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The collection is intended for specialists in state, military management, military strategy, military art, history of wars and technologies, scientists, teachers, doctoral students, associate professors, postgraduate students.

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PREFACE

Ambassador Extraordinary and Plenipotentiary of Ukraine to the United Kingdom of Great Britain and Northern Ireland
Valery Fedorovich Zaluzhny

Dear colleagues and readers!

Modern conditions on global security require constant scientific understanding of the processes occurring in the spheres of national security, military technologies, armaments and information systems. In-depth study of the wars' history, defense technologies and analysis of new threats development are becoming determining factors for ensuring the sovereignty and stability of the state.

Today we can firmly state that the war in Ukraine has become not only the bloodiest act of violence in the 21st century in Europe, but also the driving force behind many forces that have led to a change in the World order. The World security system has also changed. It has transformed not only because the geopolitical space is changing, but also because the war in Ukraine has changed the power itself on that this security system was based.

Today, success on the battlefield depends entirely on the implementation of innovations and new solutions. Unmanned systems and digital technologies have appeared – traditional types of weapons have become history. Armored vehicles, which have been the basis of offensive operations since 1915, are now defenseless against cheap air attack tools.

High-precision weapons that used GPS positioning are no longer effective due to the development of combat electronic warfare. Drones have appeared, and therefore it is economically inexpedient to use expensive missiles for air defense systems.

The airspace above the battlefield has become inaccessible to manned aircraft, turning it into an auxiliary tools of air defense. And the sea space has gradually been occupied by naval drones. Now powerful ships are hiding in protected ports.

The world must rethink the forms and methods of applying new technologies. And this is not only a matter of supporting Ukraine – it is a matter of joint readiness for a new era of warfare, dominated by technology, information, and automation of decisions.

It is obvious that success on the battlefield now depends entirely on the ability to stay ahead of the enemy in technological development. It is very important that changes occur precisely in the chain "science (development) – production – application". It is from the effective relationship between them that innovative development will depend.

The development of artificial intelligence and machine learning, the development of electronic warfare, the development and production of various types of drones, and civilian or dual-use technologies will be a key on this path.

And it is the speed of implementation of these innovations that directly increases the state's ability to achieve victory. In the future high-tech war, the one who adapts to the technological conditions of the battlefield faster than the enemy will win. The side that is the first to systematically and qualitatively make the transition to another military-technological level will gain an unconditional strategic advantage and impose its will on the other side.

On the international stage, the way out of the situation we are talking about today lies not only in adapting to new challenges, but in shaping a new global security reality, to that Ukraine has already joined as an equal and active participant. Ukraine is no longer just an object of

support – we have become a source of experience, technologies and solutions that are of strategic importance for the entire civilized World.

This journal is a platform for publishing scientific research, analytical materials, and innovative developments in the fields of military affairs, security, and information technologies. All this will contribute to the development of scientific potential, the exchange of knowledge between specialists, and the implementation of scientific achievements in the practice of defense activities.

Therefore, we invite you to dialogue, experiences exchange, and work together towards a future in which knowledge and technology strengthen the security and defense of our country, standing in defense of peace, freedom, and human dignity.

Extraordinary and Plenipotentiary
Ambassador of Ukraine to the United
Kingdom of Great Britain
and Northern Ireland,
Commander-in-Chief of the Armed Forces
of Ukraine (2021–2024),
Philosophy Doctor in Law

Valeriy ZALUZHNY

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EUROPEAN SECURITY: THREATS AND TRENDS IN THE UKRAINIAN CONTEXT PROSPECTS

Abstract. *Analyzing the security situation in Europe, especially using methods of comparison, classification, as well as the real time method, and relying on statistical and factual data, the article identifies the dominant challenges and threats that currently affect the effectiveness of defense and security strategies in European countries. It is proven that against the background of deglobalization processes, the international system is degrading and fragmenting; in the course of the fierce confrontation between democracy and various authoritarianisms, alternative versions of the world order are being formed; European nationalisms are strengthening, that, by distancing themselves from helping Ukraine, the victim of russian aggression, in their own way ensure the legitimacy of the russian dictator, ignoring the prospects of the russian army's invasion of their own territory. In addition, the instability of the security situation in Europe is caused by the change of presidential power in the USA and the uncertainty of the policy of the Donald Trump's administration regarding Euro-Atlantic cooperation, NATO, as well as the not yet fully understood degree of "understanding of russian" by the American president, and, accordingly, his role in ultimately taming the aggressor country, or vice versa - deepening the "understanding" of russian neo-imperialism, racism and ignoring war crimes.*

Keywords*: threats and challenges to European security, internationalization of the russian-Ukrainian war, European nationalisms, policy of the Donald Trump administration, NATO.*

Introduction

Problem statement. European security is experiencing a state of turbulence, instability, uncertainty, ultimately, fragility. And this series of characteristics with a kind of destructive charge under the pressure of a new risks' cascade is expanding and diversifying almost daily. However, this concerns not only security issues, in fact, of Europe, but also of the entire planet: the world is in uncharted waters.

The world, as if resorting to testing the paradigms of the latest quantum theories and, more than ever before, began (quite clearly!) to reveal features that are not characteristic of the macro- or microworld: quantum entanglement is making its mark. Thus, events in one region (be it in Europe, the Middle East, or the Indo-Pacific region) almost immediately have one way or another repercussions in other regions of the planet, leading to global consequences: regional balances are disrupted and disappear. The world (according to the apt observation of Andrew Hyde) "is becoming more and more Hobbesian" and is getting out of control [1]. However, it is still difficult to unambiguously describe the logic of global macroprocesses.

Under such conditions, European security no longer depends only on Europe itself: it is significantly influenced by a number of factors of various scales, which are generated (in the era of total hybridity and, accordingly, hybrid wars) by a rather motley security environment. Its borders for Ukraine, as for every European country, are rather vague and diffuse in their own way, which causes a situation in which the security environment is in a state of constant transformation and specific mimicry, and the amplitude of its instability and imbalance, as we can state, is steadily growing.

In addition, the security environment constantly demonstrates an endless increase in differences between actors in their vision of the contours of the world order in the future, which leads to the formation of new fault lines. First of all, between parties within European states and, in fact, between political elites, between all those who influence political decision-making in states, that, in turn, instantly puts pressure on the policies and behavior of political actors at different levels in the international arena. New conflict lines are also emerging between neighboring states (on all continents), between regions, and ultimately between the Global North and the Global South, or, as some people today note (having heard the feedback from the past in their own way), between the Western and Eastern hemispheres, or between the geopolitical West and the non-West of the planet. Therefore, it is not for nothing that interstate conflicts "with a particularly significant crisis potential" were ranked first in the global risk rating by the business and political elites and risk analysts surveyed on the eve of the Davos Forum 2025, which took place in January [2].

