



Conference materials  
of the IV All-Ukrainian scientific  
and practical conference  
of young scholars  
and higher education applicants

# MODERN SCIENTIFIC AND TECHNICAL RESEARCH IN THE CONTEXT OF LINGUISTIC SPACE (IN ENGLISH)

Dnipro  
May 15, 2025



Oles Honchar Dnipro National University  
Faculty of Ukrainian and Foreign Philology and Study of Arts  
Department of English Language for Non-Philological Specialities

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*For students, post-graduates, teachers of higher educational establishments and scholars.*

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**Sergiy Okovytyy,**  
*Doctor of Chemical Sciences, Professor,  
Honoured Worker of Science and Technology of Ukraine,  
Distinguished Educator of Ukraine,  
Corresponding Member of the National Academy of Sciences of Ukraine,  
Rector of Oles Honchar Dnipro National University*

**WELCOMING SPEECH TO THE PARTICIPANTS  
OF THE IV ALL-UKRAINIAN SCIENTIFIC  
AND PRACTICAL CONFERENCE OF YOUNG SCHOLARS  
AND HIGHER EDUCATION APPLICANTS  
“MODERN SCIENTIFIC AND TECHNICAL RESEARCH IN THE CONTEXT  
OF LINGUISTIC SPACE (IN ENGLISH)”**



Dear colleagues and  
young researchers!

With great pride and  
sincere warmth I welcome  
you at the IV All-Ukrainian  
Scientific and Practical Con-  
ference of Young Scholars  
and Higher Education Appli-  
cants “Modern Scientific and

Technical Research in the Context of Linguistic Space (In English)”. Each year the  
conference grows in relevance and influence, this year, once again, we gather not  
only to share knowledge, but to shape the future of science and education.

The wide range of conference topics shows us that language is more than  
a medium; it is a motivation for innovation, cooperation, and understanding. In  
the 21st century, the ability to communicate complex ideas across cultures has  
become as essential as the research itself.

I am privileged to welcome an active community of students, educators, and researchers from academic institutions across Ukraine and beyond – Poland, the Czech Republic and Germany. The studies presented today, spanning natural sciences, humanities, social sciences, economics, engineering, and cutting-edge information technologies, reflect the rich academic potential.

Your participation matters not just for this event, but also for your own growth as young researchers. Let this conference be not only a venue for presenting results, but a launching pad for future collaboration and professional development. Science thrives when it is shared. Progress happens when minds connect.

I express heartfelt thanks to the organising committee and all those who made this event possible. May this conference ignite new ideas, foster friendships, and strengthen our common goal to build a better, smarter, and united world through knowledge!

***Iryna Popova,***  
*Doctor of Philological Sciences, Professor,*  
*Dean of the Faculty of Ukrainian*  
*and Foreign Philology and Study of Arts,*  
*Oles Honchar Dnipro National University*

**WELCOMING SPEECH TO THE PARTICIPANTS  
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OF LINGUISTIC SPACE (IN ENGLISH)”**



Dear conference participants!

It is a great pleasure to extend a warm welcome to all of you at the IV All-Ukrainian Scientific and Practical Conference of Young Scholars and Higher Education Applicants “Modern Scientific and Technical Research in the Context of Linguistic Space (in English)”. Today, we gather not only to celebrate academic achievements, but also to foster of an environment curiosity, collaboration, and intellectual growth. This conference serves as a vital platform for young minds across Ukraine to showcase their innovative research, exchange ideas, and lay the foundation for future academic and professional endeavors.

It is important to recognize the tremendous value that young scholars bring to the world of science, technology, culture, and society. You represent the next generation of leaders who will shape our nation's future through groundbreaking research, creative thinking, and the relentless pursuit of knowledge. Your contributions to this conference are of immense significance, not just for your own personal growth, but also for the development of our society as a whole.

The themes and topics that our young scholars are presenting cover a diverse array of disciplines, reflecting the dynamism and depth of the intellectual landscape of Ukraine. Whether their researches explore technological advancements, social and economic sciences, environmental sustainability, or the philological studies, the work they have undertaken is a testament to their dedication to their professional field.

Our university and faculty have long been committed to fostering the talents of young scholars, offering both guidance and resources to help you unlock your full potential. This conference is a reflection of that commitment. We are proud to offer you a space where you can exchange ideas with your peers, gain insights from experienced mentors, and develop the skills necessary for a successful academic or professional career.

Your efforts ensure that we continue to build a vibrant, collaborative academic community. The relationships and networks you build here could very well be the foundation of future partnerships, projects, and research initiatives that will shape the academic world and beyond.

Finally, as we celebrate the extraordinary potential of our young scholars, let us also remember the importance of lifelong learning and continuous growth. Each of you is contributing to a broader narrative of progress and discovery, and I have no doubt that the ideas and research presented here will inspire new pathways for development in education, science, and society.

I sincerely wish all the participants a productive and enjoyable conference. I hope that you will leave this event with new knowledge, strengthened connections, and a renewed sense of purpose in your academic journey. I wish

for each of you to experience the excitement of discovery and the satisfaction of sharing your unique insights with others. May your time here be filled with inspiring conversations, thought-provoking ideas, and new connections that will guide and support you in your academic and professional growth! May your work continue to inspire and create lasting impact, both now and in the future! I wish you all success in your research, happiness in your academic pursuits, and fulfillment in every step of your journey.

Best of luck, and may this conference mark the beginning of many more achievements to come!



***Olena Hurko,***  
*Doctor of Philological Sciences, Professor,*  
*Head of the Department of English Language for Non-Philological Specialities,*  
*Oles Honchar Dnipro National University*

**WELCOMING SPEECH TO THE PARTICIPANTS  
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Dear colleagues, young researchers and students!

I welcome you with great honour to the IV All-Ukrainian Scientific and Practical Conference of Young Scholars and Higher Education Applicants “Modern Scientific and Technical Research in the Context of Linguistic Space (in English)”.

This conference brings together inquisitive minds, creating a team of innovative researchers and ambitious students, who are not only shaping the future of science and technology, but also recognizing the crucial role that the language and communication play in advancing knowledge. Your active engagement, fresh ideas, and interdisciplinary approaches breathe new life into the academic sphere and foster meaningful dialogue between various fields of study. It is encouraging to see such a strong representation of young scholars and higher education applicants – the future leaders of Ukrainian and global science.

In today's rapidly changing world, the ability to integrate scientific and technical research within the broader linguistic and cultural context is more important than ever. This event serves as a platform for exchanging ideas, establishing professional networks, and inspiring one another to reach new heights in the academic journeys.

The work of the IV All-Ukrainian Scientific and Practical Conference of Young Scholars and Higher Education Applicants "Modern Scientific and Technical Research in the Context of Linguistic Space (in English)" focuses on four sections presenting the following topics: 1) modern studies in the sphere of natural sciences; 2) topical issues of social sciences and humanities; 3) modern research in the sphere of socio-economic sciences and information technologies; 4) actual problems of engineering and technical sciences and modern information technologies.

I sincerely wish all the participants inspiration for further research and valuable experiences that will contribute to your personal and professional development. May this conference open new opportunities for collaboration and professional growth! May Oles Honchar Dnipro National University continue to serve as a hub for scientific thought and academic excellence! Let this event become not only a step forward in your academic career, but also a space where bold thoughts and creative insights find their place!

## PANEL 1

### Modern Studies in the Sphere of Natural Sciences

(DNU, Zoom)

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E. Berezska, N. Kuragina, O. Osadcha

#### **BILE ACID METABOLISM AND GUT MICROBIOME: A KEY TO INTESTINAL HEALING AND INFLAMMATORY BOWEL DISEASE THERAPY**

This paper explores the connection between the gut microbiome, bile acids and intestinal mucosal repair. The gut microbiome plays an important role in maintaining the metabolic health of the host, particularly, through the production of various metabolites. Bile acids are among the key compounds that affect blood glucose levels, insulin sensitivity, obesity, and energy balance. The main pathway of their metabolism in the intestine is 7- $\alpha$ -dehydroxylation, which ensures the formation of the secondary bile acids.

Violation of these processes can lead to the development of gastrointestinal diseases, in particular inflammatory bowel disease (IBD). These include chronic diseases such as Crohn's disease (CD) and ulcerative colitis (UC), which are increasing in prevalence and pose a serious public health problem [1; 3].

Highlighting the role of bacteria in 7- $\alpha$ -dehydroxylation, Kitahara et al. (2000) suggested that members of the genus *Eubacterium* could perform 7- $\alpha$ -dehydroxylation [4]. However, later it turned out that the studied strain belonged to the genus *Clostridium*. Nevertheless, scientists believe that there are yet to be identified bacterial strains capable of this process.

Most of the literature focuses on the study of *Clostridium scindens* from the family *Peptostreptococcaceae*. However, metagenomic studies have shown that only a small proportion of *bai* genes responsible for 7- $\alpha$ -dehydroxylation originate from this bacterial family [6]. It is known that this process is controlled by the *bai* operon, which is activated by bile acids and contains eight main genes: *baiB*, *baiCD*,

baiE, baiA, baiF, baiG, baiH, and baiI. Additional genes have been identified as baiJ, baiK, baiL, and baiN [5]. The research teams of Christina Schoonjans and Rizlan Bernier-Latmani at EPFL have found that *Clostridium scindens*, which converts primary bile acids to 7 $\alpha$ -dehydroxylated bile acids, plays a key role in intestinal healing. Their study showed that the introduction of this bacterium can improve recovery from colon damage, opening up opportunities for new therapies for UC and related disorders.

An experiment on mice with a colitis model confirmed this hypothesis: the group injected with *C. scindens* showed faster recovery, less inflammation, and more active recovery of the intestinal mucosa. Further analyses showed that these effects depend on the TGR5 receptor, which responds to 7 $\alpha$ -dehydroxylated bile acids. When the experiment was repeated in mice without this receptor, the positive effect disappeared, confirming the importance of bile acids in regeneration. To test whether a similar mechanism works in humans, the researchers analyzed data from patients with UC. It turned out that their levels of 7 $\alpha$ -dehydroxylated bile acids were reduced, which correlates with impaired intestinal cell renewal. This proves that the microbiome affects intestinal healing through bile acid metabolism. Antoine Jalil pointed out that “the findings highlight the potential of microbiome-targeted strategies to modulate bile acid metabolism and promote intestinal healing” [2].

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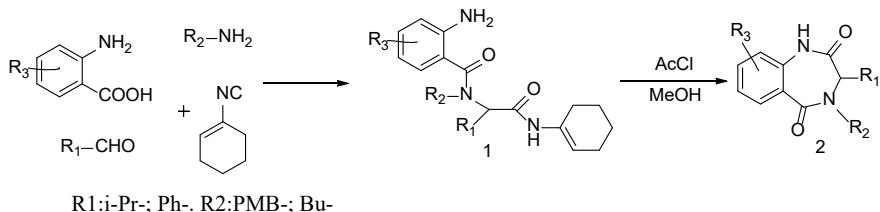
A. Bershak, S. Kopteva, O. Posudiiivska

## METHODS FOR SYNTHESIS OF 1,4-BENZODIAZEPINES

The search for efficient methods of the synthesis of heterocycles, particularly 1,4-benzodiazepines, is a relevant task due to their significant biological activity and wide application in medicine. These compounds have anti-inflammatory, antitumor, antibacterial, antiviral, sedative and other therapeutic properties, and are also used in commercial drugs such as diazepam and oxazepam [1; 3; 16; 10].

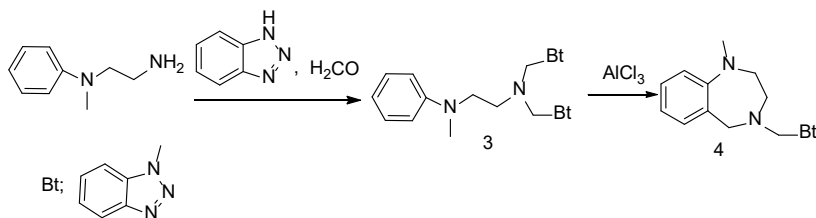
In general, methods of the synthesis of benzodiazepine derivatives are quite well described, but most approaches suffer from low yields, long reaction times, the formation of by-products, and the inability to reuse catalysts. On the other hand, the development of new effective methods of the synthesis of new representatives of a large number of 1,4-benzodiazepines based on transition metal-catalyzed processes has allowed the development of new strategies for building bonds, which has expanded the spectrum of introducing substituents into both aromatic and benzodiazepine fragments [8; 11]. The current task is to define synthesis methodologies that are simple, environmentally friendly, and economically viable. Let us dwell on some examples described in the literature.

The authors [6] showed the possibility of synthesizing two representatives of the series of 1,4-benzodiazepine-2,5-diones **2** by cyclization of condensation products **1** obtained under the conditions of the tandem (four-component) Ugi reaction upon treatment with acetyl chloride in methanol, the yields were 82% (Fig. 1).



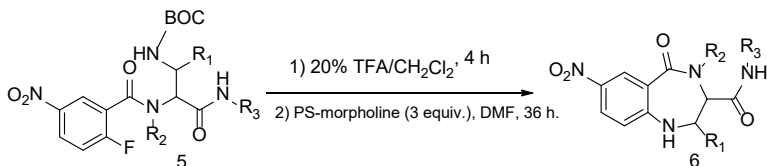
**Fig. 1. Synthesis of 1,4-benzodiazepine-2,5-diones**

In [14], the derivation of 1,4-benzodiazepine by the reaction of the corresponding 1,2-diamine with benzotriazole and formaldehyde to form N,N-bis(1H-1,2,3-benzotriazol-1-ylmethyl)-N-[2-(N-methylanilino)ethyl]amine **3** is performed, which, upon treatment with a Lewis acid, cleaved off only one benzotriazole fragment and formed 4-Benzotriazolylmethyl-1-methyl-2,3,4,5-tetrahydro-1H-1,4-benzodiazepine **4** by intramolecular Friedel–Crafts cyclization (Fig. 2).



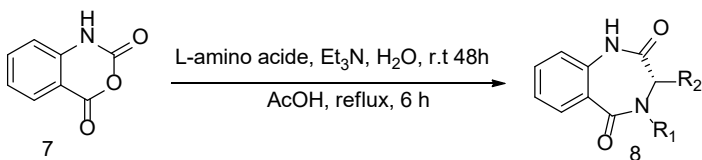
**Fig. 2. Synthesis of 4-benzotriazolylmethyl-1-methyl-2,3,4,5-tetrahydro-1H-1,4-benzodiazepine**

The authors [13] showed the possibility of cyclization of aryl fluorides **5** obtained by the tandem Ugi reaction under the conditions of their activation with a strong electron-withdrawing substituent in the benzene ring with the formation of the corresponding 1,4-benzodiazepin-5-one **6** with low yields (5–7%) (Fig. 3).



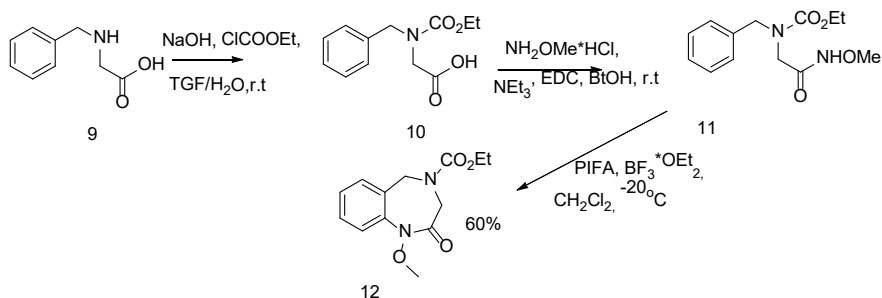
**Fig. 3. Synthesis of 1,4-benzodiazepin-5-one**

The authors [7] showed the possibility of using a simple and ecological methodology for the synthesis of substituted 1,4-benzodiazepine-2,5-diones from commercially available isototic anhydride **7** by its condensation with the corresponding L-amino acids in aqueous solution in the presence of triethylamine followed by cyclization while boiling in glacial acetic acid. Target 1,4-Benzodiazepine-2,5-diones **8** were obtained in yields of 78–92% (Fig. 4) [7].



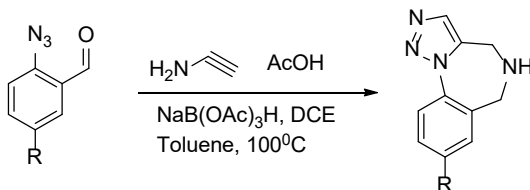
**Fig. 4. 1,4-Benzodiazepine-2,5-diones**

The authors [2] proposed a methodology for obtaining 1,4-benzodiazepin-2-one 12 from N-benzylglycine 9 as a model compound for developing a synthesis methodology (Fig. 5). Carbamate 10 was obtained by acylation of amino acid 9 with ethyl chloroformate, which was subsequently converted to amide 11, cyclized to the target benzodiazepin-2-one 12 in 60% yield. PIFA was used as a source of hypervalent iodine to generate the electrophilic N-acylnitrenium ion from amide 11.



**Fig. 5. Synthesis of 1,4-benzodiazepin-2-one from N-benzylglycine**

The possibility of synthesizing 1,2,3-triazolo-1,4-benzodiazepine from the known aldehyde using reductive amination followed by thermally induced intramolecular Huisgen cycloaddition has been demonstrated [12] (Fig. 6).



**Fig. 6. Synthesis of 1,2,3-triazolo-1,4-benzodiazepine**

### Innovative approaches:

A significant number of works are devoted to the synthesis of 1,4-benzodiazepines using microwave irradiation [9]. In particular, 2-(1H-benzimidazol-2-yl)aniline was converted into the corresponding 5H-benzimidazo[1,2-d][1,4]benzodiazepin-6-(7H)-one (Fig. 7) by interaction with 2-bromoacetyl bromide in anhydrous THF in the presence of  $\text{Na}_2\text{CO}_3$  under microwave irradiation (300 W) with an average yield.

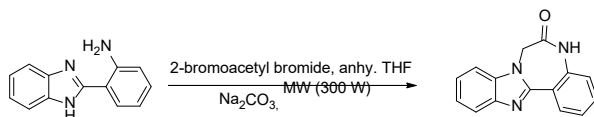


Fig. 7. Synthesis of 5H-benzimidazo[1,2-d][1,4]benzodiazepin-6-(7H)-one

Photochemical synthesis is also noteworthy, for example, the authors [5] showed the possibility of synthesizing 1,4-benzodiazepin-5-ones by irradiating potassium salts of N-phthaloylanthranilamide at 300 nm in aqueous acetone. It is specified that after photoinduced decarboxylation, a radical is generated that interacts with the carbonyl fragment to form the corresponding 1,4-benzodiazepin-5-one (Fig. 8).

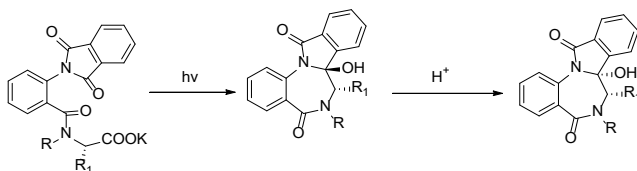


Fig. 8. Synthesis of 1,4-benzodiazepin-5-ones

The “green” reaction of isate anhydrides with amino acids in the presence of the ionic liquid 1-butyl-3-methylimidazolium bromide gave 1,4-benzodiazepine-2,5-dione in excellent yields in the absence of a catalyst [16] (Fig. 9).

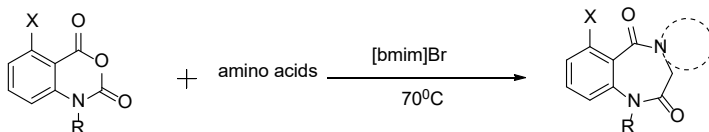


Fig. 9. Synthesis of 1,4-benzodiazepine-2,5-dione



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## **THE ROLE OF NON-CODING RNAs IN DISEASE DEVELOPMENT**

Depending on the length of the transcript, non-coding RNAs are divided into short and long. Short non-coding RNAs include tRNAs, snRNAs, snoRNAs, microRNAs, piRNAs, while long non-coding RNAs are represented by rRNAs and dsRNAs [4]. Non-coding RNAs that are longer than 200 nucleotides are known as dsRNAs. Their biogenesis is similar to that of mRNAs because both processes are regulated by transcription factors. [1].

Some types of non-coding RNAs have been found to regulate protein production by affecting mRNA function, DNA methylation or histone modification. Different types of non-coding RNAs can affect the expression of genes related to psychological processes and disease progression, making them potential targets for new drug development [3].

The methods for studying non-coding RNAs are divided into descriptive and functional methods. Descriptive methods are used to quantify and analyze non-coding RNAs. Functional methods include in vitro and on living organisms' experiments [3].

Hypertension can be caused by non-coding RNAs, as patients with hypertension have an excess of incRNA in their vascular cells. It is this incRNA that destroys proteins that maintain the elasticity of blood vessels, which leads to vasoconstriction [2].

Disorders of heart development. For the proper formation of the heart, the correct arrangement of heart cells is necessary. The development of cardiac progenitor cells is controlled by the incRNA Braveheart [2].

Regarding the role of incRNAs in the immune response to various diseases, they are involved in immune responses to Alzheimer's disease. Also, incRNAs are involved in immune responses to cancer types such as lung cancer and pancreatic cancer [4].

To conclude this research, it can be said that it is possible to assert that this type of RNA has a direct influence on the future risk of cardiovascular diseases and the predisposition to oncology.

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A. Faizulin, O. Shugurov, O. Hurko

## ACTIVATION OF AQUARIUM FISHES ABILITIES FOR LEARNING AND REFLECTION

This study explores the processes of active learning and reflection in aquarium fish, focusing on their behavioural responses during exploratory tasks in mazes of varying complexity. It also investigates the mechanisms of memory formation and the adaptation of fish to new conditions. The research aims to examine the cognitive functions and learning abilities of fish in maze environments, with potential implications for aquarium husbandry, particularly in improving feeding techniques and raising juvenile fish. Studying fish cognitive abilities is crucial for understanding the learning and memory mechanisms in aquatic organisms. Throughout this research, aquarium fish of various species and sizes will be examined, and changes in activity and nervous function will be analysed under the influence of external factors that contribute to conditioned reflexes formation. During investigation, we've developed a one-dimensional maze, in which the food dispenser is placed at varying distances from the entrance. The complexity of the maze is determined by the distance between the entrance and the food dispenser: the greater the distance, the higher the task's difficulty for the fish. Thus, the fish are required to adapt their orientation and learning skills depending on the position of the food, that allow to assess their ability to solve varying complexity tasks. This design also enables to examine how fish adapt to changing conditions that may resemble real environmental challenges.

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This deals with learning exploration and reflective abilities of aquarium fishes as they navigate mazes, as well as examining the influence of various factors on their behavioural responses and memory processes. The research involves mazes of varying complexity to observe and record the fish's behavioral responses during these tasks. Changes in activity and nervous function are measured using bioelectrical methods. It is hypothesized that aquarium fish can learn through food motivation and demonstrate adaptability to maze environments. The findings of this study are expected to provide insights into the cognitive aquatic organisms' mechanisms and contribute to the development of improved practices in aquarium management.

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## PROSPECTS FOR THE INTRODUCTION OF *DRACOCEPHALUM* *MOLDAVICA* IN THE STEPPE DNEIPER REGION

### Abstract

The article examines the prospects for introducing Moldavian dragonhead (*Dracocephalum moldavica* L.) into the agro-climatic conditions of the Steppe Dnieper region. The biological characteristics of the plant, its phytochemical composition, and potential use in medicine and pharmacy are analyzed. The study presents research results on the adaptation of *D. moldavica* in the conditions of Ukraine and discusses possible approaches to its cultivation in the Steppe zone.

### Introduction

The diversity of steppe vegetation in Ukraine is determined by the presence of various landscape features, temperature, and precipitation levels. One of the most widespread plant families in Ukraine is *Lamiaceae*. This family includes more than 230 genera and approximately 7,200 species. They are distributed worldwide but are most adapted to the Mediterranean climate, as well as temperate and tropical conditions. Species of this family are widely used in medicine, culinary arts, landscape design, and ornamental gardening. Of particular interest is the species *Dracocephalum moldavica* L., a perennial, herbaceous, pubescent plant that contains essential oil with a lemon balm aroma [1, p. 2].

### Relevance of the Problem

Moldavian dragonhead (*Dracocephalum moldavica* L.) is a promising medicinal and essential oil plant of the *Lamiaceae* family, known for its rich phytochemical composition and biological activity [2, p. 6]. Given the growing demand for natural biologically active substances, the introduction of *D. moldavica* into new agro-climatic zones, particularly the Steppe Dnieper region, is a relevant task [3, p. 12]. Studying the adaptive capabilities of this plant will contribute to expanding

the assortment of medicinal plants cultivated in Ukraine and ensuring a raw material base for the pharmaceutical industry [4, p. 120].

### **Materials and Methods**

To analyze the prospects for the introduction of *D. moldavica* in the Steppe Dnieper region, a review of scientific literature from the past six years was conducted, focusing on the biological characteristics, phytochemical composition, and adaptive potential of this plant in Ukrainian conditions. The primary sources of information included scientific articles, dissertations, and conference materials [5].

### **Results and Discussion**

#### **Biological Characteristics and Phytochemical Composition of *D. moldavica***

*D. moldavica* is known for its high content of essential oils, with citral and geranyl acetate being the dominant components [6]. Studies conducted in the Forest-Steppe zone of Ukraine have shown that the main components of this plant's essential oil are citral (49.9%) and geranyl acetate (43.9%). Additionally, a significant content of polyphenolic compounds, including rosmarinic acid, apigenin, and luteolin, has been detected in the aerial parts of *D. moldavica*.

#### **Adaptation and Cultivation in Ukraine**

Studies conducted in the Ternopil region have confirmed the successful introduction of *D. moldavica* in the Forest-Steppe zone of Ukraine, indicating its high adaptive capacity. Given the similarity of climatic conditions between the Forest-Steppe and the Steppe Dnieper region, it can be assumed that *D. moldavica* has the potential for successful cultivation in the Steppe zone as well. However, further field studies are necessary to confirm this hypothesis and determine optimal agricultural practices.

#### **Prospects for Utilization**

Due to its rich phytochemical composition, *D. moldavica* exhibits a broad spectrum of biological activities, including anti-inflammatory, antioxidant, and cardioprotective properties. This opens up prospects for using this plant in the pharmaceutical and cosmetic industries. Moreover, the essential oils of *D. moldavica* can be utilized in the food industry as natural flavoring agents.

### **Conclusion**

The introduction of Moldavian dragonhead into the agro-climatic conditions of the Steppe Dnieper region is a promising direction that requires further research.

Considering the successful cultivation of *D. moldavica* in other regions of Ukraine and its valuable biological properties, this plant can become an important source of biologically active substances for the pharmaceutical and food industries.

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Yu. Homik, K. Lavrentieva, O. Osadcha

#### THE PROBLEM OF BACTERIAL ANTIBIOTIC RESISTANCE: CAUSES AND WAYS TO OVERCOME IT

Antibiotic resistance is the ability of microorganisms to survive and multiply under conditions when the concentration of antibiotics that inhibits other bacteria of the same species is not effective for them. According to the WHO, antibiotic resistance is one of the ten most serious threats to humanity. In 2019, bacterial resistance to antimicrobials was associated with almost 5 million deaths, of which 1.27 million were the direct result of it. It is projected that by 2050, antibiotic resistance could cause up to 10 million deaths annually.

Resistance can be natural or acquired. Natural antibiotic resistance occurs due to the lack of a target for the antibiotic or its inaccessibility, which may be due to the low permeability of the bacterial wall or the presence of enzymes that destroy the drug. Such resistance is stable and does not depend on the frequency of antibiotic use. Acquired antibiotic resistance develops as a result of genetic changes – mutations

or activation of certain genes – and is formed only when a microorganism comes into contact with an antibiotic.

Antibiotic resistance (AR) has become a serious global problem that threatens the effectiveness of antibiotics and jeopardises the achievements of modern medicine. The main factors behind its development include: excessive and irrational use of antibiotics, especially without a doctor's prescription; non-compliance with treatment, which allows some bacteria to adapt; the use of antibiotics in livestock and fish farming to stimulate growth; insufficient infection control in healthcare facilities; and the lack of new drugs.

Of course, the main issue is how to overcome antibiotic resistance, as the number of drug-resistant microorganisms is growing every year, making it difficult to treat infections. To combat this problem, new strategies need to be developed to preserve the effectiveness of antibiotics and reduce the risk of developing resistant bacteria. One of these areas is the development of antibiotics with new mechanisms of action, which will help overcome resistance to already known drugs. Modifying existing antibiotics by improving their properties will increase their effectiveness and reduce the likelihood of developing resistant bacteria. It is also important to use combination therapy, when several antibiotics with different mechanisms of action are prescribed together, which reduces the likelihood of resistance. The introduction of adjuvants and nanoparticles in combination with antibiotics helps to enhance their effect, improve penetration into microbial cells and increase their toxicity. Recently, attention has also been drawn to the use of phytonutrient preparations based on plant extracts with antimicrobial properties, which can help reduce bacterial resistance and increase the effectiveness of traditional antibiotics.

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## HIDDEN DANGER OF DETERGENTS

Detergents are compounds, the main components of which are washing substances. Detergents include soap and synthetic detergents. When exactly soap making was born is not known for certain. It is known that four thousand years ago, people smeared their hair with oils and incense, which formed a cute semi-liquid substance "sapo". The first synthetic detergent appeared only in 1916. It was used for industrial use. Its invention is attributed to the German chemist Fritz Gunther. The first household synthetic detergents, which were more or less not harmful to the hands, began to be produced only in 1933. In less than a hundred years, synthetic detergents have made a real revolution. From the means with specific purposes they turned into an indispensable attribute of modern life, and their production has become an important branch of the chemical industry. Currently, the consumption of detergents during the year averages about 10 kg/year per person.

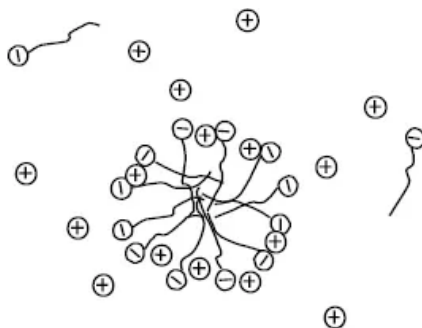
The widespread use of synthetic detergents in everyday life is due to the fact that they allow you to get rid of dirt and grease on various surfaces effectively, even in cold or hard water.

Synthetic detergents have a complex multi-component composition, but they all contain a special ingredient – surfactants, which determine the cleaning properties of detergents. Surfactants have extremely useful unique properties: removal of fat, formation of a foam. Their principle of operation is that they reduce the surface tension of water, allowing water to mix with oil and dirt, which have a non-ionic nature and under normal conditions do not dissolve in water.

A distinctive property of all surfactants is that their molecules have two-sided properties. One part of the surfactant has hydrophobic properties, and the other is hydrophilic (Fig. 1).

The hydrophilic part of the surfactant molecule attracts water, and the hydrophobic, on the contrary, repels it. The hydrophobic part of the surfactant

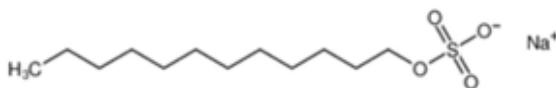
molecule is attracted to fats, oil, proteins and other organic contaminants and "captures" them. The hydrophilic part of the surfactant molecule forms colloidal particles – micelles, inside which there are dissolved contaminants. Formed micelles with contaminants dissolved in it are easily washed off the surface with water, cleaning it.



**Fig. 1. Spherical micelle of ionic surfactant**

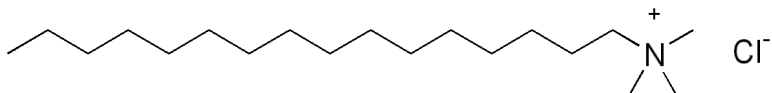
According to the modern classification of surfactants, depending on the structure of the hydrophobic part of the molecule and the ability to dissociate in aqueous solutions, as well as the type of ions, detergents are divided into four classes: anionic, cationic, amphoteric (ampholytic), non-ionic. Anionic surfactants in solutions form negatively charged organic parts of anions, cationic surfactants form positively charged cations, amphoteric surfactants in an acidic solution have cationic, and mainly anionic properties. Non-ionic surfactants in water do not form ions, their solubility is due to functional groups related to water, they have hydrogen bonds between individual molecules and oxygen atoms [1].

Anionic (alkaline) surfactants are the most common variety, combining high efficiency and availability. They are characterized by significant foaming and excellent degreasing [2]. Representatives of the anionic species are coco-, lauryl- and sodium laureth sulfate, ammonium lauryl sulfate (Fig. 2).



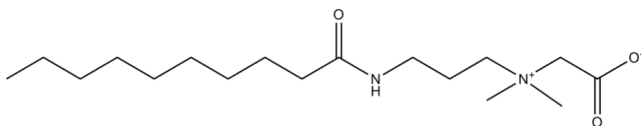
**Fig. 2. Structural formula SLS**

Cationic (acid) surfactants are substances, the range of applications of which are significantly limited due to the fact that they have a reduced detergency. But they are safer than anionic surfactants [2]. The representative of the cationic species is cetrimonium chloride (Fig. 3).



**Fig. 3. Structural formula cetrimonium chloride**

Amphoteric surfactants are substances with a neutral reaction, the surface activity of which varies based on the level of acidity of the aqueous medium: in alkaline conditions they work as anionic components, in acidic conditions – as cationic. The advantages of amphoteric surfactants are that they are "gentle" to the skin and hair, have low toxicity, cleanse gently, have bactericidal activity and good foaming. Amphoteric surfactants are best paired with anionic and cationic substances. With the first, foam formation is maximized, safety is increased for humans and nature, with the second, the work of silicones and polymers is intensified. The main disadvantage of amphoteric surfactants is their high cost, since their production requires significant monetary costs [2]. Amphoteric surfactants include imidazoline and cocamidopropyl betaine (Fig. 4).



**Fig. 4. Structural formula of cocamidopropyl betaine**

A non-ionic group combines substances that in an aqueous medium are not subject to decomposition into ions. The key purpose is to reduce the aggressiveness of other compounds that adjust surface tension [2].

Anionic surfactants are widely used in detergents, shampoos, toothpastes; cationic ones are used in hair conditioners, antiseptics; amphoternes are used in shampoos, shower gels, children cosmetics.

**Table 1. Shows the comparative characteristics of the most used surfactants of different groups**

Surfactants	Anionic	Cationic	Amphoternes
Trade name	sodium lauryl sulfate [4]	cetrimonium chloride [3]	cocamidopropyl betaine (lauramidopropyl betaine)
Chemical name by UPAC	sodium dodecyl sulfate	hexadecyltrimethylammonium chloride	2- [3- (dodecanoylamino) propyl]dimethylazaniumyl] acetate
Chemical formula	$[\text{C}_{12}\text{H}_{25}\text{SO}_4]^- \text{Na}^+$	$[\text{C}_{19}\text{H}_{42}\text{N}]^+ \text{Cl}^-$	$\text{C}_{11}\text{H}_{23}\text{CONH}(\text{CH}_2)_3\text{N}(\text{CH}_3)_2\text{CH}_2\text{COO}^-$
Label mark	SLS, SDS	ERCAQUAT CT 30 V	CAHB
Class of organic compounds	sodium alkyl sulfate	quaternary ammonium base	fatty acid amide
pH of the surfactant solution	6,9 – 7,1	4,5–6,5	5,2 – 6,4
Receipt	sulfonation of lauryl alcohol	quaternization of the primary amine with chloralkanes	hydrolysis of coconut and palm oils
Foaming ability	high	low	average
Valid content g/100 g of product	0,5 – 2	2,5	5–15
Advantages	cheapness, versatility	safety, efficacy, versatility antimicrobial action	"green" substance, efficiency, antistatic agent, foam stabilizer, biodegradable
Toxicity	average, decomposes to form $\text{SO}_3$ $\text{Na}_2\text{O}$	moderate, able to accumulate	low

The massive use of surfactant creates an additional burden for the environment. Most surfactants have an extremely wide range of negative environmental impacts. Pollution of water bodies by surfactants is largely determined by their physical and chemical properties: the ability to reduce the surface tension of liquids; high foaming ability; stabilization of other substances that pollute water bodies.

Surfactants cause eutrophication of water bodies, stimulate the growth of algae, reduce the surface tension of water, which leads to a decrease in oxygen and carbon dioxide, degrade the quality of drinking water, reduce its transparency etc. They form toxic aerosols with air, which significantly affects the quality of atmospheric air. Getting into the soil, surfactants slow down the natural decomposition processes and cause damage to vegetation.

The situation is aggravated by the fact that surfactant molecules have the ability to accumulate on different surfaces, as well as spread with the current and wind over long distances, penetrate into drinking water, plants, fruits, vegetables, berries, and then into the human body.

The main danger of surfactants for the human body is a daily constant contact with them: during cleaning the house, washing dishes, washing and wearing clothes; eating food and drinks that contain these substances; when caring for the face, body and hair with the help of cosmetics containing them etc. At the same time, despite understanding all the dangers that are hidden within the surfactants, the probability of refusal to use them in modern everyday life is almost negligible.

Clinical studies have shown that some surfactants have an aggressive attitude to the skin, which can accelerate ageing processes, provoke various diseases, worsen immunity, disrupt metabolic processes, overdry the skin, lead to irritation and allergic reactions etc. Along with environmental exposure, the effect of surfactants on the human body has a cumulative nature. For example, surfactants that remain on clothes after washing with poor rinsing of fabrics can lead to gradual deterioration of health for "unknown" reasons. Not only skin and hair can be adversely affected by surfactants, but also the liver, kidneys, gastrointestinal tract, brain and immune system. Aggressive surfactants often irritate the eyes and mucous membranes of the oral cavities.

It is possible to protect yourself from the toxic effects of surfactants. When buying detergents, it is necessary to prefer more expensive products that contain natural surfactants, such as cocamidopropyl betaine. During washing, choose safe powders that have a low degree of absorption of fabrics and do not use aggressive detergents unnecessarily. Wash dishes in rubber gloves, rinsing them thoroughly several times with water. When choosing hair and skin care products, read carefully the information on the label and follow the instructions for their use.

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S. Ishchenko, T. Denysenko, O. Posudiiivska

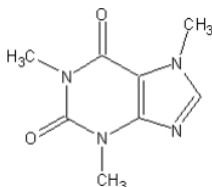
## **CAFFEINE IN DRINKS: BENEFITS AND HARMS**

Based on numerous social media reviews regarding consumer preferences worldwide, it can be concluded that the most popular and widely consumed beverage in the world is tea. In the second place is a universal drink used for all occasions – Coca-Cola, while coffee ranks third. Tea is the most highly valued in such countries as England and China, where this beverage has centuries-old traditions. More than 500 billion cups of coffee are consumed worldwide each year, with Finland and the Netherlands leading in consumption [7]. Coca-Cola, on the other hand, has gained global popularity due to its unique taste, refreshing effect, and powerful marketing system. What is the secret behind the success of these beverages?

The secret of the popularity of coffee, tea, and the carbonated soft drink Coca-Cola lies in the fact that they contain a stimulating substance belonging to the group of natural alkaloids – caffeine. These natural compounds are extremely widespread in the plant world. Caffeine is found in various parts of plants such as the coffee tree, tea bush, cocoa, yerba mate, guarana, kola nuts, and some others. It is synthesized as a defense mechanism against insects and to attract pollinators [2].

Chemically, caffeine is an organic compound that belongs to the group of purine alkaloids (Fig. 1). This subgroup of alkaloids contains nitrogen-containing heterocycles. At its core lies xanthine (3,7-dihydropurine-2,6-dione), a hydroxyl derivative of purine [5]. Other purine alkaloids include nicotine, strychnine, morphine, and curare, which are highly toxic compounds exerting negative influence

on the human body. Unlike them, caffeine is considered relatively safe when consumed in moderation, as its stimulating effect on the nervous system does not produce a pronounced toxic effect.



**Fig. 1. The structural formula of caffeine**

In terms of physical properties, caffeine is a white, odorless powder with a slightly bitter taste. It has a relatively low melting point of 235–238°C, is moderately soluble in water at room temperature, and dissolves well in boiling water (66 g/100 ml) and ethanol [2].

Caffeine can be obtained from waste products of tea and coffee bean processing; however, it is most often synthesized from uric acid. The traditional synthesis method involves two main stages: at first, under the action of formamide, uric acid is converted into xanthine, which is further methylated using dimethyl sulfate. The synthesis is carried out in a slightly alkaline medium (pH 8.0–9.0), with a caffeine yield reaching 65–70% [5].

Caffeine can also be obtained at home by conducting a simple experiment based on its ability to sublime, meaning, it transitions directly from a solid to a gaseous state without passing through the liquid phase. To extract caffeine at home, take two tablespoons of loose green tea and grind it into a fine powder using a mortar and pestle. Then, place the obtained powder into a dry porcelain evaporating dish. Cover the dish with a large glass funnel, ensuring that its edges extend about 1 cm beyond the dish. Next, heat the dish over a burner flame. During the heating process, caffeine will sublime and condense on the inner walls of the funnel in the form of white crystals [3].

When caffeine is ingested, it is rapidly absorbed in the small intestine and reaches its peak concentration in 30 minutes. Its half-life is 3–5 hours, but can be slowed down by food or liver problems [2].

Caffeine is highly soluble in fats, so it easily enters the brain, where it affects the nervous system. The main effect of caffeine is to block the receptors that are responsible for feeling tired and drowsy. This allows you to relieve fatigue and increase vigor. Caffeine stimulates the release of substances that improve concentration and attention, such as norepinephrine and dopamine, which activate neurons in the brain. It is due to this effect that we feel energized and more productive after a cup of coffee or an energy drink [5].

Caffeine has been shown to improve the condition of the cardiovascular system; reducing the risk of atherosclerosis. Moderate coffee consumption (up to three cups per day) reduces the risk of heart attack [1; 6]. Studies involving more than 120 thousand people have shown that people who drink one to six cups of coffee a day have a 17–20% lower risk of premature death, mainly due to a reduction in mortality from cardiovascular disease [1].

Regular consumption of coffee and tea reduces insulin sensitivity, which helps prevent type 2 diabetes. Caffeine has an analgesic effect, which is especially noticeable in migraines. Caffeine also has a positive effect on the urinary system [1; 6].

On the other hand, high caffeine intake can cause nervousness, anxiety, insomnia, and irritability, especially in people with anxiety disorders; it provokes heart rhythm disturbances and affects blood circulation. High caffeine intake (more than 5 cups per day) in women with low calcium levels is associated with decreased bone density and an increased risk of osteoporosis. Excessive coffee consumption is one of the possible causes of lung cancer. Cases of fatal caffeine poisoning are rare, but have been reported. They are mostly associated with excessive consumption of energy drinks or an overdose of caffeinated drugs. The main mechanism of fatal effects is tachyarrhythmia when caffeine is consumed in high doses ( $>3$  mg/kg) [1].

The analysis of academic sources on the caffeine content of the most popular beverages is presented in Table 1.

Interestingly, the caffeine content of coffee can vary significantly depending on the method of preparation. Below a chart is presented showing the caffeine content of different coffee drinks (Fig. 2).

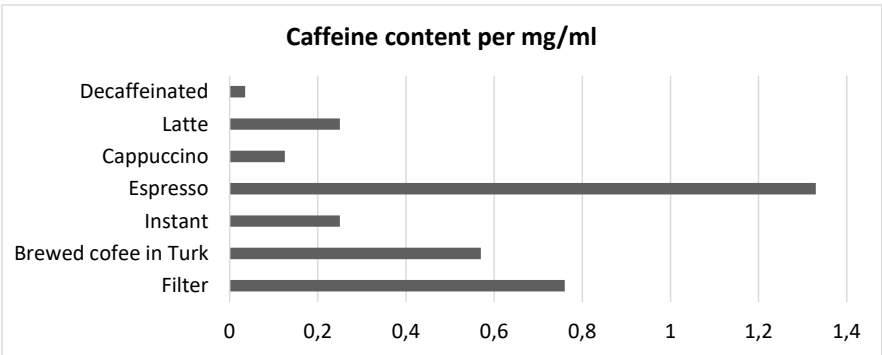
To summarize, caffeine is a biologically active substance of natural origin with a double effect on the body. Moderate consumption (up to 400 mg per day)



improves functioning of the heart and nervous system, speeds up metabolism, and improves the functioning of the urinary system.

**Table 1. Caffeine content in the most popular drinks**

Drink	Caffeine content per mg/ml
Coffee	0,0035 - 1,33
Tea	
Black	0,125-0,25
Green	0,075-0,15
Energy drinks	
Red Bull	0,33
Monster	0,32
Burn	0,32
Rockstar	0,32
Carbonated drinks	
Coca-cola	0,13
Pepsi	0,12



**Fig. 2. Caffeine content in coffee depending on the brewing process**

However, its excessive consumption is associated with significant risks to human health, up to and including death. It is important to keep this in mind when planning your daily diet.

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A. Kaliberda, R. Dolinski, N. Kaliberda

## GENE THERAPY AND LEBER CONGENITAL AMAUROSIS

Gene therapy represents a groundbreaking approach in modern medicine, offering the potential to correct genetic defects by introducing, removing, or altering genetic material within a patient's cells. This innovative technique holds promise for treating a myriad of genetic disorders, including those previously deemed incurable.

One such condition is Leber congenital amaurosis (LCA), a rare inherited retinal disease that leads to severe vision loss from birth or early infancy. Recent advancements have brought hope to individuals affected by this condition. Notably, on February 20, 2025, "The Guardian" reported that doctors in London successfully restored sight in children with LCA through a pioneering gene therapy treatment. This breakthrough demonstrates the real-world impact of gene therapy, transforming lives by reversing blindness in young patients.

Gene therapy works by modifying or replacing faulty genes within a person's cells to treat or prevent disease. Since many genetic disorders arise from mutations that cause proteins to malfunction or be absent altogether, gene therapy aims to

correct these defects at the molecular level. The core approach involves delivering genetic material into a patient's cells using vectors – most commonly modified viruses that safely introduce the new gene without causing disease.

There are several methods of gene therapy, depending on the condition being treated. One approach is gene silencing, which targets and deactivates harmful genes, commonly used in conditions where an overactive gene leads to disease, such as certain cancers. Another method is gene replacement, where a faulty or missing gene is substituted with a healthy copy. This is particularly useful for monogenic diseases like LCA, where a single defective gene causes blindness.

If we talk about LCA in detail, it is a group of inherited retinal dystrophies caused by mutations in genes essential for photoreceptor function. It primarily affects the retinal pigment epithelium (RPE) and photoreceptor cells (rods and cones). The disease is caused by mutations in over 25 different genes. These genes are involved in phototransduction (conversion of light into electrical signals), retinal metabolism, and visual cycle regeneration. Mutations lead to impaired photoreceptor function, loss of light sensitivity, and progressive cell degeneration. Photoreceptors become dysfunctional early but may remain structurally intact for a period, creating a window for therapeutic intervention before the lack of functional proteins causes progressive cell death, leading to irreversible blindness.

Gene therapy for LCA aims to deliver a functional copy of the defective gene to retinal cells, restoring normal function. This approach has been particularly successful in *RPE65*-[*gene name*]-related LCA. A functional copy of the defective gene is packaged into an adeno-associated virus (AAV) vector. AAV is commonly used because it is non-pathogenic, efficiently targets retinal cells, and has long-term expression potential [1].

The patient undergoes a minimally invasive surgical procedure under general or local anesthesia. A small incision is made, and the AAV vector carrying the therapeutic gene is injected into the subretinal space, between the photoreceptors and the RPE. The virus infects RPE cells, delivering the correct gene, which integrates into the cells and begins producing the missing or dysfunctional protein. Once the functional protein is produced, photoreceptor cells regain their ability to respond to light.

Prof James Bainbridge, consultant retinal surgeon at Moorfields and professor of retinal studies at UCL Institute of Ophthalmology, said that children born with LCA can distinguish only light and dark, and what little sight they do have they will lose within a few years. Doctors reported dramatic functional improvements, with some children experiencing vision for the first time in their lives: “Some children are even able to read and write following the intervention which is something that one would absolutely not expect in this condition, untreated” [2].

Despite its groundbreaking potential, gene therapy faces several challenges that limit its widespread application. These challenges include high costs, potential complications, accessibility issues, and ethical concerns.

Gene therapy is one of the most expensive medical treatments available today. For example, Luxturna, the FDA-approved gene therapy for *RPE65*-related Leber congenital amaurosis (LCA), costs around \$850,000 per patient. This high price can be justified by the extreme complexity of the process:

1. Custom genetic engineering is required to produce a functional version of the defective gene.
2. Adeno-associated virus (AAV) vectors must be carefully developed to deliver the therapy safely.
3. Specialized surgical procedures (such as subretinal injection) require highly trained professionals and advanced medical facilities.
4. Regulatory approvals and clinical trials take years and cost millions of dollars, further driving up expenses.

Even though gene therapy can offer a potentially lifelong cure, its financial burden raises concerns about insurance coverage and healthcare inequality, making it inaccessible for many patients.

Although gene therapy has shown remarkable success, it is not without risks. Some of the key complications include:

1. Immune system reactions: The body may recognize the viral vector as a foreign invader and trigger an immune response, reducing treatment effectiveness or causing inflammation.
2. Off-target effects: In rare cases, the introduced genetic material could integrate into the wrong location in the genome, potentially leading to unintended consequences such as cancerous mutations.

3. Limited long-term data: While early results are promising, researchers are still studying how long the effects of gene therapy last and whether patients might require re-treatment in the future.

The availability of gene therapy is highly limited, as only a few specialized hospitals and research centers worldwide have the expertise and technology to perform these treatments. This creates a major geographic barrier, particularly for patients in low-income or rural areas, where access to cutting-edge medical advancements is scarce. Additionally, because gene therapy targets rare genetic diseases, pharmaceutical companies often struggle to justify large-scale production, leading to limited supply and slow distribution.

The development and application of gene therapy raise ethical questions, particularly when it comes to gene editing technologies like CRISPR-Cas9. While current therapies focus on treating genetic disorders, the possibility of modifying human genes for enhancement purposes (e.g., intelligence or physical traits) has sparked debates about the risks of “designer babies” and genetic inequality. Strict regulations ensure gene therapy is used ethically, but they also slow down innovation and patient access [3].

While gene therapy represents one of the most promising advancements in modern medicine, its challenges must be addressed to make it a viable solution for more patients. Researchers and policymakers are working on ways to reduce costs, improve safety, and expand accessibility, ensuring that gene therapy fulfills its potential as a life-changing treatment for genetic diseases like LCA and beyond.

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## **MODERN METHODS OF TUBERCULOSIS DIAGNOSIS IN UKRAINE**

One of the most pressing medical and social issues in Ukraine in the 21st century continues to be tuberculosis. The World Health Organization (WHO) considers tuberculosis, alongside the human immunodeficiency virus, viral hepatitis, and malaria, to be one of the most dangerous infectious diseases and a significant global concern due to rising morbidity and mortality rates. Ukraine is one of the leading countries in the world for tuberculosis, particularly with multidrug-resistant strains that are not treatable with some of the most effective anti-tuberculosis medications.

Timely and accurate diagnosis of tuberculosis plays a crucial role in controlling the spread of the disease and initiating appropriate treatment. In recent years, there has been significant progress in tuberculosis testing methods, including the development of express tuberculosis tests, QuantiFERON testing, and molecular testing.

The express test for tuberculosis utilizes advanced technology to detect the presence of *Mycobacterium tuberculosis* in patient samples. These tests are designed to provide rapid results, typically within a few hours, allowing doctors to initiate appropriate treatment immediately. Compared to traditional diagnostic methods, this test minimizes personnel errors during the conduct and interpretation of studies, provides same-day results, significantly reducing both patient waiting times and the risk of disease transmission.

Another method for testing latent tuberculosis infection (LTBI) is QuantiFERON testing (QFT test), which uses advanced technologies to measure the immune response to tuberculosis antigens. This tuberculosis test is conducted after excluding active tuberculosis disease. QuantiFERON testing is based on the detection of gamma-interferon released by immune cells in response to tuberculosis infection. This innovative approach has shown great promise for accurately diagnosing latent tuberculosis infection, allowing for timely intervention and prevention of active tuberculosis. QuantiFERON testing helps prevent the development of active disease in contact patients and individuals with weakened immune systems.

Molecular testing for tuberculosis, or polymerase chain reaction (PCR), is a modern method for diagnosing tuberculosis and other infectious diseases. These tests are based on the amplification and detection of specific parts of the genetic material of the tuberculosis bacteria. Molecular tests are used to identify specific DNA sequences that are characteristic of the tuberculosis bacteria and can detect even small amounts of genetic material. They can be rapid and highly sensitive, allowing for results to be obtained in a short period and enabling the detection of infection even at early stages.

These innovative technologies have transformed the field of tuberculosis diagnostics. They offer speed, reliability, and increased accuracy, facilitating timely intervention, reducing transmission, and ensuring effective treatment of tuberculosis cases. Manufacturers continue to improve these testing methods, thereby strengthening the global fight against tuberculosis, which will ultimately lead to better control and eradication of this devastating disease.

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M. Kulinich, Yu. Matsuk, O. Posudiiievskia

#### **IMPROVING SOUR CREAM TECHNOLOGY USING COCOA POWDER**

Modern trends indicate that consumers are giving increasing preference to natural and high-quality dairy products. This makes relevant the issue of improving sour cream production technologies and expanding its product range.

This research is devoted to the study of the biological properties of cocoa powder and its usage in the sour cream recipe in order to increase its biological value and create a new product.

Cocoa has a variety of minerals, including phosphorus, magnesium, copper, potassium and calcium. Minerals play a fundamental role in several biological processes and some of them act as enzymatic cofactors in the synthesis of macromolecules [1; 2]. Cocoa is also a source of fiber and methylxanthines, such as theobromine, caffeine and theophylline. Theobromine has a positive effect on the nervous system, as well as stimulates the heart muscle.

Cocoa is a source of flavanols, and these phenolic compounds exert beneficial effect on health and aging. Studies report that bioactive agents in cocoa can act to reduce the risk of vascular and blood pressure alterations, coronary heart disease, stroke, cerebral oxidative stress, cognitive impairment and neurodegenerative disorders [2]. Thus, the consumption of cocoa can improve health in several aspects.

The technology of adding cocoa powder involved adding it to sour cream after the fermentation and fermentation stage, mixing it until it is homogeneous, and then cooling it to obtain the required consistency.

Due to cocoa powder, sour cream acquires a chocolate flavor and aroma, which makes it an interesting alternative to the classic product. Such sour cream can replace high-calorie creams or desserts, which attracts those who want to combine benefit with pleasure. Owing to its composition, sour cream with cocoa powder can be used as an ingredient for cakes, pies and muffins. It can also be served as a stand-alone dessert garnished with fruit or nuts.

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## **CHARACTERISTICS OF FUNGI DISTRIBUTION OF THE GENUS THYROSTROMA (HÖHN., 1911) IN THE STEPPE ZONE OF UKRAINE**

Prolonged research conducted in the Steppe Zone of Ukraine has revealed that the most severely affected by infectious branch dieback are tree species extensively cultivated in urban green spaces. These include Siberian elm (*Ulmus pumila* L.), hackberry (*Celtis occidentalis* L.), boxelder maple (*Acer negundo* L.), small-leaved lime (*Tilia cordata* Mill.), narrow-leaved oleaster (*Elaeagnus angustifolia* L.), black locust (*Robinia pseudoacacia* L.), Japanese pagoda tree (*Styphnolobium japonicum* (L.) Schott), and white mulberry (*Morus alba* L.).

The aforementioned trees and shrubs frequently have “semi-dead” crowns with a substantial quantity of deceased branches, sometimes surpassing the number of viable ones. It has been documented [1, p. 702; 2, p. 207] that this unsatisfactory phytopathological condition is predominantly driven by the active proliferation of certain phytopathogenic fungi (micromycetes), which induce branch necrosis. The development of these pathogens displays a recurring, annual pattern, occurring during the physiological dormancy of host plants, primarily from February to April, with heightened activity observed between the cessation of winter frosts and the onset of bud break.

Investigations into the species composition and developmental characteristics of the phytopathogenic fungi responsible for branch dieback across Europe have identified complexes of fungi within the order Pleosporales (Ascomycota, Dothideomycetes), particularly the families Camarosporidiellaceae (species of the genus *Camarosporidiella*) and, notably, Dothidothiaceae (species of the genus *Thyrostroma*), as playing a decisive role in this process.

Until recently, only a single species from this group – *Thyrostroma compactum* (Sacc.) Höhn. – was recognized in Ukraine and was considered the causative agent of *Thyrostroma* branch necrosis in lime and elm trees. However, contemporary research has demonstrated that a diverse array of specialized fungi within the family Dothidothiaceae [1, p. 731], most of which are phytopathogenic and cause significant harm to their host plants, occurs in the Steppe Zone of Ukraine.

A revision of the genus *Thyrostroma*, coupled with genomic studies, has revealed that elms and lime trees are affected by at least three previously unknown species of *Thyrostroma* [1, p. 705]. The Siberian elm (*Ulmus pumila* L.) and its hybrids are predominantly infected by *Thyrostromaulmicola* (Senwanna, Wanas., Bulgakov, Phookamsak & K.D. Hyde) and *T. ulmigenum* (Senwanna, Wanas., Bulgakov, Phookamsak & K.D. Hyde), with the former being the most prevalent. The pathogenicity of *T. ulmicola* often manifests in catastrophic consequences for infected trees, leading to the widespread death of branches and the characteristic pathological appearance of the crown. This includes the formation of cankerous growths at the necrotic branches base and the emergence of numerous new shoots from dormant buds, which predominantly succumb to dieback in the following year.

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V. Melnichuk, T. Ostanina, O. Osadcha

## VARIETY OF EQUIPMENT IN REHABILITATION

Rehabilitation has become an essential part of modern life, helping individuals recover from injuries, regain mobility, or adapt to life with long-term physical conditions. According to the definition, rehabilitation is “a set of interventions designed to optimize functioning and minimize disability in individuals with health conditions while interacting with their environment” [3].

Rehabilitation helps people of all ages stay as independent as possible in daily activities, education, work, and family roles. It addresses health conditions, adapts

environments, utilizes assistive products, and educates for self-management, enabling safer, more independent living. These strategies help overcome difficulties with thinking, perception, communication, and mobility. At some point in life, anyone may require rehabilitation, whether due to injury, surgery, illness, or age-related functional decline. To ensure optimal recovery, specialists rely on rehabilitation equipment to make the process as effective and accessible as possible [3].

Rehabilitation equipment has evolved significantly, driven by rising demand and its potential to improve patient outcomes. From basic tools to advanced, technology-driven devices, this market has seen remarkable innovation and growth. Technology has been a key catalyst, expanding the possibilities for recovery and functionality. Innovations in robotics, AI, virtual reality, and data analytics have transformed rehabilitation equipment and revolutionized recovery from injuries and surgeries. The combination of technological advancements and a deep understanding of human physiology has paved the way for a new era in rehabilitation [1].

The rehabilitation equipment can be divided into various product types. Each of these categories represents a vital aspect of rehabilitation equipment, catering to diverse needs and contributing significantly to the recovery and well-being of individuals undergoing rehabilitation programs. Rehabilitation equipment is categorized into several types, each serving a distinct purpose in the recovery process:

- **Body Support Equipment:** Body support equipment plays a pivotal role in aiding individuals during the recovery process by providing stability, protection, and assistance in movement. Orthotic devices such as braces, splints, and supports are tailored to stabilize and protect injured or weakened body parts, facilitating healing and preventing further damage. These supports can range from simple designs to complex, customized structures, catering to various injuries or conditions. With advancements in materials and design, these support devices are now more comfortable and effective than ever.

- **Exercise Equipment:** Exercise is a key component of rehabilitation, as it helps restore strength, flexibility, and mobility. Rehabilitation exercise tools range from simple resistance bands and stability balls to sophisticated machines tailored for therapeutic workouts. Balance boards, stationary bikes, and elliptical trainers offer low-impact exercise options that improve coordination, cardiovascular health,

and muscle strength. The integration of technology in exercise equipment has led to the development of interactive systems and gamified exercises, making rehabilitation workouts more engaging and motivating for patients, thereby aiding in their recovery process.

- **Mobility Equipment:** Mobility aids play a vital role in rehabilitation by helping individuals regain independence in movement. Wheelchairs, walkers, canes, and crutches are among the key tools in this category, designed to accommodate varying levels of mobility impairment. Wheelchairs have undergone significant advancements, transitioning from manual to electric-powered models, offering greater mobility and ease of use. Walkers, canes, and crutches, meanwhile, provide support for individuals with less severe mobility challenges. Recent innovations have focused on enhancing ergonomics, portability, and functionality, making these mobility aids more adaptable to diverse user needs and environments [1].

The use of specialized equipment during rehabilitation offers numerous advantages, significantly enhancing recovery and improving overall well-being. Rehabilitation equipment provides targeted support and assistance, allowing patients to perform exercises safely and effectively. Devices such as treadmills, resistance bands, and balance boards help improve mobility, strength, and coordination [2].

Technology-enhanced equipment, such as electrical stimulation devices and robotic-assisted therapy machines, accelerates recovery by stimulating muscles and improving neuromuscular function. These advancements enable individuals to regain movement more quickly and efficiently. Another key benefit is pain management – rehabilitation machines, such as hydrotherapy pools and massage devices, reduce pain and inflammation, making therapy more comfortable. Additionally, using rehabilitation equipment fosters independence and confidence, allowing patients to track progress, exercise at their own pace, and regain control over their abilities, boosting motivation and adherence to therapy [2].

In conclusion, the use of equipment during rehabilitation provides essential advantages such as enhanced safety, faster recovery, pain relief, psychological support, and professional supervision. Incorporating modern rehabilitation tools significantly improves the quality and effectiveness of recovery programs.

