs to be refined when applied at the interface level, as the user interface not only displays data, but also involves user scenarios, routing, authorization, session status, and interaction with multiple services. Special attention is paid to maintaining the integrity of the user experience, stability of the application, and compatibility between old and new interface components. Consequently, an extended model for migrating interface systems is proposed that includes analyzing user scenarios, implementing new modules in phases, configuring routing, ensuring compatibility, and monitoring the effectiveness of modernization.

Keywords: *M. Fowler model, migration of interface systems, distributed applications, modernization of software systems, user interface, routing, fault tolerance, user experience.*

Relevance of the study

The importance of this research topic is due to the need for smooth and controlled modernization of distributed applications, which cannot always be completely replaced without the risk of disruption of their functioning. Such systems often serve many users, interact with various software services, and require stability during the update process (Kanaeva I. A., Magomedov M. A., 2022, p. 121).

One of the widely known approaches to solving this problem is the Martin Fowler model, which involves the consistent replacement of outdated components with new functionality. Its use makes it possible to minimize the risks associated with a sudden transition to a new system and to monitor the modernization process at each stage.

This problem becomes especially relevant when it comes to interface systems. The user interface of modern distributed applications is

not limited to displaying information only. It is closely related to user scripts, authorization, session status, error handling, and interaction with server services. Therefore, its migration requires not only the technical replacement of individual components but also the preservation of the integrity of the user experience, as noted in (Iordanashvili O. V., Pridvorov V. V., Kolomiitseva S. V., 2022, p. 108).

Thus, the relevance of this topic is due to the need to refine the M. Fowler model in the context of migration and modernization of distributed application interface systems. The scientific significance of the research lies in developing approaches to phased user interface modernization. The practical value lies in reducing technical risks and ensuring stable application operation during the update process.

The purpose of the study

The aim of this research is to develop and validate a comprehensive model for migrating and modernizing distributed application interfaces based on M. Fowler's principles, considering specific user scenarios, routing requirements, compatibility between old and new components, application stability, and user experience preservation.

Materials and research methods

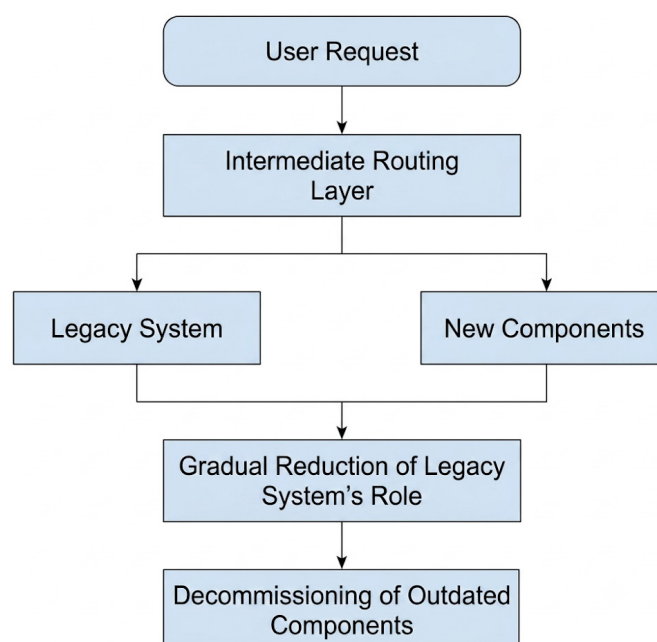
The research is based on scientific and practical works concerning M. Fowler's phased software system modernization model, micro-frontend architecture, fault-tolerant design principles, query routing, and distributed application modernization.

Methods of systematic and comparative analysis, generalization of scientific approaches, structural and functional analysis, and architectural modeling were used.

The results of the study

M. Fowler's model for software system modernization involves gradually replacing outdated components with new ones. It does not entail a complete application replacement but a phased allocation of individual functions, their transfer to a new system, and the gradual decommissioning of obsolete components. This approach reduces modernization risks as changes are introduced in stages and can be verified at each step. M. Fowler emphasizes that such gradual replacement avoids the risks associated with a complete system replacement at once (Gli-bina M. D., 2020, p. 76).

Figure 1. *The general logic of the phased modernization of the software system (author's development)*



In modern software system architecture textbooks, this model is considered a meth-

od for gradual migration of outdated applications (Karakhanova A. A., 2020, p. 258).

The Microsoft Azure Architecture Center describes this approach as a consistent replacement of individual pieces of functionality with new applications and services until the new system completely replaces the old one. AWS also offers this template as a way to safely transition from a monolithic to a microservice architecture with minimal risk

and disruption to the system (Strangler fig pattern).

The general scheme of step-by-step software modernization is shown in Figure 1.

The M. Fowler model assumes not a chaotic code replacement, but a controlled process of changing the system architecture, which is reflected in Table 1.