The state of the modern security environment in its own way expresses signs of degradation of international relations and international cooperation, "wear and tear" of the security system and the actualization of particular interests of international actors. And Ukraine, which for centuries has remained a country "flowing with milk and honey" for its neighboring invaders, in the first third of the 21st century. The state of the modern security environment in its own way expresses the signs of degradation of international relations and international cooperation, the "wear and tear" of the security system and the actualization of the particular interests of international actors. And Ukraine, which for centuries has remained a country "flowing with milk and honey" for its neighboring invaders, in the first third of the 21st century was again transformed by their own efforts into bloody European lands. European security has collapsed. Although some Europeans still do not believe this after three years of a full-scale russian invasion of Ukraine.

An analysis of recent studies and publications shows that the problem of European security is one of the key in the spectrum of research interests. Therefore, it is clear that it will constantly require analysis, as well as forecasting. This is evidenced, in particular, by works that have appeared, at least since the beginning of the 21st century. Among them, first of all, we will pay attention to the "Routledge Handbook of European Security" (2013) edited by Sven Bishop and Richard Whitman [3], which focuses on the common security and defense policy of the region through the prism of liberal, constructivist and critical approaches. "The Handbook…" is not just a cross-section of professional views on the more distant or rather recent European security past, on the "errors of the environment", its peculiarities and traps, "peculiarities of Brusseliization" (in the words of Jolyon Howorth), but also a kind of mirror in which there are reflections of the hopes and desires of Europeans within the framework of Euro-Atlantic security and the realization of the potential of strategic partnership, their feelings in a state "between aspirations and pretense" (as

Richard Youngs emphasized). "The Handbook…" is a very recent vision by the best security experts of the trends and prospects of Europe in interaction or competition, or even rivalry and conflicts. "The Handbook…" is not only the truth, but also the illusion or (to use Herbert McMaster's terminology) the "strategic narcissism" of the intellectual elite of the West just on the eve of the full-scale invasion of the troops of the russian dictator Putin into the sovereign territory of the Ukrainian state.

Also worth noting are the studies of Chris Bickerton [4], the monograph edited by Christian Kaunert and Sarah Leonard [5], the works of Diego Borracho and José Luis de Castro [6], Katharina Kinvall, Jan Manners and Jennifer Mitzen [7], Vincent Della Sala [8], which demonstrate the interest of researchers in both theoretical security issues and the problematics of "ontological security" and the European Union as a "security provider", or the attention of analysts to, for example, various aspects of European security in the context of terrorism and intelligence in the context of hybrid warfare, as well as in the context of cybersecurity, etc. It is significant that, despite the variety of challenges, threats, and risks that Europe faced during the first two decades of the early 21st century, a kind of leitmotif of the research was the thesis that "life in the European Union has never been as safe as it is today," as noted in a 2018 publication by Elke Kramann [9].

However, if we analyze security studies over the past five years, we will find that in research on European security issues, peculiar new "points of reference" have appeared for further reflections on security issues, and one of the clear analytical trends has been criticism of the state and policy of the EU's security.

A vivid example of this is the eloquent headlines of publications, such as the article by Celia Belin and Ted Reinert "The European Union's Global Influence Is Eclipsing" [10], published in the spring of 2019, or the article by Magdalena Hora in 2021 with the "cautionary" title "This is Security Stupidity! The Politicization of EU Relations with Neighbors" [11], or the works by Heidi Mauer and Nicholas Wright entitled "How Much Unity Do You Need? Systemic Confrontation in the EU's Foreign and Security Cooperation" [12] and "Still Governing in the Shadows? Member States and the Political and Security Committee in the EU's Foreign Policy Architecture after the Lisbon Treaty" [13], published in the same year of 2021.

In these, as in other publications, the authors actually sought to establish a "diagnosis for Europe" on the eve of or during the crises related to Brexit and the COVID-19 epidemic. Noting that the "end of the world" scenarios for the EU (i.e. its collapse) were premature, the authors nevertheless emphasized the components of the "diagnosis" [14]:

– the presence of forces hostile to the European Union in the governments in Budapest, Warsaw, Rome and Vienna, and their increasing representation in Berlin and Paris;

– the weakening of the EU's ability to promote liberal democratic values and global cooperation by the nationalist-populist challenge in Europe and around the world, which, as predicted, would lead to the eclipse of European power, burdened by internal "political disagreements and the evolution of the continent";

– the unpreparedness of the "European experiment in shared sovereignty" for a global era, the dominant characteristic of which is the growth of nationalism, competition between great powers and the weakening of the transatlantic bond.

Predicting the development of the situation, S. Belin and T. Reinert emphasized that the attempts of nationalists (who are concentrated in the Hungarian party "Fidesz", the Polish party "Law and Justice", and the Italian "League") to transform the EU from within are capable of disrupting further European integration, since nationalists promote the idea of an alliance of nation-states hostile to Muslims and actually lead the front of opposition to European decisions. In addition, they exercise (in particular, in Germany) a "paralyzing influence" on the main parties that adhere to "defensive positions". And one cannot but agree with this statement of the researchers: the "paralysis" or procrastination of decisions on assistance to Ukraine became clearly visible after the full-scale russian invasion of Ukraine (if we analyze the behavior, specifics and

dynamics of decisions of the government of O. Scholz, which was sworn in on December 8, 2021, that is, a few months before the war).

S. Belin and T. Reinert were concerned with the problem of Europe's transformation from a player to a field in a "more competitive world", which, in their opinion, became a threat to Europe's unique experiment in "shared sovereignty". And the problem that this created was that the world turned away from globalization and positive cooperation. In early 2022, another trigger for the weakening of Europe's security, which drew the attention of analysts to security studies, was russian's full-scale war against Ukraine. Understanding the situation with European security, researchers (such as Niklas Helwig) focused, first of all, on Europe's ability to act during war [15]. In addition, - on the scenarios in which the russian-Ukrainian war could end, and are now trying to reflect on the security issues in Europe precisely in the context of the results of its termination. In particular, Matthew Burroughs (whose publications regularly appear on the website of the American Henry Stimson Center) during 2023-2024 considered 5 options for the possible end of the russian-Ukrainian war – a frozen conflict (which involves the highest risks of a sudden new outbreak of hostilities); a ceasefire as a result of negotiations – a truce (which would reduce the chances of resuming hostilities, but would require external approval, international peacekeepers and a demilitarized zone); the development of an even larger conflict (according to forecasts – World War III between the USA/NATO and russian/China); a "Korean-style" truce, which will probably require many years to ensure or, ultimately, a "general peaceful settlement" based on a "broader settlement of differences between russia and NATO" [16]. These 5 potential scenarios, with more or less detail and differences, dominate the analytical and political practices of Europe and America. However, the scenario of a "general peaceful settlement" is assessed as the least likely. So, in particular, M. Burroughs is inclined to believe that the "decline of Europe" continues, and it (an interesting emphasis!) is simply unable to feel safe, finding itself "at a crossroads" [17] as a result (as M. Burroughs argued in another article published in the fall of 2024 under the title "Can Trump be good for Europe?"), firstly, the expansion of the spectrum of internal problems - the aging of the population and its quantitative degradation, the slowdown in economic growth and the weakness of technologies, political and social disagreements within a number of countries, as evidenced by the development and spread of extremist and populist movements that doubt the feasibility of integration into the EU; secondly, under the pressure of political instability from the outside, caused by wars, terrorism, migration. As well as, one might add, many other hybrid influences in the context of, in particular, cognitive wars.