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M. Nedotopa, T. Ostanina, O. Osadcha

## REHABILITATION FOR UKRAINIAN SOLDIERS WITH AMPUTATION

Rehabilitation of military personnel as a result of military conflicts or traumatic events is a relevant and important task in the healthcare sector. Unfortunately, due to active hostilities, a similar situation is currently occurring in Ukraine, and the number of wounded military personnel and civilians who need proper assistance from various specialists of a multidisciplinary team is increasing every day [1].

In the military context, physical therapy after amputations is extremely important, as amputations make it difficult for soldiers to return to their professional duties or adapt to civilian life after returning from war. This therapy not only aids in physical recovery but also provides psychological support, helping soldiers return to a fulfilling life [2].

Early rehabilitation starts in intensive care and includes acute, post-acute, pre-prosthetic, and long-term recovery. The focus is on patient activation: verticalization, body position changes, and wheelchair transfers. Self-care skills (washing, eating, etc.) and cognitive functions are addressed, along with prevention of complications like pneumonia and pressure sores.

The prosthetics process is complex and multi-stage. After amputation, a stump (the part of the limb that remains after amputation) is formed. During this period, contractures (reduced mobility in the joints) are prevented, and anti-edema therapy is applied, with noticeable effects appearing after a few weeks [3].

Once the scar heals, pre-prosthetic rehabilitation begins with a multidisciplinary team. Patients engage in strength, endurance, and functional exercises like limb movements, balloon flips, and resistance training. Scar massage after stitch removal prevents skin hardening, maintains mobility, and reduces sensitivity. The rehabilitation team tailors exercises and interventions.

MRHT specialists provide support from day one. If needed, a prosthetist-orthotist assesses the optimal amputation level and ensures proper stump formation. MRHT specialists may continue working with the patient in other departments post-stabilization to aid recovery.

During pre-prosthetic rehabilitation, the doctor of physical and rehabilitation medicine provides the patient with comprehensive information about all available rehabilitation aid manufacturers. After selecting a prosthetics provider, the patient begins cooperation with the prosthetist. At this stage, the prosthesis design is chosen, potential components are discussed, and manufacturing details are finalized. Once the prosthesis is manufactured, an equally important stage begins – prosthetic rehabilitation and adaptation. MRHT specialists assist the patient in learning to use the prosthesis, restoring motor activity, and adjusting to the new device [4].

Thanks to quality prosthetics and rehabilitation, patients regain their lifestyle. Ukraine provides free prosthetics for civilians and combatants. Documents are submitted via the Ministry of Social Policy. Patients receive 2–8 rehabilitation cycles yearly. Inpatient rehab lasts at least 14 days (up to 3 hours/day), while outpatient rehab exceeds 14 days (over 1 hour/day). Good residual limb mobility is crucial for prosthetic fitting. Joint mobility exercises prevent contractures, and end support stability is developed through specialized training.

Good mobility in all joints of the residual limb is essential for prosthetic fitting. Joint mobility exercises prevent and eliminate contractures. The residual limb must be pain-free and capable of withstanding pressure, which is achieved through specialized load-bearing exercises [2].

Improving blood circulation and supporting the patient's psycho-emotional state are also crucial. Physical therapists recommend starting movements with support on the residual limb, gradually transitioning to independent exercises under specialist supervision [3].

In lower limb amputation, spinal curvature in the frontal plane must be considered when selecting exercises. Overloading the healthy limb can cause flatfoot, so foot-strengthening exercises are essential.

During prosthetic preparation, focus is on strengthening the shoulder girdle and overall conditioning, as walking with crutches places heavy strain on the arms and requires four times more energy than normal walking.

Physical therapy for military personnel with amputations restores functionality, psychological well-being, and social integration. Guided by individualization, comprehensiveness, and gradual progression, timely therapy accelerates their return to active life. Future research prospects involve assessing the effectiveness of the developed program on activity levels in military personnel after amputation.

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V. Nevidomy, N. Parfinovych, O. Novikova

#### BEST RELATIVE APPROXIMATIONS OF CLASSES OF DIFFERENTIABLE FUNCTIONS DEFINED ON THE REAL AXIS

This research focuses on the theory of best relative approximations of function classes consisting of  $r$ -times differentiable functions defined on the real axis. In modern approximation theory, constrained approximation problems – where approximating functions must belong to the same functional class as the original ones play a central role. Such problems are not only theoretically rich but also highly applicable in engineering, data modeling, and computational mathematics, where preserving the smoothness of approximated functions is essential [1, p. 43].

Many existing results in this area are devoted to periodic functions. For such functions, classical tools like Fourier series and orthogonal systems are well-developed and provide powerful approximation techniques. However, for non-periodic functions defined on the entire real axis, the situation is more complex. The lack of compactness and periodic structure leads to difficulties in constructing optimal approximating subspaces and analyzing their behavior [3, p. 87]. As a result, there remain many open problems related to the order and asymptotic behavior of approximation characteristics in the non-periodic case.

This study aims to fill these gaps by addressing the relative approximation of differentiable functions on  $\mathbb{R}$ , with a focus on two main aspects: the best approximations in the  $L^1$ -metric and the behavior of relative averaged widths under class-preserving constraints. Special attention is given to spline approximations – a powerful and flexible tool in both theory and applications.

The specific objectives of this research include:

- Establishing order estimates for the best relative approximations of differentiable function classes by splines belonging to the same class. The focus is on approximations in the integral metric, which is widely used in practical applications such as signal processing and numerical integration [2, p. 98].
- Analyzing non-symmetric approximation settings, where the approximating splines are not assumed to be symmetric with respect to the origin. This reflects real-world situations where such symmetry cannot be guaranteed.
- Investigating the order behavior of relative averaged widths that preserve the differentiability of the approximated functions. These widths provide quantitative measures of the performance of approximating subspaces under certain constraints [1, p. 51].

The expected outcomes of this research include the derivation of new order estimates for best relative approximations and practical criteria for constructing efficient approximation tools. These results are relevant not only for theoretical mathematics but also for applied disciplines involving data approximation, numerical simulation, and computer-aided design.

The study contributes to the general theory of approximation on unbounded domains and expands existing knowledge on the behavior of smooth function classes



under relative approximation constraints. The findings may serve as a basis for future research in related fields such as machine learning, computer graphics, and numerical solutions of differential equations.

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O. Parfonov, A. Lyashkov

### MODELING OF CURRENT-VOLTAGE CHARACTERISTICS OF HETEROGENEOUS OXIDE SYSTEMS

A relevant issue in modern electronic technology is the study of the electrical characteristics of structures based on heterogeneous semiconductor oxide materials. Thanks to advancements in technology and the use of various methods, their potential for the development of new semiconductor devices is being revealed. The p-n junction is a key element in many semiconductor devices, such as diodes, transistors, and integrated circuits. The aim of this study was to assess the applicability of the Ebers-Moll [1] model for approximating the experimental characteristics of ZnO-NiO structures [2].

The Ebers-Moll model is a classical mathematical model of a bipolar transistor that describes its behavior in various operating modes. For a semiconductor diode, part of this model can be used since the diode is essentially a p-n junction, which is a key element of a bipolar transistor. One of the key equations used in the Ebers-Moll model [1] is the diode equation, which expresses the relationship between the current and voltage across the diode junction:

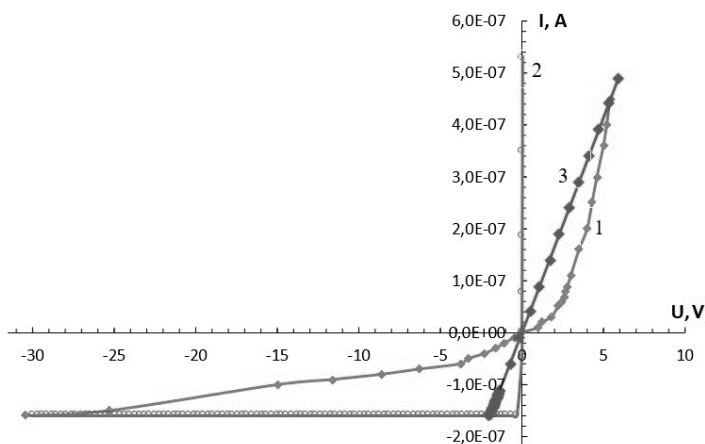
$$I = I_o \left( e^{\frac{U}{n U_t}} - 1 \right), \quad (1)$$

$I_o$  – is the diode saturation current;  $U_t$  – is the thermal voltage ( $\sim 26$  mV);  $n$  – is the ideality factor, accounting for deviations from an ideal diode junction ( $\sim 1$ – $2$ ).

This equation allows analyzing the dependence of diode current on the applied junction voltage. At high forward voltages, the exponential function increases significantly, leading to a rapid rise in diode current. Under high reverse voltages, the diode may effectively be turned off, as the exponential function grows very slowly.

The Ebers-Moll model for diodes is an essential tool in the analysis and design of electronic circuits involving diodes. It helps establish the relationship between voltages and currents in the diode, enabling the prediction of its operating characteristics and the optimization of its application in specific circuits.

Mathematical modeling of the current-voltage characteristics for ZnO-NiO structures was performed in Mathcad (Fig. 1).



**Fig. 1. Experimental current-voltage characteristics of the ZnO-NiO structure (1) [2]; modeling results for an ideal diode (2); modeling results for ZnO-NiO structures (3)**

Based on the modeling results, it can be concluded that the Ebers-Moll model for the p-n junction is not very suitable for describing the obtained structures due to their high resistance. A possible direction for improving oxide-based diode structures is doping to increase the electrical conductivity of both n-type and p-type semiconductors. For ZnO doping, oxides of Mn, Co, Sb, and Cr can be used, as they are traditionally employed for this purpose in varistor production. For NiO doping, monovalent metals such as Li, Na, K, and Ag can be applied. Additionally, electrical conductivity

can be enhanced by creating non-stoichiometric oxides – oxygen deficiency for n-type semiconductors and excess oxygen for p-type semiconductors.

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S. Roitman, T. Sklyar, O. Osadcha

## BACTERIOPHAGES AS AN OBJECT OF BIOTECHNOLOGY

Bacteriophages – bacterial viruses – are a relatively simple biological system and are a convenient model for studying the main problems of virology, molecular biology and biotechnology. Significant advances in the study of nucleic acid replication mechanisms, the fine structure of genetic material, the molecular mechanism of mutations, the regulation of protein synthesis and many other biological achievements are associated with the use of bacteriophages as convenient model objects.

Bacteriophages, like all other viruses, are absolute cellular parasites. They carry the information necessary for their own reproduction and, at the same time, do not have their own energy-synthesising systems or protein-synthesising mechanisms. Bacteriophages are the most abundant group of viruses on Earth and can be found in all possible eco-environments occupied by their hosts, bacteria [1, c. 3].

Bacteriophages are convenient objects for research due to the rapid accumulation of infectious material and the relative simplicity of manipulating their genome. Most phages consist of two structural components – a head and a tail, each of which performs a specific function depending on their chemical nature. The phage head is a nucleic acid molecule – DNA or RNA – surrounded by a protein coat, and the appendage is a rod surrounded by a protein coat.

The main function of phages is reproductive, which occurs by infecting bacterial cells with mature (active) phage particles. This process is called phage infection [1, c. 5–6].

Bacteriophages are convenient model systems because they have a simple but differentiated structural organisation that is well understood today; they multiply rapidly; there are fairly reliable methods for accumulating, isolating and purifying bacteriophages; and they are clearly detectable by negative colonies. It is also important that they carry the genetic information of bacteria. They are important in medicine as well as in veterinary medicine for the identification of bacteria and the treatment of bacterial infections. And, of course, they are effective against bacteria [1, c. 10].

The discovery of bacteriophages allowed their use in medicine and veterinary medicine as a means of treating, preventing and diagnosing infectious diseases. In fact, bacteriophages are the only highly specific and natural factor in the biological control of bacterial diseases.

Depending on the method of application, several types of bacteriophage preparations are distinguished: wound preparations for external use and intestinal preparations. Drugs intended for subcutaneous, intramuscular, intracavitary or intravenous injection [2, c.104–105].

Also, bacteriophages are used in epidemiological phagotyping as a method of identifying the pathogenic agent, and subsequently its source, method of transmission and treatment. That is, in this case, phage identification of bacterial cultures collected from a patient is used.

“Bacteriophage biocontrol”, as one of the methods of using bacteriophages, is the use of lytic bacteriophages to treat both food raw materials and finished products and surfaces in contact with them in order to kill pathogenic bacteria. Bacteriophage biocontrol is becoming increasingly popular in the US and Europe as it is effective, relatively inexpensive, environmentally friendly and positively perceived by the customers [3].

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A. Sabanskyy, K. Holoborodko

## USE OF VEGETATION INDICES FROM DRONE-ACQUIRED MULTI-SPECTRAL IMAGERY FOR ASSESSING PHOTOSYNTHETIC ACTIVITY OF ROBINIA PSEUDOACACIA

### Abstract

Monitoring the ecological status of woody plants is crucial for environmental conservation. Traditional ground-based methods are labor-intensive and spatially limited, whereas remote sensing offers broader coverage but faces challenges in assessing the physiological state of plants. This study integrates drone-acquired data to analyze the photosynthetic activity of *Robinia pseudoacacia* in the steppe zone of Ukraine. The goal of this research is to use remote sensing data to estimate leaf and canopy chlorophyll content (LCC and CCC) of *Robinia pseudoacacia*.

### Research Methodology

**Ground Measurements.** LAI data are obtained using an LAI instrument on test plots. Chlorophyll content measurements include laboratory analysis of chlorophyll content in leaves to determine LCC values. Fluorometer-based chlorophyll level assessments are also used to calculate a correlation with laboratory analysis and drone-borne vegetation indices, which are used as ground-based data sources for remote site experiments.

**Drone-borne Data and Measurements.** Estimation of leaf chlorophyll content (LCC) is performed using the Chlorophyll Vegetation Index (CVI), based on the method proposed by Vincini et al. (2008) [3, p 303–319]. Canopy chlorophyll content (CCC) is calculated with the use of the Green Chlorophyll Index (CIgreen) [2, p 271–282].

**Empirical Calibration.** A calibration model is created to link WDV with LAI [1, p. 405], and LCC using regression analysis. The relationship between

vegetation indices (VIs) and chlorophyll content (LCC and CCC) is established using both radiative transfer models and empirical methods. The LCC and CCC calibration line is created by measuring LCC in field samples, using results from biochemical lab analysis, and linking these values to the CVI (or C<sub>Igreen</sub>) pixels. Setting the calibration lines for W<sub>DVI</sub> and C<sub>VI</sub>, which are crop- and site-specific, will allow for the application of this calibration line to new situations to estimate LCC and CCC from remote sensing data.

**Assessment Using Drone Data.** The obtained calibration model is used for large-scale LAI and chlorophyll content assessment from drone imagery, enabling the analysis of the physiological state of *Robinia pseudoacacia* in other locations within the region.

### Conclusion

This study enhances the use of remote sensing indices for quantifying vegetation parameters, refining methodologies for estimating LAI, LCC, and CCC in *Robinia pseudoacacia* under steppe conditions. By integrating drone-borne spectral data with empirical and radiative transfer models, it improves the precision of chlorophyll content estimation, offering valuable insights for ecological monitoring and land management. The findings may support applications in carbon cycle modeling, climate change adaptation, and biodiversity assessment.

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## MODERN METHODS OF FORMING CRYSTALS

In many fields of science it is increasingly necessary to work with various, multifunctional poly- and single crystals, to deal with their formation, dissolution, etc. Crystals need to be grown for infrared and ultraviolet spectroscopy, radiation detectors (crystal lamps and scintillation counters), for the study of photovoltaics and ferromagnets, and as synthetic gems for the jewelry industry. Currently, there are a sufficient number of methods for obtaining crystals – both industrial and laboratory. Each of them has its own advantages and disadvantages, its own field of application. If these methods are systematized according to the principle of the phase state of the substrate, then the results can be summarized in Table 1.

**Table 1. Known main methods of obtaining crystals**

<b>From the solution</b>	<b>From melt</b>	<b>From the steam</b>
Growing from a supersaturated solution [5]	Stepanov's method [10]	Chemical evaporation with steam [11]
Hydrothermal method [4]	Czochralsky's method [10]	Physical vapor deposition (PVD) [5, 1]
Electrochemical method [3]	Bridgman-Stockbarger method [12]	Crystallization from the gas phase [5]

As can be seen from Table 1, the variety of approaches to the problem of obtaining crystals presents researchers with a difficult choice of the best method that suits their needs. The task of our work is to single out and review the most requested methods of crystal formation right now (over the past five years). This should help researchers navigate the current trends in the field under consideration and choose a reliable and relevant method. Next, we will list the most common crystals, as well as methods of cultivation.

If we consider the problem from the point of view of the quantitative need for synthesized crystals, crystalline silicon and its semiconducting properties have acquired special importance in modern life. A study in Advanced Functional Materials [16] explores the use of silicon to create large-scale photovoltaic fibers.

And in the study of Abdelbasset Bessadok-Jemai [14], silicon nanostructures are used for solar cells. Crystalline silicon is usually grown by the Czochralsky method [2]. The principle of operation of the method is that a seed crystal is immersed in the melt – a seed of the required structure and crystallographic orientation. To ensure a more even distribution of temperature and impurities in the volume of the melt, the seed crystal and the crucible with the melt are rotated, usually in opposite directions.

Chromium disilicide, a high-temperature semiconductor material with a narrow band gap, deserves special attention from researchers [7]. It is grown by electrochemical and chemical methods in melts [15]. Electrochemical synthesis is based on chemical processes that, under the action of current, occur at the boundary of the electrode-solution phase separation, in particular at the cathode (reduction) and anode (oxidation). This method allows you to carry out chemical transformations that are difficult or impossible to implement using traditional methods.

Molybdenum disulfide is used as an alloying additive to various alloys [18] and for the manufacture of electrodes for glass melting [17]. Similarly to  $\text{CrSi}_2$ , it is grown by high-temperature electrochemical synthesis [6].

The creation of progressive energy-saving technologies and new materials is one of the most important directions of scientific and technical development. Such tasks include obtaining metallurgical alumina with a given phase composition, as well as corundum ( $\alpha\text{-Al}_2\text{O}_3$ ), alloyed with chromium, which are increasingly used in machine building, as well as in the production of special ceramics. Corundum is obtained by hydrothermal synthesis [9]. Hydrothermal synthesis can be defined as a method of synthesizing single crystals that depends on the solubility of minerals in hot water under high pressure. Crystal growth is carried out in an apparatus consisting of an autoclave, where the substance is fed together with water. A temperature gradient is maintained between opposite ends of the growth chamber. At the hotter end, the substance dissolves, while at the cooler end it settles on the seed crystal, growing the desired crystal.

To create magnets of different strengths, ferromagnets are used: iron and cobalt. Cobalt is obtained by electrochemical deposition [8]. The essence of



the deposition process is the restoration of metal cations contained in the electrolyte solution on the surface of the cathode. Ferrum is obtained by the zone melting method [13]. The zone melting method consists of locally heating the material to the melting temperature to create a narrow zone of melt, which is then slowly moved along the entire sample. In this case, the solid part crystallizes behind the melting zone, and the impurities remain in the liquid phase.

From the analysis of the used literature, it can be concluded that the most common methods of crystal synthesis are the Czochralsky method, zone melting, electrochemical deposition and hydrothermal synthesis. With the development of technologies, the need for crystalline materials with various properties will only grow, and the need for specified and new methods of synthesis, in our opinion, will also grow. The methods we singled out make it possible to obtain a fairly high purity of crystals, and therefore are currently the most common.

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P. Tishchenko, O. Vinnyk, O. Osadcha

## **THE ROLE OF FAMILY MEMBERS IN CARING FOR DEPENDENT INDIVIDUALS**

In modern society, a significant number of people require constant external care for various reasons. These may include elderly individuals, people with chronic illnesses, disabilities, or those who, due to accidents, war, or other circumstances, have lost the ability to live independently and take care of themselves [2].

In such situations, close ones and family members play a key role in patient care. They not only provide physical assistance and help in daily life but also contribute significantly to maintaining the emotional and psychological well-being of the individual. The care and support of family members help reduce stress levels, enhance comfort, and improve the overall well-being of the patient.

One of the key aspects of quality care is access to reliable and understandable information about the patient's health condition, possible complications, and caregiving methods. Having up-to-date information helps family members feel more confident and provide better care [1].

Providing care at home requires significant effort and organizational skills. It is essential to create a comfortable and safe environment, ensuring access to necessary medical supplies and equipment. The physical space should be adapted to the patient's needs, with modifications such as handrails, accessible bathroom facilities, and specialized beds. Additionally, maintaining a structured care routine that includes medication management, hygiene assistance, and regular health monitoring is crucial. Although family members provide most of the care, the involvement of healthcare professionals remains vital. Medical specialists can assess the patient's condition, educate caregivers on proper caregiving techniques, and offer psychological support to prevent caregiver burnout [3; 4].

Emotional support plays a crucial role in caring for dependent patients. The ability of family members to listen, comfort, and show care helps reduce feelings of isolation and improve the patient's emotional state. This contributes to lowering stress and anxiety levels, positively impacting overall well-being [5].

Additionally, family support can enhance a patient's motivation to overcome challenges associated with illness and improve their quality of life. It is important for the family to be attentive to the emotional needs of the patient, as a sense of support and security helps maintain psychological balance.

Caring for a dependent individual is a demanding but deeply meaningful responsibility. Families play a fundamental role in providing not just physical assistance but also emotional and psychological support. To make caregiving more effective and less stressful, families should seek professional guidance, access available resources, and ensure their own well-being. By doing so, they can create

a compassionate and nurturing environment that enhances the quality of life for both the caregiver and the patient.

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O. Trukhym, O. Vinnyk, O. Osadcha

#### THE PROBLEM OF EMOTIONAL BURNOUT AMONG MEDICAL STAFF IN UKRAINE

Professional burnout among medical staff is a serious issue in the modern healthcare system. It requires special attention, particularly in Ukraine, where doctors are working in the context of armed conflict. Constant stress, high demands for work quality, limited resources, and extreme conditions significantly increase the risk of emotional and physical exhaustion. It is important to note that the phenomenon of burnout was officially recognized as a disease during the 72nd session of the World Health Assembly and included in the 11th edition of the International Classification of Diseases [3, p. 1849].

Emotional burnout is a syndrome caused by prolonged stress and strain, leading to the depletion of person's mental and physical reserves. It manifests as chronic fatigue, apathy, sleep disturbances, irritability, and may also include nervous breakdowns and outbursts of aggression [4, p. 93]. Healthcare workers may feel that their contribution to helping others is not appreciated, the situation is not improving despite their hard work. They might become dissatisfied with their job, themselves,

and life in general. It is not apparent at first. The problem lies not so much in burnout itself, but in the inability of medical professionals to identify it in time.

The three-factor model of burnout, developed by American psychologists, is the most widely accepted. It defines emotional burnout as consisting of emotional exhaustion, depersonalization, and personal accomplishment [2, p. 67]. The study, conducted at the Neurosurgery Center in Kyiv in 2024 with 50 participants from various medical specialties and positions, showed that more than half of the staff demonstrated medium to high levels of each of three aspects [5, p. 478]. Another research, conducted in the pre-war period and involving over 500 respondents, produced same results [1, p. 43–45]. It is clear that, in the current crisis, cases of emotional burnout within the Ukrainian healthcare system have become even more prevalent. It affects and will continue to affect the overall standard of medical services.

The occurrence of emotional burnout among doctors is influenced by a variety of factors. These can encompass personal characteristics, such as medical worker's stress tolerance, self-esteem, and social life. The ability to establish personal boundaries in relationships with colleagues and work with patients is important too. A professional for whom the work is meaningful and demands full emotional involvement will always be at risk. Amid low wages, medical workers are often forced to perform the duties of several people at once. A lot of people are leaving the profession or looking for better conditions abroad. Excessive workloads, staff shortages, work-related frustration, and working while unwell all contribute to the development of burnout.

Caring for the mental health and well-being of doctors is a shared responsibility between employees and hospitals management. Raising awareness of this issue, implementing measures by medical institutions to offer psychological support, promoting knowledge of self-regulation are essential steps that can lead to considerable improvement.

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D. Vertash, O. Kositsyna, O. Posudiiivska

## CALCULATION SOLUBILITY PARAMETERS OF THE POLY(URETHANE-SEMICARBAZIDES) ON THE BASIS OF PYRIDINE DERIVATIVES

Solubility parameter models are widely used for the selection of suitable solvents/non-solvents for polymers in various processing and engineering fields. The choice of solvent is crucial to avoid phase segregation during polymer synthesis, as well as to develop stable formulations that meet environmental, safety and quality standards. The need to identify suitable (non) solvents for polymers has led to the development of quantitative models of polymer-solvent compatibility, guided by the concept of "like dissolving like." A solvent with a cohesive energy density similar to that of the polymer is a good solvent for the polymer. The cohesive energy density of a condensed substance is a measure of the strength of intramolecular bonds and is defined as the energy required to isolate a unit of the volume of molecules that make up the substance from each other [1].

In our study, we focus on the Hildebrand solubility parameter model. The Hildebrand model uses a single parameter  $\delta$ , defined as the square root of the cohesive energy density, to determine whether a substance is a good solvent or non-solvent for a polymer. The solubility parameter  $\delta$  is often used to predict the solubility of a polymer in various organic solvents, as well as to preliminarily assess the compatibility of polymers with each other or with plasticizers. Solvents

with  $\delta$  values different from polymer values above  $2 \text{ MPa}^{1/2}$  are considered insoluble, and those within  $\pm 2 \text{ MPa}^{1/2}$  of polymer  $\delta$  value are considered to be good solvents; the factor  $2 \text{ MPa}^{1/2}$  is determined on the basis of empirical considerations [1, 2].

In this study, the solubility parameter of components in the synthesis of poly(urethane-semicarbazides) was determined. The main components for PU synthesis are hydroxyl terminated polybutadiene (HTPB,  $M_n = 3000 \text{ g/mol}$ ), oligooxytetramethylene glycol (PTMG,  $M_n = 1000 \text{ g/mol}$ ), toluene-2,4-diisocyanate (TDI), 2,6-dimethyl-3,5-pyridinedicarboxylic acid dihydrazide (DH) [3].

Compatibility calculations were performed by the Askadsky method, considering the Hildebrand solubility parameter (method I), mole fractions of components (method II) and surface tension of polymers (method III). It has been shown that the most effective mathematical method for predicting the compatibility of polymer systems is the Askadsky method, which uses the Hildebrand solubility parameter. The results of the calculations have a high degree of agreement with the experimental data, which confirms the correctness of the chosen method and the assumption of good compatibility of all components.

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## **APPLICATION OF POLYMER COMPOSITE AND CERAMIC MATERIALS FOR ELECTRICAL PROTECTION OF SOLAR PANELS**

In recent decades, solar energy has been rapidly developing, becoming one of the key areas in the field of renewable energy sources [2]. This is driven by the growing demand for electricity, the depletion of traditional hydrocarbon resources, and the need to reduce greenhouse gas emissions. Solar panels represent an environmentally friendly energy source that can significantly reduce dependence on fossil fuels. Despite their obvious advantages, solar panels are exposed to a number of risks, including electrical overloads, short circuits, weather conditions, and material degradation. This makes the development of effective protection methods especially relevant.

The purpose of this study is to review the main directions in the development of new materials for the electrical and thermal protection of solar panels.

Polymer composite and ceramic materials are increasingly being used for the electrical protection of solar panels due to their unique properties. These materials help in preventing electrical overloads, enhancing thermal management, and providing electromagnetic interference (EMI) shielding.

Polymer composites, such as polymeric positive temperature coefficient (PPTC) resettable fuses, are used to isolate inactive or defective areas in photovoltaic cells. These fuses increase resistance significantly when a certain temperature is reached, preventing damage from electrical overloads and enhancing the reliability of solar arrays [5].

Composites with polyvinyl butyral (PVB) matrices and ceramic fillers like boron nitride (BN) improve thermal conductivity while maintaining high electrical resistance. This makes them suitable for managing heat in solar panels without compromising electrical insulation [1].

Ceramic composites, such as those incorporating reduced graphene oxide (rGO) with mullite, provide high electrical conductivity and mechanical strength, making them effective for EMI shielding in harsh environments [4].



Multifunctional ceramic composites can simultaneously offer thermal protection and EMI shielding. These composites use layers of polymer-derived ceramics and carbon nanotubes to achieve high thermal insulation and effective EMI shielding.

Composites combining polymers with ceramics like strontium titanate ( $\text{SrTiO}_3$ ) can enhance solar reflectance and cooling properties, making them useful for temperature regulation in solar panels [3].

Polymer/ceramic composites tailored by electrophoresis can improve electrical stress control in power electronics, which is beneficial for solar panel applications.

The relevance of solar energy continues to grow, requiring advancements in technologies for protecting solar panels from various electrical impacts. The development and implementation of innovative electrical protection methods will enhance the reliability, efficiency, and longevity of solar energy systems, ensuring their uninterrupted operation in a wide range of operating conditions.

Polymer composite and ceramic materials offer significant advantages for the electrical protection of solar panels. They provide solutions for electrical overload protection, thermal management, and EMI shielding, enhancing the efficiency and reliability of solar energy systems. These materials are crucial for advancing solar technology by addressing key challenges in electrical and thermal management.

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## **PSYCHOLOGICAL ANALYSIS OF THE CONCEPT OF “IDENTITY”**

The chosen approach to analyzing the concept of “identity” integrates psychological, philosophical, and sociological perspectives, highlighting the multifaceted nature of this phenomenon. This interdisciplinary interaction illustrates how identity is shaped by the intersection of internal processes of self-determination and external social influences. It provides a comprehensive understanding of the dynamic nature of identity and its relevance in the modern world, particularly under the impact of social media and globalization.

Identity is a key concept for describing an individual's self-awareness and social roles, encompassing various aspects of development, interactions, and cultural norms. Different fields of study, such as sociology, psychology, philosophy, and cultural studies, explore what defines identity and how it is formed. Identity is a dynamic process that includes aspects of self-determination and social interaction. According to psychological theory, it constantly evolves, especially during life crises such as job changes or the loss of loved ones [4]. These changes can lead to psychological growth but may also provoke anxiety if an individual struggles to adapt [1].

Supporters of the sociological approach argue that identity is shaped through social interaction. For instance, E. Goffman describes the concept of the “façade”, which a person “wears” in social situations to influence others. Self-presentation is not identical to identity, but is a part of it [7]. P. Bourdieu highlights the influence of social structures on the formation of identity [2].

The process of identity change is multifactorial. A key aspect is the adaptation of the “possible self” to real conditions. Successful adaptation maintains integrity, while failure can lead to an identity crisis [5]. Changes in self-presentation can influence a person’s self-perception, but the deeper aspects of the “self” remain stable.

Sigmund Freud believed that identity is shaped under the influence of unconscious processes [5]. Erik Erikson viewed it as a developmental process, with

each stage involving a crisis essential for the formation of a healthy identity [3]. Crises play a crucial role in identity development. They can be both destructive and contribute to personal growth, prompting individuals to re-evaluate their values [9].

In postmodern theory, particularly in the works of Michel Foucault, identity is seen as a product of power discourses that control knowledge and individual behavior [6]. This emphasizes the social nature of identity, which is constantly evolving under the influence of external factors.

Identity can be divided into personal and collective, where personal identity is shaped through individual experience, and collective identity through group affiliation [8].

Thus, the formation of identity is a dynamic process encompassing various aspects of self-determination, self-presentation, and adaptation to different social roles [10; 11]. In today's world, where information and social media exert an ever-growing influence on identity formation, this process becomes even more complex. The modern impact of social networks illustrates how quickly self-perceptions can shift depending on social approval. However, despite external influences, individuals retain a certain level of autonomy in shaping their identity. This implies that people can actively participate in altering their own identity, making the process an act of individual creativity.

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## **PROMISING DIRECTIONS FOR OPTIMIZING GAS SENSORS BASED ON NANOSCALE OXIDE MATERIALS**

Modern gas sensors play a key role in environmental monitoring, industrial safety, and medical diagnostics [3]. In recent years, there has been active development of sensor technologies based on nanoscale oxide materials such as zinc oxide (ZnO) [1], titanium oxide (TiO<sub>2</sub>) [4], tin oxide (SnO<sub>2</sub>) [2], and others. These materials exhibit high sensitivity to gases due to their large surface area, quantum size effects, and the possibility of structural modifications.

The aim of this work is to identify ways to optimize the characteristics of gas sensors based on nanoscale oxide materials.

One of the key directions for improving the characteristics of gas sensors is to enhance their sensitivity, selectivity, and stability [3]. Research is being conducted in the following areas to achieve these improvements.

### **1. Surface activation of nanomaterials:**

- use of modified nanoparticles with various doping elements (e.g., Pd, Pt, Au) to enhance catalytic activity;
- application of heterostructures consisting of multiple oxide materials to expand the range of detectable gases.

### **2. Development of nanostructured sensor elements:**

- design of three-dimensional porous structures based on nanotubes and nanowires to increase the contact area with the gas environment;
- creation of heterogeneous structures with a gradient composition to enhance response to specific gases.

### **3. Utilization of new synthesis methods:**

- hydrothermal and sol-gel methods enable the production of nanomaterials with controlled characteristics;
- plasma-chemical and laser technologies contribute to the creation of unique surface morphologies.

#### 4. Integration with electronic and optical systems:

- implementation of nanomaterials in field-effect transistors and photonic sensors to improve measurement accuracy;
- use of optical and spectroscopic detection methods for multi-component gas analysis [5].

#### 5. Development of low-power sensors:

- creation of sensor elements operating at low temperatures through the use of new sensitive materials and catalysts.

Despite significant advancements, unresolved challenges remain, including the degradation of sensitive layers, response instability under real-world conditions, and the need for selective detection of specific gases. Promising solutions include machine learning for sensor data processing, hybrid sensor systems, and the use of graphene-like materials.

Gas sensors based on nanoscale oxide materials continue to evolve actively, finding applications in various fields. Innovative approaches to the synthesis and modification of such sensors enhance their sensitivity, selectivity, and reliability. Further research in this area will contribute to the development of highly efficient next-generation sensor systems.

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## **THE FUNCTIONAL STATE OF BLOOD CELLS IN CYPRINID FISH AS A TOOL FOR EARLY DETECTION OF AQUATIC ECOSYSTEM POLLUTION (BASED ON THE KYIV RESERVOIR CASE)**

Anthropogenic pollution of aquatic ecosystems has become a global environmental issue. In Ukraine, especially within the Kyiv Reservoir, water quality deteriorates annually due to industrial, agricultural, and domestic waste discharges. This highlights the urgent need to improve monitoring approaches for aquatic systems.

Traditional water analysis methods do not always capture the biological effects of pollutants or detect them at early stages. In this context, fish blood serves as a highly sensitive biological indicator, reflecting both the exposure and cumulative impact of pollutants. Therefore, hematological analysis is offered as an alternative or complement to standard water quality assessment tools for timely detection of ecological changes.

It is especially important to compare the physiological responses of fish in laboratory conditions with those observed in natural environments, this will help evaluate the actual adaptive capacity of ichthyofauna and identify key biomarkers suitable for systematic monitoring.

The aim of the study is to determine hematological parameters of cyprinid fish blood as aquatic pollution indicators, based on the comparison of laboratory experiments and field data from the Kyiv Reservoir.

Key research objectives:

- 1) identification of blood changes specific to different types of pollutants;
- 2) detection of differences in sensitivity between native and invasive fish species;
- 3) establishment of critical thresholds of pollutant tolerance;
- 4) identification of the most vulnerable stages of fish ontogenesis.

To achieve the aim, we have identified the following methods:

- 1) hematological blood analysis (hematocrit, RBC, WBC, MCV, poikilocytosis, pH);

2) microscopic examination of blood smears, cell counting using a hemocytometer;

3) experimental simulation of pollution (heavy metals, hypoxia, organic contaminants, pH changes);

4) sampling of fish from the Kyiv Reservoir, with identical testing methods applied;

5) comparison across species (common carp, silver crucian carp, common rudd) and between environments (laboratory vs. natural).

To sum up, under ongoing pressure on aquatic ecosystems, research focused on developing accessible and reliable bioindication methods is highly relevant. This study integrates both fundamental and applied approaches and has the potential for practical use in environmental monitoring systems at local and national levels. Hematological parameters of fish blood may become a universal tool for early detection of ecological threats.

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**PANEL 2**  
**Topical Issues of Social Sciences and Humanities**  
*(DNU, Zoom)*

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O. Anisova, K. Berezhna, O. Besarab

**CONCEPTUAL INCONSISTENCY IN THE DEFINITION OF  
INTERNATIONAL COMMERCIAL ARBITRATION  
IN UKRAINIAN AND INTERNATIONAL LAW**

Arbitration has been used as a dispute resolution mechanism for millennia. It has deep roots in various settings, particularly in international and commercial contexts. Throughout most of its history, arbitration has coexisted in a complex and often tense relationship with courts, which have traditionally been slow to accept – and at times even hostile toward the concept of private dispute resolution between parties. However, in the early 20th century, countries around the world began to embrace arbitration, enacting laws that required national courts to enforce arbitration agreements and imposing strict limitations on judicial review of arbitral awards [4, p. 62].

The term "arbitration" (fr. arbitrage), when translated from French, directly means "arbitral court". This is the meaning in which the term "arbitration" is used in most languages worldwide. This explains why legal literature employs a single term, "arbitration", to refer both to the arbitration process itself and to the arbitral tribunal. In this context, the terms "arbitration" and "arbitral tribunal" are used synonymously.

In Black's Law Dictionary, arbitration is defined as follows: "Arbitration – a method of dispute resolution involving one or more neutral third parties, who are usually agreed upon by the disputing parties and whose decision is binding" [1, p. 100].

Article 2 of the Law of Ukraine "On International Commercial Arbitration" provides the following definitions:

- "arbitration" refers to any form of arbitration (arbitral tribunal), regardless of whether it is established specifically for the resolution of a particular dispute or conducted by a permanent arbitral institution, including, in particular, the International



Commercial Arbitration Court or the Maritime Arbitration Commission at the Chamber of Commerce and Industry of Ukraine;

- “arbitration tribunal” means a sole arbitrator or a panel of arbitrators [2].

At the same time, Article 2 of the Law of Ukraine "On Arbitral Courts" provides the following definition of an "arbitral court": a non-governmental, independent body established by agreement or an appropriate decision of interested individuals and/or legal entities in accordance with the procedure established by this Law, for the resolution of disputes arising from civil and commercial legal relations [3].

The provided definitions clearly demonstrate the conceptual difference between the term "arbitration tribunal" in the Law of Ukraine "On International Commercial Arbitration" and the term "arbitral court" in the Law of Ukraine "On Arbitral Courts." However, despite this distinction, in the Ukrainian language and in the aforementioned Ukrainian laws, both concepts are referred to by a single term – "третейський суд" (arbitral court). In contrast, international law explicitly differentiates these concepts using two distinct terms: "arbitration tribunal" and "arbitral court".

Taking into account the diversity of professional opinions among scholars, theorists, and practitioners in the field of arbitration, a comprehensive approach has been formed to define the concept of international commercial arbitration, which includes three interrelated phenomena: 1) a permanent or one-time arbitration body whose task is to resolve international commercial disputes (arbitral institution); 2) the procedure (mechanism, process) for resolving disputes in accordance with the rules established by the arbitration or agreed upon by the parties (arbitration); 3) the specific composition of the arbitration panel that resolves a particular dispute – arbitrators (arbitrator), elected or appointed in accordance with the procedure established by the parties or by law, who consider and resolve the specific dispute submitted to them for consideration and are authorized to issue an arbitration award (arbitration tribunal).

As can be seen from the early mentioned definition of "arbitration" within the meaning of Article 2 of the Law of Ukraine "On International Commercial Arbitration", its content contains a significant contradiction: on the one hand, to the concept of "arbitration institution", as evidenced by the indication *"it is established*

*specifically for the resolution of a particular dispute*", and on the other hand, the indication that it is "*conducted by a permanent arbitral institution*", allows us to consider arbitration as a specific process carried out by an arbitration institution. However, the presence of this normatively determined inconsistency creates the prerequisites for distorting the true content of arbitration as a legal phenomenon.

Petryna V.N. notes that the specified legislative regulation leads to a conceptual inconsistency between the concepts of "arbitration", "arbitral court", "arbitral institution", "arbitral tribunal" in Ukrainian law with the corresponding concepts of international law [5, p. 427].

However, the previously identified terminological inconsistency in the definition of arbitration in Ukrainian law is not the only one. Also, article 2 of the UNCITRAL Model Law, adopted by the United Nations Commission on International Trade Law (UNCITRAL), and approved by UN General Assembly Resolution No. 40/72 of 11.12.1985, provides the following definition: "arbitration" means any arbitration whether or not administered by a permanent arbitral institution [6].

Thus, according to the understanding of the aforementioned UNCITRAL Model Law, arbitration may be administered by an arbitral institution but not conducted by it. At the same time, Ukrainian legislation in this context stipulates that arbitration is conducted, including by an arbitral institution.

The terminological discrepancies between Ukrainian and international law may appear insignificant at first glance. However, they create the basis for a misleading conflation of the concepts of "arbitration", "arbitral tribunal", and "arbitral institution", which refer to distinct legal phenomena. This, in turn, distorts the understanding of arbitration as an administered process (procedure) and ultimately complicates the harmonization of Ukrainian legislation with international law, which is of particular importance for Ukraine in the context of ongoing European integration processes.

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V. Bazhyn, V. Boiko, O. Hurko

## **COMPETENCY-BASED APPROACH IN CONTEMPORARY SOCIOLOGY OF EDUCATION**

The modernization of up-to-date higher education requires an in-depth study of key concepts and categories that provide an analytical framework for further transformations. One of such key concepts is the competency-based approach, which covers the standard skills and knowledge necessary for an education seeker. This strategy opens up access to a number of activities, research areas and subject areas. Among them are the functionality of the first employment positions, the correlation between social status and profession, the intergenerational gap in terms of education criteria, as well as the “educational qualification” as a modern social phenomenon.

The possibility of acquiring relevant competencies in the labor market affects individual and civic identity in an interdisciplinary dimension. The competency-based approach has long become part of the regulatory and legal support for the development of higher education. It ensures transparency of requirements for the performance of educational services, etc. However, within the framework of the scientific sociological dimension, the concept and phenomenon of acquiring competencies should be appropriately correlated with the main social processes and key social transformations.

The criterion base for attributing competencies and competence to the sociological scientific thesaurus is also important. In modern concepts and theories that have a psychological and pedagogical basis, the possibility of social

self-realization, self-perception and projection of the individual and group is progressive quite limitedly. In the conditions of modern Ukraine, despite the full-scale aggression of the Russian Federation, the reform of the higher education system continues. Accordingly, the sociological dimension of the problem is relevant for the adoption of alternatives to public management decisions.

Thus, the competency approach is considered in an interdisciplinary perspective. At the same time, a number of reviews focus on differences in the assessment of acquired competencies and the fluidity of the criterion base. Assessment of the sociological dimension of the competency approach determines not only knowledge and skills. It mostly records the social consequences of the mass distribution of used prestigious and status competencies.

Increasingly, in modern sociological developments, the question of the individual feasibility of competencies and areas of disciplinary competence interpretation as an integral property of the educational process is raised. The subject fields of modern sociological disciplines, which have the prospect of significant progress, are the optimization of population social structure according to new educational qualifications.

One more crucial point is the consequences of competency-based education formation as a social system rooted in activities expert groups. Accordingly, the social origin of these communities, their interaction with each other, the formalization of practices for assessing the competencies acquired by applicants are important. A possible part of further scientific investigations should be considered target indicators of competencies in individual socio-demographic groups, as well as their gender and age dimensions.

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## VERSIFICATION OF WILLIAM BLAKE'S POEM "THE BLOSSOM"

"*The Blossom*" [1, p. 10] is the sixth poem in William Blake's collection "*Songs of Innocence*" (1789). Like all other poems in the collection, it is accompanied by an illustration and exhibits a rich metaphorical structure. However, the explicit metrical and rhyming patterns of the poem remain largely unexplored in existing scholarship. This gap in research highlights the objective of this study, which is to analyze and specify the poem's metrical structure and rhyme scheme.

**Metrics.** "*The Blossom*" consists of two **sestains**, i.e., two stanzas, each containing six lines. The poem follows a predominantly trochaic metrical pattern, though it exhibits certain variations. The trochee, a metrical foot consisting of a stressed syllable followed by an unstressed syllable (U), is characterized by its dynamic and rhythmic quality, contributing to the poem's clear, song-like cadence.

Lines 1, 4, and 5 maintain the pattern U | U | U (e.g. *Merry*, *merry sparrow*), which is classified as **acatalectic trochaic trimeter** – a complete metrical line without missing syllables.

Line 2 is metrically one syllable shorter, following the scheme U | U | U (e.g. *Under leaves sogreen*). This variation is known as **catalectic trochaic trimeter**, where the final unstressed syllable is omitted, creating a more abrupt rhythmic effect.

Line 3 consists of two trochaic feet, but it begins with an anacrusis, an additional unstressed syllable preceding the metrical pattern. This is exemplified by the indefinite article "a" in "*A happy blossom*", producing the scheme U | U | U. As the line contains an extra unstressed syllable beyond its expected metrical form, it is classified as **hypercatalectic trochaic dimeter**.

Finally, Line 6 follows the pattern U | U (e.g. *Near my bosom*), making it an **acatalectic trochaic dimeter**, a complete two-foot line without omissions.

**Rhyme.** Both stanzas of "*The Blossom*" follow the same rhyme pattern: ABCAAC. Given that the poem's metrical structure is trochaic, the penultimate

syllable of each rhyming word carries the stress. This characteristic defines the poem's rhyme type as **paroxytonic rhyme** (commonly known as feminine rhyme), where the second-to-last syllable is stressed, followed by an unstressed syllable.

Sestain 1 exhibits **perfect rhyme**: “*sparrow – arrow – narrow*” and “*blossom – bosom*”. These rhymes maintain identical stressed vowels and consonantal endings, aligning with the traditional definition of full rhyme.

In Sestain 2, the pattern is slightly altered, as it contains one instance of **perfect rhyme** (*blossom – bosom*) and one example of **near rhyme** (*robin – sobbing*). The latter is considered an imperfect rhyme because, although the stressed vowel sounds are similar, the final consonants [n] and [ŋ] differ, preventing a complete phonetic match.

Thus, this analysis highlights the precise metrical structure and nuanced rhyme scheme of Blake's “*The Blossom*”, offering insight into its rhythmic and phonetic artistry. By identifying its trochaic variations and paroxytonic rhyme, this study fills a gap in existing scholarship, demonstrating how metrical and rhyming patterns shape the poem's musicality and emotional tone. Such an investigation deepens our understanding of Blake's poetic technique and its role in conveying the themes of “*Songs of Innocence*”.

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D. Boborykin, O. Hurko

#### SEMANTIC UNCERTAINTY OF CONCEPTS OF “PEACE” AND “NEGOTIATIONS” IN TIMES OF MILITARY CONFLICTS

In times of military conflicts, the meanings of crucial political and diplomatic concepts such as *peace* and *negotiations* become particularly ambiguous and subject to reinterpretations. Traditionally associated with conflict resolution, these terms acquire new semantic dimensions depending on political context, ideological

framing, and media representation. The concepts of *peace* and *negotiations* undergo semantic shifts in contemporary political and media discourse, emphasizing their role in shaping public perception and policy-making. Through a combination of cognitive-linguistic and discourse analysis, it becomes possible to reveal how ambiguity in meaning is strategically employed to advance different geopolitical agendas.

Utilizing cognitive linguistics, discourse analysis, and corpus-based linguistics offers a comprehensive approach to understanding the fluidity of meaning in political language. One of the key theoretical foundations is framing theory, as developed by G. Lakoff (2004) [1], which asserts that the way in which political actors frame concepts determines public perception. In military contexts, *peace* may be framed as an ultimate victory, a temporary ceasefire, or a geopolitical compromise, depending on the ideological standpoint of the speaker. Similarly, conceptual metaphor theory, outlined by G. Lakoff and M. Johnson (1980) [2], demonstrates how metaphors such as *peace as victory* or *negotiations as surrender* influence public discourse. Additionally, critical discourse analysis (CDA), particularly the works of N. Fairclough (1992) [3] and T. van Dijk (2008) [4], provides insight into how discourse reinforces power structures and ideological positions. Political leaders and media outlets strategically use language to establish narratives that support specific geopolitical interests. Lastly, corpus linguistics approach enables the identification of linguistic patterns in large datasets of political speeches, media reports, and diplomatic statements, providing empirical evidence for semantic shifts. One of the main findings of this research is the polysemy of *peace* in contemporary military discourse. Traditionally, the concept of *peace* is understood as the *absence of war* and *restoration of stability*. However, in the context of active conflicts, its meaning becomes more fluid. Some political actors frame *peace* as a complete victory, eliminating the adversary as a prerequisite for stability. Others advocate for *peace* as a negotiated settlement, emphasizing diplomacy over military force. This semantic vagueness contributes to public confusion and divergent policy interpretations.

Similarly, the concept of *negotiations* undergoes significant transformation. While it is generally associated with diplomatic resolution, its strategic use in political discourse varies [5]. In some cases, negotiations are framed as a necessary step toward de-escalation and conflict resolution. In others, they are depicted as

a sign of weakness or betrayal, undermining their legitimacy. This duality is often reinforced by media narratives, where negotiations can be portrayed as either an essential diplomatic tool or a futile gesture, depending on the political bias of the source.

Metaphors play a crucial role in these semantic transformations. The metaphor of *peace as a battlefield* suggests that achieving peace is a struggle rather than a harmonious process. Likewise, *negotiations as a chess game* implies strategic maneuvering rather than genuine dialogue. Such metaphors shape public perception, reinforcing the idea that peace and negotiations are not neutral concepts but rather contested and ideologically charged notions.

A further linguistic strategy contributing to semantic uncertainty is modality and hedging. Modal verbs such as *may*, *could* and *might* introduce ambiguity into discourse, allowing political actors to maintain flexibility in their statements. For example, phrases like *peace may be possible, but under certain conditions* or *negotiations could lead to a resolution* create an illusion of openness while avoiding definitive commitments. This linguistic vagueness serves as a rhetorical strategy, enabling politicians to appeal to multiple audiences while preserving strategic ambiguity.

The semantic shifts in *peace* and *negotiations* are not random linguistic variations but deliberate discursive strategies used to shape public perception and policy-making. The ambiguity of these terms allows political actors to frame conflicts in ways that align with their ideological positions. By manipulating the meaning of key diplomatic concepts, they can justify military actions, influence public opinion, and control international narratives.

These shifts in semantics have significant implications for political communication and conflict resolution indicating that semantic indeterminacy is often a deliberate tool used to justify military actions, manipulate public sentiment and control select narratives. Understanding how semantic uncertainty functions in discourse can help policymakers, diplomats, and media analysts develop more effective communication strategies. By critically examining the language use in military conflicts, researchers can contribute to more transparent and accountable discourse practices. Future research may proceed via investigating the role of social



media in amplifying semantic shifts to provide valuable insights into the contemporary evolution of political language.

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A. Bolivar, N. Styrnik

#### STRENGTHENING ENGLISH LANGUAGE PROGRAMMES IN VENEZUELA

Academia Angloamericana, established in 1986 in Mérida, Venezuela, began its journey under the name Instituto Angloamericano. Over time, it grew to become one of the leading centres for foreign language education in the city. The academy initially focused on offering English language courses to a wide demographic of learners, ranging from children to adults, and gradually expanded its services to incorporate British cultural activities. These cultural engagements now play a central role in the institution's activities, creating a unique educational environment that blends language learning with cultural immersion.

At present, Academia Angloamericana functions as a British-influenced cultural centre, providing not only language instruction but also a platform for cultural exchange. The institution's management structure consists of an executive board that oversees its operations. Professor Jesús Sosa serves as the Managing Director, with Angel Briceño as the Administrative Director, Xenia Oviedo as the Programmes Coordinator, and Carlos Rivera as the Operations Coordinator. The institution's teaching staff includes instructors with diverse professional backgrounds, all of whom are responsible for delivering English courses at various levels. The academy also relies on a group of advisors who offer expertise in fields such as business, law, branding, and pedagogy.

My four-year tenure at Academia Angloamericana, where I first served as a language instructor and later as Programmes Coordinator, laid the foundation for my desire to integrate linguistic research into language teaching. My academic training in linguistics, particularly in the Modern Languages School, encouraged me to seek an internship experience where I could apply my research skills. I was motivated to engage with the institution's academic department and gain insight into the challenges they were facing. After discussions with the executive board, I was offered an internship position as a pedagogical advisor, a role that allowed me to work closely with the teaching staff and contribute to the institution's ongoing development.

During my internship, I was entrusted with several significant responsibilities. Initially, I taught General English as a Foreign Language (EFL) to adult learners at levels B1, B2, and C1 of the Common European Framework of Reference for Languages (CEFR). These groups ranged from intermediate to advanced learners. The academy structures its courses according to the CEFR and I was tasked with ensuring that the lessons aligned with these standards.

Additionally, I collaborated with the Programmes Coordination team to administer and evaluate placement tests for prospective students. This was an essential task, as placement tests are a key component of the academy's language assessment process, ensuring that students are enrolled in courses that match their proficiency level. My internship also involved organising and participating in teacher training workshops, where I coached instructors on improving their teaching effectiveness, especially in terms of lesson planning, assessment techniques, and incorporating strategies that would enhance students' language skills across listening, speaking, reading, and writing.

However, the most pivotal aspect of my internship was my involvement with the General English for Children Programme (GECF). This programme was a focus of concern within the academic department due to its perceived ineffectiveness compared to the adult courses. The challenge was to assess the programme's shortcomings and propose strategies to enhance its delivery. The academy's teaching philosophy promotes standardisation and consistency across all its courses, and my task was to investigate how language planning and policies could improve the GECF's outcomes.

As part of my internship, I decided to conduct a research project focused on the GECP. My objective was to analyse the programme's structure, the teachers' understanding of the curriculum, and the resources at their disposal. I sought to identify areas where the programme was underperforming and to suggest improvements that would align the GECP with the institution's broader pedagogical goals. I also aimed to contribute to the development of the academy's language policies, particularly concerning language planning within the children's program.

Applied linguistics played a crucial role in my research. As an applied linguist, I was trained to approach language education with an analytical mindset, grounded in research. I used tools from linguistics to evaluate the effectiveness of the GECP, including analysing curriculum design, teaching materials, and teacher training practices. I also applied research methodologies to gather data on the teachers' perspectives, which included administering surveys to understand their experiences and challenges within the program.

The theoretical framework for my research was built around principles from language acquisition and teaching. For example, Brown stresses the importance of understanding the learners' needs, goals, and cultural contexts when designing language programmes [1]. I used this perspective to assess how well the GECP aligned with the goals and objectives outlined in the curriculum. Additionally, I applied Richards and Rodgers' ideas on syllabus development, which emphasise the need for clear, measurable objectives and a balanced integration of language skills in teaching [2].

My research involved a comprehensive review of several aspects of the GECP, starting with the programme's curriculum and its alignment with the institution's broader teaching philosophy. The programme's goals were to introduce children to English, develop their language skills, and foster intercultural communication. However, I found that the curriculum lacked clear, measurable objectives for each level of instruction. There was also insufficient guidance on how to cater to the specific needs of learners at different proficiency levels.

I reviewed the "Super Minds" textbook collection, which the academy used as its primary teaching material. This series, published by Cambridge University Press, was designed to develop language skills through engaging activities and content tailored to young learners. While the materials were comprehensive and

engaging, I discovered several issues. For example, the “Super Minds” collection is intended for programs that provide more than five hours of English instruction per week. However, Angloamericana’s GECP offered fewer hours, which led to a misalignment between the textbook’s objectives and the reality of the programme’s schedule. Some units from the textbooks were not adequately covered due to time constraints, affecting the students’ language development.

Furthermore, I found that teachers faced challenges in teaching key language skills such as reading, speaking, and pronunciation, particularly due to the limited vocabulary and grammatical structures covered in the early stages of the programme. The teachers expressed concerns about the lack of regular training and support, which contributed to inconsistent teaching practices.

Based on my findings, I made several recommendations to improve the GECP’s effectiveness. First, I suggested that the programme’s objectives be more clearly defined for each level of instruction. This would help both teachers and students understand the expectations and ensure that progress was measurable. I also recommended revising the programme’s curriculum to better align with the number of instructional hours available. In particular, I proposed reducing the scope of content covered in each unit to ensure that it could be taught effectively within the available time frame.

My internship at Academia Angloamericana provided me with invaluable experience in applying linguistic research to real-world teaching contexts. By investigating the challenges within the GECP and offering evidence-based solutions, I was able to contribute meaningfully to the institution’s efforts to enhance its language teaching programmes. This experience also deepened my understanding of the role that linguistic research plays in language education, particularly in the area of language planning and policy. Through this internship, I gained practical skills that will inform my future work in applied linguistics and language education.

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## **THE ROLE OF STRESS IN HUMAN LIFE AND EFFECTIVE METHODS OF SELF-HELP: A THEORETICAL ANALYSIS**

Stress is a part of human existence. A person is born into a stressful situation and lives with stress. It constantly accompanies us and we can either change the stress factor or change our attitude to a stressful situation. Thus, almost any situation can be perceived by a person as stressful [1, p.8].

It is well known that stress occurs when a person is forced to change his or her usual way of life and spend additional resources. Most often, it is caused by unpleasant, unexpected events that we cannot control. We experience stress in situations of uncertainty, interpersonal conflicts, and in our everyday life. Even minor difficulties such as being late, traffic jams, canceled plans, or unfulfilled promises can trigger a stress response: heart palpitations, dry mouth, hand tremors, and sweating. At this point, it's hard to concentrate, and your thoughts keep returning to the event you experienced.

Chronic stress weakens the immune system, increasing the risk of infectious diseases. It can also cause depression, anxiety, cardiovascular disease (heart attack, stroke), autoimmune disorders (multiple sclerosis, rheumatoid arthritis), and even some types of cancer. In addition, stress often causes skin rashes, digestive problems, insomnia, and neurological disorders.

Historically, the concept of “stress” studied by G. Selye dates back to 1936. The classic definition of the concept of “stress” according to G. Selye is: “...a state of nonspecific tension in a living organism, manifested in real morphological changes in various organs and especially in the endocrine glands controlled by the pituitary gland”. Initially, it was the name of the “general adaptation syndrome”, but after years of work, the scientist still replaced this term with the concept of ‘stress’ [3, p.8].

It is well known that effective stress management contributes to health and quality of life. Although the founder of the doctrine of nonspecific adaptation syndrome distinguished two forms of stress: useful stress – eustress and harmful stress – distress, stress is most often understood as the body's reaction to the negative

impact of the environment, which is reflected in the definitions given to this phenomenon by different researchers [3, p.34].

The most common breathing technique in psychology is the 1-2-3-4 breathing technique, also known as “1-2-3-4”, which has been used for thousands of years in yoga and Buddhist meditation, and today it is often used by the military, especially special forces, to manage stress in difficult situations. Sitting or standing, you need to relax your body muscles and focus on your breathing.

There are many methods of stress management, each of which has its own characteristics and advantages depending on the situation and individual needs. Among them: “Slow Breathing”, ‘Shake off the Stress’, ‘Pebble’, ‘Grounding’, ‘Get Off the Hook’, ‘Calm Amulet’, ‘Butterfly’, ‘Axe’, as well as the techniques ‘Stop-Do Think-Act’, ‘Tram’, ‘Time to Experience’, meditation and relaxation. These techniques help to cope with life's difficulties more easily, and their choice depends on the level of stress, the situation, and personal preferences.

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V. Bukreieva, Z. Bondarenko

#### PECULIARITIES OF USING INQUIRY-BASED LEARNING TECHNOLOGY IN PRIMARY SCHOOL

One of the most pressing tasks of a modern school is to find the best ways to increase students' motivation to learn, activate their mental activity, and educate a life and socially competent personality capable of choosing their own ways of interaction, taking responsibility for their decisions, and applying the knowledge they have acquired. This means that the teacher should be focused on using

educational technologies that not only form knowledge and skills, but also develop students' abilities such as cognitive activity, independence, and the ability to perform tasks creatively. The implementation of inquiry-based learning in the educational process requires a new organization of the educational process based on planning the joint activities of teachers and students [1; 5].

In connection with the above, the study and use of inquiry-based learning tools that help to fully or partially reproduce the course of experiments, see the results and changes in conditions, observe natural phenomena, explore the world around them and participate in a scientific experiment, improve the quality of didactic and methodological support for the educational process [3].

The term inquiry-based learning has entered the professional sphere recently, in the second half of the twentieth century, although there is a long history of using research methods in educational practice [2]. The term first appeared thanks to the works of specialists in comparative education, and later it was actively used in the works of researchers in the field of educational psychology. Following the inquiry-based learning approaches to teaching students, a new approach to teacher training was proposed, called Inquiry-Based Science Teaching, which allows for the development of students' research competencies.

Studies by many educators and psychologists have noted that the development of a student's abilities is complete and successful due to the formation of the ability to cooperate and be creative, which are inherent in inquiry-based learning technologies [4]. This fact is important for elementary school students, as learning activities at this age are the leading ones and determine the direction of the child's main cognitive qualities. Such a quality as research interest is especially characteristic of a child who has just started school [3; 5].

The research activity of students includes activities related to solving a creative research problem with an unknown solution. It involves the main phases that are characteristic of scientific research: a problem, a learning theory that addresses this issue, the choice of research methods and their practical mastery, the collection of one's own material, its analysis, generalization, and conclusions. This step-by-step process is an important algorithm of research training and a standard for its implementation [5].

The purpose of inquiry-based learning is to develop students' functional research skills as a universal way of understanding reality, to develop a research type of thinking, and to activate a personal position in learning through the acquisition of new knowledge (independently acquired knowledge that is new and personally meaningful for a particular student).