Table 1. *The main elements of the M. Fowler model*

Model Element	Content	Value for modernization
Highlighting replaceable functions	Identify the parts of the system that can be migrated to the new architecture	Allows you to start migration without completely stopping the application.
The intermediate layer	Directs requests to the old or new part of the system	Ensures that the old and new systems work together.
Step-by-step migration	Consistent transfer of functionality	Reduces technical and organizational risks
Checking new components	Evaluating the performance of the new part of the system before the full transition	Allows you to identify errors at an early stage.
Removing old components	Exclusion of outdated parts after the transfer is completed	Reduces the technical debt of the system

A source: author's development

Distributed application interface systems have their own characteristics. In such applications, the user interface is responsible not only for displaying information but also for executing scripts, navigating between sections, error handling, authorization, session status, and data exchange with multiple services. Therefore, when migrating the interface layer, it is important not only to maintain the technical functionality of the application but also not to disrupt the usual algorithm of user interaction with the system (Lavrentyeva I. S., Torkhov A. E., 2021, p. 209).

Modern interface systems are characterized by a special approach called micro frontends. In M. Fowler's materials, they are defined as an architectural style in which individual parts of the user interface are developed and delivered independently of each other and then combined into a single application. This means that the interface of a large system can consist of many separate elements, each of which is responsible for its specific task (Jackson C., 2019).

When migrating an interface system, it is important to keep in mind that the old and

new parts of the application may run simultaneously for some time. During this period, it is especially important to ensure a uniform appearance, consistency of user scenarios, compatibility of data formats, and stability of transitions between sections. If these requirements are not met, the upgrade may lead to a deterioration in the user experience, an increase in the number of errors, and complication of the system maintenance process.

The need for a conceptual expansion of the M. Fowler model is dictated by the fact that it was originally developed for phased modernization, the purpose of which is the gradual replacement of outdated functions. In this model, key importance is given to separating the old and new parts of the application, as well as using an intermediate layer to direct requests either to the old system or to new components. However, when applying this logic to interface systems, additional complexity arises. The user interface not only transmits requests but is also responsible for the sequence of user actions, the visual integrity of the application, and the stability of interaction with multiple services.

The gradual migration uses a special template that creates an additional layer between the client application, the old system, and the new one. This confirms that the transitional architecture is an integral part of the migration process. However, such a description is not sufficient for front-end systems, since the interface of a distributed application is closely related to user routes, screen status, error handling, authorization, and consistency of visual representation. Therefore, the model of M. Fowler needs to be clarified precisely in the context of the interface layer.

The expansion of the M. Fowler model is necessary not only to gradually replace outdated components but also to ensure the stability of a distributed system during the transition period. An interesting approach is that of G. K. Klyukovkin, who, in his work on the Design-for-Failure principle, considers design taking into account possible failures as an important aspect of the reliability of corporate backend systems. This approach is

especially relevant for migration of front-end systems, since the old and new parts of the application have been running simultaneously for some time. The architecture should take into account possible failures, delays, routing errors, and disruptions in the interaction between components, as described in (Klyukovkin G. K., 2021).

Another reason for expanding our model is the active development of micro frontends. In the works of M. Fowler, micro frontends are defined as an architectural style in which individual parts of the user interface are developed and implemented independently of each other, and then combined into a single application. This indicates that a modern interface can be a complex distributed structure rather than a single monolithic screen. Therefore, when migrating an interface system, it is necessary to take into account not only the replacement of the code but also the coordination of the interaction of individual interface modules (Table 2).

Table 2. *What requires a conceptual extension of the M. Fowler model*

Aspect	In the classical model	What needs to be added for front-end systems
Migration object	Legacy system functions	User scenarios, screens, routes, interface states
Transition layer	Routing requests between the old and new system	Managing transitions between old and new interface parts
Compatibility	Compatibility of functions and data	Compatibility of visual behavior, data formats, and user actions
Result control	Operability of the new function	Maintaining user experience and interface stability
Completing the migration	Decommissioning the old system	Removing outdated screens, routes, and client dependencies

A source: author's development

The author's extended model of migration and modernization of interface systems is based on the concept of step-by-step replacement proposed by M. Fowler, taking into account the specifics of the user interface of a distributed application. In this model, the key migration object is not a separate function of the old system, but an interface scenario – a sequence of user actions leading to a specific result: logging in, searching for data, performing an oper-

ation, submitting a form, or receiving a notification.