Finally, the third point, emphasized by M. Burroughs (and consonant with the idea of S. Belin and T. Reinert), is related to Europe's weakness in awareness and, accordingly, in timely decision-making over many previous years.

However, having familiarized ourselves with the literature, we can also distinguish another trend in understanding the situation in Europe, which analysts point out. In particular, Heidi Maurer, Kolya Raube and Richard G. Whitman in their publication in 2024. in European Security [18], examining the capabilities of, first of all, the EU (including after the start of the full-scale russian invasion of Ukraine) are concerned with the following questions: has the EU come of age as a foreign policy player and a security player? Is it finally possible to talk about the Union coming of age in the context of a full-scale war on the European continent?

Applying the concept of maturation to the EU, the authors analyzed the features of the EU's reaction to the russian invasion of Ukraine. Noting that this reaction surprised many observers, the researchers scrupulously identified and stated: the Union used a wide range of both new and established foreign policy instruments to support Ukraine. First of all, sanctions, military support. In addition, the EU used the European Peace Fund to supply military equipment, made commitments to deliver artillery ammunition under the ASAP program and to provide financial and budgetary support and on financial and budgetary support, humanitarian and other forms of emergency assistance to Ukraine. And this, as noted by H. Maurer, K. Raube and R. G. Wittman, allowed European leaders, as well as various commentators, to talk about a new stage in the

collective capacity of the EU in the field of foreign and security policy, about the emergence of a common collective position of the Union (despite the presence of different views among the EU member states). And it is difficult to disagree with this: the idea of strengthening the collective capacity of the EU, which has become a distinctive feature and a consequence of the efforts of its members over thirty years of cooperation, is now irrefutable. The European Union's self-awareness of itself as a subject of international processes and its demonstration in practice are becoming increasingly obvious. One cannot but agree with the opinion of the aforementioned group of authors that maturation is not a linear process, since it occurs at different rates at different stages of life, moreover, in different ways, and, moreover, does not acquire some "final completion" in a changing security/international environment.

However, maturity can, in our opinion, be manifested in the ability of the subject to permanently adapt to changing situations, while remaining able to make decisions, take responsibility, etc. It is in this vein that Heidi Mauer, Richard J. Whitman, Nicholas Wright [19] as well as Brigid Leffan [20] conducted their research.

Finally, it is worth mentioning the latest book by Richard Rose [21], which was published in January 2025. The book aroused interest for at least three reasons. First, R. Rose, noting that "security is conditional, not permanent", attempted to comprehend not only the past of European security, choosing 1945 as a starting point and emphasizing NATO's role in the security of the space from the Black Sea to the Potomac River in Washington (which, in particular, allowed Europeans to enjoy unprecedented economic security), but also the present, to which he devoted the third part of the study ("Security is Escalating"). Secondly, it was in the third part that R. Rose noted that Europe is not free from the "curse of war," and pointed out the significance for Europe of the struggle of Ukrainians against Putin's invading russian (pp. 123–142, "Ukraine: A Proxy War for Europe"). Thirdly, he set out his reflections on the future of European security in a situation where US commitment to Europe is decreasing and Putin has made security the "main concern" of Europeans. In addition, R. Rose considered three possible scenarios for the end of the war:

- the war reaches a stalemate; russian troops cannot seize more Ukrainian territory, but are strong enough in defense to maintain control over the territory they hold;
- an armistice similar to the 1953 Korean armistice is concluded, which contributes to the cessation of hostilities, but Ukrainian territories remain occupied;
- trying to avoid the risk of russians renewing the war, Ukraine will seek a long-term guarantee of military assistance.

Thus, in the scientific discourse, areas of analysis of European security have already been formed, in which one way or another Ukraine is at the center, as the leading trends of the time have been outlined. But, in our opinion, there is a lack of emphasis: the results of the end of the war should satisfy Ukraine, the Ukrainian State and society.

The purpose of the article is to analyze the threats faced by Europeans and track the trends of European security practices taking into account the Ukrainian perspective.

Presentation of the main material

Starting the analysis of political practices, let us pay attention to several points.
The first concerns European demography as one of the dominant factors that can both strengthen/guarantee security processes and act as their brake:

– at the beginning of 2025, *Worldometer*, analyzing Europe, identified 44 countries in its composition, starting the list/rating with russia, as the country with the largest population in 2024 – 144,820,423 people, and ending with the Holy See with about 500 inhabitants. In addition to the aforementioned 44 countries, 3 "dependent territories" operate within Europe – the Isle of Man, the Faroe Islands, Gibraltar). Together, the 47 entities were home to over 9,21% of the world's population, or – over 744,717,000 people (out of about 8 billion 200 thousand people on the planet, who were residents of 195 countries of the world). Thus, comparing Europe's human resources

with similar ones in other parts of the world, we find that Europe ranked third among the regions of the planet in terms of population, behind Asia and Africa, which at the end of 2024 had over 4,806,898 people and about 1,515,141 people, respectively [22];

– according to *Worldometer*, the population of Ukraine at the beginning of 2025 was about 38.5 million people (0,47% of the total world population), which allowed it to take 40th place among countries in terms of population;

– according to the latest published data from Eurostat [23], as of January 1, 2023, 448,8 million people lived in the European Union. The most densely populated country was Germany, with 84,4 million people (19% of the total EU population), followed by France with 68,2 million people (15%), then Italy – 59,0 million people (13%), Spain – 48,1 million people (11%) and Poland with 36,8 million people (8%). Just in these 5 countries the 66 % of the EU population has been settled. The smallest population quantity was in Malta (542 thousand people or 0,1 % from the total strength of the EU population), Luxemburg (661 thousand or also 0,1 % from the EU population), and in Cyprus (921 thousand or 0,2 %).

Among other important features of the EU's demographics that are worth paying attention to in the context of security is that in the EU, according to the aforementioned Eurostat, in 2023 the share of people aged 65 and over was 21%, and people aged 80+ – increased to 6%; there were almost 5% more women than men (229 million versus 219 million); the average age of the population in the EU was 44,5 years. At the same time, at the beginning of 2025, the average age of the population [22] in the USA was 38,5 years, in China – 40,1 years; in Russia – 40,3 years; in Ukraine – 41,8 years; in France – 42,3 years; in Poland – 42,5 years; in Germany – 45,5 years; in Spain – 45,9 years; in Italy – 48,2 years (High indicators of the average age of the population in some European countries are, among other things, evidence of the longest life expectancy in them).

Second point worth keeping in mind concerns the ranking of military strength of European countries and–wider–world, because with the election of US President Donald Trump and his determination to reconsider the US role in the Russian-Ukrainian war, transform transatlantic cooperation and, accordingly, American participation in NATO, as well as in other international organizations, understanding the military power of the world's countries (leading as well as others) will create a basis for comparing resources and provide a key to understanding the imbalance of qualitative indicators, as well as, accordingly, the risks associated with this imbalance.