As a learning strategy, inquiry-based learning is about having learners create their own understanding and knowledge through questions. Unlike traditional learning, which focuses primarily on drills, memorization, and rote learning, inquiry-based learning is largely learner-centered. This approach to learning has transformed traditional classrooms into high-energy learning centers where children enjoy learning and engaging in research [2; 4].

The analysis of the literature has shown that inquiry-based learning has the following characteristics: attention to process (communication, reflection, collaboration, analysis, etc.) and content; genuine curiosity, wonder, and questioning (on the part of teachers and students) are central; students' questions are taken seriously and addressed rather than dismissed; prior knowledge is confirmed and built upon (formative assessment and follow-up planning are important); learning takes place in a social context; reflection, metacognition, and depth of thought are valued and planned for assessment; learning leads to action – informing [1; 3; 5].

Inquiry-based learning is the approach that best allows students to experience the processes of knowledge acquisition. The key attributes of IBL include inquiry-driven learning, a learner-centered or student-centered approach, and the role of the teacher is to act as a facilitator, where the focus is on the transition to independent learning. Students should develop research skills and be prepared for lifelong learning [4]. They should achieve outcomes that include critical thinking, independent research ability, responsibility for their own learning, intellectual growth, and maturity. Support for the IBL approach comes from constructivism, cognitive research on learner motivation, intellectual development, learning approaches, and the learning cycle. In addition, there has been a recent movement toward strengthening teaching and research links, and IBL is an interesting and compelling technology that offers to make the path of teaching and research closely integrated for the benefit of all stakeholders (students and teachers) [5].



The success of inquiry-based learning often requires a change in school culture. Some schools, either individually or as part of an overall initiative, have made inquiry-based learning an instructional priority [1]. Research on the implementation of inquiry-based education, inquiry-based information, literacy programs, and other inquiry-based educational innovations has led to guidelines for building a culture of inquiry.

In summary, inquiry-based learning is a useful method that educators should use because it helps to improve the learning experience of students. The method gives children the opportunity to apply a hands-on approach to their education, gaining several important skills that can be used at all levels of education and even in their future careers. By participating in research, students learn about forms of social life, go beyond personal interests, and conduct research that helps them achieve a sense of positive self-realization and significance.

Preparing the educational environment for the study is an important stage in this activity. Thus, the choice of tools and situations of interaction seem to be relevant. Not every teacher is ready to implement inquiry-based learning due to lack of knowledge and unpreparedness to use tools and resources. The use of modern technologies in teaching requires not only high professionalism and skills, but also dedication, innovation and creativity. When creating and organizing learning, the teacher should take into account the peculiarities of perception and individual typological characteristics of each student. The teacher's technical literacy is also a significant criterion in organizing inquiry-based learning. Therefore, we see the prospects for further research in the review and description of tools for inquiry-based learning for students who seek to increase the level of mental activity, motivation to work, and develop skills in the practical, creative application of acquired knowledge.

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V. Bukreieva, O. Marchenko, O. Hurko

## **TYPES OF ENVIRONMENTAL INFORMATION UNDER UKRAINIAN LEGISLATION**

To exercise or protect one’s right to an environment that is safe for life and health, one must have access to environmental information and the right to participate in decision-making on environmental issues. As stated in Article 50 of the Constitution of Ukraine, everyone is guaranteed the right of free access to information on the state of the environment, the quality of food products and household items, as well as the right to disseminate it. Such information may not be classified by anyone [2]. These provisions of the Constitution of Ukraine comply with the provisions of the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters [1], signed by the UN Member States on June 25, 1998, and is the basis of environmental democracy.

Article 34 of the Constitution of Ukraine guarantees everyone the right to freely collect, store, use and disseminate information orally, in writing or in any other way of their choice [2]. That is, every individual, regardless of their status or citizenship, and every legal entity has the right to information.

However, in order to obtain the necessary information, there is a need to contact the appropriate administrator. In order to realize the possibility of citizens to have access to information, participate in the decision-making process and access justice on environmental issues, Ukraine passed the Law of Ukraine “On Access to Public Information” and the Law of Ukraine “On Environmental Impact Assessment”.

These regulatory acts established a list of types of environmental information. These include information on:

- the state of the environment or its objects;
- land, water, subsoil, atmospheric air, flora and fauna and the levels of their pollution; – biological diversity and its components, including genetically modified organisms and their interaction with objects of the environment;
- sources, factors, materials, substances, products, energy, physical factors (noise, vibration, electromagnetic radiation, radiation) that affect or may affect the state of the environment and human health;
- the threat of occurrence and causes of emergency environmental situations, the results of eliminating these phenomena, recommendations for measures aimed at reducing their negative impact on natural objects and human health;
- environmental forecasts, plans and programs, measures, including administrative ones, state environmental policy, legislation on environmental protection;
- expenses related to the implementation of environmental protection measures at the expense of environmental protection funds, other sources of financing, economic analysis conducted in the process of making decisions on environmental issues [3].

So, in conclusion, it can be noted that Ukrainian legislation regulating the concept and types of environmental information, in general, complies with international standards.

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## **NARCISSISTIC ABUSE AS A SPECIFIC FORM OF VIOLENCE IN RELATIONSHIPS**

Modern society is increasingly focusing on various forms of violence that occur in interpersonal relationships. Issues such as domestic, sexual, psychological, economic violence, and violence perpetrated through social media are actively being raised. In response, attention is being given to preventive, educational, and rehabilitative measures for representatives of different social groups. Thus, the scientific community faces the task of researching and developing more effective intervention methods that would help survivors of various types of violence cope with traumatic experiences and restore their psycho-emotional well-being.

One form of violence is psychological violence, the specificity of which lies in its difficulty to recognize and, without sufficient understanding, to resist [1]. Psychological violence is carried out through regular and systematic manipulation aimed at controlling another person's behavior and asserting power over them. It is a component of other forms of violence and can occur anywhere: in romantic, familial, professional, and friendly relationships [1]. For a deeper understanding of this phenomenon, it is necessary to identify the forms psychological violence can take depending on the perpetrator's personality. Some scholars argue that one of the extreme forms of psychological violence is violence perpetrated by individuals on the narcissistic spectrum – the so-called narcissistic abuse.

The term '*narcissistic abuse*' is relatively new in professional literature, and in Ukraine, this concept has not yet gained widespread usage. This phenomenon has been studied by foreign researchers such as S. Arabi, R. Durvasula, M. Dixon, S. Ellis, J. Harrison, T. Haum, B. Herring, V. Howard, S. Shalchian, among others. The difficulties in studying narcissistic abuse are currently due to the absence of unified terminology, which leads to a lack of academic and clinical programs, particularly Marriage and Family Therapy programs, that could help identify, assess, and rehabilitate survivors of narcissistic abuse [5].

Most scholars (V. Howard, D. Lancer, N. J. Day, and others) define narcissistic abuse as *'a form of violence perpetrated by a person with a narcissistic personality type in any form of relationship, including but not limited to intimate, parental or caregiving, peer, or collegial relationships'* [5, c. 32]. In particular, V. Howard points out that the primary components of such abuse are psychological and emotional violence carried out within interpersonal interactions: a person with narcissistic personality disorder (NPD) uses their 'victim' as a resource to enhance their sense of significance, reinforce their reality, and bolster the narcissist's self-esteem [3; 5].

According to V. Howard, narcissistic abuse can have the following features: love bombing, pathological lying, criticism, the demonstration of a false 'self,' silent treatment, devaluation and 'knocking the victim off the pedestal,' gaslighting, victim amnesia (loss of memories related to traumatic events), exploitative behavior, emotional and physical withdrawal, the involvement of a third party in the relationship or triangulation, abusive behavior and disrespect towards the victim, isolation from friends and family, among others [3]. The specificity of narcissistic abuse lies in its staged implementation, creating a cyclical pattern of relationships from which it is difficult for the victim to escape [2]. This cyclical nature fosters what is known as a *trauma bond*, which can keep the victim in a relationship with the narcissist for years [2].

Among the stages of the abusive cycle identified by researchers are the idealization stage, the devaluation stage, the distancing stage, and the hoovering stage [2; 3]. 1. The idealization stage involves mirroring the victim's behavior, copying their personality traits, behaviors, interests, beliefs, and worldview. At this stage, the narcissist convinces the victim that they have found the perfect partner to build a relationship with. 2. The devaluation stage occurs after the victim has been drawn into the relationship, at which point the narcissist no longer feels the need to maintain the fictitious self-image. Key characteristics of this stage include devaluing the partner and intense manipulations aimed at controlling the victim: unwarranted sabotage of intimacy, emotionally cold and indifferent behavior, occasionally punctuated by small displays of affection (intermittent reinforcement, as per Skinner), which creates dependence on the relationship, gaslighting, triangulation, among

others [4]. 3. The distancing stage or break-up stage occurs when the narcissist ends communication through humiliation, silent treatment, sometimes without explanation. 4. The hoovering stage is the final stage, which restarts the cycle: after distancing, the narcissist suddenly begins showing renewed interest in the relationship and attempts to bring the victim back. If the victim has ended the relationship, the narcissist may begin stalking them or publicly enter new relationships to regain lost control (applying the 'winner' principle in the break-up) [4].

Thus, a person involved in a narcissistic relationship experiences a traumatic ordeal. Research findings indicate that victims of narcissistic abuse are prone to developing symptoms of PTSD, and in some cases, Complex PTSD (C-PTSD), which arises from prolonged and repetitive trauma over time [4, 5]. Additionally, Lewis de Cannovil introduced the concept of '*Narcissistic Victim Syndrome*,' which includes symptoms such as avoidant behavior, loss of interest, emotional detachment, sleep and eating disorders, irritability, hypervigilance, flashbacks, helplessness, psychosomatic illnesses, dissociation, obsession with the relationship, among others [4].

**Conclusions.** Narcissistic abuse is a specific form of psychological and emotional violence that manifests in interpersonal relationships through manipulative strategies aimed at controlling and subjugating the victim. Its cyclical nature is a distinctive feature that significantly complicates the process of leaving the relationship and leads to severe psycho-emotional consequences, such as Post-Traumatic Stress Disorder (PTSD) or Complex PTSD (C-PTSD). The lack of clear terminology and methodological approaches to studying narcissistic abuse underscores the need for further research into this issue, particularly for the development of effective diagnostic and rehabilitation programs, as well as raising awareness about this form of abuse among professionals and society at large.

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V. Chaus, H. Mudrenko

## **STEM EDUCATION AS A MEANS OF DEVELOPING SPATIAL ORIENTATION SKILLS OF CHILDREN WITH INTELLECTUAL DISABILITIES**

STEM is a concept, an educational system used by developed countries in various levels of education to equip children and young people with the skills they need to be successful in the 21<sup>st</sup> century and to contribute to the innovative development of the country as a whole [3].

The abbreviation “STEM” was first proposed by the American bacteriologist R. Colwell in the 1990s and used by the National Science Foundation (NSF) as a complete combination of words. However, STEM began to be actively used in 2011 on the initiative of biologist Judith Ramaley [1].

The first to start using STEM education in the educational process were economically developed countries such as the USA, Canada, Singapore, etc. Each country had its own interests in implementing STEM education, but the main goal was to increase the country's economy through the activities of highly qualified specialists in the field of science and technology.

In Ukraine, STEM education was introduced at the legislative level in 2015 [2]. Also in August 2020, the Government adopted the Concept for the Development of STEM Education until 2027. The document outlines a number of measures related to the formation and development of skills in research and engineering, invention, entrepreneurship, early professional self-determination and readiness for an informed choice of a future profession, popularization of scientific, technical and engineering professions, and the spread of innovations in education.

When working with children with intellectual disabilities, STEM education is an effective tool for performing exercises and activities that include solving certain problems that are posed in the context of educational activities and through practical actions that children perform every day, which will allow them to better navigate the environment in which they are, develop their skills and help them better solve everyday problems.

The peculiarities of the development of spatial orientation skills of children with intellectual disabilities were revealed. Namely, among the peculiarities, we can distinguish the fact that children of preschool and primary school age have an insufficient degree of mastery of spatial skills and concepts. Children also have insufficient knowledge of spatial terminology, have vague ideas about spatial orientation and are unable to use the knowledge they have already acquired in practical experience without the help of an adult.

Children with intellectual disabilities can navigate freely in everyday life only when they are familiar with the surrounding situation or task. However, if you change even one detail, or change the child's location, it can lead to confusion or even helplessness in actions.

In our opinion, the STEM approach can develop spatial orientation skills, because the main advantage of STEM education is that everything is built on clarity, which has a very effective effect on the development of children with intellectual disabilities during their studies and makes it easier for them to perceive educational material.

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## **THEORETICAL ANALYSIS OF PROCRASTINATION**

In psychology, there is a concept of ‘procrastination’ which is used to denote the tendency to postpone difficult or unpleasant thoughts, decisions and affairs ‘to a later date’, ‘until tomorrow’, ‘to the future’.

There is never enough time for all matters. Not all matters can be redone. It is a mistake to think that the problems of procrastination can be solved by increasing our productivity. No matter how many personal productivity techniques we possess, there will always be more things than we can do in the available time, even if there is a lot of it. We can learn to control our time and life only by changing our way of thinking. We can control tasks and activities only by stopping doing certain things and starting to spend more time on new activities that you really need in your life.

Among such types of procrastination as postponing household chores, putting off vital decisions such as choosing a profession or starting a family, postponing completing educational tasks, let’s focus on political procrastination and procrastination in the health sector in this thesis. A separate type of procrastination, based on the analysis of scientific publications on this topic, is procrastination in the health sector – postponing activities that are beneficial to health, medical examinations and treatment. An interesting phenomenon is the so-called bedtime procrastination – postponing bedtime to a later time than expected, in the absence of important external circumstances. Sufficient hours of sleep is increasingly recognized as essential for people to function optimally, with many studies showing that sleep deprivation is linked not only to attention and memory problems, but also to more serious health consequences such as obesity, essential hypertension, and cardiovascular disease. The difference from many other types of procrastination in the health field is that, unlike actions that are either done or not done (e.g., to eat an apple or not to eat), bedtime procrastination is more about ‘when’ than ‘if’. Overall, going to bed is a typical health behavior that can be procrastinated. Numerous pieces of evidence indicate that chronic bedtime procrastination is a common experience for many people, but there is still a lack of scientific literature describing this phenomenon in detail.

In political science, there is a concept of 'political procrastination', which is the postponement (avoidance) of an important political decision. This phenomenon is most often caused by the unwillingness of the subject, who must make such a decision, to take responsibility for its consequences, which may be due to doubts about the success of the implementation, or the awareness of the inability to overcome the conflict that will arise as a result of making a decision. Accordingly, political procrastination can be caused by both the peculiarities associated with the process of making a decision by power, and the motivation of the subject who makes the decision. As a process, this phenomenon is revealed in cognitive concepts: reflection, tasks, experience, goal-setting, etc. Political procrastination, which is due to motivation, i.e., arises from the self-identification of the subject of political decision-making and his/her interests, is described by axiological and ethical concepts: identity, worldview, values, responsibility, interest, etc.

Therefore, the topic of procrastination will always be relevant. We often encounter it in everyday life, but it is still not sufficiently studied.

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Y. Demianushko, O. Dysa, O. Aliseienko

#### CHALLENGES OF SOCIAL AND PSYCHOLOGICAL ADAPTATION OF REFUGEES WITH CHILDREN

Since February 2022, a substantial number of Ukrainians have been forced to flee their homes in search of safety from military conflict. Among those who have fled, one of the primary groups is women with children.

Forced migration is a specific type of migration that involves the relocation of individuals either within their country or across the borders due to the political,

national, racial, military, environmental, and other factors that pose a threat to human life and necessitate urgent decisions regarding migration [1].

Changing the place of residence is always associated with significant challenges and difficulties related to social and psychological adaptation in a new environment. In the case of forced migration, the impact of these stressors is further intensified.

Social and psychological adaptation is a complex process involving the interaction between individuals and society, playing a critical role in ensuring their ability to co-exist comfortably within various social groups. This process becomes particularly critical during periods of profound social change or when individuals enter new social environments characterized by unfamiliar demands and conditions. Under such circumstances, the adaptation of women with children may be further complicated by their relative isolation.

It is widely recognized that mothers with children constitute a vulnerable segment of the population, even under normal conditions. The situation becomes more complicated when a mother finds herself alone in a new country with one or more children. In such circumstances, mothers may face not only the usual challenges of emigration (language barriers, adapting to cultural differences, issues of self-actualization, and challenges in interpersonal relationships) but also a lack of personal psychological resources necessary for effective adaptation to new conditions. Caring for children often prevents many women from attending language courses, working, or maintaining an adequate psycho-emotional state.

One significant issue faced by forced emigrants with children is the deterioration of parent-child relationships, often arising from stress and the adaptation difficulties experienced by all family members. Both parents and children experience heightened stress and uncertainty levels, which can disrupt traditional family roles and diminish parental authority. Additionally, the stress associated with emigration can heighten emotional reactivity among all family members, reducing their ability to interact effectively, particularly in conflict situations. Being under stress, parents may be less emotionally available, which negatively impacts on the quality of parent-child relationships [2].

Therefore, it is crucial to identify the factors that assist individuals in adapting to such challenging conditions; among these factors, the level of emotional intelligence

should be pointed out. Emotional intelligence refers to the ability to recognize, understand, and manage your own emotions as well as those of others. It influences how individuals interact with others, make decisions, and approach various life situations.

In the context of forced emigration, the significance of emotional intelligence becomes increasingly crucial. A high level of emotional intelligence contributes to better adaptation to changes, ensures emotional resilience, and enhances the ability to manage emotions across various life situations.

Research on emotional intelligence within the framework of social and psychological adaptation can provide valuable insights for offering psychological support to individuals who had to relocate and who require assistance in successful adaptation to new conditions. Furthermore, it can benefit to the development of various training programs and workshops focused on enhancing emotional intelligence to foster effective interactions between parents and children while adjusting to new environment.

Thus, studying emotional intelligence as a factor of social and psychological adaptation of individuals with children abroad is both important and up-to-date.

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K. Halich, N. Zimivets, O. Osadcha

#### USAGE OF AI IN SPEECH DEVELOPMENT OF PRESCHOOL CHILDREN

Artificial Intelligence (AI) is increasingly being integrated into early childhood education, offering innovative approaches to enhance the speech and language development of preschool children. AI-powered tools offer personalised learning experiences, early detection of language disorders and support for diverse linguistic backgrounds.

AI-powered applications, such as AI-enabled augmentative and alternative communication (AAC) devices, help non-verbal children communicate effectively. These tools use predictive text, picture-based communication boards and advanced machine learning algorithms to better understand and anticipate a child's needs or preferences [1, p.4].

In education, AI technologies are being used to create adaptive learning environments for children with autism, ADHD and other neurodivergent conditions. These AI-powered tools support speech and language development by providing personalised, targeted interventions that support each child's developmental journey [2].

AI is also being used to automate the analysis of children's speech in the classroom. For example, automated frameworks using open source software can classify speakers and transcribe their utterances to help assess language development and inform teaching strategies.

Furthermore, AI applications are being developed to assess the pronunciation of non-words in language development tests for preschool children. By automatically assessing whether spoken non-words have been pronounced correctly, these applications help to determine whether a child's language development is age appropriate [3, p.169].

The integration of AI in early childhood education also extends to the development of AI literacy in young children. Well-designed AI toys and services allow children to experience AI-driven interactions, potentially fostering an understanding of AI concepts at a preschool level.

However, the introduction of AI in early childhood education needs to be approached with caution. Ensuring that AI tools are designed with ethical considerations in mind and that educators are equipped with AI literacy skills is essential to maximise the benefits of AI while mitigating potential risks [3, p.171].

In conclusion, AI offers promising opportunities to enhance language development in preschool children through personalised learning, early diagnosis of language disorders, and support for diverse learning needs. Ongoing research and thoughtful implementation are essential to realise the full potential of AI in early childhood education.

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Y. Havrylov, O. Nikilev

## THE TRANSFORMATION OF THE TERM “AIR CLUB” IN HISTORICAL CONTEXT

That is well known fact that any word or term inevitably undergoes through some transformation. It depends on the context and the time when one or another term emerges. According to the Oxford dictionaries the first emerge of the word-combination “air club” appeared in the late XIX century [1]. For that time some flyable machines like hot-air-balloon, airship and glider were already invented. A lot of enthusiasts wanted to take part in such a promising process for mankind. The self-organization of the aviation enthusiasts was just a matter of time.

On the 20<sup>th</sup> of October 1898 L’Aero-Club de France was founded by aviation enthusiast Ernest Archdeacon and French petroleum businessman Henry Deutch de La Meurthe [2]. It was the first air club. The main aim of the organization was the promotion of air travel. Soon French Air Club became all-nation organization. Another national coordinating body for popularization air development and sport was founded in the United Kingdom in 1901 and was named Aero Club of Great Britain (known as Royal Aero Club since 1910) [3]. In the same year appeared an Air Club of Vienna (later – Austrian Air Club) [6], which was founded by famous Austrian journalist, flight-enthusiast, flight-instructor and promoter of air travel Victor Silberer. The co-founder of first air club of Austro-Hungarian Empire was his former student in ballon-flights military officer Franz Hinterstoisser. In 1905 was

officially formed Aero Club of America – just two years later of the maiden flight of Wright-brothers “Flyer” on the 17<sup>th</sup> of December 1903. All these organizations were all-nation coordination bodies for aviation development and popularization of air travel. Those organizations were also one of the first flying schools, which gave certificates, licenses and permissions for flights for the first pilots. In Roaring Twenties private ownership of a notable number of flying machines made it possible to organize local collegiate air (or flying) clubs. One of the first flying clubs was organized at Clemson University in 1927. Therefore, the common meaning of an air (or flying) club gradually changes to the following: a civilian voluntary organisation of aviation enthusiasts created for the purpose of primarily flying education, recreation, promotion of aviation and participation in sports competitions.

However, it should be clearly understood that in addition to democratic societies, anti-democratic regimes such as Bolshevik Russia, Fascist Italy and Nazi Germany emerged at that time. These were largely militarised societies based, respectively, on the ideology of “World Revolution”, “Imperial Ambition” and “Revenge”. Of course, flying clubs in these countries were also voluntary, but their main goal was to train aviation personnel for the upcoming war. For example, in Soviet Union the concept of a flying club *de facto* means a paramilitary organisation for the primary training of young people to become military aviation professionals: pilots, aircraft technicians and parachutists. Their main goal was to provide armed forces with young aviation specialists [4, c.54]. That is why the final stage of their training was an exam conducted by a military commission, which, if passed, gave them the opportunity to continue their studies at a military flight school or another aviation-related military educational institution. Of course, graduates of Soviet flying clubs had the opportunity to continue their careers in the civilian aviation sector, but neither the “civil air fleet”, nor aviation and sports training in the “OSOAVIAKHIM” system required such many aviation specialists. Flying clubs could not function as voluntary civilian clubs in the Soviet reality, because of the lack of private ownership of aircraft. These were institutions of primary aviation training, managed and strictly regulated by the state: one of the stages of training for future aviators of the Red Army.

After the Second World War, there was no need to train a large amount of aviation specialists, so the number of flying clubs in the system of the DOSAAF decreased. Thus, flying clubs are gradually becoming more associated with aerobatics and parachuting and preparation for international air competitions.

In the post-Soviet era aviation training in such clubs gradually declined due to lack of proper founding. Therefore, in Ukraine in particular, the understanding of the concept of an air club turned back to a voluntary organisation of aviation enthusiasts for the purpose of spending their leisure time, promoting aviation and developing aviation sports.

Therefore, the term “air club” has different meaning throughout different historical conditions. The first meaning is for national coordinating body for popularization air development and sport, which emerged at the turn of the XIX and XX centuries. The second one is for paramilitary organisation for the primary flying training of young people in the historical context of USSR of 1930’s. The third (which still actual in nowadays) is for a civilian voluntary organisation of aviation enthusiasts created for the purpose of primarily flying education, recreation, promotion of aviation and participation in air sports competitions.

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## **CORPORATE SOCIAL RESPONSIBILITY IN THE CONTEXT OF WAR IN UKRAINE**

Under the current conditions marked by economic hardship caused by the war, an important factor for the effective functioning of business organizations is their contribution to the well-being of communities and society through socially oriented and environmentally significant measures. The presence of a well-thought-out corporate social responsibility (CSR) strategy influences how the brand is perceived by the target audience and society. People support brands that share their values and contribute to positive changes. Businesses that ignore social responsibility, especially during difficult times for society, risk losing customer trust and falling behind in the competitive struggle. The social orientation of corporate interests also promotes more effective engagement of employees and investors, who prefer the corporate social responsibility goals defined by the company [1].

Socially responsible business is an approach where companies integrate social, environmental, and ethical aspects into their strategy and operational activities. Corporate social responsibility is “consciously and purposefully chosen by a company not just to exist and make a profit, but to voluntarily make a positive contribution to the development of modern society” [2]. Of course, integrating social responsibility into a corporation's development concept can be challenging: it requires additional material resources, time, and changes in corporate culture. However, the long-term benefits outweigh the initial costs. Among the advantages of social responsibility are not only improved brand reputation (companies with social priorities attract more customers) but also the value of the company for talented professionals who respect the social stance of the employer and demonstrate loyalty to a corporation that cares about their interests. Corporate social welfare programs are a useful tool for improving the balance between private and professional spheres, as well as for creating a corporate climate that enhances employee motivation and makes them feel like an integral part of the company's activities [3, p. 438]. It also fosters an innovative climate that inspires companies to seek new solutions and approaches, ensuring

long-term sustainability and adaptability to changes and risks. Socially oriented companies are typically models of ethical business practices, honesty, and transparency in internal operations and relationships with partners. They care about workplace safety and gender equality, invest in employee training and development, and openly communicate and inform about their actions and achievements in the field of social responsibility. Today, their participation in charitable projects helps enhance the resilience of Ukrainian communities, contributing to the well-being of their residents. Socially responsible business companies are involved in purchasing military equipment, supporting volunteer organizations, funds aiding the army and war-affected population, as well as implementing rehabilitation programs for wounded soldiers.

In the current Ukrainian context, the concept of social responsibility is one of the key strategies for companies striving not only for financial success but also for improving the social situation in the country. Socially responsible business aims to achieve a balance between economic benefit and positive societal impact. Despite the difficulties and challenges associated with the full-scale war, social responsibility in Ukraine is gradually becoming a necessary element of the strategy for firms and corporations that wish to maintain their competitiveness in the rapidly changing socio-economic conditions of a globalized world.

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## **DELIBERATIVE AND AGONISTIC TECHNOLOGIES OF POLITICAL CONSENSUS FORMATION**

Political consensus serves as a mechanism of social coordination, ensuring the alignment of actions among various political and social groups. It provides a foundation for making long-term strategic decisions that reduce social tension and enhance public trust in the government. Political consensus formation technologies belong to the political technologies class, as they encompass procedures, methods, and processes aimed at the optimal realization of political actors' goals in acquiring, consolidating, and expanding power through the attainment of political agreement. The concept of "political consensus formation technologies" covers a broad spectrum of processes, procedures, and methods related to power relations and designed to achieve consensus effectively in the interests of specific participants in the political process. Differentiating political technologies based on teleological criteria enables both strategic and tactical analyses of political processes, depending on the objectives set.

In the modern world, two models of democracy – deliberative and agonistic – can be considered as technologies for forming political consensus, each influencing state stability in its own way. Regarding the deliberative technology of political consensus formation, Jürgen Habermas identified deliberative democracy as a mechanism for achieving consensus through rational debate and open discussion of socially significant issues [2, p. 195, 209]. The primary advantage of this model, which underpins the corresponding consensus formation technology, lies in creating conditions for decision-making that reflects the general interest [1, p. 95–96, 225, 244–246]. However, deliberative democracy also has its weaknesses. Its emphasis on rational discourse and its underestimation of the emotional politics dimension may render it vulnerable to external informational threats. Disinformation campaigns and manipulative strategies can undermine the communicative process, jeopardizing the formation of genuine political consensus and threatening national security.

Agonistic democracy, as a technology of political consensus formation, is associated with the work of Chantal Mouffe. She offered an approach in which political consensus is viewed as a dynamic process of conflictual negotiation between different social groups [3]. The tools of agonistic democracy as a consensus-forming technology include: 1) political articulation; 2) politicization of social issues; 3) a conflictual public sphere; 4) a cultural counter-hegemonic project; 5) political differentiation through key agents such as activist movements and 6) the formation of political identities through an agonistic identifications process, meaning that identities must remain open to change and avoid falling into essentialism.

Political consensus is a central element in ensuring strategic stability within the state and in international politics. It is based on the mutual agreement of political actors on the fundamental principles of social order. The technologies of political consensus formation rest upon a balance between social trust and the political power legitimacy. Consensus can be either formal (legally enshrined) or informal (arising from societal agreement). Chantal Mouffe's concept of conflictual consensus implies the preservation of differences within agreed democratic rules. Jürgen Habermas' deliberative democracy envisions consensus as emerging through public discourse and rational argumentation. In contrast, agonistic democracy (Mouffe) recognizes conflict as an inherent component of the political process, which contributes to the formation of a dynamic consensus.

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## **LANGUAGE AS A BEARER OF TRUTH IN ALAIN BADIOU'S POSTCLASSICAL PHILOSOPHY**

Language has long been a fundamental subject of philosophical inquiry, serving as a medium for expressing truth and shaping human cognition. In the post-classical philosophical landscape, Alain Badiou offers an alternative approach to truth that challenges traditional epistemological frameworks. His theory of the event, truth procedures, and the role of language redefines how multiple truths can coexist within a singular ontological structure.

Badiou's ontology is grounded in mathematical set theory, particularly the concept of the multiple. Unlike classical conceptions of truth as singular and universal, Badiou asserts that truth emerges through events – ruptures in established knowledge systems that reveal new possibilities of being [1]. In this regard, language becomes both a vehicle for articulating these emergent truths and a structure that can limit or distort them through ideological constraints.

A crucial aspect of Badiou's philosophy is the distinction between opinion (*doxa*) and truth. While *doxa* aligns with socially constructed narratives, truth, in Badiou's sense, is an ongoing process tied to fidelity to an event. Language, therefore, operates within a dual role: it can be an instrument of ideological reproduction or a means of disrupting established norms, paving the way for radical transformations in knowledge and being [2].

Language plays a crucial role in the formation of truth procedures. Badiou identifies four primary truth procedures – science, art, politics, and love – each of which relies on language to articulate new realities. The process of naming, a central theme in Badiou's philosophy, serves as an act of inscription that stabilizes the emergence of a truth event. However, traditional language structures often struggle to accommodate the radical novelty introduced by truth events, necessitating the invention of new terminologies and symbolic forms [3].

Moreover, the intersection of language and ontology in Badiou's philosophy raises important questions about the limits of representation. If truth is fundamentally

tied to events that disrupt established orders, then traditional linguistic structures may prove insufficient for fully capturing these ruptures. This necessitates the creation of new conceptual vocabularies that resist ideological closure and maintain openness to radical transformation. Thus, language is not merely a passive tool of communication but an active participant in shaping the ontological field.

In conclusion, Badiou's postclassical philosophy challenges the monolithic perception of truth, advocating for a multiplicity grounded in ontological consistency. Language plays a pivotal role in both articulating and obscuring these truths, highlighting the dynamic interplay between discourse, knowledge, and being. By rethinking the ontological status of language, Badiou provides a framework for understanding truth as an event-driven and structurally diverse phenomenon.

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O. Hlazunov, V. Myronenko

#### TRANSFORMATION OF MEDIA CONTENT CREATION UNDER THE INFLUENCE OF INFORMATION AND COMMUNICATION TECHNOLOGIES

One of the defining characteristics of media is the active integration of cutting-edge information and communication technologies (ICTs) into the processes of data collection, content creation, and its subsequent dissemination. At all media discourse stages, journalists and representatives of related social communication fields utilize cutting-edge electronic and digital tools, including various types of software that automate or effectively separate content creation from subjective – human intelligence. The introduction of new practices and methodologies into media activity leads to a number of consequences, including: a reduction in the time

required for each specific information product creation, minimization of the impact of the author's "self" on media content, acceleration of media convergence processes, among others.

Media convergence traditionally indicates the merging of different platforms, formats, and communication channels into a single integrated system. Convergence, facilitated by information technologies and communication systems, affects various industries by integrating technologies, types of social communication, and media production [2, c. 9].

Among the technologies that are currently actively used by journalists and media managers, it is worth mentioning artificial intelligence (AI) tools, which encompass a wide range of applications formed and functioning based on complex algorithms for acquiring non-linear experience. In Ukrainian journalism studies, the term "artificial intelligence" primarily refers to an automated process involving processing, analytics, management and data generation, with the aim of optimising production, communication and interaction with the audience [1, p. 256].

The potential for the advancement and large-scale integration of artificial intelligence within new media is a matter of mounting significance for the contemporary media industry. The process is driven by several factors. Initially, it allows for significant resource savings and increased efficiency in production processes, as artificial intelligence algorithms can automate many mechanical and labor-intensive tasks in the media industry, particularly editing, content generation (writing), and moderation. At the same time, according to expert forecasts, artificial intelligence will increasingly accelerate news processing and make this process accessible to more people [3].

The development of ICTs contributes to the fact that current media texts acquire new characteristics, among which the following can be distinguished: hypertextuality, multimedia, and interactivity. Hypertextuality is realized through a system of hyperlinks that connect the main text with additional resources, such as articles, videos, infographics, and audio files. This promotes non-linear navigation and a deeper understanding of the material. Similar mechanisms are used in journalistic investigations and interactive reports. Multimedia consists of integrating various modalities of content – text, images, audio, and graphics – into a single information

space. This approach increases the accessibility and cognitive appeal of information. The use of multimedia narratives in media practice contributes to optimizing communication and audience engagement. Interactivity provides active user engagement with content, allowing them to influence its structure and presentation. This is realized through non-linear narrative mechanisms, comments, ratings, voting, and surveys. Thus, users become not only consumers but also participants in content creation.

Present-day information and communication technologies significantly transform the media space, enhancing interactivity, content personalization, and communication efficiency. The use of digital solutions, including artificial intelligence, multimedia platforms, convergent technologies, and automated algorithms, not only improves the quality of media products but also contributes to their adaptation to the individual needs of the audience. As a result, ICTs play a central role in shaping the modern information society, ensuring effective interaction between the media and their audience.

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M. Hnatenko, N. Yuzikova

#### **CRIMES AGAINST HUMANITY IN THE DR CONGO: BRINGING TO JUSTICE AS A PATH TO FAIRNESS**

The modern world is full of social cataclysms, the destructive impact of which is exacerbated by crimes against humanity that often go unpunished. However, there are exceptions to this common rule. Despite the difficulties in bringing the perpetrators to justice, there are successful cases where criminals have been convicted of their actions. A striking example is the punishment of Bosco Ntaganda, a former Congolese



rebel leader who was found guilty of committing war crimes and crimes against humanity in 2002–2003. In particular, the International Criminal Court found B. Ntaganda guilty of 18 crimes (13 war crimes and 5 crimes against humanity). Thus, the case file shows the following accusations against the Congolese.

1. “Murder as a crime against humanity (Article 7(1)(a) of the Statute) and as a war crime (Article 8(2)(c)(i) of the Statute), as a direct perpetrator (Article 25(3)(a) of the Statute), of Abbé Bwanalanga in Mongbwalu during the First Operation, and murder and attempted murder as a crime against humanity (Article 7(1)(a) of the Statute) and as a war crime (Article 8(2)(c)(i) of the Statute) as an indirect co-perpetrator (Articles 25(3)(a) and 25(3)(f) of the Statute), in relation to the following killings and attempted killings committed by UPC/FPLC soldiers and – in relation to the killing of people in Mongbwalu during ratissage operations – also by Hema civilians” [1, c. 526].

As a result of the prosecution, B. Ntaganda was found guilty of committing the following crimes against humanity:

- a) murder (direct perpetrator, who participated in the First Operation);
- b) murders and attempted murders (indirect co-perpetrator during the Second Operation).

2. “Rape as a crime against humanity (Article 7(1)(g) of the Statute) and as a war crime (Article 8(2)(vi) of the Statute), as an indirect co-perpetrator under Article 25(3)(a) of the Statute, of women and girls during and in the immediate aftermath of the UPC/FPLC assault on Mongbwalu, and of girls in Kilo, in the context of the First Operation; and of detained women and men in Kobu, of women in Sangi, and of P-0113 in Buli, in the context of the Second Operation (Counts 4 and 5)” [1, c. 527].

On this charge, B. Ntaganda was found guilty of a crime against humanity, rape, in which he participated as an indirect co-perpetrator (in particular, it was established that soldiers forced women in communities captured by the military to make love).

3. “Sexual slavery as a crime against humanity (Article 7(1)(g) of the Statute) and as a war crime (Article 8(2)(vi) of the Statute), as an indirect co-perpetrator under Article 25(3)(a) of the Statute, of P-0113 and of an 11-year-old girl in Kobu and Buli, in the context of the Second Operation (Counts 7 and 8)” [1, c. 528].

In addition, B. Ntaganda was found guilty of sexual slavery as an indirect co-perpetrator of this crime against humanity (during the investigation, it was found that children involved in military operations were forced to have sexual relations with soldiers whenever they wished).

4. “Persecution as a crime against humanity (Article 7(1)(h) of the Statute), as a direct perpetrator under Article 25(3)(a) of the Statute, by killing Abbé Bwanalunga in Mongbwalu, in the context of the First Operation; and, as an indirect co-perpetrator (Article 25(3)(a) of the Statute), in Mongbwalu, Nzebi, Sayo, and Kilo, in the context of the First Operation; and in Nyangaray, Lipri, Tsili, Kobu, Bambu, Sangi, Gola, Jitchu, and Buli, in the context of the Second Operation (Count 10)” [1, c. 528].

On this charge, B. Ntaganda was found guilty of persecution both as a direct perpetrator during the First Operation and as an indirect co-perpetrator during the First and Second Operations.

5. “Forcible transfer and deportation as a crime against humanity (Article 7(1)(d) of the Statute) and ordering the displacement of the civilian population as a war crime (Article 8(2)(viii) of the Statute), as an indirect co-perpetrator under Article 25(3)(a) of the Statute, in Mongbwalu, in the context of the First Operation; and in Lipri, Tsili, Kobu, and Bambu, in the context of the Second Operation (Counts 12 and 13)” [1, c. 529].

Under this count, B. Ntaganda was found guilty of forcible displacement of the population as an indirect co-perpetrator during the First and Second Operations.

In total, B. Ntaganda was sentenced to 30 years in prison. The importance of bringing the Congolese to justice, for its part, was also emphasized by Human Rights Watch: “... The fact that Ntaganda is facing justice at the ICC is highly significant for the thousands of people across eastern Congo who have suffered, witnessed, or documented serious abuses allegedly committed by him and troops under his command.

The trial also sends a strong warning to other abusive commanders still active in Congo. Ntaganda’s military career moving from one armed group to the other, with occasional integration into the Congolese army, resembles those of other rebel leaders whom the Congolese government has often rewarded with positions, wealth,

and power while civilians suffer. That Ntaganda remained free for so long shows that grave abuses often continue while impunity persists. Seeing Ntaganda in the dock and judged by the ICC is a powerful reminder to other leaders of abusive armed groups that they too could face prosecution” [2].

Bringing B. Ntaganda to justice should demonstrate that punishment for crimes against humanity is inevitable and serve as a deterrent to other criminals who believe that their actions will go unpunished and will not be addressed by international justice.

In addition, it should be noted that Human Rights Watch also emphasized the importance of the DR Congo’s domestic judicial system in the context of bringing perpetrators to justice: “Over the past 15 years, Congolese military courts have prosecuted a number of cases involving war crimes and crimes against humanity, but much still needs to be done to effectively address impunity for serious international crimes. The vast majority of atrocities committed in Congo remain unpunished and the proceedings in recent years have highlighted challenges and gaps in the domestic judicial system. The Congolese government should prioritize the delivery of justice for grave international crimes at the domestic level by strengthening national accountability efforts” [2].

Thus, despite some efforts by Congolese military courts to prosecute international crimes over the past 15 years, the vast majority of atrocities remain unpunished, indicating significant problems and gaps in the national judicial system that need to be addressed as a matter of priority to effectively combat impunity. At the same time, the conviction of B. Ntaganda confirms the implementation of the principle of justice, according to which it is natural to bring to justice and impose a commensurate, proportionate measure of punishment as a consequence of crimes against humanity.

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## **MICROLEARNING IN HIGHER EDUCATION: CHALLENGES AND PROSPECTS IN TIMES OF WAR**

Under martial law in Ukraine, the higher education system has undergone significant transformations due to the necessity of adapting to crisis conditions. The destruction of educational institutions, forced displacement of students and faculty, unstable access to electricity, and unreliable internet connectivity have complicated traditional approaches to learning. In response to these challenges, the digitalization of the educational process, particularly through microlearning, has emerged as a mechanism to ensure uninterrupted access to knowledge even in crisis conditions.

In contemporary academic literature, there is no consensus on a unified definition of microlearning. Various terms such as micro-learning, micro-training, micro-courses, micro-lessons, bite-sized learning, and learning nuggets are commonly used. However, scholars generally agree that microlearning is a form of instructional organization characterized by segmenting information into small portions and utilizing digital technologies [3, p. 59].

Microlearning has become particularly relevant in wartime, as students must study in an unstable environment while experiencing heightened levels of stress. An analysis of the psychological state of higher education students under martial law reveals that the war has exacerbated existing psychological issues, further intensifying chronic stress experienced by students in the aftermath of the COVID-19 pandemic. The learning process in crisis conditions is accompanied by cognitive overload, emotional instability, and physiological disturbances. In the initial stages of the war, students and cadets experienced exhaustion and distress, manifested in anxiety, inattention, sleep disorders, and changes in eating behavior. Over time, acute stress evolved into a persistent state, exacerbated by new challenges such as blackouts, and constant air raid alarms. These factors pose a risk of long-term negative consequences while also fostering adaptive strategies depending on individual resources and the support of the educational environment [2].

In this context, microlearning – an educational approach that involves the use of short, focused learning modules – ensures flexibility and accessibility in education. It allows students to quickly absorb information without cognitive overload and can be seamlessly integrated into various learning formats, including offline, online, and blended learning. Thus, microlearning is a universal approach suitable for different educational settings. Furthermore, the incorporation of multimedia content such as videos, audio materials, images, and interactive elements enhances student engagement and improves knowledge retention [1].

However, the war in Ukraine has significantly complicated the provision of educational services, creating several technological and organizational barriers to implementing innovative teaching methods, including microlearning. One of the primary constraints limiting the effective use of this approach is restricted access to the internet and digital platforms. Due to infrastructure destruction and frequent power outages, many students and faculty members are cut off from stable internet connectivity, hindering the use of digital learning platforms – the foundation of microlearning. This issue is particularly acute among socially vulnerable groups, who have limited access to the necessary technological resources, such as computers, tablets, or smartphones.

Another challenge is the necessity of adapting academic programs to a microlearning format. Traditional teaching methods require substantial transformation to be suitable for microlearning. This process demands considerable time and effort from educators and instructional designers, as it involves restructuring existing courses, which can be resource-intensive and organizationally complex.

The social challenges arising from the war also have a significant impact on the effectiveness of microlearning. Traditional educational methods, which involve personal interaction between students and faculty, provide not only knowledge acquisition but also foster social engagement and support. Since microlearning is predominantly implemented in an online format, it may lead to student isolation and a reduction in social support, which are critical aspects of the learning process.

Despite these challenges, microlearning has significant potential for development within modern higher education. One promising avenue is the integration of microlearning formats into blended and distance education. Through microlearning,

students can acquire knowledge at their convenience and in manageable portions, preventing cognitive overload.

Another promising direction involves incorporating gamification elements and adaptive educational technologies. The inclusion of interactive tasks, rewards, and personalized learning trajectories can significantly enhance student motivation and improve learning outcomes.

Interactive platforms and personalized learning pathways that support microlearning create opportunities for students to select their own pace and content, thereby accommodating individual learning preferences and ensuring a more flexible approach to education.

For successful implementation, a series of strategic steps must be taken to overcome existing challenges. One of the first priorities should be improving digital infrastructure. This includes investments in developing reliable internet access and modern technologies for all participants in the educational process.

Equally important is the professional development of educators in working with microlearning formats. Faculty members must receive specialized training that includes instruction in modern digital pedagogy methods. Conducting training sessions and workshops on this topic will contribute to enhancing educational quality and facilitating the effective integration of microlearning into higher education.

Based on the findings of this study, it is reasonable to assume that microlearning holds great potential for transforming the educational process in crisis situations, particularly during wartime. This approach ensures flexibility, accessibility, and adaptability in learning, enabling students to effectively absorb material without experiencing cognitive overload.

However, several challenges must be addressed for its successful implementation, including issues related to digital platform access, the adaptation of curricula to a microlearning format, and social barriers such as student isolation. The future of microlearning lies in its integration into blended and distance learning, as well as the application of gamification and adaptive technologies to enhance student motivation.

Key factors for success include improving digital infrastructure and preparing educators to work with new learning formats. Microlearning has significant potential

for ensuring uninterrupted access to education during wartime, but its effective implementation requires consideration of both technical and social factors.

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M. Irchyshyna

#### FEATURES OF LEARNING ENGLISH FOR STUDENTS OF DNIPRO STATE UNIVERSITY OF INTERNAL AFFAIRS

The study explores the key aspects of learning English for students at Dnipro State University of Internal Affairs. The emphasis is placed on professional orientation, interactive teaching methods, legal terminology, modern technologies, and cross-cultural communication. The research highlights the importance of English proficiency for future law enforcement officers in an international context. In today’s globalized world, English has become an essential tool for professionals in various fields, including law enforcement. The ability to communicate effectively in English is crucial for international cooperation, legal documentation, and professional development. This paper examines the specific features of English language learning for students at Dnipro State University of Internal Affairs, focusing on methods that enhance their professional competencies [1].

English courses at the university are designed to meet the specific needs of law enforcement professionals. Students learn legal terminology, participate in simulated court proceedings, and engage in case analysis exercises. The curriculum integrates modern pedagogical approaches such as role-playing, debates, and problem-solving tasks. These methods help students develop practical communication

skills applicable in real-life law enforcement situations. A significant part of the course is dedicated to legal English. Students acquire knowledge of legal vocabulary, draft official reports, and learn how to conduct negotiations in English. The implementation of digital tools, online learning platforms, and interactive applications enhances the learning process. Virtual reality simulations and online legal databases help students improve their language proficiency [2].

Since law enforcement often involves international collaboration, the program includes modules on intercultural communication. This prepares students to interact effectively with foreign colleagues and institutions.

Mastering English is vital for future law enforcement officers as it facilitates professional communication, international cooperation, and career growth. The specialized approach at Dnipro State University of Internal Affairs ensures that students acquire the necessary language skills for their future careers.

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S. Khazova, H. Mudrenko

#### **CONTACT IMPROVISATION AND BODY-ORIENTED THERAPY IN THE CONTEXT OF ALLEVIATING CONDITIONS IN INDIVIDUALS PRONE TO SUICIDE AND DEPRESSIVE DISORDERS IN ADULTS**

Suicidal behavior is one of the most complex problems of modern society. As experts note, it arises due to the interaction of psychological, social, biological and cultural factors. At the heart of this problem are deep emotional experiences, isolation, anxiety, depression and a decrease in the meaning of life [2]. During challenging periods of conflict, such as the war in Ukraine and other regions, it is particularly important to acknowledge the significance of this matter for the individual, the family unit, and the nation. Constant stress, loss of loved ones, forced relocation



and uncertainty of the future significantly increase the risk of developing suicidal tendencies in the population. People who experience these events often face emotional burnout, depression and a sense of helplessness to some degree. Young people are more prone to depressive disorders than adults, their nervous system is less protected and may not have enough resources for recovery. Depressive disorders and suicidal tendencies are difficult to notice both in society and for an individual and even for their family.

Contact improvisation (CI), as well as body-oriented therapy (BOT), recognize that the body is an important tool for personality development, emotional expression, and working with psychological blocks. But they are used in different contexts. After all, BOT is aimed at learning about hidden emotions and traumas through the body. Movement techniques are aimed at releasing tension, working with emotions or traumas. The essence of CI is to embody one's own desires through improvisation, research, perception of one's own emotions, moods, and states in the body, maintaining dopamine levels, and embodying one's creativity, which helps to improve mood, self-actualization of the personality, and adds meaning to life [12]. For instance, physical contact in dance helps to improve socialization and increase the level of trust, motor activity is well perceived regardless of the level of physical fitness, etc. After all, anyone can start dancing CI at any age and with any level of energy. The person who dances decides for himself what pace he wants and how much energy he wants to use, and in what plane. Therefore, it is suitable for people in difficult conditions, who do not have enough strength and feel exhausted.

BOT and CI are innovative approaches that can become important tools in working with adults who are prone to suicidal thoughts and actions. It is worth emphasizing that CI is aimed at restoring connection with one's own body, emotions and the world through movement, body awareness and interaction with other people and the environment. Because of that the level of human proprioception increases, as well as the body's ability to react quickly in unusual sudden situations using muscle memory. It results in liberation from oppressive thoughts and introduction to a state of self-exploration through improvisation since every new dance is a new adventure. In addition, relying on the physiological processes of the body during safe contact and physical exercises, the body releases dopamine and oxytocin, which

may be insufficient in a person's everyday life. Thus, socialization, motivation for movements, curiosity and pleasure, motor self-realization and creativity increase. This is especially important for individuals with suicidal tendencies, who often lack positive emotional connections.

It can be argued that BOT is based on the idea that a person's mental state is inextricably linked to their body [5]. The approach involves working with bodily blocks, which can be a physical reflection of psycho-emotional tension. The main methods are the following: breathing practices, physical exercises and psychosomatic analysis. For people with suicidal tendencies, BOT allows reducing the level of emotional tension by removing physical blocks, restoring a sense of control over the body and life, and also creating a space for the safe expression of emotions that usually remain suppressed. The features of the therapy are healing psychological trauma, working with psychosomatic symptoms and increasing awareness of your body. Structured techniques are used, namely breathing exercises, relaxation, movement practices. It is usually carried out in a therapeutic environment with a therapist, where the participant works on their inner experiences.

In turn, CI is a form of dance practice based on free movement in a pair or a group. It involves constant physical contact between participants, which helps to create trust and a deep emotional connection. You can also use the involvement of appropriate musical accompaniment to create a general atmosphere of acceptance and permission to explore your own movements, whatever they may be. After all, according to research on the type of thinking of a person with depressive disorders and those prone to suicide, any condemnation can be unbearable. For people with suicidal behavior, CI can perform such functions as restoring trust in others because participants learn to support and accept the weight of a partner, which symbolizes mutual trust and support. A person can experience and express repressed emotions by releasing them through free movement and contact. Working in a group not only reduces feelings of isolation and loneliness, but also helps to foster a sense of belonging and support. Based on the above, we can conclude that such practices have every chance of being longer than other types of physical activity, which require greater physical effort and endeavour from a person. Any person will be able to join an interesting and comfortable interaction. The essence of movement in

contact improvisation is built in such a way that it is also possible to involve people with moderate physical disabilities in the process, which requires further study and development of a special program. It is widely known that mental health is important for a sense of fulfillment of life, activity and creativity of the individual, as well as for social unity, labor productivity and stability of society. And this pleasant motor activity can be an excellent prevention of difficult emotional states.

BOT helps a person become aware of their bodily sensations, which are often signals of suppressed emotions. CI helps explore their own movements and reactions to their partner, which allows them to better understand their emotional states. This awareness is the first step to reducing emotional tension.

Suicidal tendencies often arise from the accumulation of emotional pain. During body-centered therapy, the person learns to recognize and release these emotions, while contact improvisation creates a safe space for release. Alternatively, integrating BOT and CI allows having a deeper impact.

The main advantage of CI is the lack of the need for verbalization as for many people with suicidal tendencies, verbalizing emotions is a difficult task. Bodily methods bypass this barrier, help restore trust in others and form a sense of support.

BOT and CI share common features, but their main goals are different. BOT is more focused on the therapeutic aspect, while CI emphasizes creativity and self-expression. At the same time, their integrated approach can be very useful for those working with corporeality, emotions and interpersonal interactions. CI can be used as a tool in BOT to explore interaction, trust and connection with others. And BOT can support CI participants by helping them become more aware of their bodily reactions, tensions or blocks that may arise during improvisation.

According to some modern research in various fields and personal experience, it can be concluded that BOT and CI are powerful tools in working with adults who have suicidal tendencies and depressive disorders [4]. They have many advantages over other physical activities. These methods can help to reduce anxiety, restore emotional balance and boost self-confidence and trust in others. Integrating these approaches into psychotherapeutic practice can significantly improve the quality of people's lives and help them find a new meaning of existence and self-realization.

In wartime, these methods become particularly relevant, as they help overcome crisis situations, restore internal resources, and promote social support.

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S. Kiriakhno, O. Hurko

#### CONSERVATIVE RHETORIC IN THE INAUGURAL SPEECH OF GEORGIA MELONI

The study of the language aspects within conservative discourse, in particular, in Georgia Meloni's inaugural speech, is based on approaches that combine methods of analyzing political language and studying word meanings. The research aims to identify and review the linguistic peculiarities that characterize conservative political discourse in the speech of the first female Italian Prime Minister. To investigate this issue, three aspects that Giorgia Meloni used in her inaugural speech were considered.

It is noteworthy that an important characteristic of Georgia Meloni's speech is the use of value-coloured words usage. According to famous linguist T. van Dijk, axiologically marked lexemes (i.e. words with a value component) are a key tool of political discourse [3, p. 732]. Researcher O. Selivanova argues that such linguistic

units do not simply name phenomena of reality, but also express an attitude towards them, forming an appropriate perception of political realities in the listeners [2, p. 67]. In the speech, one can find many words associated with traditional values (*family, nation, identity, roots*) that appear repeatedly in the text: "*It is a commitment of ours... to put the **family** back at the center of society*" [1, p. 5]. Combining these words creates a kind of semantic speech core. Often, words are used that appeal to patriotic feelings (*homeland, sovereignty, national pride*) – "*the **Fatherland** will always be grateful!*", [1, p. 8] or "*Italy is the most **beautifulship** in the world*" [1, p. 12]. We observe the frequent use of antonyms to construct political reality. The politician operates with the oppositions *we/they*, *order/chaos*, and *progress/decline*, which allows to clearly distinguish position and views of the opponents. For example: "*We are not here to do the easy thing*" [1, p. 3]. In the above-mentioned sentence, the first-person plural is opposed to the indefinite "*other*". In another fragment, "*We will not use the vote of millions of Italians to replace one system of power with another different and opposing one*" [1, p. 4], G. Meloni builds an ideological picture that is understandable to voters.

In the analysed speech, metaphors become a kind of common path that connects complex political concepts with everyday experience. In politician's speech, the *STATE-FAMILY* metaphor takes a central place and depicts the state system as a natural system of relationships based on traditional family values. For instance, Georgia Meloni used the following phrase: "*Italy is the common home of the European peoples*" [1, p. 10], where the home symbolizes the state itself. This approach is a conservative discourse characteristic – it builds a bridge between the political system and the most understandable social structure.

One more separate group of metaphors is formed by numerous navigational and spatial metaphors. Georgia Meloni notes the following: "*Our boat has suffered several damages, and the Italians have entrusted us with the task of steering the ship into port on this very difficult crossing*" [1, p. 7]. In the same row are the expressions: "*we are here to try to mend the torn sails, fix the hull planks*" [1, p. 7], "*return to putting the southern issue at the center of the Italian agenda*" [1, p. 7]. These metaphors construct the image of a ship-state in a stormy sea, which sails among numerous dangers. This is especially clearly demonstrated by the expression: "*With*

*the compass of our beliefs to show us the course to our chosen destination*" [1, p. 8]. The choice of metaphors in the speech is not accidental – it systematically supports a conservative narrative, building a holistic picture of the world and providing landmarks in the future, giving faith in the correctness of the chosen path. Traditional values, through metaphorization, acquire concrete embodiment in political actions. The image of roots and stability is very eloquent in this context: *"I cannot but be that of being the first woman to head the government in this Nation"* [1, p. 2], *"dared, out of impetus, out of reason, or out of love... who by their example opened wide the gates"* [1, p. 2]. One can trace how the metaphorical system forms an unbreakable connection between the past, present, and future.

Linguistic means of conservative ideology expression: conservative ideology is reflected in speech through a system of linguistic markers that indicate the speaker's traditionalist worldview. Philologist R. Wodak, a specialist in critical discourse analysis, considers discursive markers as elements of the text that signal the author's ideological position [4, p. 78]. Ukrainian researcher G. Yavorska emphasizes their systematicity and interconnectedness – this is what allows for the formation of a holistic ideological narrative [5, p. 23]. The vocabulary associated with national identity densely permeates the text. It creates a vivid picture of a national community with a centuries-old history, common values, and traditions. In the text we read: *"Italy is rightfully part of the West and its alliance system, a founding state of the European Union, the Eurozone and the Atlantic Alliance, a member of the G7 and, even before all this, the cradle, together with Greece, of Western civilization and its value system"* [1, p. 11]. Meloni addresses historical figures: *"We are the heirs of St. Benedict, an Italian, the main patron saint of the whole of Europe"* [1, p. 11]. Such rooting in historical soil is one of the typical conservative rhetoric features. G. Meloni's speech is accompanied by emotionally colored vocabulary when describing *"their own"* and *"others"*. Like-minded people are characterized through positively marked lexemes: *"For their dedication, patriotism, and values"* [1, p. 3]. In contrast, opponents appear in a negative light: *"those who have brought a worsening of the main macroeconomic fundamentals"* [1, p. 6]. The text of the speech contains words that represent conservative worth: *honor, pride, loyalty, duty, tradition, heritage*. They are contrasted with negatively colored ones: *betrayal, decline, destruction*.

Thus, the analysis of Georgia Meloni's inaugural speech demonstrates the systematic linguistic means usage to construct a conservative picture of the world and legitimize a right-wing conservative political course. Value-coloured vocabulary, use of metaphors, and opposition words create a holistic communicative strategy aimed at strengthening conservative sentiments in Italian society. Therefore, it can be concluded that the language of politics is not just a means of transmitting information, but also a tool for forming a particular worldview and value system. In the case of Georgia Meloni, this approach promotes conservative ideology through carefully selected lexical and stylistic means that create an emotional connection with the audience and form a clear ideological profile of the speaker.

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O. Kiselevskyi, I. Batrachenko

#### **THE PERSONALITY OF UKRAINIAN FREELANCERS AS AN OBJECT OF PSYCHOLOGICAL RESEARCH**

The psychological study of freelancers' personalities is especially relevant in the context of labor market transformations driven by digitalization, economic instability and globalization. Freelancing is becoming not only an alternative but also a primary form of employment for many specialists, particularly in the fields of information technology, design, marketing and copywriting. At the same time, this style of work imposes specific demands on freelancers' personal characteristics, psychological resilience and adaptability. Therefore, researching freelancers' personalities is

essential for understanding the factors that contribute to successful professional self-realization under conditions of remote and self-employed work.

Freelancing as a phenomenon is characterized by self-organized work activity, flexible schedules, the absence of a permanent employer and, consequently, increased responsibility for professional outcomes [5, c. 49–50]. From a psychological perspective, freelancers possess a set of distinctive personality traits that facilitate their adaptation to non-standard working conditions. These psychological characteristics of Ukrainian freelancers include:

- A high level of self-regulation and self-discipline, necessitated by the need to independently organize their work processes, which requires well-developed self-control skills.
- Cognitive flexibility, enabling them to adapt quickly to life and work situations in the absence of a standardized working environment [3, c. 339].
- A propensity for risk-taking and tolerance for uncertainty, which are inherent in freelancing due to income instability [4, c. 56–58].
- Strong motivation for self-realization, manifested in the desire to work on engaging projects and to develop skills in parallel with professional activity.

Key aspects which justify the relevance of psychological research on freelancer's personality and may constitute the focus of such research include the following:

### **1. Autonomy of self-employed individuals.**

Freelancing involves decision-making autonomy, independent work organization and the boundaries establishment between personal and professional life. This requires a high level of self-discipline, responsibility and self-regulation. Investigating these traits can help identify psychological components contributing to success in freelancing.

### **2. Stress factors and emotional burnout.**

Despite the apparent advantages of flexible scheduling, freelancers often face income instability, lack of social protection, tight deadlines, and high competition [1, c. 98–100]. These factors may lead to chronic stress and burnout, highlighting the need for effective prevention strategies and psychological support.



### **3. Time perspective and subjective perception of career and life paths.**

Freelancers tend to approach future planning in ways that differ significantly from traditional career models [2, c. 39–40]. Studying their time perspective can help reveal factors influencing long-term motivation and professional self-determination.

### **4. Motivation and professional identity.**

Many freelancers choose this mode of work driven by a desire for self-realization, creative freedom and independence. Exploring their motivational attitudes and professional identity can provide insights into how these aspects affect productivity and job satisfaction.

### **5. Social isolation and its consequences.**

The absence of a traditional workplace community may influence freelancers' psychological well-being, social connectedness and emotional health. It is important to understand how participation in professional communities or online social networks contributes to their adaptation.

In investigations aimed at analyzing the personality traits of Ukrainian freelancers, it is advisable to employ both quantitative and qualitative methodologies. Qualitative methods include surveys to assess levels of motivation, job satisfaction and stress, as well as interviews to collect and analyze personal narratives. Quantitative psychodiagnostic tools, such as standardized tests, can be used to measure emotional burnout (MBI), self-regulation (SRQ) and anxiety (STAI).

Preliminary research indicates that Ukrainian freelancers exhibit high levels of autonomy and stress resilience; however, they are also prone to emotional burnout due to irregular schedules and excessive workloads[3, c.339]. Future research may focus on developing effective strategies for burnout prevention and professional self-preservation among members of this occupational group.