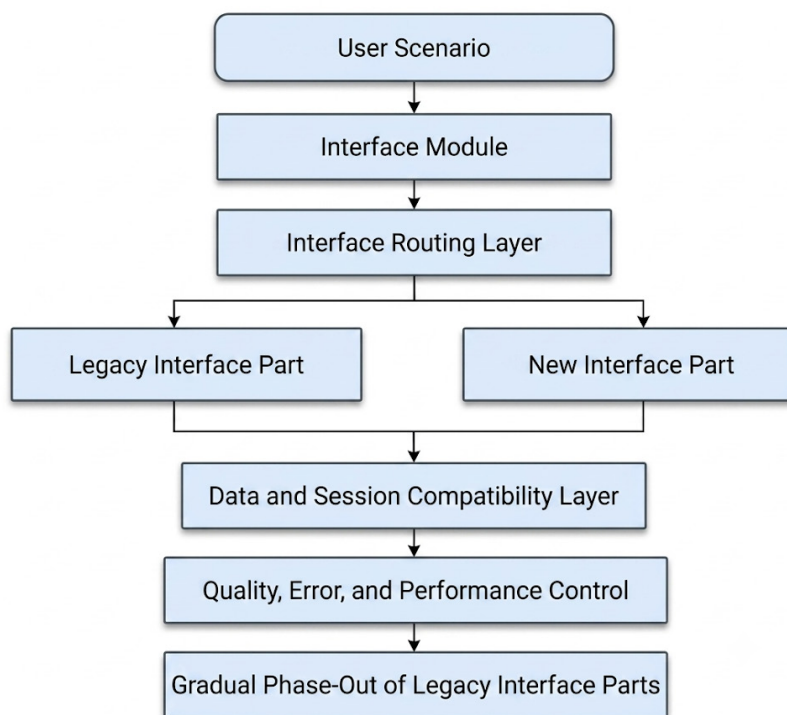
The extended model includes several interconnected levels (Figure 2).

The practical logic of this model is that the simplest and safest user scenarios are considered first. Then, new interface modules are developed for them, which are connected through the routing layer. After checking stability and compatibility, migration zones are expanded to more complex scenarios. Finally, outdated screens, routes, and depen-

dependencies are removed from the system. This approach corresponds to the general idea of gradual modernization but is adapted specif-

ically for the interface layer of a distributed application.

Figure 2. *The author's extended migration model for interface systems (author's development)*



The migration process of the interface system begins with a thorough analysis of the current interface: user scripts, screens, routes, connections to server services, as well as authorization and error handling processes. This allows you to identify the most significant and risky areas of the application.

Next, separate migration zones are identified. It is recommended to transfer the interface in accordance with scenarios or functional blocks: login, personal account, data search, form submission, and completion of an operation. First, less complex sections are chosen that can be replaced without disrupting the entire application.

After that, we begin creating a new interface, configuring routing, and ensuring compatibility with the old system. Then, the new module is checked for key parameters: correct operation, download speed, stability of transitions and the number of errors. If all indicators turn out to be satisfactory, the migration zone is gradually expanded, and outdated screens, routes, and dependencies are decommis-

sioned (Kamolov A. B., Tuleubaeva A. A., Rychkov V. A., Davydenko V., 2022, p. 34).

The effectiveness of the extended model is assessed according to several groups of criteria. Technical criteria include interface stability, download speed, number of errors, correctness of data exchange, and reliability of routing between the old and new parts of the application.

Evaluating the effectiveness of the extended model should include not only checking the completeness of the transfer of interface components, but also analyzing the system's ability to maintain stability under high load. The study on the design of fault-tolerant systems, which takes into account extreme load peaks, highlights the importance of architectural solutions aimed at maintaining operability with a sharp increase in the number of requests. For front-end migration, this means that you need to control the download speed, the number of errors, the availability of new modules, and the stability of user scripts. These aspects are key to ensuring the

smooth operation of the system under high load conditions (Klyukovkin G. K., Mikhailov B. A., 2021, p. 46).

User criteria include maintaining familiar work scenarios, providing a clear interface, maintaining a consistent design, and preventing failures when performing basic actions. Architectural criteria include reducing reliance on legacy components, minimizing code duplication, and simplifying system maintenance. The model can be effective if the migration process is phased, allowing the application to continue working without interruptions and gradually reducing technical dependence on the old architecture.

The main risk associated with this approach is a potential disruption to the user experience if there is a mismatch between the old and new interfaces, logic, or behaviors of elements. To mitigate this risk, it is important to establish uniform design guidelines, use a common design system, and thoroughly test user scenarios prior to implementation.

Another risk is data incompatibility, session status, and access rights. This can be minimized by using a compatibility layer, standardized data exchange formats and critical scenario testing before migrating.

Additionally, it is possible to complicate the architecture and decrease performance

during the migration phase. To avoid these issues, a migration plan, monitoring of interim solutions, regular removal of obsolete components, and continuous interface speed testing are necessary. If these requirements are met, an extended model allows for a safer and more manageable upgrade.

Conclusions

The M. Fowler model serves as an important basis for the phased modernization of software systems. However, when it comes to distributed application interface systems, it requires some expansion. The interface layer is responsible not only for displaying information but also for executing user scripts, interacting with server services, maintaining session status, and ensuring the integrity of the user experience. The extended model allows interface migration to be considered a managed process. It includes analyzing the existing system, defining migration zones, creating new interface modules, configuring routing, ensuring compatibility, and quality control. The use of this model helps reduce technical risks, maintain application stability, and make the transition from outdated interface solutions to a modern architecture more secure.

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