So, according to *PowerIndex-2025* (*PwrIndx*; an indicator of 0,0000 is considered "ideal") [24]:

– the United States ranked first among 145 countries in the world, including 60 indicators – *PwrIndx: 0,0744*. Second place–russia (*PwrIndx: 0,0788*);

– the 10 strongest armed forces in Europe (excluding the russian army) include the armies of the United Kingdom (6th place in the world ranking, *PwrIndx: 0,1785*), France (7th place, *PwrIndx: 0,1878*), Italy (10th place, *PwrIndx: 0,2164*), Germany (14th place, *PwrIndx: 0,2601*), Spain (17th place, *PwrIndx: 0,3242*), Ukraine (20th place, *PwrIndx: 0,3755*), Poland (21st place, *PwrIndx: 0,3776*), Sweden (27th place, *PwrIndx: 0,4835*), Greece (30th place, *PwrIndx 0,5337*), the Netherlands (36th place, *PwrIndx: 0,6412*);

– the armed forces of the European Union countries that were not mentioned above, but those that were included in the world ranking (except Malta and Cyprus), were located in *PwrIndx* in the following order: Portugal (39th place), Denmark (45th), Finland (48th), Romania (51st), Czech Republic (53rd), Hungary (55th), Belgium (61st), Bulgaria (62nd), Austria (68th), Slovakia (71st), Croatia (74th), Lithuania (88th), Slovenia (96th), Ireland (97th), Latvia (99th), Estonia (107th), Luxembourg (117th);

– let's also take into account the *PwrIndx* of several satellites/partners, or currently "sympathizers" of russia: China, taking 3rd place in the world ranking, has a similar indicator to the russianan federation *PwrIndx: 0,0788*; Iran was ranked 16th with a *PwrIndx of 0,3048*; North Korea was ranked 34th with a *PwrIndx of 0,6016*; Kazakhstan was ranked 57th with a *PwrIndx of*

1,1016; Belarus was ranked 70th with a *PwrIndx of 1,3954*; Kyrgyzstan was ranked 105th with a *PwrIndx of 2,2543*.

These figures should be viewed in the context of NATO's capabilities (and this is a third observation) compared to russian's. The data available for analysis [25] were as of March 2024. According to them, 29 of the 32 member states were located in Europe. According to 27 indicators, NATO and russian's power looked like this (Table 1):

Table 1

The estimated NATO-russia firepower ratio (2024)

Indicators	NATO	russia
Joint manpower (personnel)	1,506,750	810,000
Frontline strength (personnel)	851 350	623 175
Manpower reserve (personnel)	649 150	187 500
Total air power (units)	5 253	3 137
Fighters/Interceptors (units)	881	580
Dedicated attack AC (units)	277	558
Transport (units)	381	333
Special mission AC (units)	244	110
Air refueling (units)	155	14
Helicopters (units)	2 172	1 148
Attack helicopters (units)	360	403
Armored combat vehicles (units)	3 184	9 425
Armored combat vehicles (units)	251 909	113 731
Self-propelled guns (vehicles)	1 158	4 931
Towed artillery (units)	1 765	3 252
Rocket artillery (units)	429	2 915
Total naval assets (hulls)	687	449
Aircraft carriers (hulls)	4	1
Helicopter carriers (hulls)	3	0
Destroyers (hulls)	28	11
Frigates (hulls)	34	8
Corvettes (hulls)	16	65
Submarines (hulls)	37	53
Mine vessels (hulls)	45	37
Available manpower (personnel)	103 333 500	52 500 000
Combined/Defense budget	$235.5 billion (combined)	$82.6 billion (defense); in 2025 –
Oil production (barrels per day)	6,838 million	10,750 million
Oil consumption	---	3,700 million

Thus, as the above data show, the world has accumulated significant resources that characterize the significant "firepower" of countries located in different regions of the planet; NATO has advantages over russian's in most "firepower" parameters, but the potential withdrawal of the US from the Alliance, and even more so the combination of russian's potential with the potential of its closest partners/satellites/sympathizers or dependent countries (like the de facto annexed Belarus, which has clearly lost its sovereignty) constitutes a powerful resource for a war against Europe with its (in the words of Josep Borrell) "bonsai armies" and, accordingly, the

subsequent defeat of Europe, as well as for a potential Third World War, which, however, as the media occasionally report, has already begun, and the escalation of violence is only intensifying. Arguments "against" such a statement are difficult to find. And not only because in previous cases (two world wars that the 20th century experienced) the "worldwide" characteristic was singled out after their end, but also because before our eyes the internationalization of the Russianan-Ukrainian war is taking place against the background of Europe's unpreparedness (although the categorical "Poles, wake up!" has already sounded in the European expanses, but it seems that it has only fully responded in its eastern part).

The above prompts us to pose rhetorical questions: *is the "firepower" of democracies and authoritarianisms really becoming dangerously equal? Will the 21st century become the century of the dominance of authoritarian regimes and, accordingly, the economic and geopolitical retreat of the West and democracy? What will be the role of numerous nationalisms, stunningly hyper-polarized by the political elites of Europe, as well as in other regions of the planet, in these processes?*

The Ukrainian view of the consequences of the defense and security, international and domestic policies of the EU and the policies of NATO member states (from the moment of the full-scale russia`s invasion of Ukraine until the beginning of 2025) allows us to distinguish the characteristic features of these policies and defense and security practices: indifference or "concern"; the excitement of representatives of the European establishment, comparable only to horse racing, and bets/predictions as to whether Ukraine will fall in three days? In a week? Will it hold out for a month…; sympathy for the victim or undisguised contempt for it and assistance to the aggressor; insignificant preventive (on the eve of the full-scale invasion) assistance to Ukraine and the further inhibition and endless procrastination of decisions and actions (for example, in the area of sanctions, closing the sky, etc.); resource assistance – from apparent to a kind of "restrictive": assistance "for the continuation of the war", but not "for the victory" of Ukraine, and, ultimately, – the transformation of Ukraine into a "laboratory of war of the 21st century"; latent cooperation with russian (continuation of business and payment of taxes on the territory of the russian federation by a number of European and, in general, Western companies, growth of trade with the aggressor through third countries, use of the shadow fleet of russian, etc.); ejection by part of the political elite of Europe of the thesis that for the old russian dictator the borders of the European Union or NATO countries will not be a significant obstacle.

In addition to the "russia factor", other, no less, or even more significant signs of the times, other factors whose effect on European security is undeniably destructive, can be distinguished.

The first concerns the fact that the international security system is completely broken. UN arbitration, often, does not work. How the norms of international law do not work properly in the modern world. Shameful evidence of this is not only the fallacy of the Budapest Memorandum, or, for example, the position of Mongolia, which, as a signatory to the Rome Statute, did not arrest the russian dictator putin [26], although it should have done so, according to the warrant for his arrest issued by the International Criminal Court (ICC): it is not only Asian Mongolia that is inclined to ignore the "spirit and letter" of international law. Thus, in January of this year, Polish President Andrzej Duda asked [27] the government headed by Tusk to ensure that Israeli Prime Minister Benjamin Netanyahu can attend the 80th anniversary of the liberation of the Auschwitz-Birkenau death camp on January 27, without fear of arrest under an ICC warrant. Even earlier, France [28] and Hungary [29] announced that they would not arrest Netanyahu. Romania has spoken in the same spirit: on January 19, the country's Prime Minister Marcel Ciolacu reported on the X network [30] that Romania and Israel are working on preparing a joint government meeting, to which Netanyahu has been invited to Romania.