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A. Kliuiev, T. Potnitseva, O. Besarab

## **MODERN BIOGRAPHICAL VERSIONS OF OSCAR WILDE’S LIFE AND CREATIVE ART**

In the second half of the twentieth century, a new trend emerged in literature – *postmodernism*, which, according to literary critics, replaced modernism and is characterised by a wealth of techniques and styles, as well as genre diversity [2]. During this period, writers became increasingly interested in biographies, that can be explained by many reasons, among which researchers consider the desire to understand better the national past and the search for the foundations of national identity in a changing world.

The solution of such problems required expanding the boundaries of the *biographical genre*: applying the philosophical ideas of postmodernism, which justifies the need to destroy conventional systems, including the system of genres, which leads to the fact that biographical literature manifests itself in various genre modifications and is characterised by a multivariate stylistic embodiment, so it still remains relevant. At the same time, the main theme of biographical works is the personality that stands at the centre of literature [2].

*Oscar Wilde* is one of the most iconic writers and poets of the late nineteenth century, who became the embodiment of an aesthetic movement and a symbol of literary decadence. His creative art is known for its sharp social and political views, sumptuous metaphors and deep philosophical reflections. Over the decades of his life and after his death, Oscar Wilde’s biographical sketch has been the subject of much discussion and debate. The prominent literary biographies written by Richard Ellmann, Neil McKenna, and Peter Ackroyd (his biographical novel “*The Last Testament*” is meant) are modern biographical versions of Oscar Wilde’s life and creative art.

Two leading biographers Richard Ellmann and Neil McKenna popularised and made the writer famous and each of them focused on different aspects of his life and contribution to culture. For example, Ellmann describes the difficulty of Wilde's life and his difficult family situation, and also examines his creative art in the context of the *aesthetic movement*. On the other hand, McKenna focuses more on the writer's *sexual orientation* and its impact on his life and creative art.

However, there is no doubt that the complexes of characteristics and iconicity of Oscar Wilde's personality were deciphered and interpreted at each stage of cultural development in their own combination, with an emphasis on something very important for a particular time. This is always the case with a great author and his creative art, the greatness of which is based on the potential of meanings. They easily respond and project to the challenges of society and are therefore easily embedded in a particular *cultural context*.

Richard Ellmann worked on the biography of the writer, which was published in the year of his death (1987), for over 20 years. And for good reason, because his painstaking work became one of the most authoritative sources of information about Wilde's life and creative art and was highly appreciated by the *Pulitzer Prize*, which the literary critic received posthumously in 1989. In his biography, Ellmann explores in a traditional, chronological way various aspects of the great poet's life, analysing his early years, education, career, personal life, and particularly, his influence on the literary scene.

The biographer takes a detailed look at Oscar Wilde as a writer and also focuses on the very complex aspects of the writer's personality, his sexuality, and the repeated scandals and conflicts that to some extent led the playwright to such a tragic end [4]. A vivid confirmation of the fact that the American literary critic's unsurpassed work has become conceptually important is the fact that Ellmann's book was used as the basis for the 1997 film "*Wilde*", starring Stephen Fry, Vanessa Redgrave, and Jude Law.

Thus, one of the main contributions of Richard Ellmann's literary biography is in the way the American critic presents and interprets the life and art of Wilde – in their proper context as *moral criticism*, not just as clever outpourings. It is considered to be one of the most authoritative biographical versions of Oscar

Wilde's life and creative art and the fact can mainly explain by the special morality of the time without the freedom yet to speak of everything.

The development of certain new accents and impulses was presented in the biographical interpretation presented by another biographer of Oscar Wilde, whose book impressed with the shocking nature of the proposed view and looks like a paraphrase of the writer's own work. We are talking about the famous biographer Neil McKenna and his work "*The Secret Life of Oscar Wilde*", which, in our opinion, is further popularisation and glorification the English writer.

Neil McKenna's literary biography was published in 2003 and represents a quite different approach to the study of Oscar Wilde's creative art and life compared to Richard Ellmann's biography, as McKenna sets out to analyse the sexual aspects of Wilde's life and their impact on his creative art. In the book, he focuses on the homosexual aspect of the English writer, revealing his romantic relationships with other men and certain "*homosexual experiments*" [6].

It explores the importance of sexual identity for Oscar Wilde and the role of this aspect in shaping his creative art. The biography draws attention to a complex and controversial aspect of the Irish writer's life and its impact on his famous works and it can be mainly explained by the fact that the biographer becomes known, like Oscar Wilde, for his outspoken shock value and challenge to the morality of society, i.e. his unconventional sexual orientation.

Neil McKenna is in fact tearing the masks off Victorianism, which has been mythologised as an ideal of moral behaviour for decades. According to historical documents, homosexuality was very widespread at the time, but remained illegal in Britain. The society of the new, twenty-first century, already tolerant of a person's sexual choice, perceived McKenna's book about this particular *phenomenon* at that time from a different perspective, and highly appreciated the writer's work.

In Neil McKenna's book, we can see a reflection of the journalist's own image in a rather *shocking interpretation* of Oscar Wilde's life and creative art. The extremely interesting version of the modern English biographer is also a reflection of the time itself and changes in the perception of the world, creativity and oneself, as well as new signs and traits of mentality [6]. Thus, McKenna's biography reveals not only

Wilde's literary achievements, but also the complex personality of the writer, which combined his *genius*, *controversy*, and *relations with the society of his time*.

Neil McKenna has drawn on a variety of archival sources, correspondence, contemporaries' testimonies and other materials to provide a deeper insight into Wilde's character and life, and to show the influence of the writer on the literary scene, making his biography an essential companion to a fuller understanding of Oscar Wilde as a writer and a person, revealing his talent and rather tragic fate through the prism of his time and social context [6].

Another prominent representative of postmodern literature, Peter Ackroyd, produced a peculiar combination of biographical facts and fiction in his work "*The Last Testament of Oscar Wilde*" (1983). Even though the biographer wrote his work earlier than the previous two authors, we believe that this mixture of biographical facts and fiction is extremely significant mainly because of the mastery of narrative, as Peter Ackroyd has a unique style that captures the reader's attention, turning the biography into a whole literary journey. He skilfully combines documentary with fiction, which makes the book interesting not only for scholars but also for a wide audience.

In its external form, it is a diary (allegedly kept by Wilde in 1900), which, in turn, is a genre of autobiography. However, the peculiarity of Ackroyd's style lies in the fact that the main technique on which the work is based is *pastiche* [5, p. 15–16]. It is believed that "*The Last Testament*" is an imitation of three traditions at the same time: *biography*, *autobiography*, and *diary prose*. In this way, Peter Ackroyd blurs the boundaries between these three genres, creating a postmodern biography – a first-person narrative written in the third person at the same time [1, p. 80].

Ackroyd's main idea is to show the *spiritual death* of a great writer caused by his aesthetic and existential collapse. According to Peter Ackroyd's idea, the diary becomes not only a means of self-disclosure for Wilde, but also a way of prolonging his life. No wonder the last sentence of the diary contains the words: "***I knew I would create a sensation...***" [4]. We can see that despite the apparent parallels, Ackroyd's novel differs from the inherited tradition.

It demonstrates characteristics that, although slightly and occasionally present in the previous periods, most often as isolated phenomena, appear united and amplified in the postmodern period, creating a synergistic effect that transforms the narrative into a story with new and *open perspectives*. In this way, Peter Ackroyd has succeeded in creating a work that is loyal to the *postmodern tradition* that gave rise to it, but at the same time a true literary mirror reflecting another time and another author. If there is a significant difference between the postmodern and traditional approaches to biography, this version certainly favours the postmodern approach [5, p. 15–16].

These literary techniques and methods, whether new or intensified in *postmodern biography*, only help us to identify better with its subject: through new freedoms in the use of genres, imitation of the subject's own works and even parody of some aspects of them, we can only gain an improved understanding of our subject's life. Thus, Ackroyd's postmodern prose breathes new life into the biography of the famous writer Oscar Wilde, deepening it with new revealing shades of insight and understanding.

We have concluded that all the authors provide us with valuable interpretations of Wilde's life and creative art, but from different perspectives. R. Ellmann focuses on Wilde as a *literary genius*, while N. McKenna highlights him as a *social and cultural reformer*, and P. Ackroyd draws a line between *historical recovery* and *literary invention*, and by that creating a similar mixture of painstaking research and biographical speculation.

Thus, all three biographies of Oscar Wilde together provide a rather *extensive* and *multifaceted* image of the life and creative art of this extraordinary novelist and playwright, who is currently perceived in a special way by society due to the relevance of certain topics and serious turns and challenges in the lives of people in the twenty-first century. We have also come to the conclusion that each interpretation of the biography of the famous writer Oscar Wilde depends on several factors, namely: 1) *the vision of the literary critic himself and his perception of the text*; 2) *the era in which the writer himself lived and, no less importantly, the time in which the author of the biography lived*; 3) *on the society that surrounds him and what rules or laws it dictates*.

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K. Kocherzhyna, S. Riabovol

## THE REPRESENTATION OF THE PROBLEM OF EDUCATION DURING THE WAR IN THE POEM “A CENTURY LATER” BY IMTIAZ DHARKER

Art is a reflection of society. Poetry has resonated with the problems of personal and political life since ancient times. Unfortunately, war remains one of the most urgent social challenges we face today, jeopardizing not only numerous lives but also education and our future in general. This is highlighted in the poem “A Century Later” by Imtiaz Dharker.

Imtiaz Dharker was born in 1954 in Pakistan and later moved to India and Great Britain. Introducing herself as a South Asian poet, she brings together the historical and cultural experiences of the three countries she is connected to, creating powerful poetry concerned with modern challenges such as violence and limited rights, seen from the point of view of ordinary people.

“A Century Later” takes inspiration from the most striking social and political tragedies of the modern era. The poem was written in 2014, a century after the beginning of World War I. However, wars are still ongoing, and some take place in areas that are not always obvious to the general public. Imtiaz Dharker reflects on the remarkable story of Malala Yousafzai, a young Pakistani girl who stood up for women’s right to an education after the Taliban occupied her hometown and closed girls’ schools. At only 15 years old, she became a target for assassination because of her activism

but survived. She later moved to England and became a global advocate for women's education, winning the Nobel Peace Prize in 2014 for "their struggle against the suppression of children and young people and for the right of all children to education" [5].

Imtiaz Dharker draws parallels between these issues, describing the attempt to study as a young person's personal war: "The school-bell is a call to battle, every step to class, a step into the firing-line" [1 – here and further cited according to this source]. Next, she values the courage of an unstoppable girl who "takes the bullet in the head and walks on" despite all the cruelty and violence of politics. Moreover, this shot only skyrockets her determination to fight for her vision of a better world: "... cuts a pathway in her mind, to an orchard / in full bloom, a field humming under the sun, / its lap open and full of poppies." These soothing, homelike images correlate with poppies, known as a symbol of Remembrance and hope for a peaceful future. In the lines, "This girl has won / the right to be ordinary," the author reminds us that, in some parts of the world, women are prevented from such simple daily things as wearing bangles, painting their nails, and – what is most terrifying – going to school. Knowledge and awareness help people think effectively, make their own decisions, and oppose dictatorship.

Finally, Dharker ends her poem with a manifesto from the surviving girl: "Bullet, she says, you are stupid. / You have failed. You cannot kill a book / or the buzzing in it." These lines make us believe that no war can destroy the exciting, lively energy of books and young people's desire to learn. In conclusion, "one by one, / the schoolgirls are standing up / to take their places on the front line," bravely joining the fight for their right to education.

Introducing this heart-piercing piece of poetry, Imtiaz Dharker said, "I was thinking about civilians in the firing line, especially children and young people. Many of them across the world have to struggle to get to school" [3]. Certainly, this statement also relates to Ukraine.

The full-scale war is ongoing in Ukraine because of the Russian invasion. It has caused considerable losses and difficulties for children in terms of schooling. According to analysts, the inevitable consequences of the conflict involve the destruction of educational infrastructure, a severely negative impact on the organization of



the study process, and a decrease in education quality [4]. Due to relocation, schools and universities lose valuable, experienced tutors and prospective students. Educational institutions have always been places not only for learning but also for communication and friendship. However, now Ukrainian children and teens cannot attend them, and thus they are deprived of useful facilities (libraries, gyms, pools, theatres, etc.) and opportunities to build connections. Safe shelter within the buildings has become a crucial factor in enabling children to continue going to school. During air raid alerts, they follow their teachers calmly to the basement, where various exercises, games, and activities are carried out. Still, the educational process remains unstable because of alerts and blackouts. It is hard to learn when you spend 40% of your school day in the shelter [6]. Otherwise, it can lead to huge human casualties from drones and missiles. Most schools and universities are now switching to a hybrid educational mode. Some classrooms have in-person attendance, while others study online, then they change turns. Such a system gives students a regular chance to socialize.

Online studying makes people feel isolated and uninvolved, reducing their motivation. They depend on internet connection speed and learning platforms prone to flaws and compatibility issues. Further, students are prevented from gaining practical experience, as they do not have access to labs and cannot fully use their skills in real-life conditions [2, p. 1117].

Despite the difficulties, Ukrainian students are eager to learn and improve. Imtiaz Dharker's poem "A Century Later" resonates with their daily fight for knowledge and a better future. Young people in Ukraine keep envisioning those blooming orchards and sunny fields, hopeful to become ordinary one day and bring back offline studying – if not for themselves, then at least for their children. Being a manifesto of fight and hope, poetry should be promoted across the world as a source of stories, feelings, and solutions.

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Ya. Kozynets, T. Lytvynova, S. Riabovol

## **SOCIAL HISTORY OF THE COSSACKS IN THE WORKS OF UKRAINIAN HISTORIANS**

Many Ukrainians have a strong affection for the Cossacks and consider them true Ukrainian heroes. Simply put, the Cossacks are popular among both the general public and professional historians. However, there are several gaps in this area, particularly in the social history of the Zaporozhian Cossacks. The problem is that most scholars have focused on military history, leading to the stereotype that the Cossacks' only accomplishments lie in military exploits and glory. However, the reality of the Cossacks extends beyond military and political history, and the social dimension of this topic is equally important. Recently, social history has gained popularity among academics. It is a relatively new field of study that focuses on social formations and society as a whole. Among Ukrainian historians who have explored the social history of the Cossacks, we can mention A. Skalkovsky, N. Polonska-Vasylenko, V. Milchev, and T. Kuzyk. The works of these historians will be discussed in this article.

The first person to attempt to explore the social history of Zaporizhzhia based on sources is Apollon Skalkovsky. Skalkovsky presented a fairly systematic, unified, and extensive analysis of Zaporizhzhia society, describing in detail each social stratum and its place in Cossack society [6]. According to A. Skalkovsky's work, it cannot be said that the author sympathizes with or is hostile to the Cossacks. He objectively analyzes the documents and draws balanced conclusions.

Natalia Polonska-Vasylenko conducted significant archeographic and research work. She not only published archival documents but also carefully studied, analyzed, and drew conclusions from them [1]. This work holds an important place in the field of social history, marking the beginning of many subsequent studies that gradually made significant contributions to the field [5].

Tetiana Kuzyk's work and research are significant contributions to the social history of the Cossacks. Similar to previous historians, she draws on the archives of the New Sich, although she addresses more specific and significant topics. She reconsiders and approaches social history from a new perspective [2]. Her approach differs from those of Skalkovsky and Polonska-Vasylenko in the way she presents the material, although some similarities can be noted. Kuzyk's work is characterized by creative vision, moderation, and a degree of objectivity.

Volodymyr Milchev's work focuses more on understanding the social history of the Zaporozhian Cossacks and the process of researching it. The author describes his monograph as follows: "This is a purely historical narrative of the text combined with source research, starting not from abstract producers of historical sources, but from the lives of specific people" [4]. It is worth mentioning the anecdotes from the 18th century, which go beyond modern understanding, as they were not just retellings of jokes but entire speeches in a theatrical form [3, p. 193].

To summarize all of the above, each historian has their own unique approach to studying the social history of the Zaporozhian Cossacks in the 18th century. Their perspectives were influenced by various factors, such as time, location, and position. It would be difficult to single out any one of these works and claim that it best reveals the problems of Cossack society in the 18th century. Only together do these works form a comprehensive picture of the social history of the Cossacks during this period. Each work has its own unique characteristics and is distinct from the others. For example, A. Skalkovsky was a pioneer in this field, while N. Polonska-Vasylenko delved deeper into the social history of the Cossacks. T. Kuzyk focused on microhistory, while V. Milchev provided a source study review, describing in detail the process of researching social history. An interesting trend can be identified: the more recent the research, the more attention is given to details. While A. Skalkovsky focused on the general social history of the New Sich, Polonska-Vasylenko's work focused

more on the leaders, and T. Kuzyk went further and studied scribes. This approach is logical for studying any topic, and the social history of the Cossacks of the 18th century is no exception. The more attention is paid to the topic, the more questions arise, leading to the study of smaller topics. Despite the work done by previous historians, scholars who research the Cossacks and prefer military and political aspects of history pay less attention to social history. However, it should be taken into account that the Zaporizhzhia Sich had a unique social structure.

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S. Krutikova, Yu. Honcharova

## CLARIFYING THE CONCEPT OF POST-TRAUMATIC GROWTH

In today’s world, where each day presents new and serious challenges, the issue of post-traumatic growth (PTG) is particularly significant. The study of PTG has become a priority in modern Ukrainian psychological science, especially given the country’s ongoing military conflict and social crisis. Research indicates that individuals who endure painful life challenges often reassess their values and strive to enhance their lives [1]. Understanding the mechanisms of PTG is essential

for social workers and society as a whole, as it enables better support for individuals experiencing difficult times. Consequently, the topic of post-traumatic growth has gained considerable relevance for both scientific research and practical applications aimed at assisting those affected. However, one of the main challenges is the pronounced ambiguity in defining the term, which complicates understanding this phenomenon. Given the urgency of clarifying the concept of post-traumatic growth (PTG), it is essential to explore its various interpretations in greater depth.

Scientists are exploring various approaches to understanding this complex phenomenon. For instance, M. Westphal and G.A. Bonanno argue that while resilience focuses on returning to a baseline level of functioning after a setback, post-traumatic growth (PTG) involves transformative growth that surpasses pre-trauma levels [8]. In contrast, T. Elam and K. Taku examine how perceived PTG and resilience relate to empathy and the ability to recognize emotions [2]. According to N. Kharitonova, “post-traumatic growth (PTG) is a concept describing positive psychological changes that occur as a result of struggling with extremely challenging and stressful life circumstances” [4, p. 171]. The author emphasizes PTG's transformative nature, noting that it can lead to significant changes in thinking and overall psychological development. This transformation results from adaptive abilities that help individuals adjust to new situations.

O. Melnyk articulates that “post-traumatic growth is a possible outcome following a traumatic event, standing at the opposite pole of PTSD, manifesting through a renewed appreciation of life, strengthened interpersonal relationships, increased sense of personal strength, redefined life priorities, and enriched spiritual and existential dimensions of life” [5, p. 81]. V. Shcherbiy and O. Lyashenko view PTG as “the potential of an individual's dynamic system to adapt to negative events and thus expand existing resources” [6, p. 63].

Overall, modern science identifies three main approaches to interpreting the phenomenon [4, p. 172–174]:

- **Functional-descriptive model** (R.G. Tedeschi and L.G. Calhoun). This approach interprets PTG as personal enhancement, changes in worldview, and the acquisition of new experiences following a traumatic event [7, p. 1–18].

• **Person-centered model** (S. Joseph). This perspective considers PTG as an adaptation to stressful situations. The adaptation process can involve both negative and positive changes. The authors note that meaningful and positive transformations are possible only when individuals make an effort to understand the cause-and-effect relationships of their experiences.

• **Biopsychosocial model** (M. Christopher). Advocates of this theory consider PTG a complex process involving biological, psychological, and social factors. A key issue in this process is the conflict between evolutionarily older systems (subcortical structures), responsible for stability, and newer ones (neocortex), responsible for adaptability. This conflict can lead to vulnerability. Proponents of this approach suggest that resolving this conflict requires restructuring cognitive schemas and enabling the organism to harmoniously adapt to environmental changes.

Based on a brief literature review, it can be confidently stated that the concept of "post-traumatic growth" demands serious academic attention. A widely accepted understanding of PTG views it as the ability of the psyche to transform severe life crises, such as disasters, violence, or losses, into the potential for personal growth. This phenomenon includes transformative changes in worldview and attitudes towards oneself and the world, fostering spiritual development. Despite the growing interest in PTG, researchers have not yet reached a consensus on unified terminology. As a result, post-traumatic growth remains a complex phenomenon that requires deep scientific reflection.

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T. Kyrpyta, T. Davydova

## **HANDLING STRESS IN EFL CLASS IN HIGHER SCHOOL DURING THE WAR OF RUSSIA AGAINST UKRAINE**

Recent studies have explored stress management strategies for EFL teachers, particularly in the context of the ongoing Russian-Ukrainian conflict. Armed aggression has significantly increased stress and burnout among Ukrainian EFL teachers due to disrupted school functioning and heightened emotional demands [3, p. 127]. To address these challenges, research suggests implementing targeted interventions, promoting positive teacher-student relationships, and offering tailored professional development opportunities [3, p. 135–140]. Korniyush [2] emphasizes the importance of adapting teaching methodologies, organizing online classes, and focusing on teacher self-care and well-being. Additionally, enhancing teacher self-efficacy and emotional regulation skills has been shown to reduce teaching stress [1]. These strategies can help EFL teachers in Ukrainian higher education institutions better manage stress during the ongoing conflict.

After studying relevant articles we identified some general strategies for managing stress in EFL classes:

### **1) Creating a Supportive Environment**

Establishing a safe and empathetic classroom atmosphere helps students feel secure.

## 2) Flexible Teaching Methods

Teachers can adapt lessons to accommodate interruptions and provide asynchronous learning options for students who may have limited internet access due to power outages or displacement.

## 3) Incorporating Mindfulness and Relaxation Techniques

Short breathing exercises, mindfulness activities, or even calming music before or after lessons can help students manage anxiety and stay focused.

## 4) Using Engaging and Motivational Content

Selecting texts and activities that are inspiring, such as stories of resilience, helps students maintain motivation.

## 5) Encouraging Peer Support and Collaboration

Group activities and pair work foster a sense of community, reducing feelings of isolation.

## 6) Fostering a Sense of Normalcy

Maintaining a structured schedule and regular assessments (with flexibility) provides stability.

## 7) Providing Psychological Support

Teachers should remain attentive to students showing signs of extreme stress or trauma and refer them to school psychologists or support groups when needed.

By fostering a supportive and flexible environment, integrating mindfulness, and encouraging peer collaboration, educators can help students navigate this challenging period while continuing to develop their English skills. Despite the hardships, EFL classes can serve as a space for resilience, communication, and hope for a better future.

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## FORMATION OF NICHE AUDIENCES IN THE PLATFORMIZED MEDIA SPACE

In today's media landscape, digital platforms play a fundamental role in shaping niche audiences. Through algorithmic targeting and personalized recommendations, users receive content tailored to their specific interests, facilitating the development of specialized communities. From social networks to streaming services, platforms leverage big data to segment audiences and deliver personalized user experiences [8].

According to Deloitte's research (2025), hyperscale social video platforms are shaping digital media trends, challenging traditional media and reimagining content consumption [7]. This indicates that users are increasingly turning to platforms with niche content that aligns with their interests.

The formation of niche audiences occurs through several mechanisms:

- **Algorithmic targeting:** Analysis of user behavior enables platforms to select content and advertising based on individual preferences [1]. Modern platforms analyze user behavior to deliver relevant content and targeted advertising, which shapes users' information bubbles [13].

- **Content specialization:** The growth of blogging culture and podcasts contributes to the development of audiences with clearly defined information needs. As Napier (2007) notes, specialized content helps create loyal communities that actively engage with creators [10].

- **Gamification and interactivity:** Platforms actively use interactive engagement mechanisms such as streams, chats, voice rooms, and polls to attract niche users. Deterding et al. (2011) emphasize that elements of gamification significantly increase user engagement, especially in niche communities [5].

- **Crowdfunding and subscription models:** Platforms like Patreon, Boosty, and OnlyFans allow content creators to monetize narrow audience segments. Mollick's (2014) research demonstrates that crowdfunding platforms have become effective tools for niche creators, enabling them to find their audience without involving traditional media corporations [9].

**Statistical Data and Analysis**  
**Table 1. Monthly Active Users by Platform (2025)**

Platform	Users (millions)
Reddit	606
Weibo	599
X(Twitter)	586
QQs	562
Pinterest	537

Source: DataReportal [4].

Comparing these numbers with previous years reveals steady growth in the user base of niche platforms, confirming the trend toward media space fragmentation and personalized content consumption. According to DataReportal forecasts [4], by the end of 2025, the number of niche platform users is expected to grow by 8–12%, highlighting their importance in the contemporary media landscape.

The platformization of media space facilitates the formation of niche audiences, changing approaches to content creation and consumption. The growth of specialized platforms and personalized content opens new opportunities for audience engagement and the development of the media industry. At the same time, it is important to consider potential risks and develop regulatory mechanisms for the information environment to ensure content diversity and preserve democratic principles in the media space.

For future research, it would be valuable to focus on developing ethical principles for algorithmic content formation, as noted by Taylor (2018) [17], as well as analyzing the impact of niche audiences on social cohesion and information pluralism.

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D. Lebedenko, Yu. Halayko, N. Kaliberda

## **EMOTIONAL BURNOUT OF MATHEMATICS TEACHERS AS A PSYCHOLOGICAL AND PEDAGOGICAL PROBLEM**

The concept of “burnout” was introduced by the American psychiatrist Herbert Freudenberger in 1974 to describe a special kind of emotional fatigue that affected social workers. It was a form of communication and work fatigue, which Freudenberger called “emotional burnout” [1, p. 128–133]. Emotional burnout is a syndrome of constant fatigue and mental exhaustion caused by prolonged stress and excessive emotional strain in professional activities [2]. It develops gradually, against the backdrop of emotional exhaustion, chronic fatigue, low material motivation, and lack of support from the state and society. The syndrome of emotional burnout includes three main components: emotional exhaustion (a feeling of emptiness and fatigue caused by one's own work), depersonalization (cynicism), and reduction in professional achievements (the emergence of a sense of incompetence in one's professional field and an awareness of lack of success in it) [6].

The main manifestations of emotional burnout are:

- **Emotional:** feelings of chronic fatigue, irritability, apathy, and decreased self-esteem.

- **Physical:** frequent headaches, sleep disturbances, general weakness, decreased immunity, and increased fatigue even after short-term work.

- **Behavioral:** performing professional duties without much interest or inspiration, decreased contact with colleagues, students, and parents, and unwillingness to participate in methodological associations, trainings, or conferences.

- **Psychological:** feelings of professional crisis, constant anxiety, stress, feelings of hopelessness, and unwillingness or inability to emotionally respond to students' problems.

Most often, emotional burnout is manifested by a combination of all these signs and symptoms.

The teaching profession is one of the most stressful and prone to emotional burnout because it involves "people-to-people" interactions. A modern mathematics teacher performs the following tasks: mastering new curricula regularly, adapting to new teaching methods, implementing humanistic ideas, and adjusting to rapid changes in society and the information space. To do this, a teacher must maintain strong mental health, a stable emotional state, and be professional and creative. Excessive tension at work can lead to professional stress, emotional and mental exhaustion, and, as a result, burnout. As a consequence, work efficiency decreases, and relationships with colleagues, management, students, and parents deteriorate [5, p. 201–205].

Today, the main factors contributing to emotional burnout among math teachers include the desire to achieve ideal results in teaching students, self-criticism due to non-compliance with expectations, lack of self-regulation skills, working with a large number of students, pressure for students' results in control work and exams, heavy educational load, the complexity of the subject, explaining complex concepts to multi-level students, insufficient support from school administration, monotony of work, low wages, the need to constantly master new technologies and platforms, the underestimation of the importance of the profession in society, distance learning, constant reforms, and the difficult situation in the country.

One of the main strategies for preventing emotional burnout is prevention. The primary form of prevention of emotional burnout in mathematics teachers is training (preventive training to prevent emotional burnout among teachers). The objectives of such training programs include: providing teachers with knowledge about the essence, causes, and factors of emotional burnout, developing self-regulation skills, and equipping educators with techniques for preventing and overcoming emotional burnout. In line with these goals, training sessions are divided into theoretical and practical components. The theoretical component is aimed at providing teachers with knowledge about the content, structure, signs, symptoms, and specific manifestations of emotional burnout, as well as the factors that lead to its occurrence. The practical component focuses on equipping educators with skills for self-regulation of negative psycho-emotional states, overcoming stressful situations, and developing communication skills to establish effective interactions with colleagues, administration, and students [7].

The main methods for independently overcoming and preventing emotional burnout include normalizing sleep schedules, maintaining a work-life balance, engaging in favorite activities or hobbies, mastering time management skills, following a healthy diet, exercising, switching from mental to physical activity, practicing aromatherapy, praising oneself for small achievements, developing a sense of humor, and finding ways to escape routine. If teachers feel unable to cope on their own, seeking help from a psychologist is recommended [3].

As noted by the authors of the book *Burnout*, Emily Nagoski and Amelia Nagoski, physical activity is the most powerful tool for combating stress and emotional burnout. This can include sports, laughter, breathing exercises, creativity, dancing, or even crying – all of which involve action and movement. They also emphasize the importance of living one's own life not for others, but with them. The authors recommend treating oneself to enjoyable meetings with friends, walks in the fresh air, and small trips, even just outside the city [4, p. 304].

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A. Maiboroda, I. Popova

## EMOTIONAL SYNTAX OF OLEKSANDR DOVZHENKO'S EPISTOLARY TEXTS

The problem of emotions in language has always attracted scholars, as it is one of the fundamental issues in scientific research.

In psychological terms, emotionality is the characteristic of a subject, an ability to experience emotions. In linguistics, this category is considered as one that "functions to express feelings regarding a certain object or phenomenon" [4, p. 136]. One of the main and relevant areas of modern philological research is the study of emotionality at the syntactic level, as syntactic units can express the peculiarities of a person's psychoemotional state. Syntactic constructions that convey emotions are always expressive.

An important source for the comprehensive study of this topic is epistolary texts, especially private correspondence. In intimate letters, the author openly expresses his feelings and emotions. We will trace the categorization of emotions at the syntactic level in Oleksandr Dovzhenko's epistolary works.

An ideal example of epistolary love lyric texts is the letters Oleksandr Dovzhenko wrote to Olesia Chernova, whom he met in Odesa while filming *The Diplomatic Pouch*. Of the eighteen letters, only seven have been published. However, these texts are small in volume and highly charged emotionally and sensually. A powerful emotional potential in O. Dovzhenko's letters is conveyed

through interrogative sentences. They help the author introduce his emotions and feelings: "Хочеться мені жалкувати за тим, що так мало ми одне одного знали. Чи не жалкувати?" [1, p. 31]; "Хіба не краще мені вже живеться, тому що ти є?" [1, p. 33]; "Ти чекаєш відповіді. Якої, Олесю, про що?" [1, p. 32]. When answering his own questions, the author creates the feeling of a dialogic conversation: "Чи знаєш ти, де межі для душі? Я знаю." [1, p. 32]; "Олесю, моя маленька, Ви гадаєте, допомагає? Не допомагає." [1, p. 33]; "Лесю моя! Що це, Ви не бачите? Я розкажу Вам." [1, p. 33].

Emotional-expressive potential is also present in exclamatory sentences, where "the emotional-expressive coloring is condensed, and the emotional and sensual state of the speaker is expressed" [2, p. 22]: "Мені здається, що Ви для мене сьогодні грали. Ось чому горів мій мозок!" [1, p. 32]; "Щоб я провалився на цьому місці, якщо брешу, або помиляюся!" [1, p. 34]; "Правда, Олесю, правда!" [1, p. 34].

Interrogative and exclamatory sentences are means of emotional influence on the addressee. In one of his letters, where O. Dovzhenko described a cinematic dispute with biting satire, he used 11 exclamatory sentences, thus expressing his anger and indignation regarding the decisions made.

Impersonal sentences are also among the means of emotional syntax. Here, the main constituent expresses the state to which the speaker is reluctantly exposed. These sentences are confessional, where he describes his suffering due to separation from his loved one: "Душно мені, душно. Губи висохли, як рани" [1, p. 32]; "Вчора писалося погано" [1, p. 33]; "Ой, Олесю, скучно мені тут живеться" [1, p. 33].

Researchers mention that one of the defining features of O. Dovzhenko's unique style in letters is the use of parcellated constructions [3]. In scientific literature, parcellation is defined as a phenomenon of expressive syntax. A parcellated element that is widely spread in O. Dovzhenko's letters is the predicate: "Ще трошки часу. Переступлю я через останні дротяні загорожі. І голосно гукну тобі, Олесю – це я!" [1, p. 32]; "Недавно вночі я вигadaв зовсім новий сценарій з усіма діями, цілком закінченою фабулою. Вигадав і заховав десь далеко, в глибині мозку. Подумав, буду з Олесею, витягну і розкажу їй." [1, p. 33]; "Ви думаєте з підозрою,

чи не задумав Сашко яку-небудь гидоту. Нив, плакався, скавулів і раптом маєш тобі!" [1, р. 34]. Parcellated predicates metaphorically depict a wide range of actions, deeds, and feelings.

The author reproduces his emotions and feelings with the help of parcellated attributes: "Я говорив їм прості слова. Зовсім прості, давно забуті." [1, р. 34].

A productive means of expressive syntax is the complex sentence: "Люба, рідна моя дівчинко, спасибі Вам за те, що я зустрівся з Вами. Що можу Вам писати, розмовляти з Вами?" [1, р. 34]. The subordinate clause focuses the attention of the addressee on the author's feelings.

A peculiar feature of Dovzhenko's letters is the use of vocatives. They are very diverse in both meaning and structure: "Моя маленька, хороша дівчинко, вибачте мені мою ніжність." [1, р. 31]; "Де Ви, Олеся, Олеся?" [1, р. 31]; "Моя любя, розумна дівчинко." [1, р. 34]. The author uses these constructions quite frequently: in seven letters, there are approximately seventy instances. Vocatives are extended with emotional attributes, such as "маленька", "хороша", "розумна."

To summarize, Oleksandr Dovzhenko's private letters can be characterized by sincerity and directness in conveying his emotions, which is expressed at the syntactic level through the use of interrogative and exclamatory sentences, impersonal sentences, parcellated constructions, and peculiar vocatives. At the same time, it must be mentioned that letters to other addressees also require linguistic research concerning the emotional syntax aspect, considering the wider range of emotions present.

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## AN ASPECT IN FORMAL LOGIC INTERPRETATION

The main point to understand when discussing the relevance of the question of the importance of formal logic is that, without such a discipline as logic, any field of knowledge would be merely a collection of information without structure or precision.

To understand the influence of this on science as a whole, it is necessary to define it. Formal logic is the discipline of correct thinking [4]. (The use of the word "discipline" seems to be correct, as it is considered the most neutral term and serves as a common term in debates about what logic is: a language, a method, a science, or something else).

Logic is the invention of the ancient Greek philosopher Aristotle. His research on logic is presented in six treatises, which form a collection of books called the *Organon*. Understanding the influence of logic on science and what it represents can be significantly aided by knowing the translation of the collection's title – *Organon*. This word is translated as "Instrument." Consequently, it follows that logic is an instrument that must necessarily be used. There are several reasons for this. The first and primary reason is the laws and principles established by formal logic, namely:

1. **Law of Identity:** It states that, when speaking in the language of formal logic,  $(a) = (a)$  [4].
2. **Law of Non-Contradiction:** This law states that no statement can be both true and false at the same time [3]. Statements  $(a)$  and  $(-a)$  cannot be simultaneously true and false.
3. **Law of the Excluded Middle** [3]: This law introduces the principle that if a statement is not true, it must necessarily be false. This law excludes the existence of any intermediate status for statements.

The above-mentioned laws, in combination with such a logical construction as the syllogism, or its shortened form, the enthymeme, ensure the ability to derive absolutely clear inductive or deductive conclusions during research or reasoning [2].

However, today, my subject of study is a principle that is generally implied but rarely mentioned – the **Principle of Sufficient Reason**. This principle implies that, in order to claim logical validity, a statement must be sufficiently supported by some form of reasoning. The thesis is that the definition of this aspect of formal logic seems to be inappropriate. Specifically, it cannot be considered a principle, and it will be further proven that it is a law, using the deductive syllogism as the method of proof. A law is a defined condition that must necessarily be observed, whereas a principle is an accepted norm that is not obligatory [1]. The tendency to sufficiently justify a conclusion with reasoning is called a principle, which presents a significant contradiction. It should be considered a law, mandatory for observance. This view seems to be correct, as the mechanism of the syllogism proves it by itself. A logical syllogism is a construction consisting of two premises and a conclusion drawn from them [2]. For example:

- **Major premise:** All men are mortal.
- **Minor premise:** Socrates is a man.
- **Conclusion:** Socrates is mortal.

This conclusion has been made on the grounds that there is one common subject in both the general and the particular premises – being human. This similarity justifies the conclusion that Socrates is mortal. The "principle" of sufficient reason is once again under analysis. This construction necessarily compels one to justify the above-mentioned conclusion, for without at least one common feature between the subjects of the general and particular premises, it doesn't seem possible to construct a syllogism at all. This demonstrates that this principle is always observed and cannot be violated. Moreover, as asserted, in order to claim scientific validity and precision, any statement must be made using formal logic. Therefore, the conclusion regarding the classification of this tendency as a law in the form of a syllogism can be formulated as follows:

- **Major premise:** A law is a condition that must necessarily be observed.
- **Minor premise** (derived through a deductive conclusion on the necessity of fulfilling the principle): The Principle of Sufficient Reason is always observed and serves as the foundation of the syllogism's construction.
- **Conclusion:** The Principle of Sufficient Reason is a law.

This issue is considered vitally important, as this principle is a key aspect of formal logic, and its correct definition determines the accuracy of conclusions built on the foundation of the syllogism.

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S. Minaichenko, N. Styrynik

#### ACCESSIBLE MENTAL HEALTH SUPPORT: A SOCIETAL & POLICY PERSPECTIVE

The ability to adapt to an increasingly dynamic and unpredictable world necessitates not only patience but also psychological resilience. Daily life presents individuals with numerous challenges, whether in professional settings, educational institutions, or interpersonal relationships. In contemporary society, resilience and psychological endurance are essential attributes. However, social media and mass media often create unrealistic images of success and happiness, making people feel pressured, insecure, and emotionally drained.

For the third year in a row, the psychological pressure on Ukrainians has been compounded by the extreme stress of war. Our daily routines are interrupted by air raid sirens, calls from fathers on the frontlines, and the sounds of air defence systems at night. Numerous studies and surveys indicate that a large portion of Ukraine's population is experiencing mental health issues, with common symptoms including heightened anxiety, sleep disorders, and panic attacks. According to the WHO, more than 8.5 million Ukrainians are at potential risk of developing mental disorders such as depression and post-traumatic stress due to the war. This estimate is based on

the fact that one in five people suffers from mental health issues during wars and emergencies [2].

Empirical studies indicate a significant rise in mental health concerns among the population, with common manifestations including heightened anxiety, sleep disturbances, and panic disorders. Despite the growing demand for mental health services, access remains restricted due to high costs and the limited availability of free or subsidized psychological support programs. Attitudes toward mental health remain sceptical, particularly among older generations. Many still believe that seeking help from a psychologist is something to be avoided or ashamed of, as mental distress isn't visible on an X-ray or in blood tests. However, psychological issues are real, no matter how much their existence is ignored.

A significant proportion of individuals have encountered mental health disorders arising from various sources, including childhood trauma, familial instability, bereavement, and, more recently, wartime experiences. The psychological distress endured by both civilians and military personnel is profound and necessitates professional intervention. The issue of free mental health care is especially relevant for military personnel, who risk their psychological well-being as much as their physical health.

In the reality of war, nothing exists except for the relentless horror and torment that for some people have lasted for years. It has been established that between 20% and 40% of military personnel require psychological assistance. Symptoms of acute trauma are identified in 60–80% of service members who have witnessed the death of comrades or civilians or have seen the bodies of the deceased. The risk of developing symptoms of mental disorders is higher among younger soldiers aged 18–24, particularly those who exhibit signs of depression or have had issues with alcohol. PTSD symptoms develop in approximately 12–20% of soldiers who have experienced combat trauma but have not sought psychological help due to fears of being stigmatized for showing weakness or cowardice, as well as concerns about threats to their military careers [3]. Those who no longer flinch at explosions or gunfire do not actually know peace or a sense of security. I sincerely wish for them to return home to a place where mental health is valued just as much as physical health – and where no diagnosis leads to condemnation.

One of the most important indicators of a country's level of civilization, reflecting the degree of social development and success, is the health of the nation. Preserving and strengthening the health of citizens has become one of Ukraine's most pressing issues, as it is directly linked to the country's future and has gained particular significance in times of war [1]. Providing free psychological support is not only a humanitarian obligation but also a pragmatic policy measure. Ensuring access to mental health services decreases the long-term social and economic repercussions of untreated mental illness. Neglecting these issues may contribute to increased social isolation, diminished workforce productivity, higher suicide rates, more crime, and increased violence. Another argument for free psychological support is that the longer a society ignores mental health issues, the more severe the consequences become. Potential outcomes include social isolation, decreased productivity, and increased suicide rates across different age groups.

If Ukrainians feel that their government truly cares for them, there will be more trust between the people and the state, greater unity and social cohesion, and enhanced national well-being. This extends beyond free psychological support to include modern mental health centers, improved psychiatric institutions, and more public awareness about and acceptance of mental health issues.

Although the provision of free mental health services is an ethically and socially commendable initiative, a more sustainable and balanced approach may involve a hybrid model combining public and private sector support. Universal free access to psychological assistance presents substantial logistical and financial challenges, particularly in a post-conflict economy. Instead, focusing on those most in need – such as soldiers, displaced people, and those with severe mental health issues – may be a more practical and effective solution.

Adding mental health education to basic healthcare and community support ensures early intervention, thus reducing the need for intensive treatment. Training more mental health professionals and using digital tools like telemedicine and AI therapy can also make support easier to access and more effective.

In conclusion, mental health care should be an integral component of public health policy. A comprehensive national strategy should therefore encompass not only direct financial support for mental health services but also structural reforms

that promote long-term sustainability. By fostering greater awareness and ensuring a diversified mental health support framework, governments can create an inclusive system that balances accessibility with economic feasibility.

The normalization of psychological well-being as a legitimate and essential concern will not only enhance individual quality of life but also contribute to a more resilient and stable society. The invisible wounds of psychological distress require treatment, and recognizing the legitimacy of mental health concerns is a crucial step toward fostering a healthier, more supportive, and more cohesive community.

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K. Miskevych, O. Novikova

### FEATURES OF COLLOQUIAL STYLE IN WRITTEN TEXTS ON THE TWITTER (X) PLATFORM

Colloquial style is a linguistic register characterized by spontaneity, informality, and the use of expressive means that mimic spoken communication. Unlike formal or academic discourse, which adheres to strict grammatical and syntactic norms, colloquial style is marked by flexibility, emotionality, and a tendency toward simplification. It is commonly found in everyday communication, personal correspondence, and digital discourse, particularly on social media platforms.

A key feature of colloquial style is its interactive nature. In spoken communication, interlocutors use various linguistic and paralinguistic devices – such as intonation, pauses, and facial expressions – to convey meaning effectively. In written discourse, especially in digital environments, similar functions are performed by punctuation, capitalization, emojis, and other graphical elements. For example,

repetition of letters (“sooo good”), excessive punctuation (“What??!!”), or the use of informal markers (“lol,” “haha”) serve to compensate for the absence of vocal and visual cues [1].

Although colloquial style appears in both spoken and written forms, significant differences exist between the two. Spoken conversational language is inherently fluid, relying on real-time processing and immediate feedback. It features incomplete sentences, false starts, hesitation markers (“uh,” “well”), and overlapping speech, all of which contribute to its dynamic and interactive nature. In contrast, written conversational language – particularly in digital contexts – exhibits a more structured form while still retaining informal and expressive elements.

The transition of colloquial style into written discourse, as seen on platforms like Twitter, leads to certain adaptations. Due to character limits and the fast-paced nature of online interactions, users often rely on abbreviations (“idk” for “I don’t know”), phonetic spelling (“gonna” instead of “going to”), and unconventional punctuation to replicate spoken intonation. Additionally, while spoken conversational language allows for immediate clarification through verbal cues, written digital communication may require explicit context-setting, often achieved through hashtags, memes, or shared cultural references.

These distinctions highlight the evolving nature of conversational style in the digital era, demonstrating how written discourse increasingly adopts features traditionally associated with spoken communication. This phenomenon is particularly evident in social media environments such as Twitter, where users engage in rapid, informal exchanges that blur the boundaries between oral and written language.

Twitter (X) is a unique social media platform that facilitates rapid, real-time communication through concise text-based posts. Unlike traditional forms of digital discourse, Twitter imposes structural constraints on user-generated content, which significantly influences linguistic choices and communicative strategies. The platform's features, including character limits, interactive engagement mechanisms, and algorithm-driven content distribution, contribute to the development of a distinctive conversational style in written form [3].

One of the defining features of Twitter is its strict character limit, originally set at 140 characters and later expanded to 280 characters. This constraint necessitates

linguistic economy, encouraging users to employ abbreviations, contractions, and non-standard orthographic strategies to convey messages effectively within the limited space. For instance, users frequently replace full words with acronyms (e.g., “btw” for “by the way,” “idk” for “I don’t know”), omit function words (e.g., “Going out tonight” instead of “I am going out tonight”), and rely on symbols or numerals (e.g., “u” instead of “you,” “b4” instead of “before”). These adaptations contribute to the compression of meaning while maintaining communicative clarity [2].

Furthermore, the brevity of tweets influences sentence structure, often leading to the use of paratactic constructions (short, loosely connected clauses) rather than complex syntactic patterns. Additionally, to maximize engagement, users may employ strategic phrasing techniques such as rhetorical questions, ellipses, and deliberate ambiguity to encourage interaction and responses.

Twitter’s interactivity extends beyond individual tweets to an interconnected network of replies, retweets, and trending discussions. Unlike traditional written discourse, which is often linear and self-contained, Twitter fosters a non-linear, dialogic form of communication where meaning is constructed collectively through user engagement.

Replies serve as digital conversational turns, creating threaded discussions that mimic real-time dialogue. These exchanges often feature an informal tone, rapid back-and-forth interactions, and multimodal elements such as GIFs, emojis, and memes, which function as visual and emotional enhancers of text-based communication. Retweets, on the other hand, facilitate content amplification, enabling the rapid dissemination of information while preserving the original wording of a tweet. The viral nature of retweeting can lead to the widespread adoption of specific phrases, slang terms, or neologisms, further shaping the linguistic landscape of the platform [2].

Additionally, Twitter’s trending topics – generated through hashtag usage and algorithmic analysis of user engagement – contribute to the emergence of linguistic patterns tied to current events, cultural phenomena, and digital subcultures. Hashtags (e.g., #MondayMotivation, #BreakingNews) function as both indexing tools and stylistic markers, allowing users to categorize their tweets while also participating in broader discourses.



Twitter's algorithm plays a crucial role in shaping the visibility and stylistic features of tweets. Unlike a chronological feed, the platform's recommendation system prioritizes content based on engagement metrics, including likes, retweets, and comments. As a result, users tend to adopt stylistic strategies that maximize engagement potential, leading to a preference for emotionally charged language, provocative statements, and concise, attention-grabbing phrasing [3].

Moreover, algorithmic amplification incentivizes the use of specific linguistic features, such as exaggerated expressions, humor, and controversy, to increase the likelihood of content being promoted in users' feeds. Tweets that align with trending topics or incorporate viral linguistic patterns are more likely to gain traction, reinforcing the cyclical nature of language evolution within the platform.

Overall, Twitter's structural and algorithmic constraints contribute to the emergence of a distinct conversational style characterized by brevity, interactivity, and engagement-driven linguistic choices. These features position Twitter as a dynamic space where written discourse increasingly adopts characteristics traditionally associated with spoken communication.

As a social media platform that prioritizes brevity, immediacy, and engagement, Twitter (X) has significantly influenced the evolution of conversational style in digital discourse. The platform has contributed to shifts in communication habits, the emergence of new linguistic phenomena, and the establishment of certain language norms. These transformations extend beyond Twitter itself, shaping broader trends in online and even offline communication [2].

The rise of Twitter has altered the way individuals engage in written communication by fostering a more spontaneous and interactive conversational style. Traditional written discourse typically involves structured, elaborative, and grammatically coherent sentences, whereas Twitter encourages conciseness, informality, and directness. The character limit has conditioned users to prioritize efficiency, leading to the widespread adoption of fragmented syntax, abbreviations, and multimodal elements (e.g., GIFs, emojis, memes) to convey meaning effectively.

Another notable shift is the increasing prevalence of real-time, public dialogue. Unlike private messaging or long-form blogging, Twitter facilitates open discussions where multiple users can participate in a single conversation thread. This

has led to the emergence of rapid-response communication, where users express opinions, react to events, and engage in discussions with minimal time for revision or refinement [1]. As a result, informal discourse strategies – such as rhetorical questions, exaggerated expressions, and conversational markers (e.g., "y'all", "bruh", "frfr") – have become dominant.

Twitter serves as a catalyst for the creation and dissemination of new linguistic expressions. Due to the platform's viral nature, trending phrases and catchphrases often gain widespread recognition within hours or days. Many of these terms originate from specific subcultures, including meme communities, political discourse, and fandom spaces, before entering mainstream digital lexicon.

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V. Parshutina, Y. Polishchuk, O. Aliseienko

#### ART THERAPY IN SPEECH THERAPY ACTIVITY WITH PRESCHOOL CHILDREN

The current stage of educational development in Ukraine is characterized by a change in its conceptual foundations and the emergence of a new, personality-oriented approach, with the personality of each child being placed in the center of the whole educational system. An urgent problem is the fact that the number of children with speech impairments has been growing every year. Our modern educational system should provide children with special educational needs with psychological, pedagogical, correctional and developmental assistance by creating special conditions for them. Such children, who are especially prone to anxiety, may feel insecure during classes with a speech therapist, if this is their first experience or if they have previously

encountered negative situations of cooperation, which, on the background of their insufficiently formed processes of cognitive activity, only increases their tension. The usage of art therapy methods and approaches in the work of a speech therapist helps children become more confident, overcome difficulties and increase motivation to cooperate and learn. In speech therapy practice, modern and effective methods and approaches are used, which contribute to the efficiency of specialist's activity. Various forms of art therapy should be highlighted here.

Art therapy in psychological and correctional work is a complex of techniques based on the use of various types of art to correct disorders by stimulating the artistic and creative inclinations of a child with special needs.

Art therapy is being integrated into a system of correctional and developmental process. It is an effective method that uses art (drawing, modeling, music, dancing and other forms of creativity) to develop children's speech, social skills, emotional sphere and cognitive functions. It is an important tool in speech therapy practice, as it promotes the development of speech in playful manner, which is very important for preschool children. Art therapy includes a variety of methods and techniques that allow children to express themselves through creativity. It helps to use not only speech skills, but also develop emotional, sensory and cognitive spheres, which is considered to be an important aspect of any speech therapy.

The main techniques of art therapy in speech therapy work with preschoolers are: isotherapy, music therapy, doll therapy, image therapy, fairy tale therapy, sand therapy, etc.

### **Isotherapy**

Drawing is one of the main means of art therapy. This method allows a child to express his or her emotions and thoughts through drawing, which is a powerful tool for speech development and helps to identify and correct speech disorders. When a child draws, even chaotically, the picture reflects his or her inner state. One of the most effective methods is the method of "doodling with dirty hands". It is an unconventional drawing with dirty hands, which is effective in correcting aggression and hyperactivity of children with speech disorders.

Modeling is a great way to develop hand motor skills and also helps develop speech. The child makes figures, animals, objects and then can describe them, which

stimulates the development of vocabulary and grammar. It allows children to learn how to use new words in different contexts. Sculpting according to a given story or free creativity contributes to the development of creative thinking, imagination and speech abilities.

### **Musical art therapy**

Music is one of the most accessible factors in the formation of a personality, including for children with special educational needs. Music helps to develop the child's emotional sphere and stimulates speech activity. Singing, playing with musical instruments, and listening to melodies help develop hearing, memory, attention, and emotions. Singing songs together on themes from children's fairy tales or everyday life stimulates speech and helps expand vocabulary. The use of simple musical instruments (tambourines, drums, maracas) helps to develop coordination, auditory perception, and interaction with peers.

### **Image therapy**

Theatrical games enable children to actively use speech to express roles, emotions and model social situations.

This is important for the development of communication skills and for overcoming the fear of communication. Simple theatrical performances, where children play scenes from fairy tales or familiar stories, help to learn new words, phrases and dialogues. Role-playing is aimed at breaking down communication and behavioral stereotypes.

### **Sand therapy**

Playing with sand develops sensory sensation and motor skills linked to the language centers. Classes with the usage of natural materials help children combine creativity with knowledge of the world around them, and also provide an opportunity to work in groups and interact with each other. The sandbox becomes a good incentive for the dialogue: the speech therapist asks questions, encouraging the child to describe his or her actions. Sand creates an atmosphere of safety, helps the child to relieve anxiety as well as to interact more openly.

In group art therapy sessions, children learn to interact in a team: drawing, modeling, listening to music. Music can help children express their emotions, relieve tension, and improve their emotional state. Art therapy promotes the active use of

speech by children in the process of creative activity, which helps to develop vocabulary, improve grammar, phonemic hearing and sound pronunciation.

Art therapy, as a form of interactive learning, makes the process of speech therapy more interesting and exciting, which helps to maintain the child's attention and increases his or her interest.

Art therapy is an extremely effective tool in speech therapy. It allows not only to develop speech, but also to improve the emotional, social and cognitive development of the child. Through the use of creative methods, it is easier and faster for children to overcome language barriers, develop communication and interaction skills with others.

The effectiveness of the use of art therapy in the conditions of inclusive education depends on taking into account the needs and capabilities of children, as well as the professional work of specialists. Its goal is the creation of favorable conditions for the development of each child, a harmonious combination of his personal and creative qualities, and the formation of important life skills.

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## **INFORMATION AS A MEANS OF INFLUENCE ON THE CONSCIOUSNESS OF MODERN MAN**

In the information society, people's dependence on information is becoming increasingly greater. Modern man lives not so much surrounded by natural objects as in an environment that is artificially created by him. A situation has developed in the world when information flows exceed the capabilities of humanity to use them effectively. A person is literally drowning in a stream of information that is constantly changing and updating. Behind the streams of information, people do not have time to develop a personal attitude to the problem raised – they unconsciously adopt the view dictated by those who create the message. We see everything around us through the eyes of the one or those who inform us about it.

The discrepancy between the growth rate of information and the ability of a person to perceive and assimilate it leads to the fact that humanity is faced with a mass of cognitive and psychological problems. There are significant changes in human consciousness and ways of thinking, modifications of the very principle of human perception of the world. Thus, modern information technologies form a new type of person.

The informatization of society and the dynamics of information flows change human mental activity. Deep understanding is replaced by superficial situational grasping – there is simply no time, no desire, no skills and competencies to delve deeper. The influence of the Internet affects the process of interpreting information. The illusory possibility of receiving a ready-made answer to any question reduces interest and the ability to engage in independent thinking. The network search system replaces thinking itself. This type of cognition is best suited to clip consciousness, which allows you to quickly switch from one message to another, quickly respond to this or that information, and operate with large volumes of information, but without much immersion in its content and meaning. Clip thinking is a type of thinking in which a person perceives information fragmentarily, in short pieces and bright images. Clip thinking is characterized by fragmentation and heterogeneity of perceived information, high speed of switching between fragments of information,

illogicality, lack of understanding of contextuality and connections between semantically related phenomena, as well as the lack of a holistic perception of the surrounding world. Clip consciousness, on the one hand, is the most adequate to the modern situation, and on the other hand, it is fertile material for targeted information influences, manipulative information technologies, etc. [2].

Y.N. Harari calls the view that links the concept of information with the concept of truth “naive” and assumes that the main role of information is to represent reality. According to his version, most of the information in human society does not represent anything. Information creates new realities by connecting different things together [1]. Information has value and performs certain functions in society not so much because of its reliability, a true reflection of reality, but because of the possibility of its use for one purpose or another.

Information not only reflects and constructs reality but is also used as a means of influencing consciousness, as a means of control. The development of communication technologies and their spread have led to the fact that information has become as effective an instrument of power and control as physical force, tradition, and law.

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D. Pysmak, D. Arkhireiskiyi, O. Hurko

#### ANGLO-GERMAN COLONIAL RIVALRY AS A MIRROR OF THE EUROPEAN CRISIS (1890–1914)

In the modern world, international relations occupy one of the most critical places in global discussions. It is no secret that questions of power, influence, and competition between nations are among the most debated topics. Many people believe that conflicts between states arise from simple misunderstandings or

inevitable rivalries. However, not everyone realizes that these conflicts often stem from deeper systemic issues, such as political, economic, cultural, religious or even historical contradictions that have been accumulating for a long time.

Among academic examples of such international rivalry is the Anglo-German confrontation of the late 19th and early 20th centuries. In this case, the main reasons for their rivalry were the colonial ambitions of a new power in colonial powers list – Germany, political rivalry within Europe, and competition for world markets. This eventual confrontation not only determined their bilateral relations, but also largely led to the First World War.

The term “colonial rivalry” refers to the intense competition between European powers for overseas territories and resources during the Age of Exploration and beyond. This rivalry caused mainly by economic needs, as it provided markets and access to cheap resources to increase their influence around the world.

It should be noted that colonial competition was defining features of Anglo-German relations during this period. Since by that time Britain still adhered to the concept of “Brilliant Isolation” and did not interfere much in European affairs. It is known that by the end of the 19th century, Britain had established itself as the world's largest colonial empire, controlling territories in Africa, Asia and the Americas. After all, it was called “The Empire over which the sun never sets” for a reason [1, p. 217]. Germany, in turn, entered the colonial race much later, but with its resources and ambitious ambitions, sought to challenge the dominance of established colonial powers, including Great Britain, expanding its influence in Africa and the Pacific.

During this period the interests of two countries began to clash directly:

1. The Scramble for Africa: At this time, Germany successfully gained control of what was known as German East Africa (modern Tanzania) and German South West Africa (modern Namibia), which caused serious tensions with Great Britain, as at that time it considered these territories as part of its sphere influential. Then, at the Berlin Conference (1884–1885) German attempts to divide these spheres were unsuccessful.

2. The Moroccan crises (1905–1906 and 1911): During these events, Germany began to seriously challenge French domination of Morocco, demanding a redistribution of spheres influential, which in turn was already beginning to



threaten the interests of Great Britain, which had formed an alliance with France in the Entente Cordiale (1904).

These events vividly emphasized Germany's desire to assert itself as a new world power capable of competing with others, while at the same time demonstrating its isolation in European diplomacy.

Competition for these resources fueled mistrust and intensified their geopolitical rivalry.

The economic factor of the Anglo-German rivalry was no less significant, because by the early 20th century Germany had become a leading industrial power that challenged Britain's dominance in world trade. This was due to Germany's rapid industrialization, which allowed it to produce goods for hire more efficiently and cheaply. It allowed to compete successfully with British exports in the world markets. British industry has come under increasing pressure from German producers in sectors such as steel and chemicals. Nor should it be forgotten that Germany's adoption of a protectionist policy under Chancellor Bismarck created additional barriers for British goods, further complicating relations between the two nations [2, p. 459].

In general, the Anglo-German rivalry was not an isolated phenomenon, but a symptom of deeper structural problems within Europe [3, p. 326]. After the tenths, overlapping claims on spheres of influence appeared in all European powers, and the only solution they saw at that time was a military one.

Anglo-German relations in the late 19th and early 20th centuries demonstrate how colonial ambitions and economic competition can exacerbate international tensions [4, p. 64]. Their rivalry not only reflected wider European instability, but also contributed directly to the conditions that led to World War I.

By examining these historical examples, we gain valuable insights into how unchecked imperial ambitions can destabilize global systems – a lesson that remains relevant in today's world.

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## **THE CREATION OF A SUPPORTIVE ENVIRONMENT FOR INCLUSIVE EDUCATION OF CHILDREN WITH SPECIAL EDUCATIONAL NEEDS IN GENERAL SECONDARY EDUCATION INSTITUTIONS**

### **Introduction**

Inclusion in education is one of the key priorities for the modern educational system in Ukraine. According to the Ministry of Education and Science of Ukraine, an inclusive and barrier-free educational environment should be developed to ensure equal learning opportunities for all children, including those with special educational needs (SEN). The successful implementation of inclusive education requires an integrated approach that considers pedagogical, psychological, and social factors.

### **Research Aim and Objectives.**

The aim of this research is to identify the organizational and pedagogical conditions necessary for the effective implementation of inclusive education in general secondary education institutions. The research is based on theoretical and empirical methods, including pedagogical observation, surveys, and experimental analysis. The specific objectives of the study are:

- To analyze the theoretical foundations and legal frameworks of inclusive education in Ukraine.
- To explore international best practices in the implementation of inclusive education.
- To determine the key factors that contribute to a supportive and effective inclusive learning environment.
- To develop methodological recommendations for improving inclusive education policies and practices.

### **Theoretical Framework and Legal Aspects.**

The study outlines the theoretical foundations of inclusive education, focusing on the importance of equal access to quality education for all students. It also examines the legal framework regulating inclusive education in Ukraine, including policies and laws that govern special education provisions. The research highlights

the importance of compliance with international standards, such as the UN Convention on the Rights of Persons with Disabilities.

### **Key Organizational and Pedagogical Mechanisms.**

The research identifies key organizational and pedagogical mechanisms for creating a supportive educational environment. These mechanisms include:

- **Psychological and pedagogical adaptation:** Ensuring a flexible curriculum that meets the diverse needs of students with SEN.
- **Professional training of teachers:** Enhancing the competencies of educators to effectively teach in an inclusive setting.
- **Collaboration between stakeholders:** Encouraging cooperation between teachers, parents, specialists, and school administrators to create a holistic support system.
- **Technological integration:** Using assistive technologies to enhance the learning experience of students with SEN.
- **Classroom modifications:** Adjusting the physical and social environment to facilitate accessibility and participation.

### **Planned Experimental Study.**

A case study will be conducted to evaluate the effectiveness of the proposed conditions. The study will involve observations, interviews, and performance assessments of students with SEN in inclusive classrooms. The expected outcomes of the research include:

- Increased student engagement and participation in learning activities.
- Positive changes in peer interactions and acceptance of diversity.
- Enhanced confidence and independence among students with SEN.
- Improved teacher preparedness and adaptation to inclusive teaching methods.

The study will collect data over a set period, analyzing the impact of inclusive education strategies and adjustments made to improve their effectiveness.

### **Conclusion and Recommendations.**

The findings of this research are expected to contribute to the improvement of inclusive education policies and practices in Ukraine. The study emphasizes the necessity of developing structured teacher training programs, strengthening

collaboration between stakeholders, and implementing technological solutions to support inclusive learning. The developed methodological recommendations can be used by teachers, school administrators, and policymakers to create more inclusive and supportive learning environments. Future research should focus on long-term evaluations of inclusive education strategies and their impact on student development.

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A. Shpachinska, Y. Ryabchenko, O. Osadcha

#### THE ROLE AND THE PLACE OF ECtHR JUDGEMENTS IN UKRAINIAN JUDICIAL SYSTEM

The European Court of Human Rights (ECtHR) plays a significant role in ensuring human rights in Ukraine. Its decisions not only affect individual cases but also change national legislation and judicial practice. After 2022, Ukraine's legal interaction with the ECtHR has become increasingly popular in connection with military events and numerous human rights violations. The judgments of the ECtHR are binding on Ukraine in accordance with Article 46 of the European Convention on Human Rights [1].

The European Court of Human Rights considers its practice to be precedent-setting. This means that its decisions impact future proceedings of similar cases. A judicial precedent, in a broad sense, is a ruling in a specific case, which is either binding on the courts of the same or lower instance or serves as a guide for the interpretation of the law.

The Court itself generally adheres to the already established approaches, if it sees no grounds for changing them. Often, in the motivating part of decisions, it doesn't repeat the previous arguments, but simply refers to the already formed practice. Any precedent is made up of two main parts: *ratio decidendi* and *obiter dictum*.

*Ratio decidendi* is a key part of a court decision, which contains legal norms and principles on which the decision is based. This part is mandatory for applications in future similar cases. Instead, *obiter dictum* covers the court's observations that don't directly affect the final ruling. These are comments or reflections on issues that aren't decisive for the resolution of the case. They don't establish legal norms and aren't obligatory for future judgments, unlike *ratio decidendi*.

Therefore, it can be concluded that a court decision recognized as a precedent due to the authority of the court that made it is not a source of law in the broader sense.

Today, the European Court of Human Rights (ECtHR) is an accessible mechanism for protecting the rights of Ukrainian citizens. After the entry into force for Ukraine on September 11, 1997, the Court received a significant number of complaints from Ukrainians. The ECtHR is currently considering 8 thousand applications against Ukraine [2]. In terms of the number of complaints, the country is among the top five.

One illustrative case of a Ukrainian in the ECtHR, which demonstrates the importance of the Court's decisions as precedent-setting legal sources, is the case of *Nechyporuk and Yonkalo v. Ukraine* [3]. The ECtHR recognized a violation of the rights of Ukrainian Volodymyr Nechyporuk, who was unlawfully detained, tortured, and convicted on the basis of extracted confessions. The Court found a violation of Art. 3 (prohibition of torture), Art. 5 (right to liberty), and Art. 6 (right to a fair trial) of the ECtHR. This decision was an important "persuasive precedent," as the ECtHR clearly defined standards for the prohibition of torture and due process. It influenced Ukrainian judicial practice, forcing it to take into account the *ratio decidendi* regarding the evaluation of evidence and the protection of human rights.

Summing up, it is important to highlight the significance of ECtHR rulings, as they serve as an effective mechanism for safeguarding the rights, freedoms, and legitimate interests of individuals. Their value lies in the fact that they impact law enforcement practices more quickly than other criminal procedural measures, fostering improvements in criminal procedural regulation. As a result, they contribute to

the enhancement of the legal framework and promote the protection of human rights at both the national and international levels.

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O. Stebliuk, A. Liasota, N. Styrnik

### THE CHALLENGE OF NATIONAL IDENTITY IN POLITICAL TRANSITIONS

The study of political transitions and the preservation of national identity during the process of state modernization is highly relevant. Classical study of political transitions, which assumes a gradual transition to liberal democracy and even “Westernization”, has faced significant challenges.

Many countries remain in a state of so-called ‘hybrid regimes’ after their transition periods (for example, Hungary, Turkey). Others seek alternative modernization models that do not entail full Western liberalization (for example, China, some Persian Gulf countries). Meanwhile, the successful transition of Central and Eastern European countries (for example, Lithuania, Poland, the Czech Republic) has demonstrated that market reforms can be combined with a clearly defined national cultural policy. However, the example of Hungary illustrates how a strong national discourse can also serve as a tool for reinforcing authoritarianism.

Thus, modernization can both strengthen national identity and take on different configurations. The fact that many states today do not follow the classical political transitions model but instead explore alternative modernization paths that emphasize national identity rather than Westernization underscores the relevance of this topic. Furthermore, Ukraine, currently undergoing economic transition while

facing wartime challenges, also grapples with the critical issue of national identity and its preservation.

The concept of classical study of political transitions was developed by researchers Guillermo O'Donnell and Philippe Schmitter, who analyzed transitions from authoritarianism to democracy in Latin America and Southern Europe. Their model outlines three main stages: liberalization, democratization, and "Westernization".

The first stage, liberalization, occurs within an authoritarian regime. Political elites begin to ease repressive measures, allowing for greater opposition activity, freedom of speech, and civil society participation. This phase is often accompanied by economic reforms, such as reducing state control over markets and permitting private enterprise. While authoritarian regimes become less rigid, they do not necessarily allow for full democratization. For instance, in the 1980s, Chile and Spain relaxed political repression, permitted partial freedom of the press, and allowed political parties to operate.

The second stage, democratization, is the most critical, as it involves dismantling the authoritarian system and establishing democratic institutions. This stage is typically marked by the adoption of a revised constitution that guarantees democratic rights and freedoms, the implementation of free elections, and the establishment of political pluralism, independent courts, and the separation of powers. A historical example is Portugal, which transitioned to parliamentary democracy following the 1974 Carnation Revolution.

The third and final stage, Westernization, occurs when democracy becomes institutionally stable and fully integrates into the Western system of values. This phase involves joining international organizations such as the WTO and security and economic alliances, while also adopting liberal market mechanisms such as free trade and privatization. Cultural transformation also plays a significant role, as Western norms and values influence the media, legal system, education, and culture. Lithuania, Poland, and the Czech Republic exemplify this process, as they joined the EU and NATO after democratization and adopted Western legal and economic frameworks.

However, political transition is not without its challenges. One major limitation of the classical model is its assumption of linear progression, as not all

countries follow the three stages sequentially. Some states, such as Russia, Turkey, and Hungary, experienced periods of liberalization only to later revert to authoritarianism. Furthermore, Westernization is not always automatic, as some states maintain national traditions and restrict Western influence. Consequently, certain countries remain in a “hybrid” state, never fully achieving democracy.

An alternative perspective is offered by Samuel Huntington, who argues that civilizational factors play a crucial role, and not all societies are suited to the Western democratic model. He emphasizes that democratization is not a universal process but is influenced by historical traditions, religion, and cultural context.

However, Huntington’s view has been criticized for underestimating the roles of economic development and political elites in modernization. Scholars such as Juan Linz and Alfred Stepan argue that democratization is not an automatic process and that its success depends on a society’s unique characteristics and the nature of its authoritarian past. They highlight the importance of national identity in ensuring the stability of a political system.

Similarly, Shmuel Eisenstadt challenges the notion that modernization inevitably leads to Westernization. He argues that modernization follows different cultural trajectories and does not necessarily result in liberal democracy. Various civilizations adapt modernization processes to their historical and cultural contexts. For example, Japan and China modernized without directly replicating Western political models. Successful modernization, therefore, requires a synthesis of traditional values with economic, political, and technological advancements. This explains why countries such as China, South Korea, Turkey, and the Gulf states have retained their traditions while simultaneously developing modern economies.

Despite globalization’s role in increasing interconnectivity, it does not necessarily lead to cultural homogenization. On the contrary, many societies experience a strengthening of national identity in response to globalization.

In conclusion, there is no single model of political transition. The classical model by O’Donnell and Schmitter assumes a universal path of modernization. Huntington’s model highlights the limitations imposed by civilizational factors. Linz



and Stepan's model argues that democratization varies depending on the previous regime and the creation of stable democratic institutions. Finally, Eisenstadt's approach demonstrates that modernization can take multiple forms without necessarily leading to Westernization.

Therefore, each state – including Ukraine – must find its own unique path to modernization, one that preserves national identity rather than simply replicating foreign models.

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D. Svystun, O. Osadcha

## THE ROLE OF GAME TECHNOLOGIES IN THE CORRECTIONAL WORK OF A SPEECH THERAPIST

Speech is an important means of communication that affects a child's socialization, cognitive development, and emotional state. In today's world, more and more children have speech disorders, which makes it difficult for them to learn and interact with others. Speech correction requires special methods that ensure effective teaching and correction of speech defects. One of the most effective methods is the use of game technologies in speech therapy. Play is a natural form of activity for a child, so it is through game tasks that it is easier to form correct pronunciation, develop phonemic awareness, expand vocabulary and improve communication skills. Educational game technologies in speech therapy work with children are focused on building new models of interaction

between an adult and a child. Close attention to the development of play activities is due to its status in preschool childhood, its leading role in the cognitive, social, physical and cultural development of preschoolers [2].

Interactive whiteboards allow speech therapists to create dynamic lessons using videos, animations and interactive tasks. This helps to keep children's attention and actively engage them in the learning process. Multimedia presentations can be used to explain new material or to repeat what has been learned [1].

The use of game technologies in speech therapy practice has several important functions. Firstly, the game is a powerful motivational factor that helps a child overcome fear of speech and reduces anxiety during speech therapy sessions. Secondly, the game promotes the development of the speech apparatus, improves articulatory motor skills, coordination of speech movements and proper breathing. Thirdly, it allows you to consolidate the correct speech skills in the process of interactive interaction, which is especially important for children with speech disorders.

A separate category is made up of moving speech therapy games that combine speech with movement. This contributes to faster memorization and proper acquisition of speech skills. For example, the game “Jumping on Syllables” helps the child to break words into syllables, jumping on each syllable, which improves awareness of the phonetic structure of the word.

The practical application of gaming technologies can take place in different formats: individual lessons, group trainings, or in the form of homework. Individual sessions allow the speech therapist to pay maximum attention to the speech difficulties of a particular child, while group sessions promote socialization and development of communication skills.

So, gaming technologies are an integral part of speech therapy and significantly increase its effectiveness. They make the learning process interesting, natural and motivating for the child. The combination of traditional games, motor exercises and modern technologies creates optimal conditions for speech development, correction of speech disorders and successful socialization of children. The use of game methods in speech therapy not only improves pronunciation, but also contributes to the overall development of thinking, attention and communication skills, which are important factors for further learning and adaptation of the child in society.

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M. Sydorov

## TECHNOLOGIES OF POLITICAL COMMUNICATION

Modern political communication has undergone radical transformations due to the technological revolution, primarily shifting into the virtual space across various digital platforms and being conducted through information technologies. Consequently, political communication has become a crucial factor shaping the state's information environment, constructing social narratives, and influencing societal stability level. The deployment of advanced political communication technologies can either strengthen or undermine state resilience by promoting community consolidation around a shared identity or, conversely, intensifying social conflicts. Thus, analysing political communication from a technological perspective is a highly relevant task, driven by its growing influence on political processes and societal security.

### **Concept of political communication**

Traditionally, political communication is defined as the process of creating, disseminating, receiving, and processing messages that significantly impact politics, either directly or indirectly. In other words, it is a communicative activity capable of altering cognitive models and behavioural citizens' responses and political actors through the exchange of politically significant messages. Technologies of political communication can be defined as a set of specialized methods, techniques, and procedures for transmitting information aimed at shaping public interpretations of events favorable to specific political forces.

Such technologies function as mechanisms for constructing and directing public opinion, facilitating the attainment, maintenance, or transformation of political actors' power positions. Therefore, the concept of political communication

encompasses both a substantive aspect (exchange of politically significant information) and an instrumental aspect (application of technologies influencing political processes).

### **Functions of political communication**

Political communication serves several significant socio-political functions, including:

- *Interpretation management.* Political communication aims not merely at transmitting information but at altering public perception according to the communicator's interpretative framework. By establishing cognitive paradigms and evaluative frameworks, it supports ideological unity and standardizes political perspectives among citizens. This mechanism allows political actors to dominate information channels and shape preferred interpretations of events.
- *Consciousness regulation.* Communication acts as a tool for shaping and correcting public consciousness, attracting new adherents to ideological positions and maintaining existing supporters' loyalty. Constant informational influence enables political leaders and institutions to manage mass sentiments, ensuring support for their decisions and policies.
- *Behavioural catalyst.* Knowledge and perceptions acquired by the audience through communication translate into motivational impulses for action. This function encourages citizens to undertake specific political actions aligning with communicators' strategic objectives, thus mobilizing masses-ranging from electoral participation to protests and support for social initiatives.
- *Ideological competition.* Political communication fulfills a competitive role, often structured to discredit alternative positions and diminish the attractiveness of opponents' ideas. Such communicative efforts reduce competitors' mobilization potential, extending beyond purely political contexts and creating tension in broader social interactions, highlighting the binary nature of political communication ("us vs. them" in the information space).
- *Protective (defensive) function.* Communication counters opponents' informational and psychological attacks through measures including refuting hostile disinformation and initiating communicative campaigns to neutralize negative impacts. This function encompasses information security, defense against informational attacks, and societal resilience against hostile propaganda.

- *Legitimization function.* Influencing social dynamics, political communication ensures public recognition and acceptance of political power. Through communicative mechanisms, authority is legitimized – justifying the governance rights of particular individuals or groups via persuasion, positive image creation, and appeals to commonly shared values and norms.

These functions serve as analytical frameworks to comprehend how communication technologies influence political processes. Managing interpretations, behavioral motivations, ideological competition, information space protection, and legitimization of power, political communication is integral to the functioning of power relations in society. Practically, these functions interconnect—for instance, legitimization may involve managing interpretations and emotional appeals, while protecting the information space entails countering disinformation and fostering public trust.

### **Legitimization of power as a communication function**

Legitimacy of power refers to the extent to which citizens accept governing institutions and leaders as lawful, justified, and entitled to make binding decisions. Legitimization of power largely occurs through communicative processes: authorities must explain and justify their actions so that society perceives them as fair and appropriate. Consequently, political communication is the primary tool through which governing bodies acquire public trust and support, essential for establishing their legitimacy.

Justification of the right to rule. Every government or leader requires a specific legitimacy narrative – a story or explanation justifying why they should lead the state. In democratic states, this narrative is often derived from the popular will expressed through elections: elected officials communicate that they have received a mandate of trust from voters and are thus obligated to fulfill it. However, even after elections, authorities must continually reaffirm their legitimacy through public reports on accomplished tasks, explanations of adopted decisions, and participation in public debates. Indeed, every official communication, from parliamentary debates to televised addresses, is aimed at reinforcing public confidence that the authorities are acting in citizens' interests based on legitimate authority. As researcher P. Aagaard notes, achieving legitimacy in the public sphere is the central aim of any political organization's communicative efforts. In other words, governmental institutions and

politicians constantly communicate with citizens precisely to recreate and strengthen public faith in the legitimacy of their governance.

### **Digital platforms and modern political communication technologies**

The advent of digital communication platforms drastically transformed the political communication landscape. Social media and Web 2.0 technologies converted audiences from passive information recipients into active communication participants – "prosumers," simultaneously content creators and consumers. Platforms such as Wikipedia, YouTube, Facebook, and X (Twitter) reshaped the internet towards interactivity, user-generated content, and horizontal connections. Consequently, audiences became interpersonal communities, with users serving as political message sources and transmitters. This transformation implies political communication increasingly requires considering interpersonal communication and network dynamics, as messages spread virally, and traditional media lose their agenda-setting monopoly.

However, social networks also present challenges, including echo chambers – environments reinforcing users' existing views. Algorithms delivering personalized content amplify confirmation biases, reducing exposure to alternative perspectives. Studies show disinformation thrives within echo chambers, fragmenting society into isolated interest-based groups. Scholars like Díaz Ruiz and Nilsson have described a two-phase disinformation model: initially, echo chambers establish a niche audience accepting false narratives, which subsequently spread widely, masquerading as legitimate public opinion.

Additionally, political bots – automated social media accounts mimicking human behavior – have become significant tools, generating vast political content volumes, simulating mass support or dissent. Scholars B. Bulat and M. Hilbert note bots follow algorithmic patterns, boosting narratives, polarizing public opinion, and undermining discourse integrity, masking orchestrated campaigns as genuine public voices.

Digital-age disinformation campaigns pose separate threats due to their speed and extensive reach. Unlike traditional media, social networks enable numerous actors, including states and non-state entities, to disseminate coordinated falsehoods rapidly, destabilizing trust in democratic processes.

Despite risks, digital communication technologies have positive potential, enabling direct government-citizen communication, mobilization during crises, and

timely disinformation rebuttal. Ethical, transparent technology use strengthens societal trust – crucial for democratic stability. Hence, balancing digital communication's opportunities and risks represents a contemporary challenge for democracy and security.

### **Conclusion**

Political communication fundamentally influences political processes by shaping messages guiding public opinion and behaviour. Communication technologies significantly impact power relations, serving authority acquisition, retention, and state informational security mechanisms. Responsible usage ensures democratic stability, while manipulative exploitation risks societal destabilization. Thus, advancing theoretical insights and strategic application constitutes a core contemporary political science and practice objective, essential for fostering open, stable democratic societies.

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V. Takhterin, O. Hurko

## **THE TRANSFORMATION OF SPORTS REPORTING IN THE DIGITAL AGE**

Sports reportage has traditionally been regarded as a genre that combines rapid response to events, emotional intensity and documentary accuracy. Both the genre itself and its theoretical comprehension have undergone significant transformations. Currently, there exists a broad spectrum of approaches to understanding sports reporting, including classical, literary, interpretative, constructivist, hermeneutic etc.

The evolution of the reportage genre began in the 19th century with newspaper reports about sport competitions. Initially, these reports were brief, precise and straightforward, aimed at informing readers of the results. In form, the earliest reports closely resembled modern summaries [4]. However, with the advent of new technologies such as radio and television, reports began incorporating audio and visual elements, enhancing emotional richness and providing a more immersive depiction of sporting events. The genre became multi-format, ranging from textual news to video analysis, integrating live broadcasts, statistic data, and expert commentaries.

Particularly, radio journalists were able to not only report results but also convey the emotional atmosphere of events through intonation and pauses. Television sports reports covering the Olympic Games, FIFA World Cups, hockey championships, and other major international competitions evolved from mere reports on winners to full-fledged media events including interviews, analyses, and fan reactions, providing a comprehensive contextual understanding of each event.

With the advancement of digital technologies, sports reporting has become more analytical, flexible, and interactive [3]. The immediacy of updates, live streaming, real-time detailed statistics, and personalized news via mobile platforms have fundamentally altered the nature of reporting, reshaping audience engagement strategies.

Thus, the internet has propelled sports reporting to a new level, where journalists started using digital platforms to create interactive content. Sports websites and mobile applications not only provide results but also deliver personalized information through notifications, interactive statistical tables, polls, and other features. Platforms such as *ESPN*, *Bleacher Report*, *Tribuna*, with their intuitive interfaces, enable viewers to interact with content in real time, choosing specific aspects of an event they wish to explore further, whether it be in-depth match statistics or moments that might not be included in live broadcasts.

Social media platforms such as *Instagram*, *X*, and *TikTok* have become an integral component of modern sports reporting, facilitating new forms of instant audience interaction. This has led to the concept of real-time reporting [6], which constantly ensures information accessibility and interactivity for users. Sports reports are now



available at any time and place, providing instantaneous updates for fans and fundamentally altering the perception of sporting events. A significant aspect of this transformation is the adoption of platform-based journalism, where journalists involve audiences in content creation, thereby enhancing emotional engagement and news personalization. For instance, during NBA matches or European football championships, social media users can not only receive textual updates but also watch video reactions, discuss game moments, and share their thoughts and impressions through comments or reposts. This approach expands event coverage and enhances audience interaction, making sports reporting more inclusive and dynamic.

The transformation of sports reporting has also been caused by cutting-edge technologies integration, particularly AI, augmented reality, and virtual reality. These technologies expand broadcasting capabilities and facilitate the creation of new forms of interactive content that provide a deeper immersion into sporting events. During broadcasts of major sports events such as the FIFA World Cup or the Olympic Games, networks like *Eurosport* and *Sky Sports* employ 3D graphics and augmented reality to illustrate complex tactical schemes or analyze athletes' movements. In Ukraine, *UPL TV* utilizes such practices for broadcasting Ukrainian Premier League football matches. This allows viewers to observe event developments, analyze game episodes themselves, and select aspects of the event that are most relevant to them.

New formats of analytical reports utilizing interactive panels, virtual tours based on augmented reality, and personalized data (e.g., individual player statistics) enable audiences to analyze matches in greater detail. This approach fosters a novel aesthetic of sports reporting and contributes to the formation of new media practices. It enhances the understanding of team strategies and tactics, allowing viewers to influence the selection of materials covered during broadcasts. For instance, the ability to choose different camera angles or specialized replays (such as slow-motion) allows each viewer to create a unique content consumption experience, thereby enriching the very concept of sports reporting as a genre.

In summarize, the evolution of sports reporting from a traditional textual genre to a multi-format content medium incorporating advanced technologies highlights significant transformations in media practices within this genre. The use

of digital platforms, social networks, and interactive technologies enables the creation of new forms of sports reporting that not only inform but also actively engage viewers in the content consumption process. This shift transitions the focus from passive perception to active interaction, where the viewer is no longer merely an observer but a participant in the event. Consequently, sports reporting, which integrates real-time responsiveness, emotional intensity, and personalized experiences, has become a crucial tool in the modern media industry.

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N. Tsurikova, L. Nikolenko, O. Aliseienko

## TECHNOLOGY OF SOLVING INVENTIVE TASKS AS METHOD OF KNOWLEDGE FORMATION WITH INTELLECTUAL DISABILITIES CHILDREN

Today, human health is considered as one of the priorities and the most important indicator of social well-being of society. Health is the greatest value, which, undoubtedly, should take the first place among human needs. In our state, great attention is paid to the development and upbringing of a caring attitude towards health and the desire to have a healthy lifestyle among children and youth.

The primary task of the state's social policy is to ensure normal living conditions and fulfill adaptation of children with disabilities in society, which is

provided by the governmental program "Children of Ukraine", "National Doctrine of the Development of Education in Ukraine in the 21st Century".

The themes of using "health-saving technologies" were addressed by such scholars as E. Bakh, V., Lozinsky, V.P. Besspalko, B.S. Bluma, M.V. Klaryna, M.A. Choshanova in their scientific works. In these studies, they determined the unity of systems in pedagogy, psychology, and medicine, which are aimed at preserving and strengthening the health of preschoolers and students with intellectual disabilities.

From the current perspective, the use of health-preserving technologies in primary school contributes to improving the quality of the educational process and the formation of a stable motivation for a healthy lifestyle of children with intellectual disabilities.

The goal of all health-preserving educational technologies is to form the necessary knowledge, skills, and abilities with students for a healthy lifestyle, to teach them to use the knowledge gained in everyday life.

In general, the technologies of correctional and developmental education of students with intellectual disabilities are based on taking into account individual working capacity in accordance with the opportunities (availability of material); diversifying teaching methods and techniques (dosing, visualization, means of maintaining attention); creating conditions that will stimulate students to study and prevent fatigue (stimulating agents, didactic games and exercises). In this regard, the introduction and organization of health-preserving technologies in the educational activities of preschoolers and younger schoolchildren with mental disorders is of particular relevance.

According to the concept of the formation of positive motivation for a healthy lifestyle among children and youth, the main tasks of the teacher are:

- to introduce into the educational process a personally oriented model of healthy lifestyle skills formation among the students, the ability to make optimal decisions regarding the preservation and strengthening of their own health in various situations, including the extreme ones;
- to improve the forms and methods of a healthy lifestyle formation;
- to form a negative attitude towards harmful behavioral habits with children.

In his article, the teacher Hrytsyuk N. [3, p. 58] among the main technologies of educational activities of students with intellectual disabilities indicates the modification of the content of education to special educational needs of the child, which is in reducing the volume and simplifying the nature of the educational material; positive assessment of even the smallest successes of the child, and also highlights that in the process of teaching children with intellectual disabilities it is necessary to use special equipment (special textbooks, planar models, three-dimensional dummies, educational games, etc.).

Taking into account the above-mentioned tasks, we believe that in order to form a focus on a healthy lifestyle among the primary school children with intellectual disabilities, it is possible to effectively apply the TRVZ technology (technology for solving inventive tasks), which is called the school of creative personality. Scientists have identified its motto – "creativity in everything": in posing a question, in methods for solutions, in presenting the material. They note that the TRVZ methodology does not have methods in the usual sense of the word, it is a tool with the help of which teachers and parents themselves "invent" their own pedagogy, which will be interesting to children.

Thus, the problem of preserving children's health and the search for effective means of knowledge formation about their health prompted the creation of didactic games of a health-saving direction using the TRVZ technology. This system of developmental didactic games and classes is not intent to changing the main program, but to maximally facilitate the assimilation of the material, improve the effectiveness of educational activities. TRVZ gives positive results in terms of developing children's imagination, fantasy, and creativity. Games developed using TRVZ technology are an important means of cognitive development, speech development, and cognitive activity of children with intellectual disabilities, which contributes to their knowledge enrichment about the world.

We introduced this technology in the development of games to form a healthy lifestyle with younger schoolchildren with intellectual disabilities.

Game technology. TRVZ games are built on Lullian circles. This is a device that consists of circles strung on a common core. The circles are arranged in the form of a tower with an arrow at the top. Everything should move freely. Each circle is

divided into sectors. The smaller the circle is, the fewer sectors are. Pictures of household items, animals, birds, fairy-tale characters, numbers, etc. are placed in each sector. A trio or pair of pictures is formed, which must be logically and consistently connected, providing an answer to the question. According to the rules of the game, the child is given the opportunity to formulate an answer.

Regarding the formation of a focus on a healthy lifestyle, we have identified the following topics:

- 1) the connection between nutrition and health;
- 2) the high level of morbidity associated with malnutrition;
- 3) the importance of a balanced diet;
- 4) the advantage of products rich in nutrients;
- 5) the need for proper nutrition for health and successful learning;

The following cards (images) were selected:

- generalized names of products (dairy, meat, fish, confectionery, bakery, cereals, vegetables, fruits, berries, drinks);

- product cards: milk, kefir, sour cream, meat, sausage, sausages, bread, bun, pie, candy, cake, cookies, fish, canned fish, juice, vermicelli, buckwheat, rice, flour, salt, apples, apricots, plums, cherries, cherries, apples, potatoes, onions, carrots;

- dish cards: porridge, soup, borscht, dumplings, stewed potatoes, sour cabbage. compote, tea;

- cards of harmful products: chips, hamburgers, fried crackers, chewing gum, cakes, Fanta, Coca-Cola;

- cards – time of day (morning, day, evening, night); child at breakfast, lunch, dinner;

- cards of fairy-tale characters: Marijka, Ivasik;

- cardboard baskets (flat – 3);

- cards – trees: apple tree, pear, bush, plant; garden, vegetable garden, bushes in the garden;

- cards: refrigerator, kitchen cupboard, breadbasket, candy box, boxes, bags for cereals;

- chip cards: unhealthy food – red chips, healthy food – green chips.

*List of tasks that were solved using Lull's Circles:*

1. To form a focus on a healthy lifestyle with children.
2. To teach the concepts of "healthy nutrition", "healthy, harmful foods".  
To understand that diseases can be associated with nutrition.
3. To enrich and replenish children's knowledge about food products, their diversity in the diet.
4. To outline a conscious approach to the diet (analyze, generalize, draw conclusions).
5. To form the ability to distinguish between products that can be consumed constantly and those that cannot be consumed in large quantities.
6. To teach to choose healthy products, dishes in their diet.
7. To enrich child's active and passive vocabulary of product names.
8. To teach to name dishes of national Ukrainian cuisine, their ingredients and ways of cooking.
9. To develop cognitive activity, speech, thinking, attention, memory of children.
10. To teach children to make up the names of fantastic products and dishes.
11. To develop the ability to establish the cause-and-effect relationships between health and balanced nutrition.
12. To consolidate children's ability to distinguish fruits, vegetables, berries and summarize them in one word.
13. To practice the ability to name parts of the day, count images, and navigate in space.
14. To teach to explain their choice in solving a problem, to justify their opinion in choosing a product or dish.
15. To educate children in a caring attitude towards their health.

Thanks to the playful focus and unusual nature of the device in the form of Lullian Circles, children learned to be aware of the impact of high-quality and balanced nutrition on health.

Children understood such concepts as healthy and harmful products. Children acquired knowledge about the names of products, dishes as well as learnt to summarize them in one word. Children got acquainted with the names of national Ukrainian dishes and their ingredients and ways of cooking. They mastered such

skills as choosing dishes and eating food correctly during the day. Children developed a desire to be healthy and strong; cultural and hygienic skills were instilled and a focus on a healthy lifestyle was brought up.

Thus, the effectiveness of the use of the TRVZ technology in forming a focus on a healthy lifestyle in younger schoolchildren with intellectual disabilities was practically proven.

The materials of studies by Ukrainian scientists on the formation of a focus on a healthy lifestyle in younger schoolchildren with intellectual disabilities were under consideration. The goal of all health-saving educational technologies was determined, i.e. to form the necessary knowledge, skills and abilities for a healthy lifestyle with students, to teach them how to use the knowledge gained in everyday life.

The possibility of using the TRVZ technology in the formation of younger schoolchildren with intellectual disabilities adaptation to a healthy lifestyle has been shown. With the help of this technology, it is possible to approach the formation of children's knowledge of the basics of health creatively as well as to form the skills, abilities and adaptation to a healthy lifestyle. According to the observations, in the process of the game activities children learnt not only how to serve themselves, but also how to take care of their own health.

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## **STALINIST REPRESSIONS IN POSTWAR SOVIET UKRAINE IN THE CONTEMPORARY SCIENTIFIC LITERATURE**

A separate chronological segment in the history of Stalinist repressions in Ukraine is the period from the end of hostilities on its territory (1944) to the death of J. Stalin (1953). The report attempts to analyze the special scientific literature on the topic, which reflects the course of repressive processes directly or indirectly related to the above-mentioned chronological framework.

The analyzed specialized scientific literature can be divided into the following groups:

1) Generalizing works. As an example, we can cite the in-depth studies by Y. Shapoval [34], V. Baran and V. Danylenko [1], I. Bilas [2], V. Nikolsky [25], I. Vynnychenko [5], and a number of others. It is noteworthy that they characterize Stalinist repressions of the postwar period only in passing, mainly in the context of broader geographical, chronological, and problematic boundaries.

2) Studies that have a more specific subject matter, but within a fairly broad chronological framework, for example, focusing on individual facts and manifestations [4], a region [17; 37], etc. Most often, the authors of studies in this group characterize repressions against certain social groups, such as “enemies of the people” [7], employees of punitive special services and military personnel [35], etc. Such publications are distinguished by their own specifics, but with regard to the chronological framework of these studies, it should be noted that the postwar period of repression occupies a prominent, but far from the main place in them.

3) The next group of studies consists of publications directly related to this period. First of all, it is worth noting that during the independence period S. Vasylenko already made an attempt to analyze the scientific literature on the course of repressions throughout Ukraine in the postwar period [3]. His research focuses on the “relationship” of the state in general and punitive and repressive bodies in particular with certain social and ethnic groups. Also noteworthy are studies the chronological boundaries of which cover the entire period, but within certain



regions of Ukraine (for example, articles by M. Shytyuk [36], V. Mishchanyn [24], and others). Most of the publications in this group deal with thematic aspects that are “trendy” in contemporary Ukrainian historiography when it comes to the postwar period. These include the following topics: collectivization of the village in the western regions (monograph by O. Maliarchuk [22], articles by M. Senkiv [29; 30], L. Misinkevych [23], O. Havryliuk [8], L. Drohomiretska [16], and others); the Holodomor of 1946–1947 (works by V. Kalinichenko [18], V. Kyrychenko [19]); persecution of UGCC figures (publications by N. Serdiuk [32], V. Pashchenko [28], etc.); deportation of the population of the western regions (studies by I. Pater [26; 27]), particularly – of the Poles (articles by S. Makarchuk [21], Y. Soroka [33], V. Serhiichuk [32], etc.). There were also works that examined the repressive state policy towards certain social (articles by N. Gerus-Bakhtina [9], V. Danylenko [10]) and ethnic groups (works by O. Kurabtsev [20], Y. Danyliuk [11]).

The issue of publishing purely historiographical research on the topic should be addressed separately. Here, the almost complete absence of them is striking. Of particular interest are the historiographical studies by Olha Dovbnia, which are, in fact, almost the only works of this nature [12–15]. The author emphasized the analysis of the peculiarities of coverage of certain pages of the repressive policy of the Soviet punitive bodies in the special scientific literature in a wide chronological framework. She also mentions the postwar period of repression in the context of the phenomenon under study. In view of this, it can be stated that no generalizing historiographical research works that would relate directly to this historical period have been published so far.

In conclusion, the analysis of special scientific literature that directly or indirectly relates to the history of Stalinist repressions on Ukrainian lands in the postwar period allows us to draw the following conclusions:

- first, if we divide the entire Ukrainian historiographical tradition on the topic into that which appeared “before” and, accordingly, “after” S. Vasylenko's dissertation. Vasylenko's dissertation, defended in 2011, which was the first attempt to summarize the preliminary results of the state of development of the topic at that time, there is a clear downward trend in the total number of publications on topics related to this problem within the defined chronological framework (most of the mentioned publications appeared before 2011);

- second, in most publications, this thematic aspect appears either as part of a study of larger historical phenomena and a broader chronological framework (most often either in general, the period of Stalin's rule or the time of the most massive repressive measures during the 1920s and early 1950s), or in publications mainly in the form of articles in professional journals, the subject of which was more specific facts (such as repressions against a particular ethnic or social group) during this period in certain Ukrainian lands;

- finally, apart from O. Dovbnya's work, no other attempts have been made to analyze the state of development of the topic at the historiographical level, not to mention publications that would generalize the historiographical tradition as a whole.

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O. Verbonol, O. Aliseienko

## FORMATION OF CULTURAL IDENTITY

Cultural identity is a deeply rooted yet continuously evolving construct that defines how individuals and groups perceive themselves in relation to their heritage, values, traditions, and social environment. It is not a static artifact passed from one generation to the next, but rather a dynamic process influenced by historical forces, social pressures, and personal choices. Among the many factors shaping cultural identity are the collective acts of preservation through resistance, the stabilizing power of cultural anchors, and the complex negotiations involved in migration and resettlement. This essay examines these forces while incorporating segmented assimilation theory to explore how identity formation varies across generational and social lines. Using the Chinese diaspora as a focal case, it illustrates how cultural identity is both resilient and adaptive in the face of global movement and sociocultural challenges [4].

Preservation through resistance has long been a method through which communities maintain cultural identity in the face of assimilation, marginalization, or erasure. Resistance may manifest as a refusal to adopt dominant cultural norms or as an active effort to sustain endangered languages, belief systems, or practices. For diasporic communities, especially those who have experienced colonization, discrimination, or forced migration, resistance becomes not only a strategy for cultural survival but a statement of dignity and self-determination.

Cultural anchors are the enduring elements of a culture that provide a sense of security and rootedness. These may include language, food, religion, dress, art, music, and communal narratives that reinforce a shared history and worldview. For individuals and groups navigating new environments or generational shifts, cultural anchors provide consistency and context. They act as markers of identity and collective memory, helping diasporic individuals stay connected to their cultural heritage [3, p. 69–70].

Within the Chinese diaspora, food has proven to be one of the strongest cultural anchors. Chinese cuisine, rich in regional diversity, has not only persisted but thrived globally. Restaurants, family meals, and food festivals are more than sources of nourishment – they are vehicles for cultural storytelling and identity reinforcement. Likewise, traditional Chinese medicine, martial arts, and ancestral worship rituals continue to act as cultural anchors, bridging generational and geographical divides. Even in urban centers far removed from China, these anchors provide Chinese communities with a sense of cultural wholeness.

Migration adds layers of complexity to the formation of cultural identity. Migrants and their descendants are often caught between the culture of origin and the culture of the host country, navigating competing expectations and loyalties. This negotiation process can lead to a range of identity outcomes – from assimilation to hybrid identities to cultural reaffirmation.

This complexity is well illustrated through the experience of Chinese immigrants and their children in Western countries. First-generation migrants often maintain strong ties to their homeland's culture, while second-generation individuals may feel the pull of both cultures – struggling to fit fully into either. This tension can lead to

identity crises, but it can also produce new cultural forms that blend both Chinese and local practices, creating a unique diasporic identity [2].

The segmented assimilation theory, proposed by sociologists Alejandro Portes and Min Zhou, provides a nuanced framework for understanding how immigrant identities form over time [6]. Unlike traditional assimilation models that suggest a linear path toward cultural absorption, segmented assimilation recognizes that outcomes vary based on multiple factors including socioeconomic status, community networks, and experiences with discrimination.

According to this theory, second-generation immigrants may follow one of three paths:

1. Upward assimilation into the dominant culture,
2. Downward assimilation into underprivileged or marginalized segments of society.
3. Selective acculturation, where they integrate economically and socially while retaining significant aspects of their ancestral culture.

In the case of the Chinese diaspora, many families have experienced selective acculturation. Chinese-American youth, for example, often achieve educational and professional success within mainstream society while maintaining fluency in Chinese, observing traditional holidays, and participating in community associations [5, p. 100]. Chinese-language schools, weekend cultural programs, and multigenerational households reinforce these cultural ties. On the other hand, in some contexts where Chinese communities are economically disadvantaged or face racial exclusion, assimilation trajectories may differ, reflecting the fragmented nature of identity development under segmented assimilation.

Cultural identity is not something people passively receive – it is something they actively shape, protect, and redefine over time. Whether through resisting pressure to assimilate, holding onto cultural anchors like language and tradition, or navigating the complexities of life in a new country, individuals and communities are constantly building and rebuilding who they are. The experience of the Chinese diaspora shows how cultural identity can survive across generations, not just through preservation but through adaptation [1, p. 100–101]. And when we look at these experiences through the lens of segmented assimilation theory, we see that there is

not just one path to identity – there are many, shaped by context, opportunity, and choice. In the end, understanding how identity forms helps us better appreciate the diversity around us – and reminds us that identity is as much about resilience as it is about roots.

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B. Zamoruiev, O. Hurko

## THE FUTURE OF EXISTENCIALISM: ETHICS AND RESPONSIBILITY IN THE MODERN AGE

Existentialism, as a philosophical doctrine, emphasizes the importance of individual existence, freedom, and choice. It suggests that human life is made possible, real, and authentic through conscious and deliberate actions. Unlike deterministic or essentialist views that define human beings by predetermined nature or external forces, existentialism argues that individuals have to create meaning and value through their choices, actions, and reflections.

Existentialism emerged primarily in Germany and France during the interwar period, shaped by the immense social upheavals following World War I. However, existentialism only gained widespread prominence after the World War II, when it

expanded beyond Germany and France to influence other European countries and beyond. Today, just like before the Second World War, we find ourselves once again thrown into a new chaotic period where absurdity reigns, leading to new chaos. These times surely also require rethinking and new philosophical foundations.

If existential philosophy is to be relevant in the 21st century, it must address not only the individual's sense of freedom and alienation but also the broader social, technological, and environmental crises shaping our era. The modern subject is no longer merely struggling with the absurd in an existential vacuum but is deeply enmeshed in global systems of power, digital surveillance, and artificial intelligence, all of which complicate traditional existentialist notions of freedom, responsibility, and authenticity.

The question arises: what does it mean to be an authentic self in an age where personal identity is increasingly mediated by algorithms, social networks, and data-driven profiling? The existentialist call for self-creation and responsibility, championed by Sartre and Camus, must now be reconsidered in light of a world where external structures predefine many aspects of individual agency. Does the postmodern fragmentation of truth and meaning render existentialist commitments to authenticity and freedom obsolete, or does it make them even more urgent?

A renewed existentialist philosophy therefore needs to be both deeply personal and radically collective, engaging with the dilemmas of the Anthropocene while preserving the individual's struggle for meaning. If the 20th century existentialists contended with the alienation caused by war and industrialization, the existentialist of the 21st century must confront the disorientation of a world shaped by globalization, climate change and increasing power of artificial intelligence.

Additionally, contemporary existentialism has to grapple with ecological concerns. The human-centered philosophies of the past, rooted in Renaissance humanism and later refined through Enlightenment rationality, largely ignored the interdependence of human existence with the environment. Today, however, we face an existential crisis not only in the philosophical sense but also in a literal, planetary sense. The existentialist idea of responsibility must extend beyond the scope of individual to be able to include the ecological framework, recognizing that freedom is not merely personal but collective, tied to the fate of the planet itself.



It signifies that developing a clear awareness and a better understanding of what it means to be a living being is necessary. But as existentialism adapts to the realities of the 21st century, it has to address the implications of these new technological realities, like an existence of AI. As AI systems become more sophisticated, existentialism must also consider the implications of human dependence on machines. If we rely on AI to shape many aspects of our lives, from personal decisions to larger societal choices, what does that mean for our sense of self and our personal agency? As an example, we can look at discussions surrounding the ethical norms of autonomous vehicles: who should be held accountable for a potential traffic accident: the driver, the car manufacturer, or the creator of the AI algorithm controlling the vehicle? Then there's the more urgent ethical dilemma of autonomous weapons. Imagine a weapon without any human intervention in deciding when to deploy or fire. Picture a weapon programmed by humans to identify human targets, but left to scan its own database to determine whether certain physical characteristics indicate a friend or foe. If an AI-controlled system makes a catastrophic mistake, the traditional structures of accountability collapse: is blame to be assigned to the algorithm itself, the programmers, the companies that deploy it, or society for allowing such systems to exist in the first place? This is not a hypothetical scenario; such questions were seriously considered by delegates at the Conference on Autonomous Weapons Systems in Vienna (April 2024) [1].

Existentialism, traditionally focused on individual choice and the responsibility that comes with it, now needs also to take into account systems we create and the consequences they produce. This includes not just the technological forces, but also the economic and social systems that concentrate power and limit the range of possibilities for many people.

The existentialist focus on personal angst and alienation needs to expand to include collective forms of existential crisis, crises that affect entire communities and species. Furthermore, the rapid pace of technological advancement, while offering new possibilities, has also led to unforeseen consequences, such as mass surveillance, economic inequality, and the automation of jobs. These systemic issues are no longer just existential questions of individual freedom or authenticity, but

questions of how societies, communities, and even entire cultures are reshaped by forces beyond any single person's control.

The future of existentialism in the 21st century hinges on our ability to navigate these unprecedented ethical frontiers. If we fail to do so, we risk creating a world where responsibility is diffused beyond recognition, and moral agency becomes an illusion lost in the algorithms we designed.

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P. Zhenikhova, Y. Borysova, O. Osadcha

#### UKRAINIAN SPIRITUALITY IN TIMES OF CRISIS

Religion has always been a source of strength, hope, and inspiration, especially during difficult times. For Ukrainians, it's not just a spiritual foundation but also a key part of cultural and national identity. Its influence is evident throughout history – from Kyivan Rus, where Christianity united the people, to the struggle for independence, where the church supported national consciousness [1, c. 29]. For centuries, Ukrainians upheld religious traditions: celebrating holidays, attending services, and passing faith through generations. However, in recent years, religion has been losing its prominence. Younger generations are turning away from traditional practices, embracing rational thinking and science instead.

Yet, even as traditional religiosity declines, people continue to seek answers to life's big questions. Newer generations are drawn to alternative spirituality: Generation X to cults, millennials to astrology and energy practices, and Gen Z to esotericism and mysticism. Since the 1990s, Ukraine has faced global challenges – Soviet collapse, economic crises, political instability, and wars – that reshaped

spirituality. This period saw a rise in sectarianism. The fall of Soviet atheism left a spiritual void, and traditional religion hadn't yet regained its footing. People sought meaning and stability, making them vulnerable to cults, pseudo-Christian groups, and commercial organizations posing as spiritual movements. Sects infiltrated every aspect of life, promising quick spiritual growth, healing, and success. Groups like the "White Brotherhood" and Scientologists gained influence, sometimes threatening public safety. Although such sects have largely faded into the past, along with the youth of Generation X, they have been replaced by millennials embracing astrology, numerology, and a new wave of mystical beliefs. Spiritual quests have moved from churches to the digital space. Social media is now filled with "enlightened" gurus offering pseudoscientific services like destiny matrix analyses, feminine energy courses, and wish marathons – all marketed as spiritual growth but often just profit-driven schemes [3].

Gen Z has taken this further, turning esotericism into a self-sufficient digital subculture. For them, it's more than energy flows or Tarot readings – it's a tool for self-expression, simplifying a complex world, and creating an illusion of control [2].

The digital age has made spiritual trends spread instantly, with influencers amassing followers and profits. This isn't just a Western trend; in Ukraine, Tarot readings and online predictions are widespread. For Ukrainians, this trend is risky. Amid global dehumanization and local challenges like historical trauma, economic instability, and war, people are more vulnerable to manipulation and quick fixes.

Religion and spirituality can provide psychological support, especially in hard times. But it's crucial to approach them thoughtfully and critically. In a world of information overload, it's easy to fall prey to those exploiting spirituality for profit or control. We must develop critical thinking to separate genuine spirituality from manipulation.

Education, constructive communication and cultural development are key to helping people find meaning through knowledge, self-discovery and mutual understanding. Only then can we preserve spiritual freedom and avoid being exploited. Religion and spirituality can remain important, but only if rooted in conscious choice and inner freedom.

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D. Zubkovskyi, I. Batrachenko

## METHODS OF ASSESSING PERSONAL TIME PERSPECTIVE

Time perspective is a crucial psychological aspect of an individual that affects its decision-making, planning, resilience, and general life satisfaction.

In general, time perspective is an individual's cognitive, emotional, and motivational orientation toward the past, present, and future, which influences perception, decision-making, and behavior. It represents a habitual way of relating to temporal frames and affects psychological well-being, goal setting, and life satisfaction.

According to Zimbardo and Boyd (1999), "Time perspective is the often non-conscious process whereby individuals automatically partition the flow of their personal and social experiences into time frames or time zones that help to give order, coherence, and meaning to those events" [4, c. 1271].

Such an influential aspect is a key topic in scientific research, especially in the context of various local and global crises, as well as wars, financial crises, and technological revolutions.

Researchers such as Paul Fraisse, Jean Piaget, William James, Kurt Lewin, Lawrence K. Frank, Joseph Nuttin, Willy Lens, Theo G. G. Meijers, Y. I. Holovakha, O. O. Kronik, Philip G. Zimbardo, Alfredo González, and John N. Boyd have contributed to the development of the main theories on time perspective. Additionally, researchers currently working on different aspects of time perspective and related topics in Ukraine include O. Bakalenko, V. Dibrova, I. Batrachenko, etc. Additionally,

time perspective researchers from other countries include Dennis M. McInerney, Joke Simons, Lisa Drake, and many others.

As we can see, time perspective is a well-researched topic; nevertheless, there are plenty of fields for further investigation. For example, the psychological aspects of personal time perspective in the context of war. This could lead to a better understanding of personal and social challenges that many people had to go through, particularly relevant to Ukrainians during the Russia-Ukraine war.

Understanding the different methods of assessing personal time perspective is essential for such research due to the importance of precisely choosing scientific instruments for the research aim. Additionally, any of these methods could be used in the context of psychological consulting, psychotherapy, and social projects. Therefore, this thesis must focus on some of these methods, evaluating their advantages and disadvantages.

First, there are two main methods of assessing personal time perspective in contemporary psychological discourse – causometry and Zimbardo Time Perspective Inventory (ZTPI). As mentioned earlier in this text, both of them have their advantages and disadvantages; however, if they are correctly used, they could lead to a deep understanding of personal time perspective.

We begin with causometry. Y. I. Holovakha and O. O. Kronik developed causometry in 1982. It focuses on structuring links between subjectively significant life events (often represented graphically) [1, c. 1].

Causometry has its own therapeutic effects and offers a broad view of a person's time orientation and life satisfaction. Nevertheless, it requires a significant amount of time and equipment for each case, which may pose challenges in large-scale research in today's fast-paced world. However, there is a possibility that new technologies, such as AI, could offer solutions to this problem.

Next, we turn to the Zimbardo Time Perspective Inventory (ZTPI), developed by Philip G. Zimbardo and Alfredo González in 1999. This method is focused on finding a personal balance between five time orientations:

- Past negative or PN reflects a negative or aversive attitude toward the past;
- Past positive or PP represents a warm, sentimental, and nostalgic attitude toward the past;

- Present fatalistic or PF describes a helpless and hopeless belief about one's life;
- Present hedonistic or PH reflects an orientation toward present pleasure with little concern for future consequences;
- Future or F indicates behavior dominated by striving for future goals and rewards [2, c. 1].

While ZTPI is definitely less therapeutic than causometry, it offers significant advantages for scientific research. Firstly, the Zimbardo Time Perspective Inventory is structured as a standardized questionnaire, which is comfortable for both respondents and researchers. Moreover, ZTPI is adopted for multiple languages and cultures (including a Ukrainian version), which is a huge advantage for cross-cultural experiments. In spite of the fact that ZTPI requires less time than causometry, some studies suggest that in today's fast-paced world, a 56-question questionnaire could still be a challenge [3, c.1].

In summary, it is important to emphasize the significance of further research on different aspects of personal time perspective, especially in the context of war, financial crises, and other local and global events. For such purposes, we have to use the correct instruments according to the main aim. After reviewing two of the most popular methods – causometry and ZTPI, we can conclude that causometry may be better suited for smaller experiments or psychotherapeutic usage, while ZTPI is better designed for larger research with less focus on individual differences. Additionally, the analysis of the literature shows that both methods have their limitations, particularly in today's rapidly changing world. However, this fact provides more opportunity for further improvement of methods of assessing personal time perspective.

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**PANEL 3**  
**Modern Research in the Sphere of Socio-Economic Sciences**  
**and Information Technologies**  
(DNU, Zoom)

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N. Agafonov, T. Vorova

**REACTIVE APPLICATIONS: DEVELOPMENT AND FUTURE**

**Abstract**

In an era of rapid technological advancement, reactive applications represent a significant paradigm shift in software engineering. This paper explores the foundations of reactive programming, its current state, and the potential future of reactive applications in social-economic systems and information technology. By leveraging event-driven architectures, scalability, and resilience, reactive applications hold the promise of revolutionizing how we build and interact with software systems.

**Introduction**

Reactive applications have gained prominence as modern systems demand responsiveness, elasticity, and resilience. Coined by the *Reactive Manifesto* in 2013 [1], the term defines a software architecture approach designed to handle real-time events, adapt to user needs, and scale effectively. With social and economic systems becoming increasingly digitalized, the role of reactive technologies cannot be overstated.

This article examines the development trajectory of reactive applications and their implications for the future, particularly in the context of social-economic systems and advanced IT solutions.

**Core Principles of Reactive Applications**

Reactive applications are underpinned by four key principles:

1. **Responsiveness:** ensures systems provide prompt feedback to users, creating seamless interactions.
2. **Resilience:** maintains high availability and stability even under failure scenarios through features like replication and isolation.

3. **Elasticity**: dynamically adapts to workload variations, making them cost-efficient and scalable.

4. **Message-Driven Architecture**: uses asynchronous communication to decouple components, enhancing modularity and flexibility [2].

These principles are crucial for designing systems that handle high concurrency while maintaining system integrity and performance.

## **Development of Reactive Applications**

### ***Historical Background***

Reactive programming originated from the need to improve software responsiveness in environments with heavy workloads. Early reactive systems were built for domains like telecommunications, where responsiveness and uptime were critical [1]. Over time, frameworks like **Akka**, **RxJava**, and **Spring WebFlux** popularized reactive programming in mainstream software development [4].

### ***Current Trends***

Today reactive applications power many aspects of digital life, including:

- **Real-Time Data Processing**: systems such as stock market platforms rely on reactive architectures for instant data updates.
- **IoT (Internet of Things)**: devices connected in smart homes and cities use reactive systems to process and act upon large volumes of data in real-time.
- **Cloud-Native Development**: reactive principles are integral to Kubernetes-based microservices architectures for scalability and resilience [4].

## **Reactive Applications in Social-Economic Systems**

The intersection of reactive applications with socio-economic technologies reveals significant benefits.

### ***Financial Systems***

Reactive systems enhance online banking and trading platforms by ensuring real-time responsiveness and handling millions of simultaneous transactions securely [2].

### ***Healthcare Systems***

Medical applications leverage reactive designs to manage patient data streams and provide instant alerts for emergencies [3].



## ***Smart Cities***

The integration of reactive applications in smart city solutions enables efficient traffic management, energy optimization, and citizen engagement through real-time data analytics [4].

### **Challenges in Reactive Development**

Despite their advantages, reactive systems face challenges:

- **Steep Learning Curve:** developers must learn complex frameworks and asynchronous programming paradigms.
- **Debugging Complexity:** asynchronous behavior complicates troubleshooting.
- **Tooling Limitations:** existing tools for testing and monitoring reactive systems are less mature than traditional methods [5].

Addressing these challenges is vital to unlocking the full potential of reactive applications.

### **The Future of Reactive Applications**

The future of reactive applications is promising, with innovations in the following areas:

1. **AI and Machine Learning Integration:** reactive architectures will seamlessly integrate AI models to enable adaptive systems that respond intelligently to changing environments.
2. **Quantum Computing:** with advancements in quantum technology, reactive systems will scale to solve previously intractable computational problems.
3. **Blockchain:** reactive systems can enhance the performance and scalability of decentralized applications (DApps), making them more efficient for large-scale economic ecosystems.

The adoption of standards and advancements in tooling will also make reactive development more accessible.

### **Conclusion**

Reactive applications represent the next frontier in software development, addressing the need for scalable, responsive, and resilient systems. Their growing adoption in social-economic and IT domains highlights their transformative potential. However, addressing existing challenges is crucial to realize the vision of fully reactive, adaptive, and intelligent systems for the future.

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O. Bazyk, T. Grynko

## DIGITAL SHADOW AS AN INTERMEDIATE MODEL IN THE PROCESS OF DIGITAL TRANSFORMATION OF AN ENTERPRISE

### Introduction

The current stage of global economic development is characterized by a rapid shift from traditional models of production and management to digital formats of business operations [3]. This transition is driven by the growing volume of data, dynamic market changes, and intensifying competition, which stimulate the search for innovative technologies and methods to increase productivity [7]. Among these technologies, the concept of the "digital shadow" is gaining increasing traction as an intermediate model of digitalization that can be less costly and easier to implement compared to the traditional "digital twin" [1] [6].

In the context of enterprise management, the digital shadow serves as a flexible tool for quickly tracking the state of key processes, analyzing accumulated data, and making prompt decisions. Unlike the creation of a full-scale digital twin, a digital shadow does not involve building a deep virtual replica of all internal processes, which significantly reduces time and resource expenditures [5]. It can be particularly useful for enterprises seeking a gradual transition toward comprehensive digital transformation while maintaining flexibility and cost control [2].

Therefore, studying the theoretical and practical aspects of the digital shadow is of great importance in the context of Industry 4.0 technologies, as the accumulation

of necessary data and analytical tools lays the foundation for deeper automation and innovation [9].

### **Theoretical Foundations of the Digital Shadow Concept**

In the context of contemporary research on enterprise digital transformation, the concept of the "digital shadow" is increasingly referenced as an intermediate form of digital representation of production or business systems [1]. Unlike the "digital twin", which aims to create a comprehensive and dynamic replication of a real object, the digital shadow can offer a lower level of detail and cover only critical parameters [5], [6]. This approach simplifies the process of implementing digital technologies, as there is not always a need or possibility to immediately transition to a comprehensive model [8].

From a theoretical perspective, a digital shadow is viewed as a data set reflecting the current state of an object with minimal latency, serving as a kind of "informational footprint" of activities [2]. Its structure and completeness depend on the enterprise's primary objectives. For instance, a manufacturing firm may focus on data regarding equipment condition or production cycles, while a logistics company may prioritize order processing dynamics or shipment statuses [9]. Through integration with analytical systems (Big Data, cloud platforms, etc.), the digital shadow enables monitoring deviations from planned indicators and promptly responding to market fluctuations [3].

Moreover, the digital shadow can be considered a transitional stage toward a fully developed digital twin, allowing enterprises to gradually accumulate the required data and analytical tools [4], [7]. This approach supports rational resource allocation, reduces the risks associated with full-scale digitalization, and delivers tangible benefits through real-time monitoring and analysis of key performance indicators.

### **The role of the Digital Shadow in the development of enterprise management processes**

One of the key advantages of implementing a digital shadow in modern enterprise management systems is the ability to promptly monitor real-time performance indicators [6]. By using digital platforms for data collection, analysis, and visualization, managers and other stakeholders can obtain near real-time information on the status of production, logistics, and financial processes [2]. This

enhances transparency in management, as data is delivered in a standardized format and can be processed using analytical tools (Big Data, predictive analytics, etc.) [3]. As a result, the risk of errors and inaccuracies in decision-making is reduced an especially important factor under volatile market conditions and intense competition [7].

A second significant aspect of applying digital shadow technology is the improvement of control systems and the detection of deviations in business processes. Through integration with both internal and external data sources (e.g., ERP systems, CRM platforms, supplier systems), a continuous stream of operational information is created [4]. This facilitates the identification of problem areas such as excessive resource consumption, supply chain delays, or reduced equipment productivity [9]. Timely detection of such deviations enables prompt response and corrective action, which directly impacts operational efficiency and profitability [8].

A third factor defining the role of the digital shadow in management process development is the acceleration of communication between different organizational levels and departments. According to the concept of integrated information systems, the digital shadow should be accessible to both top-level management and operational personnel [1]. This fosters the creation of a unified "digital space" for decision-making, where all participants work with consistent and up-to-date information. This approach reduces the time spent on data exchange, metric alignment, and report preparation, thereby enhancing overall enterprise controllability.

Furthermore, the digital shadow serves as an effective tool for planning and forecasting. By accumulating historical and current data, the digital shadow enables the construction of various development scenarios (what-if analysis) and the assessment of potential outcomes before actual decisions are implemented [5]. This capability is particularly valuable when enterprises aim to respond swiftly to market changes or plan to introduce innovative solutions (new technologies, products, or business processes).

Thus, the role of the digital shadow in enterprise management extends beyond mere technical monitoring of production processes. Rather, it provides the foundation for building an integrated management system that enables real-time tracking of

key performance indicators, swift problem-solving, and strategically sound decision-making. As such, the digital shadow, within the context of accelerated digital transformation, functions not only as a control instrument but also as a catalyst for innovation and increased enterprise competitiveness.

### **Conclusion**

To summarize, the digital shadow represents a fundamentally new phase in the development of comprehensive digital enterprise models. It combines the ability to promptly monitor and analyze key production and business processes with relatively low investment and risk levels compared to traditional approaches to creating digital twins. As a result, the enterprise gains a more transparent and controllable management system that facilitates the identification of bottlenecks and supports effective decision-making in a dynamic economic environment.

Despite its clear advantages, the implementation of a digital shadow must be accompanied by comprehensive measures to address the complexity of information flows. This includes updating or expanding IT infrastructure, improving employee qualifications, enhancing change management systems, and ensuring robust cybersecurity measures. Failure to meet these requirements may result in fragmented data collection, communication conflicts between departments, and risks of confidential information leakage.

From an economic standpoint, the digital shadow serves as an intermediate link that enables businesses to build capacity for integration with broader Industry 4.0 concepts. It not only lays the groundwork for advanced analytics and automation but also fosters an environment conducive to further innovation. On its foundation, enterprises can integrate machine learning algorithms, cloud services, and even artificial intelligence components making production or service delivery more flexible and consumer-oriented.

Finally, the maximum benefit from implementing a digital shadow is achieved when it evolves into a fully functional decision-making mechanism. In such a case, managers gain the ability to rapidly model the impact of various factors, coordinate departmental activities, and ensure stable development even amid intensified competition and high uncertainty.

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V. Bovkunov, O. Bovkunova

## FORECASTS AND FACTORS FOR THE FUTURE DEVELOPMENT OF STARTUPS IN THE GLOBAL ENERGY INDUSTRY

The economic recovery from the COVID-19 pandemic has led to price increases for a range of commodities. Russia's war against Ukraine has led to further increases in energy prices and concerns about security of supply. However, the transition to a low-carbon energy system is ongoing and accelerating, and

the energy landscape is likely to continue to change in the coming decades. Therefore, it is relevant to consider long-term trends that will continue to be important for shaping future energy systems. Global energy consumption is projected to decline in the coming decades. Despite the rapid growth of the global economy and an increase in population by two billion people, energy consumption is projected to grow by only 14%. The continued decline in the energy intensity of GDP is a key factor, driven by improvements in end-use efficiency in buildings, transport and industry [2].