That is, if we do not focus on who, whom and why is protecting from punishment/arrest (as well as the fact that Israel is not a member of the ICC and disputes its jurisdiction), but simply analyze these facts of violating the ICC's decisions, the conclusion is obvious: international law is being "roded" by the Europeans themselves. And this is a dangerous precedent and a threat to

Ukraine (to be left with an unresolved issue – punishing putin for numerous crimes). And if we take into account that the US House of Representatives even approved sanctions [31] against the ICC (due to the "bias" of the ICC), then we can say that the existing international law is becoming, for one reason or another, a kind of burden for Europeans, Americans, and Asians. And if some analysts in this situation draw attention to the fact that the "collective West" simply does not "surrender" its own (for example, the same Netanyahu), then we emphasize another point: contempt for international law becomes a trigger for dividing the world, since each player wants to establish his own rules of the game and control the processes, which, as we understand, will not contribute to European security, as well as security in the world.

The second, no less obvious factor, shows that international institutions (from the UN to the International Committee of the Red Cross) are showing their incompetence or bias (often as a result of their leaders being "on Putin's payroll." And this applies not only to Gerhard Schröder, or, to one degree or another, Angela Merkel, but also to many European MPs from Austria or France, Hungary or Slovakia, or even Olaf Scholz, who was in no hurry with German aid to Ukraine, and even blocked packages [32] proposed by the German Foreign Ministry and the German Ministry of Defense, which simply does not let the idea die that the Federal Chancellor of Germany is still dependent on Putin in one way or another (due to compromising material, money, or previous commitments of party members). These, as well as numerous other facts, lead to a simple conclusion: European leaders and international institutions today clearly lack not only responsibility, but also, so to speak, high morality (in particular, in the process of identifying the victim and the aggressor), as well as much else.

The third point indicates that there is a rapid reformatting of military and other blocs. NATO expanded at the expense of Finland and Sweden (in 2023-2024); Armenia (in the winter of 2024) announced the "freezing" of its participation in the CSTO at all levels, in August refused to participate in the September CSTO exercises in Kyrgyzstan, and in January of this year launched the process of joining the EU [33] and signed a strategic partnership agreement with the USA [34]; to BRICS in early January 2024. 5 countries joined (Egypt, Iran, UAE, Saudi Arabia and Ethiopia, although, as we recall, Argentina refused to join), and at the beginning of January this year, 2025, the fourth most populous country in the world, Indonesia, officially joined BRICS [35]. Nowadays, there is increasing talk about the "Eurasian Entente" consisting of China, russia, Iran and North Korea.

The fourth feature of the time: we are recording many signs of deglobalization processes (initiated by the spread of COVID-19, which are now deepening, in particular, as a result of sanctions against the Putin regime after the full-scale invasion of the russian aggressor into the sovereign territory of Ukraine), from which all of Europe is clearly suffering. And the conclusion is obvious: deglobalization is destroying containment systems in regions of the planet, as well as in the world as a whole.

Finally, and this is another, *fifth, feature of the first third of the 21st century*: there is a confrontation between the elites of seemingly friendly or partner countries both within Europe itself, and between European and American or Asian elites. What is the audacity of, for example, Elon Musk, who called Canadian Prime Minister Justin Trudeau a "girl" [36], whose opinion is not important, or his blatant rudeness when Musk (in response to criticism about his support for the German far-right) called Olaf Scholz a "fool" and "shit" [37]. Musk also declared his support for the British right-wingers, united in the Reform UK party [38]. So, we are not only talking about interpersonal conflicts between representatives of political elites, but also, as one might assume, about the increasingly powerful dictate in the international arena of leaders or representatives of corporations, their interference in the politics of European countries through, for example, somewhat veiled support for opposition European far-right forces. The latter, as is known, prompted the Bundestag administration to initiate an investigation [39] into whether the actions of I. Musk, who actively promotes the Alternative for Germany, the German law on political parties.

And the organization Lobby Control stated [39] that Musk's actions can be regarded as an illegal party donation (which is prohibited by German law).

Thus, the "attack on Europe" is being carried out not only by russia, but also, as has become apparent recently, by the American elite. And this attack, at least, reveals its hybrid nature (if we analyze the players and their "targets", as well as the rules of the game without any restrictions).

It is clear that this series of either barely noticeable *fluctuations* (in the politics, for example, of supposedly neutral Switzerland [40]), or clearly outlined *points of numerous bifurcations*, which indicate turning points in the geopolitical history of Europe, each European country, as well as states on other continents, may be continued, capturing in the hybrid present new challenges, threats and, accordingly, risks for the geopolitical stability of Europe and the world both today and tomorrow, as well as after the end of the russia-Ukrainian war. Or, "conflict", as European politicians call our, Ukrainian, struggle for the survival of the nation and state, resorting to a "condescending" euphemism.

When predicting the state of security in Europe in the future, it is worth taking into account not only the general negative trends that characterize the present of the planet and affect the geopolitical and security prospects of Europe, but also the critical (and most obvious) challenges of the present:

– no one can say with certainty when the war in Ukraine (as a European state) will end. Trump's claims about its end "in 24 hours" have disappeared. After the inauguration, a new horizon for the long-awaited peace appeared – 100 days;

– no one knows the final results/conditions for the cessation of russia's aggression against Ukraine. That is, in a hypothetical "tomorrow," will the EU border a sovereign Ukraine within the borders of 1991, a Ukraine that shares democratic European values and poses no existential threats to Europe, or will Europe, as in the previous, twentieth, century, have a border with transformed Soviet imperialism, which now appears in the guise of russia's neo-imperialism and racism? Will Europeans, in the event of a shameful "surrender" of Ukraine to the aggressor, have to build walls and other fortifications not only on the border with Belarus and russia, but also with Ukraine, as "friendly" Poland has zealously begun to demonstrate, having begun construction of the "Shield of the East" fortification complex in the Warmian-Masurian Voivodeship in the fall of 2024 [41])? Will European countries, predicting their future, take up the challenge of covering their territories with warning siren systems, following the Estonian city of Paide [42]? Like Norway, develop plans for the construction of bomb shelters [43]? Following Switzerland, renew the network of outdated nuclear shelters [44]? Or, like the already mentioned Poland, take up the reform of the civil protection system [45], realizing that the European future has little chance of being carefree. That is, the "facts on the ground" portend the fragmentation of Europe;

– after all, those hybrid challenges in the economic, social and other spheres that will appear even before or after the end of the war and which, one way or another, but definitely will affect the further security of Ukraine and the whole of Europe are unknown today.

However, today there are already known and understandable aspects of the security of European existence. It is known that the security of Europe will be influenced by a number of internal factors, which, in our opinion, are related, first of all, to the coming to power in a number of European countries of far-right political forces that, so to speak, are in constant contact and cooperation with Putin. Thus, let us recall that in September 2024, for the first time in the 11-year history of its existence, the far-right party "Alternative for Germany" won [46] the state elections in Thuringia, significantly ahead of its closest competitor – the Christian Democratic Union (CDU). In Saxony, in the east of Germany, "Alternative for Germany" took second place, lagging behind the CDU by less than one and a half percent of the vote. The Austrian far-right and anti-immigration "Freedom Party" on September 29, 2024. won the parliamentary elections in Austria, receiving about 29% of the vote [47]. And, thus, it reflected in its own way the terrifying transformation of Austria, because for the first time since World War II, the far right won a powerful victory in national elections. That is, the number of Putin's allies in Europe has increased

in 2024, and they, by maintaining (sometimes demonstratively) ties with the Russian dictator, in their own way contribute to the legitimization of his regime. And let's also keep in mind that in the summer of 2024 As a result of the parliamentary elections in France [48] (in which, by the way, voter turnout was the highest since 1987 and amounted to 67%), a coalition of left-wing parties called the "New Popular Front" won 182 seats in the National Assembly (against 168 seats for the "Together" coalition led by Emmanuel Macron), and the "National Union" of Marine Le Pen's protege Jordan Bardelli came in third place. Let's not forget the policies of Slovakia under Robert Fico, and Hungary under Viktor Orban. And here we emphasize: the values professed by European far-right populists turn out to be close to the population of the countries, which supports them in the elections. What will happen next? How right-wing or left-wing populists will build defense/security strategies for their countries after the war ends, how they will build economic and trade relations with the US, Russia, and China – we will understand only over time.

To the above, it is worth adding that we currently do not know how the second round of the presidential elections in Romania (to be held in May 2025) will end: will the hybrid Russian interference in their course end in a triumph for Russia, and again (as in the first round) will the winner be Călin Gheorghescu? Will the Romanians protect themselves from Russian influence? How will the "final round of the battle for Moldova" end – the 2025 parliamentary elections? Will the Moldovan parliament declare deepening relations with Russia as its geopolitical priority?

And who will become the sixth president of Poland after the end of Andrzej Duda's second term - Warsaw Mayor Rafal Trzaskowski or the head of the Institute of National Remembrance Karol Nawrocki, known for his anti-Ukrainian rhetoric? On January 9, Nawrocki already "distinguished himself" by stating that he "does not see Ukraine in either the EU or NATO" [49].

That is, under the influence of internal factors, value and geopolitical transformations are taking place in Europe before our eyes. And if we take into account external factors that have already influenced the geopolitics of a number of European states, and therefore their security factors, then France's geopolitical retreat from Africa will be striking. Although E. Macron, firstly, interpreted the withdrawal from the Sahel countries (where French troops were stationed for ten years) as a consequence of the coups that took place there and, accordingly, the reluctance of the French to help pro-Russian putschists in this regard, and secondly, he stated that another consequence is that France is "growing up and reorganizing" rather than retreating from Africa [50]. Another case is related to the challenges to Europe from Turkey, which at the start of 2025 again speaks out in favor of the creation of two states in Cyprus [51] and, in particular, the Turkish Republic of Northern Cyprus.

Ultimately, Europe's security will be determined by its relationship with the U.S. Since Donald Trump's claims to Greenland, which is not only characterized by its "in-between" position (between the Arctic and Atlantic Oceans and between Europe and North America, which is arguably strategically important for the US military, in particular its ballistic missile early warning systems), but also reserves of "the most important minerals", as Mike Waltz put it. So, Greenland is not just about the US's relationship with Denmark, but also with the entire EU, with the European NATO member states.

Today, of course, we cannot say whether Denmark will retain its state sovereignty, and in the EU, accordingly, the borders will remain unchanged, as we do not know what will prevail – Trump's calls to reduce external spending and, as a result, limit the involvement of the American military in international conflicts (in particular, in their creation and fueling by one means or another, or by abstaining from decisions and participation), or vice versa – the escalation of conflicts with Denmark/the EU, Panama and neighboring Canada, if the desire to turn it into the 51st American state prevails, which, in the end, will mean both increased spending and aggravation of conflicts. Therefore, it is clear that the delineation of the American-European problem will definitely affect the security situation in Europe and throughout the world. And it will also become an "exemplary basis" for the actions of the newest (overt or still latent) aggressors, and will lead

to a change in China's policy towards Europe, because if the US regains control over the Panama Canal, from the use of which the Chinese today have much greater trade benefits than the Americans, who actually built it (in the period from 1904 to June 1920, when the canal was officially opened), and it was transferred to Panama only after December 31, 1999, then China will most likely be forced to reorient itself more towards Europe.

Despite the claims about the "greatness of the USA" and the promised return of "America great again" by D. Trump, what is obvious today is the geopolitical retreat of the Americans from Asia – from Afghanistan. How the audacity of competitors, which was simply unthinkable until recently, is becoming more and more visible (and not only Russia with missiles and UAVs, which fly in one form or another into the territory of the EU countries, and ships - enter the territorial waters of NATO countries, or China, but also Iran or "HAMAS", North Korea). And what lies ahead? The developing situation reflects the intensification of the strategic competition of the USA with Europe. Or, perhaps, this is the geopolitical retreat of the USA from Europe, including Ukraine? On the one hand, the aggravation of the situation will contribute to the reduction of certain risks for the USA, but on the other hand – the increase of new threats for the USA, Europe, and, in particular, for Ukraine.

In the event of further fragmentation of the international system, undermining the capacity of international organizations (as a result, in particular, of not only the US withdrawal in 2018 from the "hypocritical and self-serving" UN Human Rights Council [52], but also from the WHO and the Paris Climate Agreement, which the world learned about with the beginning of Donald Trump's presidency [53; 54], with the decrease in US participation in NATO, and then his withdrawal from the Alliance altogether), a deepening of the American Republican president's "understanding" of the dictator-war criminal putin, the growth of unstable political systems near European borders and the strengthening of the authoritarian challenge, the growth of populist and extremist movements, terrorist attacks, and migratory pressure, will Europe be able to become independent from the US security umbrella, remain liberal-democratic and become more technologically advanced, and thus be able to become (and continue to be) a full-fledged center of power (global state), a center of attraction for Ukrainians (regardless of whether with the "capital of the EU" in Brussels or, as George Maloney wants, in Rome)?

Conclusions

European security in the context of deglobalization is under pressure (caused by new challenges and threats) from russian aggression against Ukraine and uncertainty related to the prospects of its cessation/deepening (up to russian aggression against NATO countries). The uncertainties are added by brutal new authoritarian and particularist practices, cooperation of undemocratic regimes among themselves, as well as their desire to play a zero-sum game with the "collective West". And also – the rise of nationalist values to the detriment of universal human values and almost the "last chance" for Europe and the entire geopolitical West not to lose its democratic prestige.