Electrification also plays a major role in this, as the transition to electric solutions typically leads to a step change in efficiency in many segments, such as space heating and passenger cars. Electricity consumption is projected to triple by 2050 as electrification increases and living standards rise. Electrification is one of the first levers of decarbonization, which is the cheapest and easiest to implement in most sectors. The projected growth rate of electricity demand during 2025–2050 will be 3–4%. The electricity, synthetic fuel and hydrogen sectors will account for 32% of the global energy balance by 2035 and 50% by 2050. All scenarios project that renewable energy sources will lead the way in electricity generation, reaching 80–90% in 2050. In the further acceleration scenario, the share of renewables is expected to double while the next 15 years from 29% to 60%. Most of the growth in renewables is expected to come from onshore solar and wind due to falling costs, and are projected to account for 43% and 26% of generation respectively in 2050 under a further acceleration scenario. Offshore wind is expected to remain at 7% of global generation due to permitting restrictions and political obstacles, with the potential for further growth if onshore wind restrictions, such as land use, remain. Thermal generation is expected to play an important role, providing a significant share of baseload generation until 2040 in regions with favorable fuel costs.

Accelerating the energy transition requires significant investments in various sectors, and the expected returns are highly scenario-dependent, especially in the traditional energy segment. Investment in oil and gas is projected to remain stable in absolute terms, but its share in global energy investment is projected to decline from 54% in 2021 to 36% in 2035. While many energy companies remain

in a precarious financial position, there are signs that startups are using the niche provided by easy monetary policy and government support to plan infrastructure development and invest in new projects. Over the past year, governments, companies and financial institutions have made more commitments to achieve net zero emissions by 2050. The financial community in many advanced economies is rallying around sustainable finance, launching funds and initiatives to channel the growing appetite from capital markets and comply with new disclosure rules [2].

Meanwhile, clean energy companies have performed well in financial markets. Electric vehicle sales continue to grow, as automakers introduce new models, supported by fuel economy targets and zero-emissions requirements. Furthermore, in economies where governments have more fiscal space and can borrow at low rates, recovery strategies offer significant opportunities to increase investment in infrastructure, efficiency, and clean energy technologies. Therefore, spending on infrastructure development, including electricity grids, is expected to increase in the near term, primarily in China, European countries, and the United States [3]. Major countries have increased funding for innovation as they strive for net zero emissions. Overall, more than \$50 billion could be available by 2030 for large-scale demonstration projects for low-carbon energy technologies, including CCUS and other ways to mitigate industrial emissions.

The renewable energy industry remained remarkably stable in 2024. Rapid technological improvements and falling costs of renewable energy sources, as well as the increasing competitiveness of batteries, have made renewable energy sources one of the most competitive energy sources in many areas. Despite supply chain constraints, increased shipping costs, and rising prices for essential commodities, capacity remained at historically high levels. The growth of renewable energy sources is set to accelerate in 2025 as concerns about climate change and support for environmental, social and governance (ESG) considerations grow, and demand for clean energy sources from most market segments accelerates. The following five trends are expected to come to the fore in 2025, paving new paths in the growth story of renewable energy [3].

First, there is growing interest in next-generation clean energy technologies. For an industry largely focused on solar and wind power, private investment and



pilot projects, combined with government support for research, could help accelerate the commercialization of new technologies, such as green hydrogen, advanced batteries, and other forms of long-term storage. These technologies can provide zero-carbon electricity and long-term seasonal electricity storage, ease grid congestion, reduce the use of renewables, increase reliability, and facilitate the integration of solar and wind power into the grid, supporting 100% clean energy goals [3].

Second, new business models are emerging in the energy sector. After a 85% drop in cost over the past decade, solar PV systems are among the most competitive energy resources on the market. As the solar industry strengthens its competitiveness, it is likely that efforts to explore new configurations and business models will increase.

Third, the development of energy transmission infrastructure is becoming a key priority, especially for offshore wind. The development of electricity transmission, which is key to connecting new, often remote renewable energy capacity to electricity consumption centers, is expected to become an important part of the renewable energy industry agenda in 2025. Policy and regulatory support, investment, and innovation are likely to help unlock the development process in this area. Electricity transmission projects, especially interregional ones, have so far remained a major challenge to the growth of renewable energy sources, as they face difficulties in obtaining regulatory approval in each state they cross, as well as landowner objections and opposition from environmental groups.

Fourth, the supply chain ecosystem continues to evolve. However, profits have recently suffered amid pressure on logistics costs and global trade tensions. In 2021, the solar industry remained under pressure, with prices increasing year-on-year for the first time in seven years due to shortages of components, raw materials and labor, as well as rising shipping costs.

Fifth, the circular economy is crucial for sustainable growth in the renewable energy sector. End of Life (EoL) management strategies for renewable energy products and materials gained traction in 2022 as early installations approach the end of their useful life. This can help reduce waste, increase resource security and provide additional financial value, as well as sustainability certificates. As solar, wind and battery installations are expected to reach new highs, waste generation in the renewable energy industry is likely to increase as well, requiring urgent solutions. By 2030,

the number of decommissioned photovoltaic modules could amount to 1 million tons of waste.

Industry stakeholders, regulators and policymakers have begun to explore solutions to extend the life and improve the performance, recovery and reuse of products and materials. Building a circular economy for batteries requires deep collaboration between industries, businesses and policymakers, taking into account the demand for batteries. But regulations for battery reuse and recycling are in their early stages, and incentives are needed to attract private investors.

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V. Bovkunov, O. Bovkunova

#### **THEORETICAL PRINCIPLES OF RESEARCHING STARTUP DEVELOPMENT IN THE GLOBAL ENERGY INDUSTRY**

An indispensable condition for the functioning and development of the country's economic system is entrepreneurial activity, the participants of which are entrepreneurs, who organize economic activity at the expense of their own or borrowed funds, are ready to bear responsibility for its results and risk their capital. In general, entrepreneurship as an economic concept is considered in two aspects: firstly, as a form of economic activity, the purpose of which is to make a profit and which is oriented towards prospects and the implementation of innovations, and is also characterized by independence in making management decisions; secondly, as a type of economic behavior based on dynamism, creativity, initiative, risk-taking and the desire to satisfy consumer needs.

The concept of entrepreneur in its modern sense was first introduced into scientific circulation by the 18th-century English economist Richard Cantillon in his “Essay on the Nature of Commerce in General” in 1755. In his opinion, an entrepreneur is a person who acts in risky conditions [1]. The following stages can be distinguished in the development of entrepreneurial theory: the first stage arose in the 18th century and is associated with a focus on the entrepreneur's ability to bear risk; representatives of the second stage highlight such a distinctive feature of the entrepreneur as innovation; the third stage is associated with a focus on the entrepreneur's personal qualities (the ability to respond to changes in the situation, independence in choosing a solution, the presence of management skills); the fourth stage is associated with an emphasis on the managerial aspect of entrepreneurial activity, in particular on intra-company entrepreneurship, for which the availability of creative freedom is a prerequisite [2].

During the development of the history of economic thought, the entrepreneur acquired more and more characteristic features for adapting to the conditions of the economic environment. Two models of entrepreneurial activity are distinguished: classical and innovative [1]. The first model is traditional, reproductive entrepreneurial activity, in which the entrepreneur seeks to organize work with the expectation of maximum return on the resources invested in it. It is within the framework of the classical model that concepts of efficient production and production growth management are formed, the implementation of which involves its optimization through the implementation of management functions and the effective use of external factors and internal resources of the enterprise. The second model is innovative, pioneering entrepreneurial activity, which aims to generate profit through the creation and active dissemination of innovations in all areas of business. Unlike classical entrepreneurship, innovative entrepreneurship is completely based on the search and active use of new ideas, new solutions to meet consumer needs and non-trivial approaches to enterprise development [2].

The world economy dictates changes in development at both the macro and micro levels, which has led to the emergence of innovative business models of entrepreneurial activity. It is innovative business that disrupts market equilibrium that becomes the driving force of economic development. Innovative business is a type of entrepreneurship that results in the creation of new products that have no

analogues or the improvement of existing products. A startup is one of the forms of conducting innovative business, which involves the creation of a product based on an innovative business idea that did not exist before its introduction [3].

The term "startup" first appeared in the USA in 1939. At that time, almost all enterprises and firms engaged in high-tech developments were concentrated near the city of San Francisco, in the Santa Clara Valley (California). At that time, Stanford University students David Packard and William Hewlett, creating their small project here, called this business a startup (from the English Start-up – “to start, to launch”). Over time, this startup grew into such a huge and successful company as Hewlett-Packard [4]. It should be noted that to date, the legal concept of startups has not been fully formed.

So, a startup is a special organizational structure (a project, a newly created company, or a company that is in the process of being created) with high intellectual potential, aimed at developing and implementing an innovative product or technology, which is at the stage of searching for or developing an optimal scalable business model and requires capitalization [3].

Startups emerge and develop in all areas of activity, but the most widespread and successful remain in the field of information technology. The main features of modern startups include the following:

- a newly created enterprise or project that is a temporary organizational structure and can be implemented for quite a long time without legal registration. The goal of any startup is to first optimize the model, eliminate all types of uncertainty, and only then expand the scope of activities, increase profitability, increase capitalization and investment attractiveness. After a few years, a successful startup turns into a full-fledged company, is sold or becomes a division of another company;

- the basis of a startup is an interesting innovative business idea that has a special value and involves the creation of a new product or the introduction of a new technology. This makes startups a serious competitor to corporations, which are most often focused on the production of a certain range of goods and services with their periodic minor modification;

- the ability to scale the business and high development potential. Startups are often called “fast” businesses, since the average time for their creation is 3–4 months,

and in the case of high-tech businesses – up to a year. In the early stages of their existence, they can grow rapidly, despite the limited financial, human and material resources;

- a startup must be replicable. This characteristic is closely related to the previous one and implies the startup's ability to earn money from the sale of its product or technology by repeatedly repeating the chosen business model without significant changes in different geographical and time frames;

- high risk due to unstable market conditions and uncertainty of existence due to insufficient funding to implement the idea. Startups operate in a fundamentally new market segment. At the beginning of the project's development, it is very difficult to even roughly analyze its potential risks;

- a startup is a mobile structure focused on finding the optimal business model. Due to high uncertainty, the natural mechanism of startup development involves constant changes to the concept of activity and monetization methods at the initial stages of its development, adapting to consumer needs, market requirements, etc.;

- the owner(s) of a startup work as top managers (leaders), most often the creators of startups are young people, the team of initiators has high intellectual potential. All successful startups were created by “fresh brains” – young people, usually students. According to statistics, the average age of a startup founder is 25. They are always extremely enthusiastic about their idea, believe in it, and are ready to put in a lot of effort to implement it. Such enthusiasm, according to experienced venture capitalists, is an important prerequisite for the future success of the project;

- a characteristic feature of a startup is the lack or insufficiency of capital to implement a business idea on the scale it claims. The key resource for the development of a startup is intellectual; therefore, in the early stages of its existence, startups can grow rapidly with limited financial investments and material resources. However, for scaling a startup, it is very important to ensure the ability to accumulate the necessary financial resources in a short time. Therefore, the decisive prerequisite for the reproducibility and scalability of the project is the attraction of venture investors [2].

Startups and small businesses share some common features. However, there are certain differences between these organizational structures, relating to: product

innovation, scope and scale of activity, trajectory of successful development, infrastructure, sources of investment, etc. According to A. Hiitinen, M. Pajarinen and P. Ruvinen, innovation orientation has both positive and negative aspects. Thus, on the one hand, innovative startups accumulate fewer tangible assets at the initial stage and, thus, have limited opportunities for collateral as a means of lending, which in turn limits their access to external financing. On the other hand, innovative newly created enterprises have a higher percentage of "survival" in the market [3].

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Z. Dolhov, V. Chernykh, T. Vorova

### **TECHNOLOGIES OF GAMIFICATION OF LEARNING IN THE FORMATION OF ALGORITHMIC THINKING THE SCHOOLCHILDREN AT COMPUTER SCIENCE LESSONS OF 5–6 GRADES**

In the modern world of information technology, teaching computer science in grades 5–6 in Ukraine faces a number of challenges and problems. One of the main trends in this process is the growing need to develop algorithmic thinking among students. The lack of interesting methods and approaches to developing this skill can be a serious limitation for the development of future information technologies in the country. In addition, traditional methods of teaching computer science often do not provide a sufficient level of motivation for students and do not stimulate their active participation in the learning process. This can lead to a loss of interest in the subject and failure to achieve planned learning objectives. Therefore, an important task for the educational systems is to develop and implement innovative approaches, including gamification methods, that would contribute to the effective formation of

students' algorithmic thinking, engaging them in learning and stimulating active cognitive activity [1].

Currently, the use of game methods to engage students in learning and develop their cognitive skills is gaining popularity. The creation of a game application for grade 5–6 students aimed at forming algorithmic thinking is one of the promising areas of educational technology development [2].

To evaluate the impact of gamification, we have developed the LearnIT software, which consists of small games aimed at developing and shaping the algorithmic thinking of 5–6th grade students in computer science classes.

The application consists of five game scenes, each of which contains objects and elements that allow students to learn the specifics of working with algorithms in the form of a game.

All the scenes are sequential, so when you complete the tasks in scene 1, scene 2 opens, and so on.

Scene 1: “Outer Space” with a canvas with cells with tools. The task: to determine the tool with the lowest weight in the minimum number of actions using a scale. Students are introduced to the concepts of sorting, sampling, and the algorithmic structure of “if...else”.

Scene 2: “Spaceship interior” with a password field and numbers. Task: encrypt passwords in different ways. Students learn about encryption and matching.

Scene 3: “The outside of a spaceship” with a canvas and figures. The task is to make a tangram to repair the ship in a certain time. Pupils get acquainted with the linear and branched structures of algorithms, systematise knowledge of sorting and matching.

Scene 4: “Open book” with a list of logical parameters and a field for the answer. The task is to analyse the parameters and provide an answer in the appropriate field.

Scene 5: An interactive blitz test to check the learner's understanding of the theoretical material. The learner has the opportunity to review the theory if necessary.

To achieve the research goal, an experiment was conducted with two groups of students.



**Fig. 1. Scene 1 of the developed didactic resource “Learn IT”  
for the development and formation of algorithmic thinking**

The study found that students who were taught using gamification technologies were more motivated and engaged in the lesson, better able to grasp basic concepts, analyse and create algorithms.

The results of the study were implemented on the basis of five general secondary educational institutions in the Dnipro and Odesa regions and showed that the use of gamification technologies could be an effective way to form algorithmic thinking of students.

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## **NEURAL NETWORK APPROACH TO REAL-TIME VENTILATION SYSTEM CONTROL MODELING AND OPTIMIZATION**

Modern ventilation systems play an important role in ensuring the energy efficiency of buildings, regulating the microclimate and maintaining comfortable conditions for people. Increased attention to indoor air quality has led to the development and application of data-driven models to predict levels of indoor pollutants and their impact on the human body. The fundamental study [2] provides information on the impact of air parameters on human comfort, methods for measuring air parameters, information on the distribution of pollution sources and their impact on air quality. According to the European Directive on the Energy Performance of Buildings [1], it is required to improve their energy performance, considering climatic and local characteristics, and to meet indoor climate requirements.

Traditional methods of automated control of ventilation systems are often based on linear models that do not take into account the complex nonlinear relationships between the state of the environment and control inputs. This can lead to sub-optimal decisions, increased energy consumption, and reduced indoor air quality.

This paper develops a new neural network approach to modelling and controlling a ventilation system in real time. The methodology is based on a discrete dynamic model, which is described in terms of bilinear systems. Bilinear models [3] allow for a more accurate account of the relationships between the system state and control inputs, which is especially important for adaptive control in variable operating conditions.

The developed control system consists of two main components: a predictive neural network model and an optimisation control module. To model the temporal dynamics of microclimate variables (temperature, humidity, CO<sub>2</sub> level), a recurrent LSTM neural network is used, which is trained on historical sensor data. This allows for accurate predictions of the system state based on current information and trends.

To control the ventilation units, a Model Predictive Control (MPC) approach is used in combination with the Deep Q-Network (DQN) reinforcement learning

method. The MPC algorithm solves the problem of optimal selection of fan operation parameters online, taking into account forecasts of the environment and physical limitations of the system. The use of a bilinear model improves the control accuracy, which helps to reduce energy consumption and ensure the stability of microclimatic parameters.

The effectiveness of the proposed approach is confirmed by numerical modelling and experimental tests. The obtained results demonstrate a 15–25% reduction in energy consumption compared to traditional PID controllers, as well as an increase in the accuracy of maintaining the set environmental parameters. The proposed methodology can be integrated into modern smart home systems and industrial ventilation systems to improve their efficiency.

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S. Kasyan, T. Grynko, O. Hurko

## THE IMPACT OF GLOBALIZATION PROCESSES ON STRATEGIC CHANGE MANAGEMENT

The rapid evolution of globalization processes has fundamentally transformed the landscape of strategic change management in contemporary organizations. According to Polinkevych and Volynets (2018), strategic change management can be defined as a complex system of measures aimed at adapting organizational structures, processes, and resources to new environmental conditions while maintaining overall strategic coherence [3, p. 48]. Modern organizations increasingly operate in

what Radović-Marković et al. (2019) describe as a "global competitive ecosystem" – an interconnected network of stakeholders, competitors, and markets that transcend national boundaries [5, p. 59].

The traditional models of strategic change management have predominantly focused on internal organizational dynamics, often overlooking the impact of external global forces. Research conducted by Plyaskina (2020) reveals that organizations frequently fail to achieve their strategic objectives due to insufficient consideration of globalization factors in their change management approaches [2, p. 51]. The complexity of global supply chains presents a critical challenge as organizations expanding their operations must navigate diverse regulatory environments, cultural contexts, and stakeholder expectations (Forostyanko, 2022) [4, p. 592].

A particularly interesting phenomenon emerging from the intersection of globalization and strategic change management is what can be termed "adaptive strategic resonance" – the ability of an organization to simultaneously maintain strategic direction while continuously adjusting implementation approaches based on local conditions and global shifts. This concept builds on Polinkevych and Volynets's discussion of strategic flexibility as a key success factor in dynamic business environments [3, p. 125].

The data collected from multinational organizations indicates significant variations in how globalization processes affect strategic change management across different industries. Table 1 illustrates these differences.

**Table 1. Industry-Specific Impacts of Globalization on Strategic Change Management**

Industry	Primary Globalization Impact	Strategic Change Management Challenge	Proposed Adaptation Approach
Technology	Rapid innovation cycles	Balancing continuous change with organizational stability	Modular strategic frameworks with variable implementation timelines
Manufacturing	Complex supply chains	Coordinating change across diverse operational contexts	Localized implementation of global strategic directives
Financial Services	Regulatory complexity	Navigating diverse compliance requirements	Adaptive governance structures with flexible oversight mechanisms
Retail	Changing consumer behaviors	Responding to global trends while meeting local expectations	Glocalized strategic initiatives with customizable components

Research by Plyaskina (2020) suggests that organizations implementing strategic changes in a globalized context often struggle with "strategic fragmentation" – the tendency for change initiatives to lose coherence as they are adapted to different regional contexts [2, p. 52]. The emergence of global virtual teams enables organizations to leverage diverse perspectives and local knowledge in implementing strategic changes, although they also introduce additional coordination complexities (Radović-Marković et al., 2019) [5, p. 63]. Andrusyshyn et al. (2023) emphasize the importance of developing a "global-local integration capability" – the organizational capacity to simultaneously address global strategic imperatives and local contextual factors in decision-making processes [1, p. 114].

Based on this analysis and building on existing frameworks, authors propose a novel theoretical framework called the "Tri-Modal Adaptive Strategy" (TMAS) for managing strategic change in globalized contexts. The TMAS model proposes that organizations must simultaneously operate in three interconnected strategic modes:

1. *Anticipatory Mode* – Proactively identifying and preparing for global shifts through advanced sensing mechanisms and scenario planning techniques [4, p. 593].
2. *Resonant Mode* – Establishing organizational structures and processes that can quickly respond to and amplify positive global influences while dampening negative ones [3, p. 127].
3. *Transformative Mode* – Deliberately leveraging global forces to catalyze deeper organizational evolution aligned with long-term strategic objectives [1, p. 116].

The TMAS framework advances beyond existing models by recognizing that these three modes must operate concurrently rather than sequentially, creating "strategic polyphony" – the organizational capacity to simultaneously execute multiple strategic approaches across different parts of the organization. This polyphony allows organizations to maintain overall strategic coherence while enabling targeted adaptations to specific global contexts.

In conclusion, the impact of globalization processes on strategic change management necessitates a paradigm shift in how organizations conceptualize and implement strategic changes. The proposed Tri-Modal Adaptive Strategy offers a novel theoretical framework for navigating the complexity of globalized strategic

environments. Future research should focus on empirically testing the effectiveness of the TMAS framework across different organizational contexts.

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I. Kotov, O. Besarab

#### **GEO-ECONOMIC PARAMETERS OF DIVERSIFICATION OF COMMERCIAL COOPERATION IN LATIN AMERICA AND THE CARIBBEAN IN 1960–1980**

The formation and development of regionalization processes in the countries of the South American region is associated with a significant time interval, which was initiated as a result of the elimination of the mandate and dependence of Latin American states on the metropolitan areas of Europe.

Under the conditions of actualization of these geopolitical changes, the countries of South America, using the method of negotiating discourse, reached a consensus and formed a constructive dialogue, which led to the establishment of acceptable conditions for the development of integration processes in the interval 1960–1980 [1, p. 123–124].

Thus, in this period, a group of associations was formed that specified the need to unite the galaxy of Latin American and Caribbean countries (LAC) to unify their model of socio-economic, political and humanitarian development trajectory. As a result, in the interval of February 18, 1960, Paraguay, Brazil, Chile, Argentina, Peru, Mexico, and Uruguay tested a treaty at the Montevideo Summit that declared the legal approval

of the compilation of the Latin American Free Trade Association (ALALC). Moreover, on December 13, 1960, the delegates of El Salvador, Nicaragua, Guatemala, and Honduras signed a treaty at a symposium in Managua, which declared the formation of the Central American Common Market Association (MCCA). At the same time, under the circumstances of ratification of the congruent interstate Treaty of Chaguaramos, dated July 4, 1973, the Caribbean Community (CARICOM) was formed, which included Trinidad and Tobago, Barbados, Jamaica and Guyana. The fourth large-scale regionalization grouping in Latin America was formed after the signing of the Treaty of Cartagena between Colombia, Bolivia, Ecuador and Chile on May 26, 1969, which was named the Andean Group (GRAN) [2, p. 66–68].

At the same time, in accordance with the semasiology of the MCCA, ALALC, GRAN and CARICOM doctrines, which determined the methodology for modernizing integration processes in Latin America, these documents prioritized the need to limit the prospects of economic expansionism of the United States and Western Europe in the LAC region. The objectification of this skepticism towards the development of economic and financial cooperation between Latin American states and highly developed subjects of the capitalist system was demonstrated in the segment of disavowal of representatives of post-industrialism, including Washington and the European Economic Union's counterparts, in the implementation of neocolonialism strategies.

As part of the codification of integration processes in Latin America within the structure of CARICOM, ALALC, GRAN and MCCA, formed in the 1960s, the processes of increasing the volume of commercial cooperation between the countries of the South American region were inspired. As a result, the leitmotif for the growth of statistical data on economic partnership of the participants of these interstate syndicates was characterized by the reduction of taxes on imports of products by the region's entities to the level of 10% after the start of the activities of these integration consortia. This indicator in the preferential condition contrasted with the tariff congruent with 40%, which was in place in the period before the establishment of regionalization alliances in the 1960s in the LAC region.

Thus, the evolution of municipal trade cooperation in the financial system was interpreted as equivalent to an intensification of 19.5 times in 1980, compared to the identical figures for the period 1960. On this basis, the total reversion of goods

exported by South American entities within this area, delegated to other states of this area, amounted to 15.6 billion US dollars in the interval of 1980, in comparative terms with the parameters of the 1960 period, demonstrated in the construction of 800 million US dollars. At the same time, under the given circumstances of the evolution of integration aspects, the average percentage that visualized the unified coefficient of goods delegated to the domestic South American market, manufactured by the states of this region, at the time of 1980 was 16.6%. This indicator, in turn, was determined as a multiple of the coefficient of trade cooperation within the LAC for the period of 1960, which was equal to 8.8%. [3, p. 66]

Summarizing the above material, it should be noted that during the initiation of the regionalization situation in the 1960s, formed as a result of the gradual diversification of economic and political cooperation between the LAC members to limit the spread of US influence in the region, the governments of these states recognized the need to unify their own commercial systems.

Under these conditions of progress in the sphere of economic partnership between the countries of South America within the framework of CARICOM, ALALC, GRAN and MCCA, positive processes of elimination of trade barriers and increase of the level of internal transit of goods in the system of economic interaction between the region's counterparties have begun. In addition, the formation of regionalization organizations ALALC, MCCA, CARICOM and GRAN created circumstances related to the syndicalization of Latin American countries, initiating the gradual construction of a common political and economic platform in South America.

Under these conditions, the participants of the integration associations received privileges to more effectively resist the veiled commercial invasion of the United States by expanding the volume of investments provided by the subjects of these organizations to other representatives of regional unification, which was determined by the main vector of functioning of congruent syndicates.

Thus, these narratives are argued by the orientation of the economic development of the LAC states on socialist and egalitarian foundations, which, combined with limited paternalism in the import of capital into the economic systems of Latin American states by highly developed entities, will lead to an increase in living standards. Based on this, the organization of research in the field of implementation

of the statutes of social capitalism in the system of regionalization processes of LAC, accompanied by the generation of free trade partnerships by the states of the region with countries characterized by representatives of minarchism, is determined as an important area of activity of the academic system.

Since, under the conditions of effective protection of the development of commercial policy in Latin America, the circumstances of determining the methodology for shaping the conjuncture of stable economic progress, consistent with ensuring permanent social stability and the implementation of national geostrategic doctrines, are incorporated.

As a result, the empirical potential of this concept will be interpreted as acceptable for adoption by other integration associations, which will increase the cadastre of segments of cooperation between the members of these organizations and codify their economic and political systems to a single standard, while maintaining a high standard of living for the population.

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O. Mykhailenko, T. Vorova

#### THEORETICAL ASPECTS OF INTERNATIONAL EXPANSION

Today globalisation opens up enormous opportunities for business development on an international scale. Increasing a company's activities abroad, i.e. international expansion, is becoming one of the key factors in ensuring long-term growth and competitiveness. Understanding the basic principles of international expansion will



not only improve understanding of global challenges, but also will increase the ability to take advantage of the opportunities offered by global markets.

With the rapid evolution of global economic processes and the changing regulatory environment, the issue of international expansion is critical importance to both large multinational corporations and small or medium-sized enterprises. Understanding the nature and principles of international expansion helps companies access new markets, diversify risk and build a global brand image.

The purpose of this research is to define the main theoretical aspects of the concept of “international expansion”, its nature and the principles underlying the successful entry of companies into foreign markets.

The main driver of international expansion is the search for markets with good growth conditions, a broader customer base and the possibility of economies of scale. For example, if the domestic market is stagnant or saturated, a company can take its product to regions with different demand and consumer preferences. Countries are at different stages of economic development, which makes it possible to extend the life cycle of goods and services by developing new segments. Diversification of income is also an important advantage: if one market is in crisis, income from other markets can compensate for the losses. In addition, the involvement of specialists from different countries increases the potential for innovation and makes it possible to respond more quickly to the challenges of a dynamic business environment.

International expansion brings opportunities, but also significant challenges. The most common of these are cultural and language barriers, which can lead to misunderstandings in marketing messages and branding. Famous cases of mistranslated slogans by multinational companies (e.g. Pepsi or KFC) highlight the importance of localisation and cultural sensitivity [1]. Another challenge is legal and regulatory: certification requirements, tax regimes, labour laws and intellectual property protection vary widely from country to country. Currency fluctuations, tariffs, quotas and economic crises also have a significant impact, making it difficult to forecast and plan costs and revenues.

When selecting target markets, companies should consider a number of factors: market size and growth potential, consumer purchasing power, geographical

proximity, cultural similarities and regulatory conditions. Good market selection sets the stage for successful integration into the local business environment. For example, small and medium-sized companies may want to start their expansion in countries that are geographically and culturally close to reduce barriers to entry and adaptation costs. Large companies can focus on large markets with high GDP or dynamic innovation, such as the United States, Singapore or Ireland, to take advantage of economies of scale and low tax rates [2].

A major stage in international expansion is the choice of strategy for entering foreign markets. The theory identifies four basic approaches: international, multi-domestic, global and transnational [3]. The international strategy is to ensure a single standard of products or services in all countries, focusing on maintaining a stable brand image (example–Coca-Cola). The multi-domestic strategy focuses on local adaptation, where a company changes its product range, formulations or packaging to suit the specifics of the market, as Nestlé does by offering original flavours for different regions. A global strategy maximises standardisation to reduce costs and provide a uniform product (e.g. Microsoft software). A transnational strategy combines global standards with local adaptations, such as McDonald's, which maintains global quality principles but adapts its menu to the culinary preferences of individual countries.

In addition to general strategic approaches, companies choose different entry models, including exporting (directly or indirectly), licensing, franchising, contract manufacturing, joint ventures, mergers and acquisitions, setting up sales subsidiaries or foreign direct investment. The choice of model depends on the company's risk tolerances, level of control over business processes and resource capabilities. For example, exporting is a relatively simple way to expand that minimises risk but also limits control over marketing and logistics. Foreign direct investment requires significant resources but offers a high degree of control and flexibility. Franchising allows rapid expansion at minimal cost, but risks reducing the quality of control over compliance with brand standards.

In summary, international expansion is a complex process that requires strategic planning, market research and the selection of an appropriate strategy. A comprehensive approach that considers both internal capabilities and external

market factors can help minimise risks and ensure successful entry into new markets. The expansion strategy should be flexible, considering both global trends and local characteristics. The effectiveness of international expansion depends largely on the company's adaptability and ability to respond quickly to global market challenges.

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V. Myroshnyk, T. Vorova

## FORMS OF INTERNATIONAL COMPETITION

International competition [1] refers to the rivalry between firms from different countries for more favorable production and sales conditions in the international market, for obtaining the highest profits, and for securing the most advantageous areas for capital investment. It acts as a market regulator that influences the productivity levels of national economies. Through international competition, the productivity levels across different countries become interdependent. This means that through international trade and capital export, the countries can enhance their resource efficiency and specialize in those market segments where the domestic producers are more competitive than the foreign ones.

Multinational competition [2] occurs when inter-firm rivalry within each country or group of countries operates independently. In this context, the international market functions as a collection of relatively autonomous national markets, where competition takes its own unique form within each national industry. Firms compete for dominance in the individual markets. This form of international competition is typical for the food product markets such as coffee, baked goods, frozen foods, canned products.

Global competition, on the other hand, involves the competitive position of a firm in one country significantly affecting its position in other countries, and vice versa. In this form of international competition, the entire global market is viewed as a single entity, and firms compete for dominance across the entire global market. Global competition is typical for the international markets of civil aircraft, televisions, automobiles, watches, copiers, telecommunications equipment, and tires.

The objectives of participating [3] in the international competitive relations can vary and include:

- Expanding potential demand by entering the new markets (increasing the production volume and improving the results through economies of scale);
- Distributing commercial risk by targeting the buyers living in different economic environments and operating under more favorable competitive conditions;
- Extending the product life cycle by penetrating the markets where demand is still growing;
- Protecting against competition by diversifying the market positions while simultaneously monitoring the competitors in other markets;
- Reducing supply and production costs by leveraging the comparative advantages.

In the process of international competitive relations, a firm can occupy a specific position depending on the level of development of its key competencies. At the first level, international competition takes place for key goods and services in the coordinates of *"price – market share"* [4]. At the second level, competition occurs for key technologies in the coordinates of *"quality – speed of new product development"*. At the third level, competition revolves around key competencies in the coordinates of *"knowledge – new types of business"*.

Participation in international competition for each individual firm begins with the selection of a method for entering a specific country's market, depending on whether the firm exports products manufactured in its domestic market or establishes a production unit in a foreign market.

Methods of firm participation in international competition [5]:

### **1. Direct and indirect export:**

this occurs when there is a surplus of production and exports happen periodically without long-term commitments. Indirect export is cheaper and less risky because the firm delegates international operations to other organizations.

### **2. Participation based on contracts (franchising, licensing):**

this form of international competition offers long-term contractual relationships, the ability to carry out production and trade under a well-known brand, and marketing support, while the firm pays royalties in return.

### **3. Establishing a foreign trade firm or joint venture:**

the firm transitions to direct investment and gains control over its partner.

### **4. Direct investment in a controlled subsidiary:**

at this stage, the firm can fully own 100% of the capital of its foreign subsidiary.

### **5. Autonomous subsidiary (daughter company):**

a foreign subsidiary transitions to autonomous development, relying on national capital, local personnel, and its own R&D (Research and Development).

### **6. Participation as a transnational corporation (TNC)**

TNCs view the international market as homogeneous, selectively adapting to local market conditions. International competition is characteristic not only of the goods market but also of the services market.

There are three forms of international competition in the services sector:

1. Mobile buyers travel to the country where the services are produced. This is characteristic of services such as tourism, education, healthcare, transportation, and the storage or warehousing of goods.

2. Firms from one country provide services in other countries using their own personnel and technical resources. Examples include business consulting and engineering services.

3. Firms from one country provide services in other countries through intermediaries – service firms located abroad. These intermediaries can be staffed either by personnel sent from the company's home country or by locally hired workers. This form of competition is common in accounting, auditing, banking, and marketing services.

Types of competition [6]:

1. **Intra-industry competition:** this is an economic rivalry between producers operating within the same industry. They produce and sell identical goods that meet

the same consumer needs but may differ in production costs, quality, price, and other attributes.

2. **Inter-industry competition:** this occurs between producers in different industries who compete for the most profitable investments and to secure the highest profits.

3. **Monopolistic competition:** this describes a market with a relatively large number of producers who sell similar but differentiated products. These products have varying attributes, but serve the same consumer need. Monopolistic competition is characterized by the firm's ability to exercise some monopoly power over its product due to differentiation. Each firm can independently raise or lower prices regardless of competitors' actions.

4. **Oligopoly:** this occurs when a small number of large firms dominate the market for specific goods or services. Oligopolies are most common in capital-intensive and technology-driven industries such as metallurgy, oil and gas, railways, shipbuilding, aviation, and high-tech sectors. Examples of oligopolies in Ukraine include the postal services market, where "Ukrposhta" and "Nova Poshta" dominate, and the mobile communications market, led by "Kyivstar", Vodafone, and Lifecell.

Pure monopoly [7] refers to a market situation where there is only one seller with no close substitutes for the product it produces. A monopoly enterprise must satisfy all potential buyers of a specific product within the given market, meaning the enterprise essentially becomes synonymous with the entire industry.

Examples of pure monopolies include local water supply companies, electricity providers, and gas supply firms. Specific cases include: "Ukrzaliznytsia" – the sole railway carrier in Ukraine; "Energoatom" – the state enterprise operating all nuclear power plants in Ukraine; Microsoft Windows operating system – which runs 90% of the world's personal computers.

The exclusive role of competitiveness [8] as the key criterion for international economic exchange creates a necessity for implementing specialized management of international competitiveness at the enterprise level. As both a theoretical model and a tool of influence, international competitiveness management becomes a specific functional direction of enterprise management. It has distinct content, goals, tasks, and organizational-economic tools for achieving them. This area of

management focuses [9] on: forming, developing, and realizing competitive advantages. Ensuring the enterprise's viability as a subject of international economic activity. The object of international competitiveness management is the level of competitiveness sufficient to ensure the enterprise's survival in international markets.

The issues of international competitiveness are not solely the responsibility of individual enterprises, as each enterprise functions as part of a broader national, regional, and sectoral economic system. The competitiveness level directly affects not only the enterprise's employees but also: 1) cooperation partners; 2) the region where the enterprise operates; 3) the state, as foreign exchange earnings for the national budget are largely formed through the external economic activity of such enterprises.

Thus, the challenge of ensuring international competitiveness has not only a microeconomic dimension but also a national-level significance.

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## **OPTIMIZATION OF CORPORATE CASH FLOWS: MODERN METHODS AND APPROACHES**

In an unstable economic environment, companies face the challenge of effective cash flow management. Optimization of the movement of financial resources is a key element of ensuring liquidity, profitability and financial stability of enterprises. L. A. Lakhtionova notes that optimization of cash flows makes it possible to maintain financial equilibrium, which is achieved if the enterprise's demand for cash equals its supply (available cash) in each period [1, p. 217].

Modern approaches to financial flow management are based on the introduction of digital technologies, process automation and the use of complex financial instruments.

The task of optimizing cash flows also means the task of distributing the enterprise's means of payment in dynamics in order to increase its financial and economic efficiency, while the criteria for efficiency are:

- increase in the enterprise's own funds for a certain period; increase in sales (market share);
- increase in financial stability (provision with own funds);
- efficiency of use of available funds (profitability);
- business reputation (fulfillment of the enterprise's [2, p. 101].

One of the most common approaches is budgeting, which allows companies to allocate financial resources in accordance with strategic goals. Cash flow forecasting is also important, as it allows companies to identify financial risks in advance and find ways to minimize them. Much attention should be paid to the management of accounts receivable and accounts payable, including monitoring the timeliness of payments and minimizing the risk of counterparty insolvency. In this context, cash flow analysis is an effective tool for assessing cash flows and identifying possible financial imbalances.

Podderiyogin A.M. and Nevmerzhitsky Y.I., in turn, note that cash flow management should be considered as a consistent process of setting tasks and their



implementation, which includes the implementation of the following stages: planning and forecasting of cash flows and preparation of internal financial documents (cash flow budget, as well as a planned cash flow statement, payment calendar, etc.) [3, p. 123].

Thus, optimization of financial flows is an important area of corporate financial management that contributes to the improvement of financial stability, resource efficiency and long-term development of enterprises.

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D. Parkhomenko, S. Adonin, Yu. Honcharova

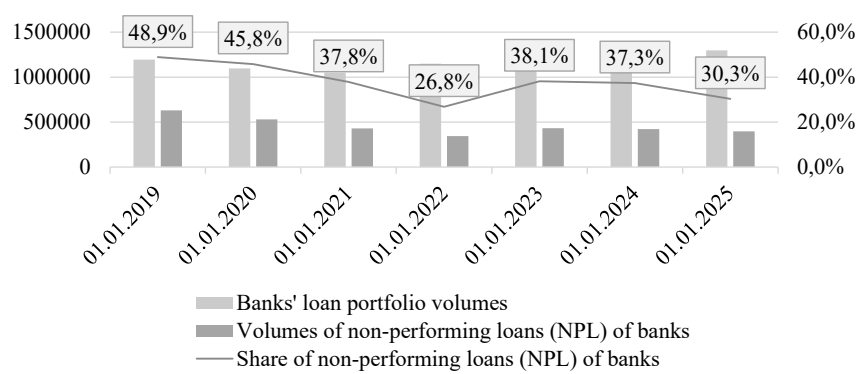
## CREDIT RISK MANAGEMENT IN THE CONTEXT OF ECONOMIC INSTABILITY

Currently, our country's economy and banking system are developing accordingly under the influence of various factors. In 2020, we faced a macroeconomic crisis due to the outbreak of Covid-19, and on February 24, 2022, we faced a full-scale invasion. These factors have significantly affected the financial condition of both legal entities and individuals, namely, by reducing their solvency to a certain extent, which in turn leads to a possible risk of debtors' failure to repay loans to banking institutions. Today, credit risk can be considered a dominant risk, as losses from it can significantly affect the stability of both an individual bank and the banking system as a whole. Thus, the issue of credit risk assessment and management is essential for timely detection of risks and minimization of losses from them.

Many scholars from around the world have tried to understand the definition of risk and have put forward two main approaches to interpreting the essence of this

term: the outcome approach and the process approach. The first approach, the outcome approach, focuses on the outcome of an event, taking into account the possibility (probability) of failure. According to the second approach, scientists consider the concept of risk as a set of factors, stages and events that led to the emergence and development of a risk situation [4]. Thus, according to the Resolution “On Approval of the Regulation on Determination of Credit Risk on Assets in Banking Operations by Banks of Ukraine” credit risk is the amount of losses expected by the bank or losses arising from the default of a counterparty or debtor of the bank that cannot fulfill its obligations to repay its own debt to the bank [3].

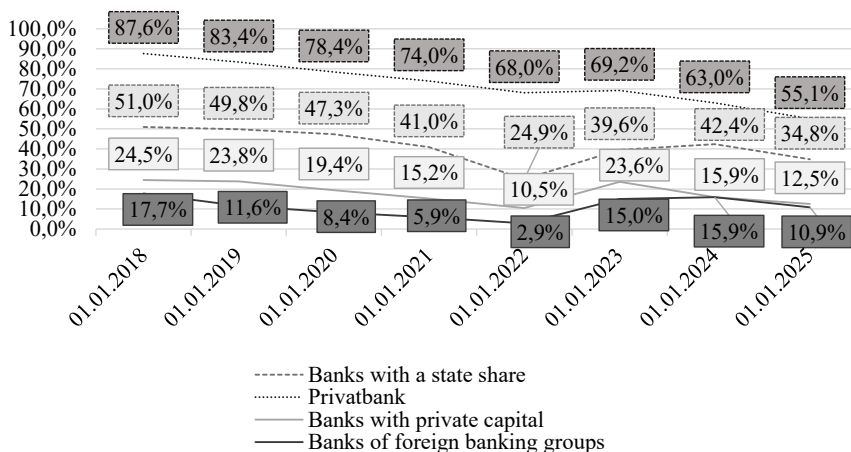
An overview of the dynamics of non-performing loans (NPLs) is an important aspect of credit risk analysis, as this indicator indicates the efficiency of a banking institution's lending activities and its sustainability. Figure 1 shows that during 2019–2021, the share of NPLs decreased, and at the beginning of 2022, their share in the loan portfolio was the lowest (26.8%). In the following years, the share increased, namely in 2023 (38.1%) and remained relatively high in 2024 (37.3%), after which it decreased to 30.3% in 2025. These fluctuations were caused by the impact of economic instability and an increase in loan defaults.



**Fig. 1. Dynamics of non-performing loans (NPL) of banks**

Figure 2 shows the change in the share of NPLs by different groups of banks. Thus, we see a general downward trend in this share across all groups. In January 2023, we can observe an increase in this indicator. This temporary increase could have

been caused by factors that affected the credit market in 2022. However, after that, there was a further decline in NPLs in all groups of banks



**Fig. 2. Share of non-performing loans (NPL) by bank group**

Successful credit risk management requires a comprehensive methodology that includes a thorough review and assessment of the loan portfolio, which includes identifying economically sensitive and non-sensitive sectors, assessing the risk of debtors, and classifying loans based on vulnerability. It is important to use modern technologies such as automated monitoring systems and digital solutions to assess creditworthiness. Stress testing and contingency analysis help to assess the potential impact of changing markets and highlight critical risk areas. The risk management policy offers clear decision-making protocols, regulation of loan agreements and control of the credit process. Facilitate the sale of non-performing loans through transparent mechanisms, such as electronic auctions, to reduce their impact on the banks' balance sheets. Amend legislation to simplify debt collection procedures and the sale of pledged property. Diversifying and setting limits on the level of lending to different types of borrowers can reduce overall credit risk. It is also important to implement practices to address credit risk based on the examples of other developed countries [1; 2].

In general, effective credit risk management requires a comprehensive approach using innovative technologies, in-depth analysis, monitoring of market changes, etc.

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B. Shchebetiuk, T. Vorova

## THE ROLE AND DIRECTIONS OF ARTIFICIAL INTELLIGENCE IN IMPROVING THE COMPETITIVENESS OF ENTERPRISES

Artificial intelligence (AI) has become a key factor influencing the business transformation and competitiveness. In today's environment, the technological innovations are the basis for the survival and development of enterprises. AI also helps to increase productivity (automation of routine processes reduces time and resources), to optimize business processes (AI analyzes large amounts of data, identifying weaknesses and providing recommendations for their improvement), to ensure innovations (the use of machine learning algorithms helps to create the new products and services.), to improve customer interactions (AI provides a personalized approach through the chatbots, the recommendation systems and the analysis of customer behavior).

The history of artificial intelligence began in the 1950s with the work of Turing, who developed the concept of a machine capable of imitating the human intelligence [2, p. 41].

In recent decades, the development of AI has accelerated significantly due to the emergence of new technologies such as neural networks and machine learning [3, p. 68].

The competitive advantage is achieved through faster adaptation to market changes, improved product quality, and operational efficiency. The main areas of artificial intelligence use in the increasing competitiveness are:

- Automation of business processes: AI allows automating the routine and repetitive tasks such as data processing, accounting, supply chain management, etc. This frees up resources for more strategic tasks.

- Big Data analysis: AI can quickly analyze the large amounts of data to identify patterns, trends, and predict customer behavior or market changes. This allows businesses to make informed management decisions.

- Personalization of products and services: with the help of machine learning algorithms, companies can offer the customized solutions to customers, such as personalized recommendations in retail or online services.

- Optimization of marketing strategies: AI is used to analyze the consumer behavior, to optimize the advertising campaigns, the segments of audience, and to evaluate the effectiveness of marketing activities.

- Risk and security management: artificial intelligence helps businesses to identify and prevent risks such as fraud, supply chain disruptions, or cyber threats.

- Innovations in manufacturing: integrating AI into production processes (e.g., using robots) improves the product quality, reduces the production costs, and minimizes errors.

- Logistics and supply management: the optimization of delivery routes, the demand for forecasting, and the warehouse inventory management are carried out using AI that reduces the costs and increases the speed of order fulfillment.

- Customer support: the use of chatbots and voice assistants helps to improve the customer experience, to reduce the response times, and to increase the customer loyalty.

- Strategic decision-making: AI analytical capabilities allow the managers to get a clear picture of market conditions, trends, and forecasts that helps them to make more effective decisions.

- Development of innovative business models: thanks to AI, the companies are implementing the new business models that allow them to generate the additional sources of income (for example, data processing platforms or cloud services).

**Table 1. Benefits of implementing artificial intelligence**

<b>Benefits of Implementing Artificial Intelligence:</b>
Improving the quality of products and services
Increase the level of customer satisfaction
Reduced operating expenses
Speed up the decision-making process
Increasing the adaptability of enterprises to market changes

Thus, artificial intelligence is a powerful tool for increasing the competitiveness of enterprises. Its implementation allows achieving high performance indicators and opening new prospects for business development in a dynamic market.

Despite its significant potential, the AI implementation faces a number of challenges:

**Table 2. Challenges and limitations of AI implementation**

<b>Benefits of Implementing Artificial Intelligence:</b>	<b>Description:</b>
Improving the quality of products and services	Enhances the overall quality and efficiency of offerings
Increase the level of customer satisfaction	Boosts customer happiness and loyalty
Reduced operating expenses	Lowers the costs of running business operations
Speed up the decision-making process	Accelerates the time taken to make decisions
Increasing the adaptability of enterprises to market changes	Improves ability to respond to market shifts

The role of AI in increasing the competitiveness of enterprises is extremely significant. Its use allows optimizing the business processes, improving the customer service, creating the new business models, and introducing the innovations. Despite the challenges associated with the integration of AI, the benefits of its implementation far outweigh the possible risks, providing the companies with a long-term competitive advantage.

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## THE ROLE OF THE STATE IN THE DEVELOPMENT OF BUSINESS STRUCTURES IN TRANSFORMATION ECONOMY

Business structures (in the context of this research this definition means economic entities of all the forms of incorporation and legal forms) constitute the basis of modern social and economic systems. Correspondingly, creation and support of mechanisms for their development is one of the main tasks of the state and the business structures themselves [4, p. 97].

Creation of mechanisms and means for business structure development is a process of many aspects that may take place at the following three levels:

- the **macro-level**: actions of state and global institutions:
  - tax and custom means of stimulation or restriction;
  - direct state support in the form of grants, state guarantees and budgetary loans;
  - financing of infrastructure projects;
  - state support of export or crucial import;
  - protectionism and protection from competition from the side of foreign companies;
  - antimonopoly regulation and other means of protection from unfair internal competition;
  - financing of the educational system and other means of human capital asset creation;
  - stimulation of innovation activity, including state financing of research programs;
  - creation and management of state enterprises (including natural monopolies);
- the **meso-level**: actions of formal or informal unions of business structures (associations and unions according to the branch, regional or other principles):
  - collective protection of interests of a certain group of business structure;

- development of standards of the branch;
- mutual consultative support, etc.;
- the **micro-level**: actions at the level of the business structures themselves:
  - process and management system digitalization;
  - creation of modern systems of analytics and decision taking support;
  - actions for supporting innovative development.

As we can see, part of the mechanisms at the first level are regulatory and related to official powers of the state, and some of them have significant market components, in which the state acts as an equal market participant.

Market mechanisms of self-regulation, like the law of supply and demand, the law of equalization of profit rate etc., that act autonomously and are resistant to external administrative influence, operate at the same time with all the aforementioned mechanisms. The market mechanisms of self-regulation predictably operate in a stable formation, but under conditions of transformation economy, their operation may have a distorted unpredictable effect, because the basis of the issue of market and state regulation interaction is the classic contradiction of the needs of entrepreneurs (individuals) and the state. Entrepreneurs are determined to increase their profits (own capital) here and now by definition, using all the available legal means. In contrast, the main task of the state in the economic sphere is ensuring long-term economic stability of both the state itself and its business structures and citizens. This contradiction becomes even more apparent under conditions of transformation economy. Coordination of the aforementioned public and private interests is the main task of state regulation mechanisms [5, p. 53–54].

It should be mentioned that in economic theory of the XX and early XXI century, the position on minimization of state influence on the market functioning mechanisms was strong, but today, the following problems caused by such approach that create threats for long-term development of the global economic system are obvious:

- stimulation of consumer economics has led to rapid depletion of natural and environmental resources, but has not led to corresponding growth of potential of states and long-term stable development;



- rapid development of capital markets and increase of volumes of debts has led to the states having lost an opportunity to sufficiently manage the financial system and forecast and prevent financial crises;

- development of information technologies and non-state payment system has made administrative means of fighting shadow economy not efficient enough, which has led to rapid development of this area;

- development of artificial intelligence and robotized systems and integration of engineering and biological systems create a danger of social disturbances that obviously cannot be balanced by market mechanisms and, correspondingly, need involvement of the state;

- non-uniform economic potential, various geographic conditions, etc. stimulate further concentration of capital and segmentation of the world that cannot be balanced by market mechanisms either.

As about Ukraine, the factor that many enterprises have exhausted their financial and human resources for efficient development without the external assistance within the war is very important to be considered as well.

Therefore, at the modern stage of economic system development, the state is an active participant of the process of creation of mechanisms for business structure development both at the expense of own budgetary funds and at the expense of international assistance funds. Participation of the state should be understood as, on the one hand, state regulation of the economic system and, on the other hand, creation of stimuli and using material and financial resources involved in the area of entrepreneurship on favourable terms or for free [6, p. 264].

However, in terms of the state support issues, the focus should be changed from extensive development to creation of mechanisms considering innovation implementation [2, p. 4] and improvement of efficiency and long-term international competitiveness of business structures, namely:

- conducting redistribution of the state support programs (grants, beneficial financing, etc.) in favour of the projects creating new industries or installing energy conservation and innovative equipment at existing industries and reducing the prime cost; stopping considering creation of working places to be the goal in itself of the state projects without consideration of their efficiency, because this is an extensive way

that is inefficient in the long term. Under conditions of an obvious demographic crisis in Ukraine, automation of manufacturing is required in order to ensure long-term competitiveness of Ukrainian industries. Even if automated equipment is going to cause dismissal of employees in the short term, they are going to be involved in other projects soon;

- expanding the activity in the area of insurance of export-related risks and protection of Ukrainian manufacturers in international markets;

- creating state programs of insurance of military risks, especially in the areas close to combat action regions, because these programs are not developed enough at the level of private insurance companies.

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## **INVESTMENT ACTIVITIES OF NON-STATE PENSION FUNDS: CHALLENGES AND PROSPECTS**

An essential component of the country's pension system is the creation and development of non-state pension funds (NPFs), which as the experience of foreign countries shows are capable of organising private pension provision on the basis of accumulation mechanisms. Another essential aspect of NPF activities is investment. In advanced economies, pension funds are active participants in financial markets. The role of NPFs in this part of their activities, along with other investors, is to inflow long-term investments into the national economy and strengthening of financial markets stability.

Based on the experience of advanced economies, it can be assumed that the improvement of the domestic economy largely depends on the further development of collective investment of all forms, including pension funds, as the citizens savings still remain an untapped reserve for long-term investment in the real sector. Economic growth depends on the flow of funds, so their increase will create conditions for its progress. This will also boost state budget revenues and lead to expansion funding for social programs.

The main financial institutions that influence citizens' pension savings are non-state pension funds. Their responsibilities include ensuring a comfortable retirement and increase pension savings. The development of non-state pension funds contributes to boosted choice and competition in the financial services market, which in turn improves the quality of pension products and strengthens the financial stability of the country's economy.

In accordance with the Law of Ukraine “On Non-State Pension Provision”, these funds are non-profit organisations whose main purpose is to accumulate pension contributions, further manage the accumulated funds and make pension payments [3].

In Ukraine, NPFs are divided into three types: corporate, professional and open. Corporate funds could be established by a single legal entity-employer or by

several legal entities-employers, and other contributing employers have the opportunity to join. Professional funds have both individual and legal founders. They could be founded by trade unions or individuals associated with their professional activities. Open funds are created for any individual, regardless of employment status and place of residence [1].

According to the statutory definition, a non-state pension fund has key characteristics that define its functional responsibilities. The fund is a non-profit organisation, which indicates that it is focused on fulfilling pension obligations to participants rather than making a profit. The key aspect is its pension focus, which is the accumulation of pension contributions and management of assets for pension payments.

The actual profitability level of non-state pension funds depends on the composition of their investment portfolio, as shown by recent analyses. Ensuring the reliability of pension reserves placement is impossible without applying the principle of broadening various financial instruments used, each of which has its own characteristics and peculiarities. Therefore, the degree of dynamism and investment diversification, used by funds when placing their pension reserves is very broad. At the same time, the choice of financial instruments is influenced by a number of economic factors [2, p. 93].

Firstly, the level of fund involvement in the investment activities of the founding corporation as for financial integration. Secondly, the influence of macroeconomic processes on the reliability and market price of certain financial instruments types. Thirdly, the fund's investment strategy, which seeks to ensure an optimal ratio of long-term, medium-term and short-term investments in its portfolio. Fourthly, specialists' qualifications of both the fund itself and the management companies it selects. A negative factor in the development investment is the underutilisation of the main potential reserve for development – long-term investments.

Currently, the following areas of pension assets are transferred for investment: bank deposits (39.8% of invested assets), bonds of Ukrainian resident companies (16.5%), securities whose income is guaranteed by the Ukrainian Cabinet of Ministers (13.7%), and assets not prohibited by Ukrainian legislation (9.8%) [1].

To address the problems of non-governmental pension funds in Ukraine, it is crucial to focus on improving governance, transparency and financial stability. Optimising the risk-return ratio in investment portfolios, monitoring compliance with investment restrictions, using international financial reporting standards, and publicly assessing the financial condition of funds through a disclosure system are steps to ensure the transparency and reliability of the pension system. Expanding the range of financial instruments available on the market will promote diversify investments, reduce risks and increase returns.

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B. Zavaliy, O. Hurko

#### IMPLEMENTATION OF INNOVATIVE FINANCIAL MODELS IN VARIOUS SECTORS OF THE ECONOMY

In today's conditions of rapid technological development and economic globalisation processes, traditional financial instruments and models often turn out to be insufficiently flexible to solve new market problems. Innovative financial models that integrate modern technologies, digitalisation, and new approaches to risk management are becoming a powerful tool for stimulating economic growth, supporting small and medium-sized businesses and implementing environmentally friendly projects. The first theoretical developments regarding the novelty in economics belong to J. Schumpeter, who emphasized it as a driving force of economic development [1].

Today, this approach is taking on new dimensions to digitalization, the emergence of blockchain technologies, crowdfunding, and other modern tools that allow for

the financial model's implementation with high adaptability to market changes. The modern financial sector is characterized by rapid fintech technology development to create new customer service models, optimize lending processes, asset management, and risk distribution. Digital banks operating without physical branches demonstrate a high level of operations automation, reduced transaction costs, and increased service speed. For example, the use of artificial intelligence algorithms to assess customer creditworthiness allows for a significant reduction in the non-performing loan level and optimization of underwriting processes. This approach not only increases the efficiency of financial transactions but also contributes to expanding access to financial services for the population, especially in regions with insufficient banking infrastructure. Crowdfunding platforms are becoming a popular tool for financing innovative projects in various industries – from IT startups to social initiatives and environmental projects.

The decentralized finance introduction and microlending based on the DeFi platform are crucial practical examples of implementing innovative financial models in the banking sector [2]. The state can launch a pilot project where fintech companies in partnership with commercial and non-commercial banks initiate a platform that allows entrepreneurs to receive small loans from investors. With the help of smart contracts, an automated microlending system can be created, where automatic interest accrual and timely repayment of loans will be guaranteed, reducing the risks of the human factor and increasing trust in the system.

The state should also form online platforms where smart contracts will be used to ensure transparent investment collection and tokenization of small and medium-sized business assets. Small and medium-sized industrial complexes can use tokenization to attract investments, and smart contracts will help automatically regulate property rights and income distribution, which will help increase asset liquidity [3]. In post-war regions, where industrial businesses and enterprises will need significant state support, financial monitoring will become a priority issue. In this case, the decentralization and transparency of smart contracts will serve as an alarm signal and temporary operations blocking in case suspicious transactions are detected. The implementation of this financial model will have a positive impact on the transparency of financing in relations between the state and SMEs in the long term.

Thus, the introduction of innovative financial models, such as blockchain technology and smart contracts, contributes not only to the financial processes optimization, but also stimulates economic growth, provides inclusive access to financial resources and contributes to the successful implementation of projects. Practical experience shows that, provided that the conditions of technological support, effective regulation and integration with traditional financial structures are met, innovative models can become an important tool for the transformation of the economy as a whole.

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## **PANEL 4**

### **Actual Problems of Engineering and Technical Sciences and Modern Information Technologies**

*(DNU, Zoom)*

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O. Bahlai, S. Bilogurov, O. Hurko

#### **METHODS FOR ENHANCING THE PROPULSION SYSTEMS FEED UNIT FOR NANOSATELLITES**

The conquest of space is becoming more economically feasible every year. What was once the domain of large corporations is now accessible to universities, research institutes launching their own satellites, and private companies building orbital constellations of spacecraft. As the number of spacecraft increases, so does the demand for propulsion systems, which play a crucial role in orbital insertion, stability maintenance, orientation, maneuvering, and the safe deorbiting of satellites at the end of their operational life. This last aspect has become especially relevant due to new, stricter regulations set by the U.S. Federal Communications Commission, which reduced the allowed deorbiting period from 25 years to just five.

An accessible path to space exploration has emerged through standardized CubeSat satellites [3]. These satellites, built in units of 100x100x100 mm with standardized electrical and mechanical interfaces, enable extensive collaboration among different developers. The CubeSat class allows significantly cheaper access to space since they are typically launched as secondary payloads on large commercial missions. Their capabilities expand considerably with the inclusion of propulsion systems, a field that is rapidly advancing [1]. The ideal characteristics of such systems include minimal cost, high dynamic performance, reliability, and ease of adaptation. At the same time, the development of these systems faces challenges such as strict mass and volume limitations, power consumption constraints, the complexity of manufacturing small-scale components with the required performance characteristics, restrictions on using aggressive propellants and high-



pressure tanks, and the high cost of certified electronic components for space use. There is increasing discussion about a complete ban on aggressive propellants due to worsening global environmental conditions. NASA and ESA programs are shifting toward "green" propellants that are safer for both the environment and ground operations. Finding technical and design solutions that meet these constraints is a relevant research topic today. This work focuses on reviewing a CubeSat propulsion system operating on green monopropellant [4].

To address these challenges, an alternative gas storage and supply system is proposed, replacing high-pressure vessels with solid-state chemical compounds that release gas upon heating. While conventional propulsion systems require continuous high-pressure expulsion, CubeSats with their limited power and extended operational lifetime could benefit from this method. By storing gas in solid compounds, such as metal nitrates or carbonates, which decompose at controlled temperatures, the system could ensure reliable and efficient operation while reducing structural complexity. The concept also opens possibilities for auxiliary thrusters using excess gas, enhancing maneuverability.

Among the analyzed compounds, ammonium carbonate  $(\text{NH}_4)_2\text{CO}_3$  stands out as the optimal choice due to its relatively low decomposition temperature, eliminating the need for additional heaters or catalysts. Unlike other compounds, it releases ammonia, a gas with a high vapor pressure, making it particularly effective for pressurization. This study contributes to optimizing their design by exploring alternative pressurization methods, potentially improving CubeSat propulsion performance while meeting strict safety and environmental regulations. These advancements are essential for the continued growth of the space industry, both in Ukraine and globally.

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## **ADDITIVE MATERIALS IN THE MANUFACTURING OF IMPELLERS FOR PUMP SYSTEMS**

Additive manufacturing will have the greatest impact on on-demand spare parts production since replacement parts are not always readily available. Many old pumps have been in operation for 30–40 years, and when such obsolete units require repair or restoration, finding spare parts can be challenging. In many cases, the drawings or digital models of the parts are no longer accessible. An impeller manufactured using additive manufacturing with fused deposition modeling (FDM) technology can exhibit functional behavior and performance similar to that of the original impeller of a centrifugal pump. This research paper conducts various tests to answer this question and evaluate the manufacturing process of functional parts using FDM [1].

The impellers manufactured using the FDM method were created through the layer-by-layer deposition of material in the XY plane. In the context of FDM technology, the orientation of the impeller on the printer's build platform is a key process variable. The impellers were printed in the Z orientation on XY layers because the resulting surface roughness in the flow direction is of higher quality than that of parts printed in the X or Y orientations. Moreover, in this Z orientation, the blade profile is optimal, as the contour geometry is formed precisely in the XY plane [2].

The fabrication of the first impeller was based on a drawing, with ABS+ chosen as the model material. The main parameters were as follows: layer thickness – 0.3 mm; infill density – 100%; support type – tree. Key printing parameters: nozzle temperature – 220°C; print bed temperature – 85°C; model cooling – none; print speed – 46 mm/s; total print time – 21 hours 50 minutes.

The second version was produced from a provided scan of an existing part, which was then used to create a CAD model. In this case, COPET was selected as the material. The main parameters were: layer thickness – 0.2 mm; infill density – 100%; support type – tree. Key printing parameters: nozzle temperature – 250°C; print bed temperature – 80°C; model cooling – none; print speed – 60 mm/s; total print time – 26 hours.



**Fig. 1. Printed impellers**

Post-processing was applied in the second case. Surface roughness determines the level of hydraulic and frictional losses in the pump impeller. The chemical post-processing involved a 20-second immersion of the impeller in an acetone ( $\text{CH}_3)_2\text{CO}$  (dimethyl ketone) bath. This caused the top layers of the part to melt, improving its surface finish and making it more similar to the original pump impeller. The resulting surface roughness (Ra) values for the original and printed parts were as follows:

**Table 1. Original impeller**

<b>Rear cover</b>	<b>Blades (top Surface)</b>	<b>Blades (side surface)</b>
0.67 mcm	1.6 mcm	1.5 mcm

**Table 2. Printed impeller after processing**

<b>Rear cover</b>	<b>Blades (top surface)</b>	<b>Blades (side surface)</b>
1.1 mcm	0.7 mcm	0.45 mcm

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## **PROBLEMS OF MAN-PORTABLE ANTI-TANK MISSILE SYSTEMS AND THEIR SOLUTIONS**

This topic is relevant in the current conditions for Ukraine, while ATGMs are a fairly versatile weapon that requires constant improvement.

ATGMs are typically designed to engage armored vehicles and other targets based on the principles of “Fire & Forget”, “Fire & Observe”, “Fire to Target Coordinates” and others. The primary focus will be on systems using the first engagement principle, as the operator does not need to adjust the missile's trajectory—the missile self-guides, allowing the operator to quickly change positions, reducing the risk of being detected or targeted by the enemy. At the same time, these missiles are less vulnerable to electronic warfare (EW) measures because the guidance system does not perceive modulated signals, but instead homes in on an infrared radiation source. However, systems with other targeting methods may have lower weight and cost [5].

ATGMs are usually fired in a direct shot, but some also use a top-attack trajectory, allowing them to strike the weakest point in the armor. For example, the FGM-148 Javelin follows this approach: after launch, the missile ascends to an altitude of 150–200 meters and then dives at a 45-degree angle [2].

Let's examine the challenges in development and operation. The high cost of a single missile and the launch unit can limit the widespread use of the system. For example, the Javelin ATGM missile has a small thermal imaging camera in the nose section and a computer that allows it to autonomously track and follow a tank after lock-on, even if the target is moving. In contrast, the NLAW is significantly cheaper due to the absence of a thermal seeker. However, this design choice also means that its power cycle and total operating time are limited solely by the battery. With the Javelin, the thermal seeker head is cooled with argon in the launch unit before firing and must be replaced after each activation. Additionally, it operates for only four minutes, within which a shot must be taken.

The infrared guidance system loses effectiveness in adverse weather conditions such as dense fog, rain, or snow. A solution to this issue is the development and implementation of beyond-line-of-sight operation modes, which enable effective performance even under active electronic warfare conditions. Additionally, integrating multi-sensor technologies – such as laser, infrared, and optical systems – reduce reliance on a single type of signal. For example, the Stugna-P system is equipped with a laser sight, while the Spike LR features a fiber-optic guidance system, allowing the operator to adjust the missile's flight path in real time. Similarly, the NLAW employs a “predicted line-of-sight” (PLOS) mode. The operator must align the crosshair with the target and track it for 3–5 seconds. The launch system's electronics then calculate the trajectory, range, and angular velocity, after which the missile can be launched. This algorithm functions even when the target is only partially visible, such as when only a tank's turret is exposed. After launch, the missile follows a preset trajectory using an inertial guidance system, maintaining an altitude of approximately 1–2 meters above the target. The activation of the tandem-charge warhead is triggered by a magnetic sensor, which detects the presence of a significant metal object beneath the missile. The developer has also refined an algorithm to distinguish between the intended target and other metallic objects along the missile's flight path, preventing premature detonation [4; 5].

Heavy systems are difficult to relocate quickly, reducing operational efficiency and increasing the risk of position detection. Using modern lightweight materials and optimizing launcher design can enhance system mobility. For example, the NLAW system, being lightweight and compact, weighs only 12.4 kg, whereas the Javelin system weighs 22.3 kg.

Insufficient situational awareness and limited remote-control capabilities can lead to targeting errors and slow reaction times in electronic warfare conditions. Implementing a hybrid guidance system and integrating machine-learning algorithms that adapt to changes in the electronic environment and optimize flight trajectory under jamming conditions can help minimize the impact of EW.

In combat conditions, rapid fault detection and preventive maintenance are critical to maintaining operational effectiveness. Integrating health monitoring systems and predictive maintenance, along with a modular design that allows for

the replacement of faulty components, will enable quick diagnostics and reduce repair time during combat operations.

In conclusion, enhancing ATGMs requires not only reducing cost and increasing mobility, but also improving adaptability through AI, advanced guidance systems, and integration into modern combat environments.

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H. Diadchenko, V. Shevtsov, N. Kaliberda

## OBJECTIVE FUNCTIONS IN THE DESIGN OF ROCKET AND SPACECRAFT

In the development of rockets and spacecraft (RSC), the design objective function plays a crucial role. Depending on the set objective function, the corresponding design parameters are selected, which subsequently form the family of flight-technical parameters of the future aircraft. Each of these parameters optimizes the design objective function and characterizes the design quality of the developed object.

Various parameters can be chosen as the design objective function. Most commonly, these functions include minimizing the initial mass  $M$  while adhering to constraints on other mass characteristics, maximizing the flight range  $L$  or altitude  $H$ , increasing the payload mass  $G_p$  under restrictions on the initial mass of the RSC, minimizing cost  $C$  while maintaining a specified

task performance efficiency  $W$ , or maximizing efficiency under cost constraints, among others [1, p. 5–6].

Based on general design principles, the primary objective functions are mass and economic efficiency [2, p. 75]. In most cases, achieving set goals is possible by creating a lightweight and cost-effective structure. However, with constant technological advancements, the requirements for objective functions are also evolving. The priority of mass and cost is gradually losing relevance in the context of modern technological progress, which slows down the development process and reduces the operational lifespan of the flight vehicle. The present demands the consideration and implementation of new fundamental objective functions.

The purpose of this study is to justify the selection of effective operational time as a promising objective function for aircraft design, optimizing it to accomplish most design tasks.

The lifecycle of a structure can be divided into two key periods: the design phase and the operational phase, i.e., the execution of the assigned task [3, p. 5]. As a rule, a significant portion of time is allocated to development, reducing the operational period. The longer the design phase lasts, the higher the likelihood of technological obsolescence before the structure is even put into operation.

To balance these phases, it is advisable to introduce a new objective function – the effective operational time. This function will determine the optimal ratio between the duration of design and operation for each structure according to its purpose. This will help avoid excessively prolonged developments and ensure the relevance and technological compliance of the structure at the time of commissioning [4, p. 65]. Additionally, and importantly, it will extend the operational lifespan of the structure and optimize design and production processes without compromising the quality of engineering work. Monitoring implemented technologies will enable the effective combination of proven solutions and innovative developments, contributing to the sustained relevance of the structure.

Moreover, defining effective operational time will facilitate a more precise selection of criteria for the fundamental and structural-layout design of the aircraft,

as well as the reliability and efficiency of its systems. This is particularly important for rocket-space and military technology, where operational requirements can vary significantly depending on specific tasks.

The main advantages of the effective operational time function include balancing the design and operational processes of the aircraft, extending the operational period, preventing development obsolescence, and accelerating the advancement and implementation of new ideas and technologies.

**Conclusion.** Prospective design and engineering solutions that consider operational time are more competitive in both domestic and global markets. The introduction of effective operational time as one of the primary objective functions opens new horizons for rocket and space technology, especially when considering that one of the main design objectives for future RSC involves missions to explore Mars, the Moon, and other celestial bodies in the Solar System.

In the future, effective operational time will also allow for forecasting trends in the development and implementation of new technologies, which, in turn, will not only accelerate the development time but also optimize the lifecycle of RSCs.

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## **USING DIGITAL PLATFORMS FOR PROVIDING PSYCHOLOGICAL ASSISTANCE DURING THE FULL-SCALE WAR IN UKRAINE**

The full-scale war in Ukraine has caused a severe humanitarian crisis accompanied by numerous psychological traumas among the population. People suffer the loss of the loved ones, are forced to leave their homes, face combat actions, as well as physical and emotional exhaustion. According to the Ministry of Health of Ukraine, the level of stress and anxiety in society has significantly increased, with about 50% of Ukrainians expected to require psychological assistance, highlighting the need for its accessibility to everyone.

Digital platforms have become a key tool for providing such an assistance. In conditions where people are in military zones or displaced, online services allow them to receive professional support while staying safe. The relevance of these platforms is increasing due to their accessibility, anonymity, and ability to operate 24/7.

Remote psychological counseling is a type of psychological assistance provided in challenging situations arising in relationships with others, self-understanding, and attitudes towards the world, events, and phenomena under complicated living conditions. Remote counseling helps individuals find ways out of difficult situations and is also aimed at preventing potential problems that clients may foresee and their undesirable consequences [4, p. 386].

Ukrainian digital services, such as “Tell Me”, “Help24”, “Resilience Hub”, and “Ukriednist”, provide a wide range of services, from crisis counseling to long-term therapy. For example, the “Tell Me” platform utilizes cognitive-behavioral therapy methods, enabling effective work with post-traumatic disorders and anxiety.

These services are particularly important for people unable to access traditional assistance due to geographical or social constraints or the dangers of martial law. Online consultations are available even in the most remote parts of the country where psychologists are absent. Thanks to digital platforms, help is accessible at any time of the day, allowing people to seek counseling when they need it most,

especially military personnel. The possibility of receiving support without revealing personal information reduces barriers to seeking help, particularly for those fearing stigmatization. Digital services can simultaneously serve a large number of people, which is critical in conditions of high demand. For internally displaced persons and those abroad, these platforms are often the only way to receive psychological support in Ukrainian. Thus, under crisis, the demand for psychological assistance grows, which can be provided for the benefit for health of both clients and consulting psychologists. Currently, remote counseling is the response to changes in people's living conditions when direct, face-to-face communication is complicated [4, p. 379].

Despite significant advantages, there are challenges which limit the effective use of digital platforms for providing psychological assistance. In military zones and remote regions, there are internet disruptions or no access to devices at all, which complicates the use of online services. The number of qualified psychologists capable of working online is limited. Many specialists face emotional burnout due to the high workloads.

Shifting psychological assistance to an online format is a qualitatively new transformation of the psychological practice, requiring a different approach to professional activity. However, to organize effective online consultations, a specialist must be technically prepared and skilled in using various video communication platforms. New tools for diagnostics, counseling, corrective work, and educational activities require practical psychologists to undergo continuous training and adapt quickly to changing working conditions [3, p. 64].

To determine the possibilities and limitations of using video communication platforms by practical psychologists in remote work, an online survey was conducted among psychologists in educational institutions. To the question "Do you conduct online counseling?" 76.5% of psychologists answered affirmatively, indicating the demand for psychological assistance during the war. Another question is focused on identifying the services and applications specialists use for providing online services. 43.1% of psychologists chose the answer "other", citing tools such as Viber, phone calls, and email. A significant number of specialists (37.3%) use the Zoom service, while 15.7% prefer Skype for consultations, and 5.7% have mastered working with Google Meet. The JitsiMeet service was unfamiliar to those

surveyed. Young specialists are active users of various video applications, while psychologists with over 15 years of experience prefer Viber communication. At the same time, respondents noted that technical capabilities allow using other platforms. Regarding the reasons for the limited use of services, psychologists highlighted the following: “Did not know that such services exist” (45%), “Yes, but don’t know how to use them” (24%), “Tried, but didn’t fully understand the capabilities” (29%), “Used to working with Viber” (2%). The study revealed the need to enhance the competency level of practical psychologists regarding the use of services during online counseling [3, p. 65].

In wartime, protecting users’ personal data is particularly important. Information leaks could pose a threat to people’s safety. Moreover, the issue of receiving low-quality psychological assistance on digital platforms should be considered. When communicating on specialized forums or in chats where anyone can express their opinion, individuals do not receive full therapy but instead rely on advice from a virtual consensus, never reaching a comprehensive individual consultation with a specialist [1, p. 65].

To address these problems, it is necessary to ensure internet access in military zones and temporarily occupied territories through mobile access points or satellite internet. It is also important to create training and emotional support programs for psychologists to improve their readiness to work under wartime conditions. Informational campaigns about the importance of psychological assistance and instructions on how to use digital platforms should be conducted. Most importantly, digital platforms should be integrated into the national healthcare system to ensure stable funding and regulation. Security measures should also be prioritized by implementing high standards for encryption and protecting users' personal data. Digital platforms have become an integral part of the system for providing psychological assistance during the war in Ukraine. They ensure accessibility and effectiveness of support even under the most challenging conditions. However, their further development requires resolving technical, social, and staffing issues, as well as an active support from the state and international organizations. Integrating these tools into the national healthcare system and informing the population will contribute to strengthening the mental health of Ukrainians during the war and beyond.

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I. Kolesnichenko, O. Khaminich, N. Kaliberda

## OPTIMIZATION OF THERMAL PROCESSES IN THE HEAT AND POWER INDUSTRY USING DIGITAL TECHNOLOGIES

The purpose of this study is to analyze the key issues of energy consumption and efficiency in the industry, examine current trends in energy process automation, and assess the potential impact of artificial intelligence and big data on improving energy efficiency. An analysis of the greenhouse gas inventory report under the Kyoto Protocol by the Ministry of Environmental Protection and Natural Resources of Ukraine shows significant changes in greenhouse gas emissions compared to 1990. For instance, the share of carbon dioxide, methane, and nitrous oxide in total emissions in the energy sector was 81.7%, 17.6%, and 0.7% in 1990, whereas in 2019, these figures changed to 78.2%, 21.1%, and 0.7%, respectively. This indicates a gradual increase in methane emissions, which may result from the rising extraction of natural gas and its transportation losses. Greenhouse gas emissions in the energy sector are divided into fugitive emissions from fuels and emissions from energy enterprises' activities [1].

The main factors leading to environmental degradation:

- the use of low-quality fuel;

- outdated production technologies and equipment;
- high energy and material intensity;
- high concentration of industrial facilities;
- an unfavorable industrial production structure with a high concentration of environmentally hazardous technologies;
- lack of adequate environmental protection systems (treatment facilities, recirculating water supply systems, etc.) and a low level of operation of existing environmental protection facilities;
- absence of appropriate legal and economic mechanisms to stimulate the development of environmentally friendly technologies and environmental protection systems;
- insufficient environmental protection control [2].

The specifics of energy supply services, particularly the need to process large amounts of information in real time – such as weather forecasts, consumption and production volumes, equipment condition, and power grid operation – create opportunities for AI applications in energy sector. For example, weather forecasting can anticipate changes in consumer energy demand, allowing better planning of generating capacity to increase the efficiency of existing installations. AI can also help stabilize the energy transmission system by detecting anomalies in production and consumption patterns and developing real-time solutions (online) to address these anomalies by activating or deactivating energy sources or additional equipment to ensure system stability and reliability [3, p. 30].

Modern boiler automation systems can guarantee safe and efficient equipment operation without direct human intervention. Human functions are reduced to online monitoring of device performance and parameters. Boiler automation solves the following tasks:

- automatic start and stop of boiler units;
- power regulation of boilers (cascade management) according to preset parameters;
- management of feed pumps and control of heat carrier levels in operational and consumer circuits;
- emergency shutdown and activation of signaling devices when system parameters exceed set limits [4].

The main idea is to transform the three-dimensional operational area (cost, power, heat) of each CHP plant into a piecewise linear curve, enabling faster identification of optimal solutions [5, p. 1219].

A well-designed and managed digital infrastructure can contribute to environmental sustainability and reduce greenhouse gas emissions.

Using IoT and artificial intelligence (via air quality sensors placed on public transport, streetlights, benches, and trash bins), real-time pollution levels and their causes can be determined. Heat recovery significantly improves the energy efficiency of the ventilation system, reducing heating and air conditioning costs.

### **Conclusions:**

1. The issue of high energy consumption and low efficiency remains a key challenge for the industry.
2. The use of modern technologies, such as artificial intelligence and Big Data, enables consumption forecasting and optimization of energy systems.
3. Automation of boiler installations and digital process optimization contribute to cost reduction and greenhouse gas emission reduction.
4. Future research should focus on the integration of renewable energy sources and the development of smart energy systems.

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## **MYTHS AND TRUTHS ABOUT WIRELESS ENERGY TRANSMISSION TECHNOLOGIES**

Everyone knows for sure that living in the 21st century, it is very pleasant to use wireless gadgets, it is simply more convenient than using their wired counterparts. There are plenty of wireless technologies these days: wireless chargers, headphones, mice, vacuum cleaners, screwdrivers, speakers, and what else is not there. But is it correct to call them that? After all, gadgets still need wires for recharging. And, probably, it is more accurate to say that now is the age of some semiconductor technologies. But it is known that already at the end of the 19th century Nikola Tesla experimented with wireless energy transmission. And although he failed to implement his idea, maybe, we can do it? Well, at least partially, and if not across the entire globe, then at least deliver energy to our gadgets so as not to constantly look for an outlet. Moreover, many new ideas have been added to Nikola Tesla's ideas, using lasers, microwaves or even magnetic beams. In this article, you will learn what real wireless energy transmission might look like. You will learn about drones that can circle in the air forever, roads that charge electric cars on the go, 19 kW transmission on the ground, and of course, we will try to understand whether wireless energy transmission across the entire Earth, as Nikola Tesla imagined, can work.

First, we must consider the wireless energy transfer that is widespread – induction charging. In them, one coil creates an alternating magnetic field, and if another one is nearby, then according to the law of electromagnetic induction, an alternating electric current arises in it, then it is rectified and fed to the battery. The same thing happens in transformers, both power and power adapters, metal detectors, induction cookers, in bank and transport cards, there, by the way, is essentially a small computer inside. And it receives power from the terminal through the receiving coil when you bring the card to the terminal. Charging toothbrushes and nostril trimmers – that's all it. The principle is simple, boring and has been known for almost 200 years. But the most important thing is that it works only at short distances, in the so-called near field – this is the area near the emitter in which the electric

magnetic fields still have a fairly strong effect on the flow of current in the source itself, well, and one can say that they do not yet break away from it, but stay close. For small flat coils at frequencies of hundreds of kilohertz and megahertz, the near field extends approximately to the diameter of the coil. For example, the most popular wireless charging standard “Chi” is up to 4 cm [1]. Does this mean that it is impossible to charge something at a greater distance, and we are doomed to eternally tying our gadgets to wireless charging stations with wires inside? No! A wireless future is possible, and even such antediluvian principle can be modified so that, for example, you can charge your phone while you are sitting at the table. And for this, it is necessary to overcome several fundamental obstacles.

Firstly, the alternating current in the coil’s experiences not only the usual active resistance due to the interaction of electrons with the crystal lattice and other fields, but also reactive resistance, due to the fact that electrons, one might say, have a certain inertia, and it is not so easy to swing them. While the coils are close, a strong field makes them oscillate without problems, but with increasing distance, it weakens greatly. And although reactive resistance does not lead to losses, it does not allow a large current to be started. But reactive resistance depends on frequency, and at one specific frequency it becomes zero. This frequency is called resonant, if such a current oscillates in the coils – this is called magnetic resonance coupling. It complicates the system a little, because the resonant frequency depends on the distance and it has to be constantly adjusted. Well, at short distances it even interferes, because the receiving coil begins to strongly influence the transmitting one, but with its help it is possible to achieve energy transfer efficiency of 80–90% at distances of the order of the coil diameter and 10–20% at a distance of even 3–4 coil diameters. And in fact, now essentially all wireless charging standards support work with magnetic resonance communication [2], so essentially the problem is solved.

But there is another problem – the mutual orientation of the coils, there is literally one position in which energy is transmitted effectively. A huge transmitting coil can be a solution, the near field is larger there, further away and, accordingly, some shift is already possible. A large size can solve the problem of shifting the receiving coil to some extent, and it does not have to be as huge, so smartphones the size of a frying pan will not be. But such a scheme will definitely not be able to



solve the problem of tilting the receiving coil. Tilting the coil is, in general, the biggest difficulty. The fact is that efficiency strongly depends on the angle, if the receiving coil is perpendicular to the transmitting one, the magnetic flux does not pass through it at all and there will be no charging at all. What to do? Use a phased array of several coils. If you apply alternating current to them not simultaneously, but with some phase shift – you can configure a field of a rather unusual shape, and in any position of the phone, the magnetic flux will pass through it, and effectively transmit energy. The coil array, by the way, also significantly increases the range. It can focus the magnetic field into a narrow and long beam, one might say, a magnetic beam [3]. Moreover, in any direction, and it is quite easy to ensure wireless charging at a distance of up to tens of centimeters, this technology is similar to “MIMO” in Wi-Fi, and beam forming in 5G networks, and therefore this technology is sometimes called “Mag MIMO” [4]. And here it is, the recipe for success: resonance and an array of coils, but, unfortunately, there are no such chargers on sale yet. This is strange. The technology is promising. And in fact, a lot of work is being done in this direction, there is a huge number of studies, articles, and scientific publications. There is a startup “Yank Tech” “Mother Box” [5] charging several devices on the table, there is a prototype of “Air Charge” from “Infinix” [6]. So why is such a promising idea, a multi-coil resonant charger not on sale? Well, perhaps it is a combination of factors: first: it is quite difficult to make everything work at one resonant frequency, so the technology is expensive, compared to a wire – multiple times. Second: all this works at radio frequencies, and there are strict restrictions on maximum power, and manufacturers do not want to bother with this. Well, and third: at a distance of half a meter, the efficiency will be 10–15%, and 3–4 watts of power will reach the device, for Nokia 3310 or the first iPhone – this is normal, but we want to charge modern devices, and for them this is not enough. But there is hope for the devices of the future, because the energy efficiency of chips, screens, radio modules, etc. is only growing, so maybe one watt will be enough. Therefore, it is quite possible that wireless charging in some time will become completely different.

But where they are good in the form in which they already exist is in charging electric cars. Wireless charging of cars is no longer inferior in power to wired charging. There are already specifications that can transmit 11 kW (Standard “SEA J2954”) for

cars, and 500 kW (Standard "SEA J2954/3") for buses and trucks, due to large coils in the parking lot and in the bottom of the car [7]. In this case, the coils are always parallel, the distance between them is only about 10 cm. So with precise alignment, the efficiency of energy transfers reaches 90%, or even more. But what is even cooler is that wireless charging of electric cars can be dynamic, that is, right on the move! Many test roads are already being built that charge cars right on the move. In these roads, coils are rolled right into the asphalt and a system for their rapid activation is installed. So even at a speed of 100 km / h, efficiency is not lost. Even now, we can achieve a dynamic charging power greater than that spent on the movement itself. So after the tests, the electric cars have a battery charged more than before the race. Sounds like a success. In this case, electric cars make even more sense, and not only is it convenient, but you also drive and feel like a trolleybus.

A distance of 10, 20, 50 cm is, of course, good, but you must agree that it is a bit small, we want to transmit energy over tens and hundreds of meters, maybe kilometers. It is still a long way from N. Tesla's ideas, we will come to this a little later, but still, we are talking about quite decent distances. So, it is not advisable to use the near field here, we need the far one – this is the area where the fields no longer affect the source in any way, because, one might say, they break away from it and fly away at the speed of light. In general, these are electromagnetic waves that carry energy at low frequencies, the wave is tens and hundreds of meters in size, and in order not to lose all the power, receivers of simply colossal sizes are needed, so this is not suitable for gadgets, but at microwave frequencies, that is, several gigahertzes, the waves are about centimeters in size, and they are already quite easy to direct, focus and send to small devices. And it not only works, it works very well. For example, in 1964, the company "*Raytheon*", which is the manufacturer of the first microwave ovens, under the leadership of Dr. William Brown, developed a small helicopter [8], the duration of the flight of which is practically unlimited. Because it received energy from the Earth from a microwave beam of up to 5 kW, the beam was formed using an elliptical plate exactly under the helicopter. Its rotor was 2 m in diameter, weighed 2.4 kg, and had a lifting capacity of 680 grams. In experiments, the helicopter rose to a height of 17 m, and hung there continuously for 10 hours, the most interesting thing is how to convert microwave energy into regular direct

current for the motor, for this they invented such a thing as a rectenna – this is an array of small antennas, each of which is connected to a rectifier diode, the radiation induces alternating current in the antennas, but the diodes force it to flow in one direction, which is what is needed to power the motor. Brown's helicopter was purely experimental and hovered only over one point, but the drone from the Canadian project “Sharp”, developed in the eighties, could fly indefinitely in any direction. The aircraft with a wingspan of 36 m was supposed to rise to a height of 21 km and cut circles with a diameter of 2 km over the desired territory at a speed of up to 200 km/h. On board was a receiving rectenna with a diameter of 4.5 m, and on the ground – a source of a microwave beam of several hundred dishes with a total power of 500 kW. Such an eternally patrolling drone was planned to be used for television broadcasting, as something between satellite TV and broadcasting from towers. Several non-full-size prototypes were built, and they flew successfully. But by the end of the eighties, the project could not withstand the competition with cheaper satellite launches and a network of low-power ground towers, and was closed. But who managed to come up with where such a principle would be useful is the people's, beloved by all Xiaomi? Three years ago, they rolled out a concept of a truly wireless charger for phones – “Xiaomi Air Charge” [9], in it a transmitting phased array of 144 antennas in the millimeter range forms a beam and directs it to the device, and the rectenna converts it into an honest 5 W of power. And all at a distance of several meters, like 5 W is not enough, but charging starts as soon as you enter the room, you don't even need to think about it. It is encouraging that Xiaomi is not the only one developing such a charger, Motorola showed something similar, and the company Ossia since 2013 has been offering the “Cota” technology [10], which works on the same principle, but at a frequency Wi-Fi, and providing up to one watt of power. Not enough, of course, but firstly, this is just the beginning, and secondly, the energy efficiency of gadgets is growing, and someday, maybe this will be enough. The most interesting thing is that such remote charging can even conceptually change our gadgets. For example, they will not have a large battery, because energy can be supplied to the device continuously. Not only at home but also on the street, in shopping centers, at stadiums, anywhere! We are already constantly online, because huge mobile networks are set up around us, and there is Wi-Fi even at bus stops. So why can't

similar networks appear for energy transmission? Well, of course, if it is effective, economically advantageous, etc. Of course, there are many nuances, and so far this is most likely far away, but at least at the physical level there are no prohibitions on this.

But let's get back to long distances. Let's raise the stakes and aim for a distance of tens and hundreds of kilometers, this is already the scale of main power lines. Is it really possible to cope without wires here? It seems that we can already start talking about Nikola Tesla, but the scale is even greater there! Now I will tell you about another proven method: microwave rectenna. In 1974, William Brown conducted another impressive experiment. He transmitted 30 kW of power over a distance of one mile without wires, the efficiency of energy collection and conversion was an impressive 82%, and this is one of the highest figures to date. Similar experiments are being conducted today, in 2008 it was possible to transmit 20 watts over a distance of 148 km, in 2015 Mitsubishi Heavy Industries demonstrated the transmission of 10 kW over 500 m, and the company EMROD generally offers power transmission lines from 15 by 15 meter rectenna, stretching in a chain for tens of kilometers [11]. However, the final efficiency of such systems rarely exceeds 50%. EMROD generally claims 36%, that is, more than half of the energy is irretrievably lost. For comparison, a conventional wire power line with a voltage of 10 kV loses only 10% of the energy over a distance of 5 km, and if the voltage is 500 kV, the same amount is lost over a distance of 1200 km. Then, is there any sense in transmitting energy by microwaves? Perhaps, yes, there is. Well, for example, when there are no other options to transmit energy, or so much of it is produced that even if half is lost, it's not a big deal. Too much energy – this, of course, sounds like an oxymoron, like extra money or free time. But this is only for now, in the future such examples may well appear.

All of the above is very cool. But it all just pales in comparison to the ideas of Nikola Tesla, he was considered a true genius of wireless energy transmission. And indeed, near the Tesla coil, lamps light up right in your hands, and if desired, you can even power some devices, and the larger the coil, the greater its range of action, of course. But it is worth moving away to a decent distance, and the efficiency of such transmission falls simply catastrophically. The field decreases greatly with distance, and most of it begins to be lost simply in the form of radiation. In fact, this is still wireless transmission in the near field, so there is no need to talk about long

distances. However, Tesla improved his ideas and, as he believed, was able to overcome this limitation. By the beginning of the 20th century, he developed a system for transmitting energy without wires, all over the globe. Without any repeaters, bulky rectenna, complex converters, and even, practically, without losses. Just imagine, there is just a transmitting and receiving station, and that's it! Isn't that what we wanted? So, what did he come up with there to make his ideas work? There is no exact data. But from numerous articles and lectures of Tesla [12], we know at least two principles that he planned to use in his wireless world system. Let's discuss them and understand whether it will work, and whether it is possible to repeat it today? So, the first principle: the conductivity of the earth. It sounds strange, because we consider it an insulator. But this is only on a local scale, globally everything is the opposite, because the current can be distributed and flow over a huge cross-section. So the total resistance will be low. The conductivity of the Earth was actively used in the 19th century in a single-wire telegraph, and is used even now! For example, in a single-wire power transmission line, the "SWER" system [13], with a return through the earth. 19 kV is passed through a single wire, and the second contact is the earth, can you imagine? In our country this is rare, but, for example, in Australia there are more than 200,000 km of the "SWER" line. It does not sound that difficult, however, for efficient energy transmission across the entire Earth, conductivity alone is not enough to reduce losses to zero, Tesla planned to use resonance. He proposed to run alternating currents in the Earth at a frequency where the reactive resistance is minimal, and to tune the receiving coils to the same frequency. He even gave an analogy that the Earth is a ball filled with liquid, and the transmitting coil is a piston that compresses and discharges it, and if at any point you put another coil tuned to resonance, these small oscillations will slowly swing the current in it, like a swing, and a large potential difference can be removed from the coil. Actually, Tesla built a huge coil to pump the Earth with alternating current. It is said that at the beginning of the 20th century he was literally one step away from launching his wireless system, but was prevented by the machinations of wily energy companies who did not want to give away energy for free, and deprived the physicist of funding at the most crucial moment. Yes, Tesla did not have enough funds in those years. But is this scheme realistic in practice? Now we know much more about radio waves,

about high-frequency currents. And, perhaps, this concept is not feasible. And there are several good reasons for this. First of all, Tesla wrote directly that the theory of propagation of Hertz waves, that is, radio waves, is erroneous [12]. And he believed that signals do not go through the air, but through the ground. Grounding was often used then, so, in principle, this was a logical assumption. But now it has become clear that the capacity of the Earth is not so important, and radio waves are reflected from the ionosphere, bend around the Earth. And Hertz was right, and Tesla was wrong. But in fairness, I will note that then everything was new, radio waves had just been discovered, so anyone could make a mistake. It is strange that Tesla did not take into account the Skin effect [14]. It is known that alternating current does not flow through the entire cross-section of the conductor, but is pushed to the surface, and the higher the frequency, the thinner the layer it flows through. For example, at 20 kHz, the current will flow through the Earth's layer for only a few kilometers, and not throughout its entire thickness. So the resistance and losses will be simply monstrously huge, and there is no point in this idea at all. And let me remind you that resonance means an incomplete absence of resistance. Only its reactive part is zeroed out, and the active, ordinary resistance does not disappear. In general, only the conductivity of the Earth will not work. That's for sure. But there is another principle that Nikola Tesla could have used – the conductivity of the atmosphere. It also sounds unusual, because, it seems, air does not conduct electricity. Well, firstly, at high voltage a breakdown occurs. The air is ionized and becomes a conductor, this, trivially, happens in lightning. And secondly, at an altitude of more than 30 km there are quite a lot of ions, which means there is an excellent conducting layer above us, which is called the ionosphere. What if we use it? It is believed that with the help of his coil, Tesla could pump the ionosphere with great energy, and not with giant lightning, but with radio waves at a frequency resonant with the ionosphere. Lightning is just a parasitic effect, because through light radiation, through heat, they carry away a lot of energy, and only reduce the efficiency. Well, the receiving coils, shorted to the ground, would remove the potential, and here you have wireless energy. But, alas, this will not work either, because of the huge losses in the ionosphere. This is not an ideal metal sphere, it is quite inhomogeneous, and some currents constantly flow in it. And this means that heat and radiation are released, and sooner or later we will lose all the pumped energy. Add to this

that radiation occurs with losses due to heating, and not all the energy is absorbed either. So the final efficiency of the entire system turns out to be extremely low. And if we also take into account that the gigantic potentials in the sky will constantly induce currents in conventional wire networks, and put them out of order, the question arises whether we need it at all, such? This method of energy delivery may work, but, alas, only on paper. In practice, everything is more complicated, the chosen conductive medium is so far from ideal that no tricks will help us.

As you can see, not everything is so simple with this wireless energy transfer. Physics and technology offer us many options for how it can be arranged. But in any of them, we have to make so many compromises, to pay such costs, that before the widespread distribution of wireless electricity, as Wi-Fi or 4G/5G networks are still a long way off. However, this does not mean that all work on wireless energy is useless. After all, if humanity manages to effectively distribute wireless energy, as well as wireless communication, then colossal opportunities will open up before us. For example, conducting communications to hard-to-reach places, improving environmentally friendly transport, the evolution of wearable gadgets, long-distance space travel, and much more. So let the final goal be difficult to achieve, but even the path to it will bring many benefits.

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S. Lazarets, S. Mamchur, O. Novikova

## OPTIMIZATION OF FRICTION WELDING PARAMETERS FOR ENHANCING THE QUALITY OF CORROSION-RESISTANT STEEL AND COPPER JOINTS

In the context of technological advancements, the development of reliable joints between dissimilar metals, such as 12X18H10T stainless steel and M1 copper, remains a critical challenge for industrial applications. Metals continue to play a pivotal role in aerospace, automotive, and mechanical engineering industries due to their strength, durability, and thermal conductivity, despite the increasing use of composite materials. However, differences in melting points, thermal conductivity, and chemical reactivity of these materials complicate the welding process, often resulting in the formation of brittle intermetallic phases and oxide inclusions. Friction welding, as a solid-state joining technique, ensures high joint integrity without melting the base materials, making it an effective solution for such systems [1]. The quality of 12X18H10T-M1 joints is governed by process parameters – relative rotational speed, heating pressure, upsetting pressure, and deformation degree – which influence the microstructure and mechanical properties.

The 12X18H10T stainless steel, valued for its corrosion resistance and thermal stability due to titanium stabilization, and M1 copper, recognized for its



excellent thermal and electrical conductivity, necessitate precise control of diffusion at the interface. Optimal friction welding parameters – rotational speed of 0.98–1.0 m/s, heating pressure of 50 MPa, upsetting pressure of 200 MPa, deformation of  $9 \times 10^{-3}$  m, and upsetting time of 3 s – ensure high joint strength. These conditions produce a uniform fine-grained structure on the copper side, parallel to the weld surface, and reduce the concentration of carbide inclusions in the steel, enhancing ductility [2]. Microhardness in the deformation zone of the steel ranges from 2260 to 2160 MPa, and in copper from 590 to 460 MPa, indicating uniform stress distribution and the absence of significant structural defects.

Suboptimal conditions, such as a rotational speed of 0.4 m/s and both heating and upsetting pressures of 80 MPa, lead to reduced strength due to the formation of copper oxide particles in the diffusion zone. Prolonged heating (up to 90 s) at low speeds promotes internal oxidation, resulting in structural inhomogeneity and increased etchability of the weld. Microhardness in such samples reaches 3240 MPa in steel and 1020 MPa in copper, reflecting stress concentration and degraded properties. Increasing the welding speed to 1 m/s reduces process time by a factor of 10, minimizing oxidation and stabilizing the diffusion zone [1; 3]. Pressures of 50–80 MPa provide an optimal balance between speed and joint quality, whereas lower pressures (30 MPa) extend process duration and compromise strength.

Control over friction welding parameters enables tailoring of the microstructural characteristics of 12X18H10T-M1 joints. High rotational speeds and balanced pressures decrease the presence of oxide and carbide phases, ensuring structural uniformity and weld reliability. Micro-X-ray spectral analysis reveals a thin diffusion zone with uneven copper concentration peaks under suboptimal conditions, while optimal parameters stabilize this process. These findings highlight the potential of friction welding for joining dissimilar metals in industrial applications. Optimization of speed and pressure not only enhances mechanical strength but also mitigates defect risks, such as microcracks, which is critical for highly loaded structures.

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O. Lysenko, O. Kolesnichenko, N. Kaliberda

## **PROBLEMS AND PROSPECTS OF USING PNEUMATIC MOTORS**

If we do not take into account large-scale wars, then in the opinion of most people the most important problem for the future generation is global warming. According to many people, the main cause of global warming is greenhouse gases, about 14–16 percent of which are cars, ships, airplanes, and other mass-produced vehicles that run on internal combustion engines. The internal combustion engine is undoubtedly one of the most useful inventions of mankind, thanks to which people were not only able to easily move from one point to another, but also to do it faster than before. Thanks to the internal combustion engine, people, in addition to the earth, conquered the sky and the great water (ocean). As with many famous inventions of mankind, due to the novelty of the invention, people do not immediately realize the consequences of the harmful effects on the planet. A simple example: after the discovery of radioactive elements by Pierre and Marie Curie, they began to be added to almost everything they could get their hands on – from cosmetics, to dyes for jewelry, to medicinal ointments. Only after years did it become clear that a large amount of radiation causes radiation sickness in humans. The same is true with internal combustion engines: only over the years did people realize that they harm the environment. Internal combustion engines are not the only engines that have been widely used in mass vehicles. Before the era of internal combustion engines, steam engines were known and widely used, later, when people began to worry about the environment, electric motors gained popularity, which quickly took the lion's share in the production of new cars. In the opinion of many people, the sharp increase in the popularity of electric vehicles can be attributed to the development

of the so-called “green energy”. Green energy is the use of renewable energy sources. Green energy is called environmentally friendly because it does not produce such harmful emissions or environmental consequences as CHP, HPP and NPP, although the so-called catastrophic harmfulness of NPP can be argued, because, as is known, thanks to scientific research, NPP does not produce such harmful emissions as CHP, but the main disadvantage of NPP is the disposal of waste, which significantly pollutes the environment. As for HPP, they are harmful because they change river ecosystems, change the climate, and often require the flooding of large areas for construction. A vivid example: the construction of the Dnipro HPP, the Soviet authorities flooded approximately 50 villages to build the station. And what about CHP? This is considered the most environmentally friendly method of generating electricity due to factors such as water and air pollution and greenhouse gas emissions. Because of these factors, people began to use green energy and electric cars, but are there even more environmentally friendly engines and cars based on these engines? Of course, electric motors do not emit harmful emissions into the atmosphere, but they require large batteries to power them, the production of which actively uses fresh water reserves to produce electrolyte, and toxic solutions and reagents are used for cathodes. Causes significant greenhouse gas emissions. Difficulty in disposal, or violation of standards, can lead to the leakage of toxic substances and heavy metals into the environment. There are also such types of engines as pneumatic and hydrogen. Pneumatic engines operate on compressed air, and hydrogen engines operate on hydrogen, which is used instead of fuel. One of the simplest methods of producing hydrogen is the electrolysis of water, a mechanism that converts water into hydrogen, is not large in size, and it can be placed in a car, as manufacturers of such cars do, but this requires fresh water, which is a limited resource, and the use of sea or ocean water, despite the fact that it is also a limited resource, is dangerous due to its high salt content; during electrolysis, a process of releasing harmful chlorine will occur, which is dangerous. Therefore, the option of using pneumatic engines for cars remains. They use compressed air as a driving force, so the so-called exhaust is when literally air taken from the atmosphere enters the atmosphere again. Instead of gas tanks or batteries, compressed air cylinders are used. It sounds like something incredible, but is everything so easy and simple with

transport on pneumatic engines, and why are they not as popular as electric transport? Therefore, to find out why pneumatic engines have not gained such popularity, in this article I will analyze their advantages and disadvantages compared to internal combustion engines and electric motors.

The first vehicle on compressed air was manufactured in France by the Polish engineer Lulu Mekarski in 1870. It was patented in 1872–1873 and tested in Paris in 1876. In 1992, a four-cylinder engine was designed and installed in a car that traveled 100 kilometers on a single tank of fuel. The engine was designed by Guy Negre. Despite such promising features, pneumatic motors have found widespread use in narrowly focused areas, such as medical instruments. Almost every one of us has seen a dental milling machine that runs on compressed air. Often, these motors are used where there is a high risk of detonation due to gas leaks, etc. For example, mining tools. Often, underground natural gas leaks can occur in mines, so in order to reduce the likelihood of a purpose, oil refineries use tools that run on pneumatics. Even when repairing cars, pneumatic tools are used. One can list the areas of application of pneumatic motors for a long time, but one thing can be said for sure: they have greatly facilitated human life, and in some areas, they constantly save it. With all of the above, there is not a single serial car running on a pneumatic engine. There is only one company that has created one prototype, the name is Motor Development International.



**Fig. 1. This car runs on a pneumatic engine**  
**(Photo taken from the official website of Motor Development International)**

Characteristics of the car of this company: engine with a volume of 430 cm<sup>3</sup>, maximum power of 10.2 horsepower (7 kW), maximum torque of 45 Nm. Tank volume 125 liters (2 pcs.), total 250 liters with a pressure of 248 bar, which is approximately 244.8 atmospheres. Curb weight 350 kg. Maximum speed 80 km/h. Range in the combined cycle – 300–360 km. This car has small dimensions and weight, which can be considered an advantage, because, as written in the article “COMPRESSED AIR VEHICLE: A REVIEW” Saurabh Pathak, Sreedhar Vulloju, the low weight of the car increases maneuverability, reduces the cost of starting the car and stopping. We can say that this is the only existing car with a pneumatic engine. This factor makes it almost impossible to compare physical indicators, because most equations will give approximate answers, which will ultimately lead to inaccurate results. To obtain accurate results, it is necessary to create engines with the same maximum power, cylinder capacity, in order to compare air engines, internal combustion engines and electric. Only then will we be able to obtain data on the amount of useful work obtained from one liter of oil fuel, one kilogram of air and one kilogram of electricity. What can be said unequivocally is that, looking at the characteristics of this car, we can say for sure that the future of cars on compressed air is. What can be achieved by comparing air engines? Let's start with the advantages. The first one can be attributed to the simplicity of the design compared to internal combustion engines and electric motors. Air engines have a simpler design, which reduces the cost of production and maintenance. As for the second, it is durability: pneumatic engine mechanisms are less prone to wear, since they do not work due to fuel combustion, which reduces their heating and mechanical load. As mentioned earlier, it is environmental friendliness: pneumatic engines do not emit harmful gases and do not require fossil fuels. Emissions into the atmosphere consist of clean air, which significantly reduces the level of environmental pollution. The fourth is the speed of refueling: a car is refueled with compressed air in a matter of minutes, which is much faster than charging electric vehicle batteries. Among the disadvantages of pneumatic engines, compared to other engines, it can be noted that they have low efficiency, since a significant part of the energy is lost during air compression and its subsequent expansion. Disadvantage number two is limited power: pneumatic engines cannot provide high power and speed, which makes them less attractive for

the mass automotive industry. Perhaps the main drawback is that cars with pneumatic engines currently cannot provide a large mileage on a single tank of fuel, which limits their practicality compared to electric cars or traditional cars.

In conclusion, it should be noted that systems using these engines will most likely depend on the development of new technologies and materials. Therefore, we see development prospects for these engines, but not in all areas. Pneumatic engines will hardly be seen in tractors, large trucks. But in most passenger cars with indicators that are no worse than they are now, you can definitely see a pneumatic engine.

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K. Maksymenko, R. Bilichenko, N. Kaliberda

### ETHICS IN THE ERA OF ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is a system that can perform tasks that require human intelligence, such as learning, pattern recognition, or decision-making. The main technologies of AI are machine and deep learning, which allow systems to adapt to new data. AI is actively used in various fields, such as medicine, finance, automotive industry, natural language processing, etc. However, its development faces ethical, security and technical challenges [8].

Artificial intelligence ethics is a part of technology ethics that deals with robots and other artificially intelligent beings. It is usually divided into robotic ethics, which addresses the issue of moral behavior of humans during the design, construction, use, and treatment of artificially intelligent beings, and machine ethics, which addresses issues of moral behavior of artificial moral agents [7].

The application of new technologies, such as artificial intelligence (AI), to science affects the methods and methodologies of research. While the responsible use of AI brings many innovations and benefits to science and humanity, its unethical use poses a serious threat to the integrity of science and literature. Even in the absence of malicious use, the Chatbot output itself, as an software application based on AI, carries the risk of containing biases, distortions, irrelevancies, misrepresentations and plagiarism. The use of complex AI algorithms raises concerns about bias, transparency and accountability, requiring the development of new ethical rules to protect scientific integrity [5].

Ethics involve imagining consequences and deciding which of several choices is most acceptable, or, is least unacceptable [1].

The emergence of ethical concerns regarding the use of artificial intelligence (AI) dates back to the early days of its development. Modern development of AI began in the early 1950s with the work of Alan Mathison Turing. He performed the “Turing test”, which showed that computers could think like humans. His paper “Computing Machinery and Intelligence” brought about debates about machine intelligence that would eventually lead to ethical considerations. The term “artificial intelligence” was first coined by John McCarthy at a conference in 1956. With the advancement of computer technology, AI became more widely applied in the years of 1970 and 1980 [6]. This raised concerns about privacy and decision-making biases. In 1976, Joseph Weizenbaum’s book “Computer Power and Human Reason” addressed the moral responsibility of AI inventors [7]. In the 1990s, Dr. Richard Wallace created ALICE (Artificial verbal Internet Computer reality), the first chatbot to interact with humans. Since the 1990s, ethical businesses using artificial intelligence have become more prominent, and stakeholders have denied the need for ethical standards and guidelines [7].

### **AI and disclosure.**

Journals vary in their policies on the use of generative AI for scientific writing. Some publishers prohibit the use of AI without explicit editorial authorization, while others require detailed annotation in the manuscript. Banning these tools could encourage the undisclosed use of chatbots, which would undermine transparency and integrity in research [4].

WAME revised its recommendations on “Chatbots and Generative AI in Relation to Scientific Publication” in May 2023. These recommendations can be considered as general principles. The first interpretation emphasizes translucency, honesty, and responsibility of authors. For the alternate interpretation, the suggestion that editors and peer pundits should inform authors and be transparent when using AI in the handwriting evaluation process was added [4].

AI is already being used to inform human decision-making. Companies can use apps to manage administrative tasks like scheduling meetings or taking minutes. In Human Resources, AI algorithms sort resumes looking for the most-qualified applicants. AI is also used to generate marketing materials, translate content for different audiences, and ensure that written content follows brand tone and style guidelines. Because AI can cover all these tasks with little cost and time burden, many fear that AI will lead to mass unemployment by eliminating entry-level white-collar jobs and increasing the skills gap [3].

The World Economic Forum predicts that AI will disrupt the future of work by eliminating specific roles while outlining how these tools cannot replace creative, social, and emotional skills unique to humans [6].

Machine learning and language processing programs require human oversight. These technologies produce “results” based on available data, human-generated prompts or commands, and their design specifications. For example, ChatGPT by OpenAI scans information from the internet or a provided resource to produce conversational responses or summarize information based on a given prompt. According to the Open AI Safety and Best Practices guide, AI can “hallucinate” by creating false or fabricated information and producing harmful responses that are inappropriate or biased [6].

As a tool, AI is dependent on data. Machine learning programs require large amounts of data to identify patterns and correlations which then fuel “learning” and allow the AI to generate predictions. When a consumer uses an AI tool to analyze a document, recording, or video, they no longer have control over how that data is stored or used. Data collection and use of AI can lead to risks like surveillance, harassment, and discriminatory profiling. The ISACA, a global association of leaders in Information Sciences and Information Technology outlines how AI programs collect



data that may then be repurposed for a secondary use. Another risk outlined by the ISACA involves lack of consent, where information is shared without the knowledge of one or more parties [6].

Ensuring the ethical use of artificial intelligence is very important. Bias and discrimination can present in many ways. When data includes one specific group, AI will generate patterns and conclusions about the training data set that may not apply to wider audiences. Another type of bias involves algorithm bias where patterns are based on human judgments and connections. AI can also promote prejudice and discrimination if it is deliberately designed to identify, track, or harass individuals from certain backgrounds. A more sinister application could be used to identify, track, and discriminate against political adversaries or minority groups.

AI can also lead to bias and discrimination in the practice of training and development. Organizations that use artificial intelligence to identify potential training candidates may worry, however, that AI mistakenly excludes different groups of employees from training and development opportunities due to bias. Trainers can realize that they can teach their AI tools and resources to work with only one group of clients, which may be useless or acceptable to all audiences. In particular, many chatbots are trained to work in Western and individualistic cultures. These tools may be useless for multinational client teams in non-Western or collectivist societies [3].

AI provides a unique opportunity to supplement and optimize specific tasks. AI is already used to support management and marketing activities. The first coaching tests showed that “coaching bots” can reproduce specific coaching approaches aimed at changing behavior with short-term success. However, these methods cannot fully reproduce the human coaching experience. Human social and emotional intelligence skills will be used in conversations with coaches and will contribute to coaching success. Human coaches will also be important to guide the development, testing, application and improvement of training products using artificial intelligence [6].

#### **AI should not learn from humans.**

Despite the fact that moral and ethical principles are formed by people, AI should not be similar to people, because prejudices inherent in society can penetrate algorithms.

This is well explained by face recognition technology. To create a suitable system, a large amount of data is selected, including images of people. Automated

robots often lag behind the process and take into account the variety of samples and contexts. As a result, the collected data may be biased.

The next stage of development is the construction of a learning model. The engineer simply does not know why the algorithm determines or another solution.

The risk of bias exists only at the level of interpretation. At this stage, people still play a big role. For example, an algorithm was trained on a specific sample of people and gave specific results. Then we applied the system to another group, and the data changed dramatically [9].

What should be the ethics of artificial intelligence?

**Justice and non-discrimination.** AI systems must be designed to minimize discrimination based on race, sex, religion or other protected characteristics. Biases in algorithms can reinforce existing inequalities and harm certain groups.

Ethical AI techniques can help identify and mitigate such biases, promoting fairness in decision-making.

Transparency and understanding are critical to building trust in AI. Systems must be designed in such a way that their decision-making processes and outcomes are understandable to all interested parties [8].

**Accountability and responsibility.**

Stakeholders must be responsible for the development and use of artificial intelligence systems and their potential impact on people, society and the environment. They must be sure that the technology is used for good.

This includes taking into account the ethical consequences of implementing artificial intelligence systems and actively participating in decision-making throughout the entire process of development and implementation.

**Privacy and data protection.**

Artificial intelligence systems often use personal information, and ensuring privacy is an important factor. Ethical AI practices include obtaining consent for data collection and use. It is also necessary to ensure control over how service providers dispose of user information. This guarantees compliance with the rights to inviolability of private life and protection of personal information [9].

## Conclusions.

Adherence to ethical norms is important for the development and implementation of technologies. This can ensure fairness, transparency, confidentiality and human orientation in the interests of the development of society.

In addition, the application of the guidelines can bring commercial benefits to companies, especially since they will relieve employees, consumers and other interested parties from anxiety.

Controversies and debates around AI can turn into a constructive dialogue. Excessive regulation can hinder the development of technology and destroy untapped potential. Therefore, there is now a need to find proven solutions in the field of ethical use of AI, which will satisfy the maximum possible number of people.

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## **UTILIZING LARGE LANGUAGE MODELS (LLMs) FOR ENTERPRISE BUSINESS PROCESS OPTIMIZATION**

This study investigates the application of Large Language Models (LLMs) in the automation and optimization of enterprise business processes. LLMs, characterized by their capacity for advanced text generation and contextual understanding, present a significant opportunity for enhancing operational efficiency and decision-making. This research provides a comprehensive analysis of LLM architectures, including autoregressive (e.g., GPT [1]), autocoding (e.g., BERT [2]), and sequence-to-sequence (e.g., T5) models, and their respective strengths in distinct business applications. Key LLM characteristics, such as parameter count, context window, and hyperparameters, are examined to elucidate their impact on model performance.

Furthermore, the study evaluates various LLM deployment strategies for enterprises, encompassing LLM-as-a-Service, open-source implementations, and resource-based deployments, detailing their respective advantages and disadvantages concerning cost, control, and data security. A critical component of this research focuses on advanced techniques for enhancing LLM performance in specific business tasks. These include Retrieval-Augmented Generation (RAG), which integrates external knowledge sources for improved accuracy; Function Calling, enabling interaction with external APIs for complex task execution; and Fine-Tuning, which customizes pre-trained models with domain-specific data.

The findings underscore the transformative potential of LLMs in streamlining business operations. However, the study also highlights the imperative for organizations to meticulously consider the inherent challenges, including development and operational costs, algorithmic biases, ethical implications, and security vulnerabilities. Strategic implementation, leveraging techniques such as RAG, Function Calling, and Fine-Tuning, is crucial for maximizing the benefits of LLMs while mitigating associated risks. This research contributes to a deeper understanding of the practical

application of LLMs in enterprise settings and provides a framework for informed decision-making regarding their adoption and integration.

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Y. Morozov, T. Zaytseva, O. Novikova

## USE OF DEEP LEARNING IN CONTACT MECHANICS

Contact mechanics involves the study of interactions between surfaces in contact, including friction, wear, adhesion, and deformation. The most widely used traditional numerical approach for simulations, the finite element method (FEM), often require extensive computational resources, especially for complex, nonlinear, and multi-scale problems. In recent years deep learning has emerged as a powerful tool to enhance and accelerate contact mechanics simulations by providing efficient data-driven models.

Deep learning has shown great potential in replacing FEM in contact simulations with following techniques:

1. Physics-Informed Neural Networks (PINNs) incorporate physical laws into neural networks and can be used for modeling of stress distribution and deformation in contact mechanics [3].

2. Neural operators learn the mapping between material properties, boundary conditions and displacement, stress without requiring a discretized solution and can be used for fast predictions for complex engineering simulations [1].

3. Convolutional Neural Networks (CNNs) for Surrogate Modeling are trained on FEM-generated data to learn complex spatial relationships and provide

near-instantaneous predictions for new input conditions and used in predictions of stress and strain distributions and contact mechanics problems approximations.

The main advantages of mentioned deep learning techniques are absence of meshing, significantly faster simulations, and the ability to handle complex, multi-scale problems. However, they require large training datasets, significant computational power for model training, struggle with discontinuities, and lack interpretability, making them less reliable for highly precise engineering tasks.

At the same time hybrid approaches can significantly improve existing FEM simulations. They include following techniques:

1. Adaptive Mesh Refinement uses reinforcement learning or CNNs to refine mesh regions dynamically, reduce overall computation speed and provide better accuracy in localized stress concentrations and singularities.

2. Hybrid FEM Deep Learning Models use results and error estimations from calculations with the coarse mesh and feeds them to the neural network to produce more accurate results of stress distributions [2].

While proposed techniques usually offer better precision and speed compared to the traditional FEM method, they require significant computational effort to generate training set and perform training and development effort to integrate them with the existing FEM solvers.

Deep learning has the potential to replace FEM in certain applications, particularly where speed is a priority, but challenges like data dependency, generalization issues, and interpretability still make FEM a more reliable choice for many engineering problems. Hybrid approaches combining FEM and deep learning currently offer the best balance of accuracy and efficiency.

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## **COMPOSITE PIPELINES FOR CRYOGENIC PROPELLANTS IN MODERN ROCKETRY**

Various recent publications in the field of rocket and space technology focus on the environmental impact of launch vehicles on the atmosphere and the ozone layer [2, p. 6; 5, p. 143; 6, p.1]. Between 2012 and 2022, the global number of rocket launches increased by 145% (from 71 to 174) [8, p. 1]. The issue of their environmental impact has become increasingly critical. The development of environmentally friendly launch technologies is an urgent task, and its significance continues to grow.

The use of the  $\text{LO}_x + \text{LH}_2$  cryogenic propellant pair is considered a promising option. Water vapor and nitrogen oxides produced during combustion have a minimal environmental impact [4, p. 6], particularly on the ozone layer. Even a significant increase in the number of launches using such propellants would have a relatively low ecological effect.

The use of cryogenic propellants in aerospace applications requires specialized tanks and pipelines capable of withstanding cryogenic temperatures ( $-196^\circ\text{C}$ ) and multiple refueling-emptying cycles.

Modern literature classifies fuel tanks suitable for storing cryogenic propellants based on their structural composition and the presence of composite components into the following types: Type I – Metallic tanks; Type II – Metallic liners partially reinforced with a composite shell; Type III – Metallic liners fully reinforced with a composite overwrap; Type IV – Composite liners fully reinforced with a composite overwrap; Type V – Linerless tanks made entirely of composite material [1, p. 2].

The presented classification, although primarily related to tanks, is also applicable to pipelines with a few exceptions: pipelines do not require rounded transitions to polar flanges, the radius of polar flange openings is close to the pipeline's own radius, and by definition, a pipeline must include two polar flanges and may not have additional technological openings.

While carbon fiber composites offer advantages in terms of lower weight and reduced susceptibility to cracking – particularly during refueling – they also present several challenges.

One major challenge is delamination. In composite-lined pipelines, cooling to cryogenic temperatures causes differences in the coefficients of thermal expansion between the liner and the overwrap, leading to internal stresses. Combined with the liner's brittleness, this can result in microcracks that compromise structural integrity and cause leakage [3, p. 2].

Eliminating the liner (type V pipelines) addresses the issue of differential expansion between the liner and the composite overwrap, with the potential to reduce the total system mass by 10–20% [1, p. 2]. However, the maximum pressure that such tanks and pipelines can reliably withstand remains an area of ongoing research.

Composite pipeline also requires special manufacturing process. To produce a linerless pipeline or tank, composite fiber must be layered (wound) onto a specialized mandrel, which is later removed – either by disassembly, dissolution, or segmentation.

A common manufacturing method is continuous filament winding (FW), which is cost-effective and well-suited for simple geometries. However, it has several limitations.

During winding, fibers are under tension, restricting application to convex surfaces. Continuous winding requires flanges or end caps at the poles. It results in thickness variations at the polar regions. Achieving non-geodesic fiber trajectories is challenging.

The design of linerless pipelines and tanks can be improved using advanced manufacturing methods, particularly Automated Fiber Placement (AFP) and Automated Tape Laying (ATL). AFP is an evolution of traditional filament winding, offering high precision, superior material utilization, and reduced waste [7, p. 45].

ATL lays wide tapes (typically 75–300 mm) at high speed on relatively simple surfaces, making it ideal for large open structures like pipelines or tanks. However, it struggles with complex contours or internal geometries due to wrinkling in the wide tapes.



AFP overcomes these limitations by using narrower tapes (typically 3.175–12.7 mm). It combines elements of filament winding and ATL, allowing fiber placement on curved surfaces with precise directional control. However, this increased flexibility comes at the cost of slower deposition speeds.

Despite its advantages, AFP also has limitations. It requires precise control over numerous parameters. Some geometric shapes are infeasible due to the size of the AFP deposition head. This issue is particularly relevant for small-scale components where the deposition head's size is comparable to the part itself.

So as a summary, we can see an increasing number of rocket launches has intensified concerns about their environmental impact, making the development of eco-friendly propellants and cryogenic storage systems crucial. Composite cryogenic pipelines, particularly linerless (Type V) designs, offer potential weight reductions but face challenges related to structural integrity, delamination, and manufacturing complexity. Advanced manufacturing methods like Automated Fiber Placement (AFP) and Automated Tape Laying (ATL) improve precision and material efficiency, though they have limitations in handling complex geometries and small-scale components. Although promising, these technologies still require development and further studying.

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O. Murashko, Y. Tkachov, O. Hurko

## **ELASTIC SEARCH-DRIVEN DECISION SUPPORT SYSTEMS FOR OPTIMIZING MATERIAL SELECTION IN THE ROCKET SCIENCE**

The development or modernization of Decision Support Systems (DSS) is currently a crucial task for any field in science and industry.

Progress in data-driven science and engineering stems from several key factors. First, there's an enormous and growing amount of data available. Second, high-performance computing has made significant strides. Third, sensing technologies, data storage, and data transfer methods have all improved. Fourth, scalable algorithms from statistics and applied mathematics have advanced. Fifth, industry has invested heavily, resulting in plenty of open-source software and benchmark problems [2, p. 3].

Advanced technologies like the Internet of Things (IoT), machine learning, and machine vision systems enhance precision, speed, and quality control by generating and analyzing large amounts of data with cognitive decision-making algorithms. These developments, supported by deep learning and real-time scheduling, optimize manufacturing processes and decision-making in cyber-physical system-based smart factories [4, p. 1052].

The exponential growth of data volumes and globalization no longer allow a human expert to process this data within a reasonable timeframe. Therefore, DSS is both necessary and practical. It enables to automate the complex processes and reduce the risks in incorrect decision making [7, p. 5]. However, there might be ethical implications when decisions affecting health or life are made by software rather than a human [6, p. 44].