Prospects for further research are related to the continuous (daily) analysis of changes in the European and, in general, global security environment, which is endlessly changing, fragmenting, and at the same time, noticeably, constantly becoming more complicated. And such analysis should enable a timely response of Ukraine, Europe, and Western democracies to future challenges, threats, and risks.

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THE MISSION FORMALIZATION FOR THE PREVENTIVE REDUCTION OF THE NEGATIVE GEOPOLITICAL PROCESSES AND MILITARY-POLITICAL SITUATION IMPACT ON THE MILITARY SECURITY OF THE STATE ENSURING

Abstract. *The article is aimed at reforming the security and defense sector of Ukraine, that involves a more rational use of existing forces and means to ensure a sufficient level of military security of the State. The practical implementation of this goal requires the development of a unified system of joint management, methods of joint use of force and non-force subjects of the security and defense sector of Ukraine, improvement of the methodological apparatus for determining tasks for these subjects and assessing the effectiveness of their implementation. This is precisely why it is necessary to formalize the task of preventively reducing the impact of negative processes (threats) of the security environment on the level of military security of the State. The developed version of the formalization of the task allows us to substantiate two target functions of ensuring the military security of the State. The first is to determine the necessary level of de-escalation of the identified threat, the second is to preventively reduce the impact of negative trends of the geopolitical and military-political situation on the processes of ensuring the military security of the state on the basis of limiting the risks of the most dangerous negative trends at the stage of their provoking crisis situations in the target state. The above indicators reveal the essence of de-escalation of a military threat, which consists in reducing or stopping the action of threat-forming factors by targeted influence on them by entities of the security and defense sector of Ukraine, which should reduce the level of risks of using military force against Ukraine in order to prevent its unacceptable (critical) value, at which a military conflict becomes a reality.*

Keywords: *military security, formalization of tasks, negative trend, de-escalation of threats, risks, security environment.*

Introduction

Statement of the problem. According to the current guiding documents on the National Security Strategy of the State [1-2], the reform of the security and defense sector of Ukraine (SDSU) should be aimed at the rational use of available forces and means to ensure a sufficient level of military security of the State.

The practical implementation of this requirement requires the development of a unified system of joint management, methods of joint use of force and non-force subjects of the SDSU, improvement of the methodological apparatus for defining tasks for these subjects and assessing the effectiveness of their implementation. This requires the correct formalization of the task of de-escalating threats and reducing the impact of negative trends in the security environment on the level of military security of the State.

Analysis of recent research and publications. In the monographs [3-5], the authors consider hybrid warfare as an integration of various real and virtual threats (diplomatic, military-economic, informational, etc.) with the aim of psychologically influencing the victim state (target), plunging it into a situation of uncertainty, destroying it without declaring war, and also creating a corresponding information environment around it, which should form an image of this state in the world community that would justify any unfriendly, even aggressive actions against it. However, the authors did not consider the issues of assessing and analyzing negative trends in the geopolitical and military-political situation (MPS).

The monograph [6] describes in detail the changes in the modern security environment (SE), concludes that it is nonlinear. However, the author does not provide a methodology for assessing and analyzing negative trends in the development of the security environment.

The publication [7] provides principles and basic methodological recommendations for organizing and conducting various types of tasks formalization, that may be taken into account to solve the problem.

The article [8] presents an applied methodological approach to formalizing the management of a crisis situation de-escalation process during an international peacekeeping operation. However, the author does not consider technologies for analyzing negative trends in the security environment.

The above-mentioned and other publications that the authors were able to read do not provide a methodological framework for assessing the level of hybrid threats and their destructive impact, if fully implemented, on key areas of national security, as well as their impact on the risks of ensuring the national security of the state.

The goal of the article is the task formalization of the threats de-escalating and the impact of negative trends in the security environment reducing on the level of military security of the State.

Presentation of the main material

The task of threats de-escalating and the impact reducing of negative trends in the security environment on the military security of the State is one of the most important. The experience of strategic decisions preparing on the crisis situations settlement indicates the need to have significant amounts of input information (an idea of the essence of the conflict; motivation and driving forces of the conflict; conflict-generating factors of various nature (political, economic, national-ethnic, ideological, socio-cultural and their significance; information about the policy of international security institutions regarding this crisis situation, etc.).

Without this array of information in a form acceptable not only for comprehension but also for the necessary calculations, developing informed decisions becomes problematic.

The issue of the State national security, in particular ensuring military security, has been considered in many specialized and general publications [4-6; 8-10]. However, in most of them, insufficient attention is paid to methodological problems, especially regarding the formalization of the de-escalation of threats process and the destructive impact of negative trends in the security environment using force and hybrid methods and means.

Formalizing the threats de-escalating task to military security and defining a system of indicators for assessing the effectiveness of military-political decisions being made is a necessary step for forming the potential for neutralizing threats to the military security of the state, which in

its essence determines a partial strategy for countering threats of a military nature and negative trends in the security environment using force and hybrid methods and means.

The quality of the military security system functioning depends on the methodological principles underlying the organization of this process.

The term "organization" in this case is considered in terms of a set of actions leading to the formation and improvement of relationships between parts of the whole, that is, a set of measures for the use of military and non-military forces and means (subjects) of the SDSU in the course of preparation and participation in the de-escalation of threats to the military security of the State. Therefore, it can be considered that we are talking about providing the above-mentioned set of measures with the features of a system with the corresponding systemic properties. This makes it possible to apply a systemic approach with its important principles for further consideration of the problem of formalizing the process of ensuring military security.

One of these principles is the principle of formalization [7], aimed at obtaining quantitative performance, creating methods that narrow the ambiguity of concepts, definitions, assessments, etc. In the process of formalization, objects (processes), their properties and connections need to find stable, identical and accessible indicators in order to identify and fix the essential aspects of the object (process). Formalization allows you to clarify the content by identifying its form and can be carried out with varying degrees of completeness and direction.

It is proposed to understand the formalization of the process of ensuring the military security of the state as the identification and description, both verbal in certain terms and numerical [7], of the components of this process and their relationships that determine the target function of the process. W_{cfs} in *s* in the field of national security.

Without determining the quantitative characteristics (indicators) of the components and the connections between them, it is impossible to build any effectively functioning complex system focused on preventing armed aggression against the state. In our opinion, such characteristics should include those that reveal the capabilities of individual components of the SDSU to perform the tasks assigned to them and provide the most accurate idea of their essence and potential.

In general, the capabilities of subjects (individual components) of the SDSU to de-escalate threats to the military security of the State are determined by their functional purpose in the system of state institutions (the spheres of state activity that they are responsible for - political, economic, military, information, cyber, etc.). This becomes the basis for the formation of a set of indicators, according to which it is possible to further formalize the process of de-escalation of threats and reduce the impact of negative trends in the security environment on ensuring the military security of the state.