One of the positive outcomes of integrating DSS is that once learned, they can generate accurate results for a family of similar challenges almost

instantaneously [5, p. 385]. Moreover, DSS facilitates the formulation of precise decisions and allows for modelling based on learned data. The more a DSS learns, the more accurate and swifter its predictions become.

Creating DSS for the administration and diverse information storage about various aspects of industries, such as material properties, energy efficiency, environmental impact, cost-effectiveness, and technological advancements, is increasingly vital.

Within DSS, document-oriented databases (DODBs) play a pivotal role, as they can store various data types and multimedia in large volumes with fast access. DODBs are better suited for handling large data volumes compared to traditional relational databases [1, p. 653]. This is because the data can be processed in the server's memory, and their decentralized storage structure allows for parallel processing. This is particularly useful for storing data about different material properties and construction technologies.

It's worth noting that DODBs can store diverse data sets in uniform documents, which in turn allows for the aggregation of different parameters into a single entity, enhancing classification and information retrieval capabilities.

According to research [3, p. 216], DODBs are preferred when data volume or growth is substantial and/or temporary. Conversely, relational data bases are more suitable for long-term data storage. Modern decision support systems (DSS) incorporate both types, capitalizing on their respective strengths.

When determining the key parameters of materials that can be classified and calculated, it becomes clear that some parameters, such as density, are important for certain material groups but irrelevant for others. For example, when comparing multilayer polymer materials with conventional metals, anisotropy (different properties in different directions) plays a pivotal role for polymers but is almost negligible for metals [8, p. 2].

Elasticsearch (ES) developed by Elasticsearch B.V. – a distributed search and analytics engine based on a document-oriented database, allows for storing and retrieving results at speeds of about 1,000,000 documents in less than 0.1 seconds, depending on query complexity. This is achieved through internal caching approaches, optimal compression algorithms, and memory performance.

The largest structural unit in ES is a cluster, which consists of separate servers or nodes. A client sends a request to only one node, which then forwards the request to other nodes. Each node generates results, which are sent back to the first node where they are compiled into a final result and sent back to the client.

The primary operational principle of ES is that the main logical structure for data storage is an index, which in turn can consist of shards, individual storage instances within the database. An index is also made up of documents.

The parallel development of materials for aerospace and computational technology enables synergy between these seemingly disparate applied sciences. Over the last decade, search engine systems in IT have increased their capacities (like speed, operations per second, memory capacity) by at least a factor of 10, while the development of lightweight materials (especially in private aerospace development) allows for reducing the cost of space vehicles.

An innovative approach to using Elasticsearch for solving problems in the rocket and space industry, where there is rapid development in materials science, lies in the following:

- automation significantly reduces the time required for designing and testing rocket systems;
- the use of expert systems minimizes the risk of errors in material selection and design.

By analyzing a large number of factors and test data, the system can predict potential failures and propose solutions to enhance the reliability of the design.

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M. Nakhod, I. Karpovych, O. Novikova

## **THE USAGE OF UNCONVENTIONAL MECHANICAL PROCESSING METHODS TO IMPROVE COMPONENTS QUALITY**

During the mechanical processing of materials, elastic and plastic deformation precedes the chip separation and the formation of a new surface layer. The deformation of material constitutes about 55 percent of the total amount of energy used to perform the processing. Also, about 99% of the energy applied during the metal cutting is transformed into heat [4]. This heat increases the temperature of the cutting zone. This contributes to the accelerated tool wearing and an increase in thermal stress in the workpiece. It results in thermal deformations, consequently, the quality and accuracy of machine parts decrease. Given what has been said, the conversion of deformation energy into the work to break interatomic or intermolecular bonds at an earlier stage of deformation is the main scientific problem in the cutting materials area.

The main idea of this work is to review unconventional and little-studied methods of cutting, turning and milling to propose a new method of technology that should eliminate finishing operations (e.g. polishing) and reduce laboriousness of machine parts manufacturing. The most promising methods were identified for further studying. These are high-speed cutting [1], rotary cutting [2] and sliding

cutting. Each of these methods has its own pros, cons and limitations and therefore can be used only under certain conditions.

The purpose of this work is to establish the features, patterns, and dependencies of sliding cutting [3] during turning and milling operations on workpieces made of various materials. Based on this data a new unconventional method of technology can be developed.

Solving a scientific problem by developing a new process for cutting materials, based on the well-known sliding cutting effect, will allow to increase the quality and accuracy of manufactured machine parts, eliminate additional operations after turning and milling. This in turn will reduce the cost of production, increase the quality of parts and at the same time speed up the process of manufacturing the final product.

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R. Pylypenko, S. Klymenko, N. Kaliberda

#### CURRENT TRENDS IN THE USE OF RECHARGEABLE BATTERIES IN THE BACKUP POWER SOURCES

The modern world is rapidly evolving, and with it, the need for reliable backup power for critical systems is increasing. Special attention is given to battery technologies, which form the foundation of such power sources. Recent advancements in this field enable the creation of more efficient, durable, and environmentally friendly solutions that meet the demands of contemporary society.

Types of batteries used in backup power sources:

### **1. Lead-acid batteries (Lead-Acid)**

This is the longest-used type of battery in backup systems. Main characteristics:

#### **Advantages:**

- Relatively low production cost.
- Simplicity of design and maintenance.
- Reliability and time-tested.

#### **Disadvantages:**

- Low energy consumption (heavy and bulky).
- Limited service life (3–5 years on average).
- Sensitivity to deep discharge.

#### **Applications:**

Used in small uninterruptible power supplies (UPS), stationary server systems, and critical infrastructure systems [4].

### **2. Lithium-ion batteries (Li-ion)**

These batteries have become the standard for most modern backup power supplies.

#### **Advantages:**

- High energy density per unit weight.
- Long service life (up to 10 years or 2000–5000 charging cycles).
- No “memory effect” (does not lose capacity due to partial charges).

#### **Disadvantages:**

- Higher cost compared to lead-acid.
- Tendency to heat, which requires a well-thought-out cooling system.

#### **Applications:**

Actively used in modern UPS, data center systems, as well as in hybrid and renewable energy systems [3].

### **3. Lithium Iron Phosphate Batteries (LiFePO<sub>4</sub>)**

This is a type of lithium-ion battery with improved characteristics.

#### **Advantages:**

- High safety: resistant to overheating and ignition.
- Durability: over 5,000 charging cycles.
- Stable operation even at low temperatures.

**Disadvantages:**

- Slightly lower energy density than standard Li-ion batteries.

**Applications:**

Used in large energy storage systems, backup power for critical facilities, including hospitals [3].

**4. Solid-State Batteries**

This new technology is still at the commercialization stage, but has significant potential.

**Advantages:**

- Long service life (10,000+ cycles).
- Compactness and high energy density.
- Absolute safety (no risk of ignition due to solid electrolyte).

**Disadvantages:**

- High cost due to complexity of production.

**Applications:**

Solid-state batteries are expected to become the basis for backup systems of the future [5].

**5. Nickel-cadmium (Ni-Cd) and nickel-metal hydride (Ni-MH) batteries**

Although these batteries are gradually being replaced by lithium, they are still used in some specialized areas.

**Nickel-cadmium (Ni-Cd):**

• **Advantages:** Longevity, resistance to extreme temperatures, ability to work in extreme conditions.

• **Disadvantages:** Cadmium toxicity, low energy density, “memory effect”.

**Nickel-metal hydride (Ni-MH):**

• **Advantages:** Less toxic than Ni-Cd, higher energy density.

• **Disadvantages:** Tendency to self-discharge, shorter durability compared to Li-ion [5].

• **Application:** Used in specialized industrial power supplies operating in extreme conditions.

**6. Sodium-ion batteries (Na-ion)**

A new type of battery that is actively being developed as an alternative to lithium.



**Advantages:**

- High availability of sodium (cheaper than lithium).
- Environmentally friendly and safe.
- Resistance to temperature extremes.

**Disadvantages:**

- Lower energy density compared to Li-ion batteries.

**Application:**

Potentially promising for stationary backup systems in industry and renewable energy [1].

**Table 1**

Battery Type	Energy Density	Lifespan	Safety	Cost	Applications
Lead-Acid	Low	3–5 years	Moderate	Low	UPS, server systems
Lithium-Ion	High	5–10 years	Moderate	High	Data centers, household systems
Lithium Iron Phosphate (LiFePO4)	Moderate	10+ years	High	High	Critical facilities, industry
Solid-State	Very High	10+ years	Very High	Very High	Promising for all sectors
Nickel-Cadmium (Ni-Cd)	Low	5–10 years	High	Moderate	Extreme conditions
Sodium-Ion	Moderate	5–10 years	High	Low	Renewable energy systems

**Conclusion:**

The diversity of rechargeable batteries allows us to meet the needs of various industries, from household appliances to complex industrial systems. The main trend is the transition to more energy-efficient, durable and safe technologies, such as lithium-iron-phosphate and solid-state batteries. This contributes to increasing the efficiency of backup power sources and their adaptation to the challenges of the modern world.

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P. Sazonov, S. Klymenko, O. Novikova

## **CALCULATIONS OF THE APPLICATION OF THE ULTRASONIC NON-DESTRUCTIVE TESTING METHOD FOR COMPLEX TECHNICAL OBJECTS**

Ultrasonic Non-Destructive Testing (UT) is one of the most effective methods for detecting internal discontinuities in products. The need for reliable defect detection is particularly critical for ensuring the safety and quality of complex technical objects (CTOs) and high-risk structures. However, existing UT methods have limitations regarding defect evaluation accuracy due to discrepancies in the amplitude responses of reflectors in calibration and reference blocks used for equipment calibration. The study investigates analytical models of amplitude signals from reflectors in calibration and reference blocks and proposes approaches to enhance UT efficiency by eliminating amplitude signal discrepancies through the application of validated correction factors.

Complex technical objects are multi-component systems that integrate a high level of technological complexity, various mechanical subsystems, and control systems. These include infrastructure facilities, power plants, transportation systems, as well as aviation and space technology. Their reliability and safety depend not only on the manufacturing quality of individual components but also on the effectiveness of the interaction between all elements, monitoring systems, and control mechanisms. Engineering structure safety is a comprehensive process involving the analysis of design solutions, material quality control, structural health monitoring, and the implementation of advanced non-destructive testing (NDT) methods. The presence of defects in materials can lead to significant economic

losses and accidents. Special attention is given to critical zones where cracks, corrosion, or other damages may compromise structural integrity and stability.

Ultrasonic testing (UT), a key method in non-destructive testing (NDT), enables the detection of internal defects in materials without causing damage, making it indispensable in modern manufacturing [1]. Due to its rapid inspection capability, automation potential, and electronic data recording, ultrasonic testing not only identifies hidden defects but also assesses their progression over time. This facilitates timely engineering decisions and prevents hazardous situations.

In ultrasonic testing, the most commonly used defect sizing techniques include the amplitude method and the conventional defect length method. The amplitude method determines defect dimensions based on the amplitude of the reflected ultrasonic signal, while the conventional defect length method measures the distance over which the ultrasonic transducer is moved while maintaining a defect signal with a certain amplitude. The latter method, however, provides highly inaccurate results. Even the amplitude method is considered reliable only when phased array ultrasonic testing (PAUT) transducers are utilized. Indeed, when using ultrasonic flaw detectors with phased array probes, such as those equipped with 16 piezoelectric elements operating at 5 MHz, measurement accuracy can reach an error margin of  $\pm 0.1$  mm for defects ranging from 2 to 6 mm in diameter at depths of 20 to 100 mm in structural steels, aluminum, or plastics. However, ultrasonic flaw detectors with phased array transducers are significantly more expensive and feature advanced processing logic. Moreover, phased array transducers themselves are dozens of times more costly than conventional ones. Additionally, these transducers are larger and require a significantly larger area for stable acoustic coupling with the test object. These limitations hinder the widespread industrial adoption of PAUT flaw detectors, despite their extensive use in medical diagnostics. The miniaturized nature of industrial inspection objects, combined with restricted access to their surfaces, significantly limits the feasibility of PAUT in industrial applications.

Conversely, when using conventional single-element or dual-element ultrasonic transducers, one major drawback of the amplitude method is the variability in signal responses from identical reflectors, even with highly precise calibration and

reference blocks [2]. Such variations can reach up to 6 dB or more, leading to defect size measurement errors comparable to the actual defect size. The combination of these limitations forces manufacturers either to over-reject products, leading to increased costs, or to tolerate inconsistent product quality. This study analyzes modern ultrasonic NDT techniques, their advantages and limitations, and examines globally recognized ultrasonic defect sizing methods. The research also reviews defect simulators used in calibration and reference blocks, such as side-drilled holes, flat-bottom holes, surface notches, and semi-infinite planar reflectors. Based on the analytical modeling of signal amplitudes [3], a method has been proposed to minimize amplitude variations from reflectors in ultrasonic testing calibration specimens by applying of validated correction factors to the actual signal amplitudes.

The application of these methodologies significantly enhances diagnostic accuracy and ensures the maximum reliability of engineering structures.

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A. Shcherbak, A. Tonkoshkur, O. Novikova

#### **MACHINE LEARNING APPROACHES FOR PRIMARY ANALYSIS OF DIELECTRIC SPECTROSCOPY DATA**

Dielectric spectroscopy is widely used to analyze the electrical properties of materials by measuring their response to an applied electric field across different frequencies. Traditional analysis techniques rely on curve fitting and statistical models, but the increasing complexity of modern materials and the large volume of

experimental data necessitate more advanced computational approaches. Machine learning (ML) has emerged as a powerful tool for improving the accuracy and efficiency of dielectric data analysis.

Recent studies have demonstrated the effectiveness of ML in predicting dielectric properties. For instance, He et al. [1] applied machine learning to predict the dielectric temperature spectrum of ferroelectric materials, significantly improving model accuracy compared to conventional methods. By leveraging algorithms such as artificial neural networks (ANN) and support vector machines (SVM), researchers can develop predictive models that capture complex nonlinear relationships in dielectric responses.

Additionally, multivariate analysis techniques have been employed to enhance the interpretation of dielectric spectroscopy data. Zhou et al. [2] demonstrated the use of multivariate statistical methods to predict the dielectric properties of nanocellulose-modified press paper. Their study highlights the potential of combining ML with feature selection techniques to optimize material characterization.

The integration of machine learning in dielectric spectroscopy provides several advantages, including improved automation, higher predictive accuracy, and the ability to process large datasets efficiently. Future research should focus on refining ML models, incorporating physics-informed learning approaches, and improving model interpretability. By leveraging machine learning, researchers can accelerate material discovery and gain deeper insights into dielectric behavior.

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## **COMPUTER MODELING OF DEFORMATION PROCESSES IN COMPLEX STRUCTURES**

The development of computer models to describe the interaction of heavy stamps with a foundation that deforms under load is a complex and multifaceted task of great significance for modern construction and engineering.

Such modeling requires consideration of numerous physical and mechanical parameters, as the foundation affected by the stamp possesses an intricate internal structure. This foundation generally consists of several layers with varying mechanical properties, which can be altered under external factors such as pressure from heavy objects, temperature fluctuations, seasonal humidity changes, and other dynamic forces. Depending on the level of applied pressure and the strength of the interaction with the stamp, the foundation's structure may change locally or at considerable depths, influencing its overall stability.

These models have essential practical value, as they enable predicting the behavior of foundations under high loads, which is especially relevant for construction structures and massive edifices. Reliable forecasting of changes in foundation structure allows for the preliminary assessment of risks associated with undesirable phenomena, such as subsidence or tilting. These effects can often disrupt the stability of buildings and require regular monitoring to prevent potential accidents.

Particular attention is paid to situations where artificial cavities are created beneath building foundations, such as underground storage facilities for natural gas or toxic industrial waste. Additionally, underground infrastructure, including subway tunnels, sewage systems, and water supply networks, plays a role.

These cavities often lead to a significant redistribution of load on the underlying layers, potentially causing the subsidence of upper foundation layers, which in turn affects the integrity of structures located on the surface. Furthermore, such changes can lead to the formation of cracks or even contribute to gradual sinking, posing risks of collapse or serious damage. Another significant aspect of research is the impact of natural conditions on foundation structure. Seasonal changes, such as soil freezing and thawing,

can induce phase transitions, leading to substantial changes in soil material properties. This process is particularly critical in regions with sharp climatic variations, where frequent freeze-thaw cycles can create cyclic stresses within the foundation structure. During freezing, moisture in the soil expands, causing individual layers to rise; upon thawing, these layers subside, adding extra load on structures.

Thus, the creation of such computer models is a challenging task requiring precise calibration and the consideration of numerous factors. A comprehensive approach is employed to solve this problem, involving the formulation of a connected evolutionary problem, the application of variational methods, and finite element methods for approximating the deformation processes.

This approach facilitates the creation of detailed models of foundation behavior during interaction with heavy objects. Furthermore, the development of dedicated software is a critical component of this process, as it enables conducting extensive computational experiments to test and refine modeling assumptions, ensuring the accuracy of predictions.

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A. Spodobets, A. Sanin, O. Novikova

#### CURRENT ISSUES IN PROTECTING MEDICAL EQUIPMENT FROM ELECTROMAGNETIC RADIATION

The year 1973 is considered the birth of the magnetic resonance imaging (MRI) method when chemistry professor Paul Lauterbur published an article in Nature titled “Image Formation by Induced Local Interactions: Examples Employing Nuclear Magnetic Resonance” [1]. By the late 1970s, Nottingham University physics

professor Peter Mansfield developed a mathematical method that reduced scan computation time from hours to just a few seconds and enabled the acquisition of clearer images.

Protons and neutrons in an atomic nucleus behave like tiny spinning magnets. As a result, atoms and molecules adopt a specific orientation in a magnetic field. However, this alignment can be disrupted using radio waves of certain frequencies characteristic of different atoms. By introducing variations in the magnetic field throughout the 1970s, Paul Lauterbur contributed to utilizing this phenomenon for imaging the internal parts of the human body. The number of hydrogen atoms is measured, and differences in water content across various tissues serve as the foundation of magnetic resonance imaging.

For their discoveries related to magnetic resonance imaging, they were awarded the 2003 Nobel Prize in Physiology or Medicine [3].

MRI is based on the phenomenon of nuclear magnetic resonance (NMR). NMR is a physical phenomenon in which the nuclei of certain chemical elements, placed in a constant magnetic field, absorb the energy of electromagnetic waves at a specific frequency known as the resonance frequency.

Therefore, magnetic resonance imaging is a highly sensitive technology that uses powerful magnetic fields to create images of internal organs and tissues. However, the effective operation of MRI can be disrupted by external electromagnetic fields (EMFs), which pose a serious problem for the accuracy and quality of images, and consequently, for the medical diagnosis of a patient. Shielding the magnet from these waves is critically important to ensure the reliability of MRI operation and safety.

One of the main challenges in MRI operation is the impact of high-frequency electromagnetic waves on the magnet. These waves can penetrate the room where the scanner is installed and interfere with the signals used to form images. This may result in noise, artifacts, or distortions in the obtained images, ultimately reducing diagnostic accuracy.

Understanding the fundamental principles that affect the efficiency of a shielded radio-frequency (RF) chamber can be extremely helpful in selecting the right shielded chamber. The choice of shielding materials and the method of their assembly are crucial for the chamber's performance.



To protect the MRI magnet from external EMFs, a so-called Faraday cage is used – a metal shield that completely encloses the room with the MRI scanner, blocking electromagnetic waves from penetrating inside. However, even with the application of a Faraday cage, certain challenges remain, including shielding effectiveness, screen material, material aging, and complex maintenance.

In today's industrial and commercial world, a wide variety of RF shielding materials are available. They range from paints and sprayed coatings to metallized fabrics and fibers, as well as solid metals. This article focuses only on solid metals due to their ability to attenuate RF signals by 100 dB or more across a wide frequency range.

Aluminum, steel, and galvanized steel are less electrically conductive and stiffer (at typical thicknesses) than copper. These more rigid metals can deform under the mechanical pressure required for high-quality RF sealing. Once deformed, they retain their distorted shape, making it difficult to restore them, which complicates achieving consistent shielding if a modular system is assembled more than once.

Copper. It is one of the most effective shielding materials due to its high electrical conductivity. Thanks to its high flexibility, copper can be shaped into various structures to fit any room configuration. At the same time, the material has good mechanical strength and durability. Additionally, copper has high corrosion resistance, making it an optimal choice for environments with strict hygiene requirements. Copper shielding materials include copper sheets, copper foil, and special copper mesh.

Aluminum. The second most important shielding material. It has properties very similar to copper but offers certain advantages. It is lighter, making it more convenient for transportation and installation, especially when working with large shielding structures. Another key advantage is its cost-effectiveness – aluminum is a more affordable material, making it suitable for budget-constrained projects. However, special attention is required when choosing aluminum.

During operation, a thin layer of aluminum oxide forms, which can affect the electrical contact between parts of the RF chamber (especially around doors, cable access points, and windows). If preventive measures (such as special coatings)

are not applied, the quality of RF shielding at moving contact points may deteriorate over time.

In the search for alternatives to copper and aluminum as materials for creating attenuation conditions of  $>90$  dB within the frequency range of 15–128 MHz, composite materials are of particular interest [2].

The choice of materials and structural solutions directly impacts shielding effectiveness, and the latest developments continue to enhance this technology. Further research in the field of materials science could significantly improve the quality of medical diagnostics by ensuring the stable operation of MRI equipment.

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Y. Suleymanov, O. Baybuz, O. Besarab

### USING CHROMA AUDIO FEATURES IN GENRE CLASSIFICATION BY NEURAL NETWORKS

The rapid growth of the music industry poses the question of automatic genre classification of songs to provide convenient access for users and offer automatic recommendations based on their personal preferences. Nowadays, artificial neural networks are widely used in many different areas. They show remarkable results in music processing. To train these networks digital features should be extracted for being used as training data. One set of these features is called chroma. Their idea relies on music theory about the relationship between notes and frequencies.

The octave is the interval that corresponds to doubling a fundamental frequency. Modern Western music is based on a subdivision of the octave into twelve equal intervals, called the semitones, which correspond to a frequency ratio

of  $2^{1/12} \approx 1.06$  (this is an interval of about 6%). Notes that differ by exactly one octave are in some sense equivalent (they are said to have the same chroma), and they have the same name. Notes are therefore names of “pitch classes” (i.e., a collection of pitches sharing the same chroma), rather than names of just one particular pitch. The whole system is locked to a fixed reference: the pitch of the so-called middle A (A4), which corresponds to a frequency of 440 Hz. Thus, for example, the note A denotes the pitch class that includes the pitches 55 Hz (often the lowest note on the piano keyboard), 110 Hz, 220 Hz, 440 Hz, 880 Hz, 1,760 Hz, and so on.

For historical reasons, there are seven primary note names: C, D, E, F, G, A, and B. The intervals between these notes are 2, 2, 1, 2, 2, and 2 semitones, respectively, giving a total of 11 semitones between C and B; the interval between B and the C in the following octave is again 1 semitone, completing the 12 semitones that form an octave. There are five notes that do not have a primary name: those lying between C and D, between D and E, and so on. These correspond to the black keys on the piano keyboard, and are denoted by an alteration of their adjacent primary classes. Raising a pitch by a semitone is denoted by # (sharp), while lowering it by a semitone is denoted by *b* (flat) [2, p. 105].

How well we perceive pitch depends on our ability to differentiate between two different pitches presented sequentially. Psychoacousticians measured the smallest “just noticeable differences” (JNDs) that can be detected by highly trained listeners. Under optimal conditions, experienced listeners can perceive a difference as small as 0.2% between two sounds (e.g., 1,000 and 1,002 Hz). For comparison, the smallest interval in music, the semitone, corresponds to about 6% (e.g., 1,000 and 1,060 Hz), approximately thirty times larger than the JND [1, p. 184].

Twelve semitones are used to split all spectrum of sound into 12 bins, which create a vector of features. Depending on the type of network, it can be used either as a vector itself for classic deep neural networks, or can be represented as an image for convolutional neural networks, having combined features by consecutive frames.

Adjusting parameters for chroma features computation – whether using them alone or incorporating statistical methods to calculate additional values like mean, median, variance, maximum, minimum, and their derivatives – significantly impacts the effectiveness of neural network training. So these choices are made by an expert

based on own experience, taking into account musical nuances, type of tasks, selected architecture of the network, existing hardware and software limitations.

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R. Syzonenko

### **INTEGRATION OF UAV WITH YOLO-BASED COMPUTER VISION SYSTEM FOR AUTONOMOUS NAVIGATION AND OBJECT RECOGNITION**

In recent years, Unmanned Aerial Vehicles (UAVs) have seen a surge in applications across various domains, including environmental monitoring, agriculture, security, reconnaissance, and even delivery of goods. Ensuring the autonomy of these vehicles is paramount for their effective utilization, necessitating the execution of real-time navigation, object detection, and decision-making tasks. A particularly efficacious approach to achieving autonomy entails integrating the UAV with a computer vision system.

A prominent and efficacious technology for executing computer vision tasks is the YOLO (You Only Look Once) framework, which has demonstrated its capacity to swiftly and accurately identify objects in imagery. When integrated with UAVs, YOLO technology can facilitate highly efficient autonomous navigation and object recognition, thereby ushering in novel opportunities for unmanned systems [1].

Integrating a UAV with a YOLO-based computer vision system necessitates the convergence of several pivotal technologies, including image processing, object detection algorithms, and algorithms for UAV navigation [2]. The primary components of such a system can be classified into multiple levels.

Firstly, Unmanned Aircraft Vehicles (UAVs), which are typically outfitted with sensors and cameras, can assist in object detection and navigation. High-quality

cameras and sensors are imperative for a UAV to execute object recognition and navigation tasks with optimal efficiency. The utilization of cameras is pivotal in capturing real-time image data, which is subsequently processed to facilitate object identification. These sensors can encompass a broad spectrum, ranging from standard RGB cameras to infrared or multispectral sensors capable of functioning in low-light or changing weather conditions.

Secondly, the YOLO algorithm is a computer vision technique based on neural networks that can recognize objects in an image with high accuracy and speed. In contrast to classic conventional methods, YOLO partitions the image into a grid, predicting the presence of objects in each cell, along with their locations and classifications. This property renders the algorithm highly efficient for real-time applications, a critical consideration for UAV operations.

The third key to UAV operation is the use of navigation and control algorithms. The UAV's navigation system uses GPS, inertial sensors, and cameras to plan routes, avoid obstacles, and correct flights. Integrating YOLO with the navigation system lets the UAV not only follow a route but also dynamically adjust its path based on objects like buildings, trees, other vehicles, or people.

The fourth point concerns the decision-making system, integrating computer vision with decision-making systems in UAVs. This system recognizes and analyzes objects to inform decisions. For example, an obstacle detected by a drone could be navigated around or over, depending on the drone's capabilities.

YOLO's high processing speed makes it advantageous for autonomous navigation. Unlike alternative algorithms, it processes images in realtime. This capability is essential for UAVs that need to make instant decisions. YOLO is also highly accurate in recognizing objects in images, which is vital for avoiding collisions during navigation. The capacity to be trained on disparate datasets to recognize an array of objects engenders a very flexible system. For Unmanned Aerial Vehicles (UAVs), this adaptability implies that the algorithm can be customized to discern objects, such as those pertinent to search and rescue missions or crop monitoring. The ability to reduce computational cost enables the utilization of less powerful hardware on board the UAV, thereby reducing the system's computational demands. YOLO does not necessitate multiple operations to extract the region of interest,

thereby reducing the computational cost and enabling the utilization of less powerful hardware on the UAV.

Unmanned aerial vehicles (UAVs) onboarded with the YOLO system demonstrate considerable potential.

A particularly salient application of UAVs equipped with the YOLO system pertains to search and rescue operations. Utilizing a drone equipped with a camera and the YOLO system enables the scanning of an area, the identification of people or vehicles, and the transmission of precise location information to rescue services. In such scenarios, processing information expeditiously and precisely is paramount.

In the realm of security, the integration of YOLO UAVs facilitates the surveillance of expansive regions, the identification of potential hazards, and the detection of suspicious objects. This application is particularly salient in the context of border control, infrastructure protection, and large-scale event monitoring.

The agricultural sector stands to benefit significantly from the integration of YOLO UAVs, particularly within the domain of precision agriculture.

These drones, equipped with YOLO technology, facilitate the monitoring of crop health, the identification of pests or diseases, and the transmission of information regarding farms.

In the transportation and logistics sector, UAVs with YOLO technology ensure the safe delivery of goods, protect passengers and enhance traffic management.

The utilization of UAVs equipped with YOLO technology facilitates the monitoring and management of traffic flows, the recognition of emergencies or traffic violations, and the efficient delivery of goods [3].

Despite the evident advantages, the integration of UAVs with the YOLO system faces numerous challenges. Chief among these is the necessity of high-speed real-time computing, a requirement that necessitates the implementation of advanced hardware within the drone. Additionally, inclement weather conditions, such as fog or heavy rain, can markedly diminish object recognition performance.

The development of specialized YOLO models for particular tasks necessitates substantial effort and data, which can pose significant difficulties for specific applications.

In conclusion, the integration of UAVs with a YOLO-based computer vision system signifies a substantial advancement towards more autonomous and efficient unmanned systems. The integration of these technologies has been demonstrated to enhance object recognition accuracy, thereby promoting enhanced safety and efficiency of UAVs in a variety of applications. Notwithstanding the challenges posed by computational cost and complexity in low-visibility environments, the further development of these technologies is poised to yield substantial benefits and unlock new opportunities for UAVs.

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O. Tymchenko, V. Korchynskyi, O. Novikova

## OPTIMAL CONTROL OF THE BANDWIDTH OF INFORMATION CHANNELS FOR TRANSMISSION OF REMOTE SENSING RASTER IMAGES

Remote sensing (RS) raster images are captured across a substantial number of spectral intervals of electromagnetic radiation, which serves as a carrier of view information. The efficiency of transmitting such data through an information channel with a limited frequency bandwidth in the presence of channel noise significantly depends on the transmitted data volume. From the perspective of applied thematic analysis of the acquired spectral data, utilizing the entire set of images obtained across all spectral intervals is redundant. This leads to the formulation of a dual optimization problem aimed at enhancing the bandwidth efficiency of

the transmission channel through compression of the original multispectral data. The optimization criteria include minimizing the difference between the original and reconstructed signals while reducing residual noise, subject to maintaining the level of informativeness and geometric integrity of the images necessary for accurate thematic analysis of spectral data.

The method proposed in this study for managing the bandwidth of information channels for transmitting multispectral RS images is based on the compression of Peano-Hilbert scans of image intensity distributions. This is achieved by representing the images in a discrete orthogonal wavelet basis at the first level of decomposition and setting to zero a portion of the decomposition coefficients, starting from a given threshold index  $K$ . A balanced thresholding approach is applied, ensuring that the residual signal energy and the number of zeroed coefficients remain equal, followed by signal reconstruction.

Varying the threshold  $K$  affects both the signal-to-noise ratio (SNR) of the reconstructed signal and its deviation from the original. This discrepancy is quantitatively measured using the Kullback-Leibler divergence [1].

The determination of the optimal threshold  $K$  is formulated as a three-criteria optimization problem, where the objective functions are:  $F_1(K)$ -the dependence of the Kullback-Leibler distance between the original and reconstructed signals on  $K$ ;  $F_2(K)$  – the dependence of the SNR of the reconstructed signal on  $K$ ;  $F_3(K)$ -the dependence of the structural similarity index (SSIM) on  $K$ , representing the preservation of the geometric structure of the image [3]. The optimization goal is to achieve predefined values for the Kullback-Leibler divergence, SNR, and SSIM index.

To solve this optimization problem, the *goal attainment method* [2] is employed, assigning equal significance to all three criteria.

In the compression process, raising the threshold for zeroing coefficients reduces residual noise power and the Kullback-Leibler distance between the original and reconstructed signals. The proposed method ensures an optimal trade-off between minimizing the information discrepancy between the original and reconstructed images and maximizing the SNR and SSIM index.



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V. Tymoshenko, A. Sanin, O. Novikova

## METHODS FOR GRAIN STRUCTURE ANALYSIS

Modern demands for materials used in the aerospace manufacturing, mechanical engineering, energy, transport require a deep understanding of the mechanisms of microstructure formation. Particular attention is paid to polycrystalline materials, where the key structural unit is the grain – an individual crystallite forming part of the overall volume. The size, shape, orientation, and distribution of these grains significantly influence the mechanical, thermal, electrical, and other properties of materials.

Quantitative grain structure analysis is a crucial tool for quality control, the development of new alloys, and the modeling of material properties. For example, fine-grained structures typically correlate with increased strength and plasticity, while coarse grains can improve heat resistance and creep resistance.

Despite decades of development in stereological and microscopic analysis methods, traditional approaches have limitations: they are labor-intensive, involve subjective evaluation, and lack reproducibility. Therefore, it is highly relevant to develop automated methods based on computer-integrated technologies, including computer vision, machine learning, and neural networks.

Moreover, combining digital structure analysis with predictive modeling enables a transition from empirical approaches to the systematic design of materials with predefined properties. This supports the implementation of Materials Informatics and Smart Manufacturing concepts in both research and industry.

To review and compare existing methods of grain structure analysis and justify the application of a computer-integrated approach for automated microstructure parameter determination.

Among the classical approaches, the random intercept method [1, p. 24] and the equivalent diameter method are commonly used to estimate average grain size from microstructure images.

The equivalent diameter method assumes a transformation of each grain's shape into a circle of equal area. The equivalent diameter is calculated using the formula (1):

$$D_{eq} = \sqrt{\frac{4A}{\pi}},$$

$D_{eq}$  – equivalent grain diameter,  $A$  – area of a grain.

The random intercept method involves overlaying a grid of random or equidistant lines onto the microstructure image. Grains are intersected by these lines, and the number of intersections is used to calculate the average grain diameter in formula (2):

$$\bar{D} = \frac{\pi}{2} \cdot \frac{L}{N}.$$

Where  $\bar{D}$  is the average grain diameter,  $L$  is total line length,  $N$  is a number of intercepts [1, p. 97]. Modern approaches increasingly rely on computer vision and machine learning. For instance, Otsu's thresholding algorithm allows automatic grain segmentation based on image brightness histograms [3, p. 334], while Random Forest and Support Vector Machines (SVM) are applied for classifying grain shapes and phase components [4, p. 669]. In addition, EBSD analysis (Electron Backscatter Diffraction) is used to study crystallographic orientation and grain boundary characteristics [5, p. 57].

The integration of classical grain structure analysis methods with modern machine learning algorithms enables the creation of an automated software system for microstructure image processing. Such a system will allow fast and accurate analysis of grain shape, size, and orientation, along with predictive insights into material properties.

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I. Volnov, I. Skuratovskyi, O. Novikova

## AI-DRIVEN REAL-TIME ECG MONITORING: CURRENT CHALLENGES AND FUTURE PROSPECTS

Artificial intelligence (AI) is poised to significantly advance the accuracy, efficiency, and scalability of cardiac diagnostics through enhanced electrocardiogram (ECG) analysis [5]. The potential for AI, especially deep learning models, to revolutionize cardiac diagnostics by enabling automated, high-precision interpretation is substantial [3–5]. AI algorithms have demonstrated remarkable capability in analyzing ECG data to identify and classify cardiovascular diseases (CVDs) [3]. Specifically, models like Convolutional Neural Networks (CNNs), including architectures such as ResNet-50, along with other approaches like Autoencoders (AE), Gated Recurrent Units (GRU), and combinations like CNN with the GOA algorithm, have shown high effectiveness [1; 3]. Research indicates that certain AI algorithms can achieve superior accuracy compared to human experts in classifying ECG patterns across multiple diagnostic categories [3–5]. For instance, studies have reported accuracies as high as 99.58% for identifying 16 CVD categories using CNN combined with GOA, and 97.63% for 27 CVD categories using ResNet-50 [3]. Comparative studies also suggest that models like Autoencoders can maximize prediction quality metrics while being computationally efficient compared to more complex models, whereas simpler models like Multi-layer Perceptrons may be poorly suited for this domain [1]. The benefits extend to the rapid and precise detection of conditions including arrhythmias, silent cardiac illnesses,

and left ventricular failure, potentially aiding clinicians significantly in interpretation, diagnosis, risk assessment, and disease management [4].

However, despite these promising advancements, the transition of AI-driven ECG analysis from research to widespread, reliable real-world clinical application faces significant engineering and information technology hurdles [2; 4; 5]. A major category of challenges involves data. Concerns about data privacy must be addressed, alongside the need for large, diversified training datasets to ensure models generalize well across different populations and clinical settings [5]. Furthermore, algorithmic challenges persist, particularly regarding model interpretability or the 'black box' problem; clinicians require transparency to trust and effectively utilize AI predictions [4; 5]. Ensuring model generalizability beyond the training data and addressing potential biases embedded within algorithms or datasets are critical for equitable and reliable performance [4]. A significant gap exists between research findings and clinical practice, highlighted by the fact that many studies are single-center, retrospective, and lack external validation [2]. Consequently, only a small fraction, reportedly less than 15%, of AI-ECG studies progress to real-world clinical deployment and testing [2]. Successfully navigating regulatory approval pathways, such as those managed by the FDA, often involves commercial collaborations, with a notable focus on applications targeting mobile or wearable devices [2]. Integrating these AI tools effectively into existing clinical workflows remains a practical implementation challenge that needs resolution [2].

In conclusion, AI-enhanced electrocardiography holds transformative potential for improving the diagnosis and management of cardiovascular diseases through rapid, accurate, and consistent analysis [4; 5]. Models like CNNs and AEs have demonstrated high diagnostic accuracy in research settings [1; 3; 4]. Nevertheless, the path to routine clinical integration requires dedicated efforts to overcome substantial challenges related to data quality and privacy, algorithm interpretability, bias, and robustness, and importantly, rigorous real-world validation and seamless workflow integration [2; 4; 5]. Addressing these engineering, technical, and implementation issues is paramount to fully unlock the capabilities of AI in real-time ECG monitoring and significantly improve patient outcomes.

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## CONTENTS

<i>S. Okovytyy</i> WELCOMING SPEECH OF THE RECTOR OF OLES HONCHAR DNIPRO NATIONAL UNIVERSITY	3
<i>I. Popova</i> WELCOMING SPEECH OF THE DEAN OF THE FACULTY OF UKRAINIAN AND FOREIGN PHILOLOGY AND STUDY OF ARTS	5
<i>O. Hurko</i> WELCOMING SPEECH OF THE HEAD OF THE DEPARTMENT OF ENGLISH LANGUAGE FOR NON-PHILOLOGICAL SPECIALITIES	8

### PANEL 1

#### Modern Studies in the Sphere of Natural Sciences

<i>E. Berezska, N. Kuragina, O. Osadcha</i> BILE ACID METABOLISM AND GUT MICROBIOME: A KEY TO INTESTINAL HEALING AND INFLAMMATORY BOWEL DISEASE THERAPY	10
<i>A. Bershak, S. Kopteva, O. Posudiiivska</i> METHODS FOR SYNTHESIS OF 1,4-BENZODIAZEPINES	12
<i>A. Cherhyk, N. Kurahina, O. Osadcha</i> THE ROLE OF NON-CODING RNAs IN DISEASE DEVELOPMENT	17
<i>A. Faizulin, O. Shugurov, O. Hurko</i> ACTIVATION OF AQUARIUM FISHES ABILITIES FOR LEARNING AND REFLECTION	18
<i>V. Halchenko, A. Kabar</i> PROSPECTS FOR THE INTRODUCTION OF <i>DRACOCEPHALUM MOLDAVICA</i> IN THE STEPPE DNIEPER REGION	20
<i>Yu. Homik, K. Lavrentieva, O. Osadcha</i> THE PROBLEM OF BACTERIAL ANTIBIOTIC RESISTANCE: CAUSES AND WAYS TO OVERCOME IT	22
<i>T. Huliaieva, T. Denysenko, O. Posudiiivska</i> HIDDEN DANGER OF DETERGENTS	24
<i>S. Ishchenko, T. Denysenko, O. Posudiiivska</i> CAFFEINE IN DRINKS: BENEFITS AND HARMS	29
<i>A. Kaliberda, R. Dolinski, N. Kaliberda</i> GENE THERAPY AND LEBER CONGENITAL AMAUROSIS	33
<i>A. Koloskova, O. Vorankova, O. Osadcha</i> MODERN METHODS OF TUBERCULOSIS DIAGNOSIS IN UKRAINE	37
<i>M. Kulinich, Yu. Matsuk, O. Posudiiivska</i> IMPROVING SOUR CREAM TECHNOLOGY USING COCOA POWDER	38

<i>K. Maliiev, K. Holoborodko, O. Hurko</i> CHARACTERISTICS OF FUNGI DISTRIBUTION OF THE GENUS THYROSTROMA (HÖHN., 1911) IN THE STEPPE ZONE OF UKRAINE	40
<i>V. Melnichuk, T. Ostanina, O. Osadcha</i> VARIETY OF EQUIPMENT IN REHABILITATION	41
<i>M. Nedotopa, T. Ostanina, O. Osadcha</i> REHABILITATION FOR UKRAINIAN SOLDIERS WITH AMPUTATION	44
<i>V. Nevidomy, N. Parfinovych, O. Novikova</i> BEST RELATIVE APPROXIMATIONS OF CLASSES OF DIFFERENTIABLE FUNCTIONS DEFINED ON THE REAL AXIS	46
<i>O. Parfonov, A. Lyashkov</i> MODELING OF CURRENT-VOLTAGE CHARACTERISTICS OF HETEROGENEOUS OXIDE SYSTEMS	48
<i>S. Roitman, T. Sklyar, O. Osadcha</i> BACTERIOPHAGES AS AN OBJECT OF BIOTECHNOLOGY	50
<i>A. Sabanskyy, K. Holoborodko</i> USE OF VEGETATION INDICES FROM DRONE-ACQUIRED MULTI-SPECTRAL IMAGERY FOR ASSESSING PHOTOSYNTHETIC ACTIVITY OF ROBINIA PSEUDOACACIA	52
<i>L. Safonov, K. Plasovska, O. Posudiievska</i> MODERN METHODS OF FORMING CRYSTALS	54
<i>P. Tishchenko, O. Vinnyk, O. Osadcha</i> THE ROLE OF FAMILY MEMBERS IN CARING FOR DEPENDENT INDIVIDUALS	57
<i>O. Trukhym, O. Vinnyk, O. Osadcha</i> THE PROBLEM OF EMOTIONAL BURNOUT AMONG MEDICAL STAFF IN UKRAINE	59
<i>D. Vertash, O. Kositsyna, O. Posudiievska</i> CALCULATION SOLUBILITY PARAMETERS OF THE POLY(URETHANE-SEMICARBAZIDES) ON THE BASIS OF PYRIDINE DERIVATIVES	61
<i>V. Yavtushenko, A. Lyashkov</i> APPLICATION OF POLYMER COMPOSITE AND CERAMIC MATERIALS FOR ELECTRICAL PROTECTION OF SOLAR PANELS	63
<i>V. Yesipova, O. Donets, Yu. Honcharova</i> PSYCHOLOGICAL ANALYSIS OF THE CONCEPT OF "IDENTITY"	65
<i>D. Yevdakha, A. Lyashkov</i> PROMISING DIRECTIONS FOR OPTIMIZING GAS SENSORS BASED ON NANOSCALE OXIDE MATERIALS	67
<i>V. Zaitsev, I. Dregval, O. Hurko</i> THE FUNCTIONAL STATE OF BLOOD CELLS IN CYPRINID FISH AS A TOOL FOR EARLY DETECTION OF AQUATIC ECOSYSTEM POLLUTION (BASED ON THE KYIV RESERVOIR CASE)	69

## PANEL 2

### Topical Issues of Social Sciences and Humanities

<i>O. Anisova, K. Berezhná, O. Besarab</i> CONCEPTUAL INCONSISTENCY IN THE DEFINITION OF INTERNATIONAL COMMERCIAL ARBITRATION IN UKRAINIAN AND INTERNATIONAL LAW	71
<i>V. Bazhyn, V. Boiko, O. Hurko</i> COMPETENCY-BASED APPROACH IN CONTEMPORARY SOCIOLOGY OF EDUCATION	74
<i>Y. Bed, O. Hurko</i> VERSIFICATION OF WILLIAM BLAKE'S POEM "THE BLOSSOM"	76
<i>D. Boborykin, O. Hurko</i> SEMANTIC UNCERTAINTY OF CONCEPTS OF "PEACE" AND "NEGOTIATIONS" IN TIMES OF MILITARY CONFLICTS	77
<i>A. Bolivar, N. Styrnik</i> STRENGTHENING ENGLISH LANGUAGE PROGRAMMES IN VENEZUELA	80
<i>A. Bonhar, R. Velychko, O. Osadcha</i> THE ROLE OF STRESS IN HUMAN LIFE AND EFFECTIVE METHODS OF SELF-HELP: A THEORETICAL ANALYSIS	84
<i>V. Bukreieva, Z. Bondarenko</i> PECULIARITIES OF USING INQUIRY-BASED LEARNING TECHNOLOGY IN PRIMARY SCHOOL TECHNOLOGY IN PRIMARY SCHOOL	85
<i>V. Bukreieva, O. Marchenko, O. Hurko</i> TYPES OF ENVIRONMENTAL INFORMATION UNDER UKRAINIAN LEGISLATION	89
<i>M. Chalykh, O. Donets, Yu. Honcharova</i> NARCISSISTIC ABUSE AS A SPECIFIC FORM OF VIOLENCE IN RELATIONSHIPS	91
<i>V. Chaus, H. Mudrenko</i> STEM EDUCATION AS A MEANS OF DEVELOPING SPATIAL ORIENTATION SKILLS OF CHILDREN WITH INTELLECTUAL DISABILITIES	94
<i>S. Chebotarov, H. Mudrenko</i> THEORETICAL ANALYSIS OF PROCRASTINATION	96
<i>Y. Demianushko, O. Dysa, O. Aliseienko</i> CHALLENGES OF SOCIAL AND PSYCHOLOGICAL ADAPTATION OF REFUGEES WITH CHILDREN	97
<i>K. Halich, N. Zimivets, O. Osadcha</i> USAGE OF AI IN SPEECH DEVELOPMENT OF PRESCHOOL CHILDREN	99
<i>Y. Havrylov, O. Nikilev</i> THE TRANSFORMATION OF THE TERM "AIR CLUB" IN HISTORICAL CONTEXT	101
<i>S. Hemay, Y. Borysova, O. Osadcha</i> CORPORATE SOCIAL RESPONSIBILITY IN THE CONTEXT OF WAR IN UKRAINE	104
<i>K. Hetman, S. Stavchenko, O. Hurko</i> DELIBERATIVE AND AGONISTIC TECHNOLOGIES OF POLITICAL CONSENSUS FORMATION	106



<i>Y. Hladyshko, V. Okorokov, O. Hurko</i> LANGUAGE AS A BEARER OF TRUTH IN ALAIN BADIOU'S POSTCLASSICAL PHILOSOPHY	108
<i>O. Hlazunov, V. Myronenko</i> TRANSFORMATION OF MEDIA CONTENT CREATION UNDER THE INFLUENCE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	109
<i>M. Hnatenko, N. Yuzikova</i> CRIMES AGAINST HUMANITY IN THE DR CONGO: BRINGING TO JUSTICE AS A PATH TO FAIRNESS	111
<i>N. Huber, O. Hurko</i> MICROLEARNING IN HIGHER EDUCATION: CHALLENGES AND PROSPECTS IN TIMES OF WAR	115
<i>M. Irchyshyna</i> FEATURES OF LEARNING ENGLISH FOR STUDENTS OF DNIPRO STATE UNIVERSITY OF INTERNAL AFFAIRS	118
<i>A. Khazova, H. Mudrenko</i> CONTACT IMPROVISATION AND BODY-ORIENTED THERAPY IN THE CONTEXT OF ALLEVIATING CONDITIONS IN INDIVIDUALS PRONE TO SUICIDE AND DEPRESSIVE DISORDERS IN ADULTS	119
<i>S. Kiriakhno, O. Hurko</i> CONSERVATIVE RHETORIC IN THE INAUGURAL SPEECH OF GEORGIA MELONI	123
<i>O. Kiselevskiy, I. Batrachenko</i> THE PERSONALITY OF UKRAINIAN FREELANCERS AS AN OBJECT OF PSYCHOLOGICAL RESEARCH	126
<i>A. Kliuiev, T. Potnitseva, O. Besarab</i> MODERN BIOGRAPHICAL VERSIONS OF OSCAR WILDE'S LIFE AND CREATIVE ART	129
<i>K. Kocherzhyna, S. Riabovol</i> THE REPRESENTATION OF THE PROBLEM OF EDUCATION DURING THE WAR IN THE POEM "A CENTURY LATER" BY IMTIAZ DHARKER	134
<i>Ya. Kozynets, T. Lytvynova, S. Riabovol</i> SOCIAL HISTORY OF THE COSSACKS IN THE WORKS OF UKRAINIAN HISTORIANS	137
<i>S. Krutikova, Yu. Honcharova</i> CLARIFYING THE CONCEPT OF POST-TRAUMATIC GROWTH	139
<i>T. Kyrpyta, T. Davydova</i> HANDLING STRESS IN EFL CLASS IN HIGHER SCHOOL DURING THE WAR OF RUSSIA AGAINST UKRAINE	142
<i>M. Kysil, O. Hudoshnyk</i> FORMATION OF NICHE AUDIENCES IN THE PLATFORMIZED MEDIA SPACE	144
<i>D. Lebedenko, Yu. Halayko, N. Kaliberda</i> EMOTIONAL BURNOUT OF MATHEMATICS TEACHERS AS A PSYCHOLOGICAL AND PEDAGOGICAL PROBLEM	146

<i>A. Maiboroda, I. Popova</i> EMOTIONAL SYNTAX OF OLEKSANDR DOVZHENKO'S EPISTOLARY TEXTS	149
<i>O. Makaida, O. Aliseienko</i> AN ASPECT IN FORMAL LOGIC INTERPRETATION	152
<i>S. Minaichenko, N. Styrnik</i> ACCESSIBLE MENTAL HEALTH SUPPORT: A SOCIETAL & POLICY PERSPECTIVE	154
<i>K. Miskevych, O. Novikova</i> FEATURES OF COLLOQUIAL STYLE IN WRITTEN TEXTS ON THE TWITTER (X) PLATFORM	157
<i>V. Parshutina, Y. Polishchuk, O. Aliseienko</i> ART THERAPY IN SPEECH THERAPY ACTIVITY WITH PRESCHOOL CHILDREN	161
<i>B. Pischanskyi, V. Vershyna</i> INFORMATION AS A MEANS OF INFLUENCE ON THE CONSCIOUSNESS OF MODERN MAN	165
<i>D. Pysmak, D. Arkhireiskyi, O. Hurko</i> ANGLO-GERMAN COLONIAL RIVALRY AS A MIRROR OF THE EUROPEAN CRISIS (1890-1914)	166
<i>Y. Savchenko, N. Zymivets</i> THE CREATION OF A SUPPORTIVE ENVIRONMENT FOR INCLUSIVE EDUCATION OF CHILDREN WITH SPECIAL EDUCATIONAL NEEDS IN GENERAL SECONDARY EDUCATION INSTITUTIONS	169
<i>A. Shpachinska, Y. Ryabchenko, O. Osadcha</i> THE ROLE AND THE PLACE OF ECtHR JUDGEMENTS IN UKRAINIAN JUDICIAL SYSTEM	171
<i>O. Stebliuk, A. Liasota, N. Styrnik</i> THE CHALLENGE OF NATIONAL IDENTITY IN POLITICAL TRANSITIONS	173
<i>D. Svystun, O. Osadcha</i> THE ROLE OF GAME TECHNOLOGIES IN THE CORRECTIONAL WORK OF A SPEECH THERAPIST	176
<i>M. Sydorov</i> TECHNOLOGIES OF POLITICAL COMMUNICATION	178
<i>V. Takhterin, O. Hurko</i> THE TRANSFORMATION OF SPORTS REPORTING IN THE DIGITAL AGE	182
<i>N. Tsurikova, L. Nikolenko, O. Aliseienko</i> TECHNOLOGY OF SOLVING INVENTIVE TASKS AS METHOD OF KNOWLEDGE FORMATION WITH INTELLECTUAL DISABILITIES CHILDREN	185
<i>P. Utkin, V. Voronov</i> STALINIST REPRESSIONS IN POSTWAR SOVIET UKRAINE IN THE CONTEMPORARY SCIENTIFIC LITERATURE	191
<i>O. Verbonol, O. Aliseienko</i> FORMATION OF CULTURAL IDENTITY	195

<i>B. Zamoruiev, O. Hurko</i> THE FUTURE OF EXISTENCIALISM: ETHICS	198
<i>P. Zhenikhova, Y. Borysova, O. Osadcha</i> UKRAINIAN SPIRITUALITY IN TIMES OF CRISIS	201
<i>D. Zubkovskiy, I. Batrachenko</i> METHODS OF ASSESSING PERSONAL TIME PERSPECTIVE	203

### PANEL 3

#### Modern Research in the Sphere of Socio-Economic Sciences and Information Technologies

<i>N. Agafonov, T. Vorova</i> REACTIVE APPLICATIONS: DEVELOPMENT AND FUTURE	206
<i>O. Bazyk, T. Grynko</i> DIGITAL SHADOW AS AN INTERMEDIATE MODEL IN THE PROCESS OF DIGITAL TRANSFORMATION OF AN ENTERPRISE	209
<i>V. Bovkunov, O. Bovkunova</i> FORECASTS AND FACTORS FOR THE FUTURE DEVELOPMENT OF STARTUPS IN THE GLOBAL ENERGY INDUSTRY	213
<i>V. Bovkunov, O. Bovkunova</i> THEORETICAL PRINCIPLES OF RESEARCHING STARTUP DEVELOPMENT IN THE GLOBAL ENERGY INDUSTRY	217
<i>Z. Dolhov, V. Chernykh, T. Vorova</i> TECHNOLOGIES OF GAMIFICATION OF LEARNING IN THE FORMATION OF ALGORITHMIC THINKING THE SCHOOLCHILDREN AT COMPUTER SCIENCE LESSONS OF 5-6 GRADES	221
<i>K. Huk, A. Sheveleva, O. Novikova</i> NEURAL NETWORK APPROACH TO REAL-TIME VENTILATION SYSTEM CONTROL MODELING AND OPTIMIZATION	224
<i>S. Kasyan, T. Grynko, O. Hurko</i> THE IMPACT OF GLOBALIZATION PROCESSES ON STRATEGIC CHANGE MANAGEMENT	225
<i>I. Kotov, O. Besarab</i> GEO-ECONOMIC PARAMETERS OF DIVERSIFICATION OF COMMERCIAL COOPERATION IN LATIN AMERICA AND THE CARIBBEAN IN 1960-1980	228
<i>O. Mykhailenko, T. Vorova</i> THEORETICAL ASPECTS OF INTERNATIONAL EXPANSION	231
<i>V. Myroshnyk, T. Vorova</i> FORMS OF INTERNATIONAL COMPETITION	234
<i>N. Onishchuk, H. Mudrenko</i> OPTIMIZATION OF CORPORATE CASH FLOWS: MODERN METHODS AND APPROACHES	239

<i>D. Parkhomenko, S. Adonin, Yu. Honcharova</i> CREDIT RISK MANAGEMENT IN THE CONTEXT OF ECONOMIC INSTABILITY	240
<i>B. Shchebetiuk, T. Vorova</i> THE ROLE AND DIRECTIONS OF ARTIFICIAL INTELLIGENCE IN IMPROVING THE COMPETITIVENESS OF ENTERPRISES	243
<i>S. Svir, T. Grynko</i> THE ROLE OF THE STATE IN THE DEVELOPMENT OF BUSINESS STRUCTURES IN TRANSFORMATION ECONOMY	246
<i>V. Ustymenko, O. Hurko</i> INVESTMENT ACTIVITIES OF NON-STATE PENSION FUNDS: CHALLENGES AND PROSPECTS	250
<i>B. Zavaliy, O. Hurko</i> IMPLEMENTATION OF INNOVATIVE FINANCIAL MODELS IN VARIOUS SECTORS OF THE ECONOMY	252

#### PANEL 4

#### Actual Problems of Engineering and Technical Sciences and Modern Information Technologies

<i>O. Bahlai, S. Bilogurov, O. Hurko</i> METHODS FOR ENHANCING THE PROPULSION SYSTEMS FEED UNIT FOR NANOSATELLITES	255
<i>B. Bakun, N. Nosova, N. Kaliberda</i> ADDITIVE MATERIALS IN THE MANUFACTURING OF IMPELLERS FOR PUMP SYSTEMS	257
<i>V. Chalova, S. Bondarenko, N. Kaliberda</i> PROBLEMS OF MAN-PORTABLE ANTI-TANK MISSILE SYSTEMS AND THEIR SOLUTIONS	259
<i>H. Diadchenko, V. Shevtsov, N. Kaliberda</i> OBJECTIVE FUNCTIONS IN THE DESIGN OF ROCKET AND SPACECRAFT	261
<i>G. Husak, I. Uchytel, O. Aliseienko</i> USING DIGITAL PLATFORMS FOR PROVIDING PSYCHOLOGICAL ASSISTANCE DURING THE FULL-SCALE WAR IN UKRAINE	263
<i>I. Kolesnichenko, O. Khaminich, N. Kaliberda</i> OPTIMIZATION OF THERMAL PROCESSES IN THE HEAT AND POWER INDUSTRY USING DIGITAL TECHNOLOGIES	267
<i>O. Koliada, K. Panin, N. Kaliberda</i> MYTHS AND TRUTHS ABOUT WIRELESS ENERGY TRANSMISSION TECHNOLOGIES	270
<i>S. Lazarets, S. Mamchur, O. Novikova</i> OPTIMIZATION OF FRICTION WELDING PARAMETERS FOR ENHANCING THE QUALITY OF CORROSION-RESISTANT STEEL AND COPPER JOINTS	279
<i>O. Lysenko, O. Kolesnichenko, N. Kaliberda</i> PROBLEMS AND PROSPECTS OF USING PNEUMATIC MOTORS	281

<i>K. Maksymenko, R. Bilichenko, N. Kaliberda</i> ETHICS IN THE ERA OF ARTIFICIAL INTELLIGENCE	285
<i>V. Moiseienko, S. Antonenko, O. Novikova</i> UTILIZING LARGE LANGUAGE MODELS (LLMs) FOR ENTERPRISE BUSINESS PROCESS OPTIMIZATION	291
<i>Y. Morozov, T. Zaytseva, O. Novikova</i> USE OF DEEP LEARNING IN CONTACT MECHANICS	292
<i>V. Murashko, T. Manko, O. Hurko</i> COMPOSITE PIPELINES FOR CRYOGENIC PROPELLANTS IN MODERN ROCKETRY	294
<i>O. Murashko, Y. Tkachov, O. Hurko</i> ELASTIC SEARCH-DRIVEN DECISION SUPPORT SYSTEMS FOR OPTIMIZING MATERIAL SELECTION IN THE ROCKET SCIENCE	297
<i>M. Nakhod, I. Karpovych, O. Novikova</i> THE USAGE OF UNCONVENTIONAL MECHANICAL PROCESSING METHODS TO IMPROVE COMPONENTS QUALITY	300
<i>R. Pylypenko, S. Klymenko, N. Kaliberda</i> CURRENT TRENDS IN THE USE OF RECHARGEABLE BATTERIES IN THE BACKUP POWER SOURCES	301
<i>P. Sazonov, S. Klymenko, O. Novikova</i> CALCULATIONS OF THE APPLICATION OF THE ULTRASONIC NON-DESTRUCTIVE TESTING METHOD FOR COMPLEX TECHNICAL OBJECTS	305
<i>A. Shcherbak, A. Tonkoshkur, O. Novikova</i> MACHINE LEARNING APPROACHES FOR PRIMARY ANALYSIS OF DIELECTRIC SPECTROSCOPY DATA	307
<i>Y. Shliakhov, V. Kuzmenko, O. Novikova</i> COMPUTER MODELING OF DEFORMATION PROCESSES IN COMPLEX STRUCTURES	309
<i>A. Spodobets, A. Sanin, O. Novikova</i> CURRENT ISSUES IN PROTECTING MEDICAL EQUIPMENT FROM ELECTROMAGNETIC RADIATION	310
<i>Y. Suleymanov, O. Baybuz, O. Besarab</i> USING CHROMA AUDIO FEATURES IN GENRE CLASSIFICATION BY NEURAL NETWORKS	313
<i>R. Syzonenko</i> INTEGRATION OF UAV WITH YOLO-BASED COMPUTER VISION SYSTEM FOR AUTONOMOUS NAVIGATION AND OBJECT RECOGNITION	315
<i>O. Tymchenko, V. Korchynskyi, O. Novikova</i> OPTIMAL CONTROL OF THE BANDWIDTH OF INFORMATION CHANNELS FOR TRANSMISSION OF REMOTE SENSING RASTER IMAGES	318
<i>V. Tymoshenko, A. Sanin, O. Novikova</i> METHODS FOR GRAIN STRUCTURE ANALYSIS	320
<i>I. Volnov, I. Skuratovskyi, O. Novikova</i> AI-DRIVEN REAL-TIME ECG MONITORING: CURRENT CHALLENGES AND FUTURE PROSPECTS	322

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**Рецензенти:**

**Бобух Н. М.**, д-р філол. наук, проф., завідувачка кафедри української, іноземних мов та перекладу Полтавського університету економіки і торгівлі;

**Бірюкова Д. В.**, канд. філол. наук, доцент кафедри іноземної філології, перекладу та професійної мовної підготовки Університету митної справи та фінансів;

**Кирпича Т. В.**, канд. філол. наук, доцент кафедри перекладу та іноземних мов Українського державного університету науки і технологій.

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