Among the specified set of indicators, it is proposed to have the following groups:

– list of spheres of state activity Π_{is}, which this SDSU entity is responsible for (for example, in the form of a matrix of spheres $\|\Pi_{is}\|$ where $i = \overline{1, I}$ – SDSU subject, *s* – sphere of state activity $s = \overline{1, S}$;

– priorities for each area *i*-th subject, if there are several such spheres;

– list and possible scope of tasks that the *i*-th subject of the SDSU can perform for each of its inherent S spheres;

– indicators characterizing the threat itself [5] (according to the Threat Passport), in relation to which a decision has been made to de-escalate, and expert assessments of the expected time intervals of the "response" to the impact *i*-th subject of SDSU on F factors that form this threat;

– indicators characterizing the identified negative trend in the security environment (T_{si}^{n}), in relation to which a decision has been made to weaken its influence on the military security of the state;

– indicators that provide a description of the task(s) *i*-th subject of the SBOU regarding the de-escalation of the threat (scope of a specific task, time and procedure for starting to influence

the threat factors, deadlines for countering the threat, required level of de-escalation of the threat) $\Delta K_{p\partial з}(T_{np})$, the permissible level of reduction in the impact of the negative trend of the security environment, the level of military danger of the threat $K(t)$ during its de-escalation, the level of military danger created by the identified negative trend, etc.

The above indicators reveal the essence of de-escalation of the threat of a military nature, which consists in reducing or stopping the action of the factors forming the threat by targeted influence on them by the subjects of the SBOU, which should reduce the level of risks of the use of military force against Ukraine in order to prevent its unacceptable (critical) value, at which a military conflict becomes a reality. $K(T_{np})$, Fig. 1.

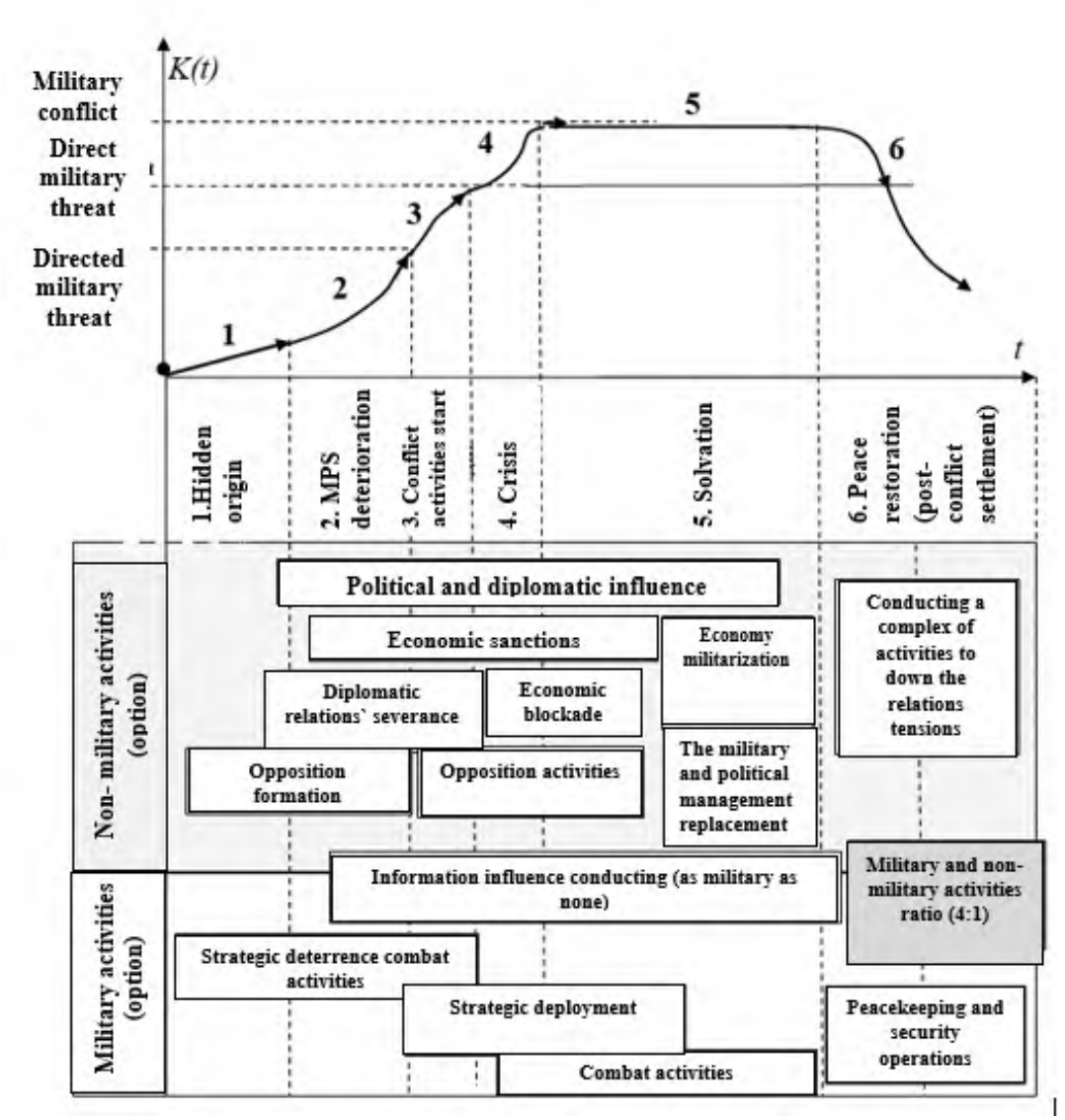

Fig. 1. The main phases (stages) of the hypothetical development of a military conflict and some possible military and non-military measures (forms) to prevent it at different stages of development: 1 – manifestation of a conflict of interests; 2 – development of differences into contradictions and their awareness by the military-political leadership; 3 – deepening of contradictions; 4 – crisis response; 5 – localization of the military conflict; 6 – de-escalation of the military conflict

The value of the reduction in the current level of military danger $K(t_1)$ to the threshold is called the “threat de-escalation level” at the time t_1.

So, a "threat de-escalation level" is needed $\Delta K_{\text{рдз}}\left(T_{\text{пр}}\right)$ during its de-escalation, it can be presented as follows:

$$\Delta K_{\text{рдз}}\left(T_{\text{пр}}\right) = f\left(I, S, \Pi\right) \tag{1}$$

The main phases (stages) of the development of a hypothetical military conflict and some possible military and non-military measures (forms) to prevent it at different stages of development are shown in Fig. 1 [8-10].

It is clear that the greatest effect from the use of forces and means of the SDSU can be achieved only if the comprehensiveness, systematicity, coherence, reachability, specificity, flexibility and acceptability of the tasks that must be assigned (defined in advance) to the executors, that is, the SDSU subjects, are ensured.

If the above conditions are met, it becomes possible to justify the most rational set of tasks for SDSU entities based on the criterion of minimal risk of aggravation of the situation, which have the appropriate forces and means, which can provide a sufficient synergistic effect at each of the stages of de-escalation of the threat.

The timeliness and adequacy of decisions made and tasks assigned to SDSU entities complement the general requirements for organizing the process of de-escalation of military threats and preventive response to negative trends in the security environment.

Naturally, all the requirements listed above will acquire a specific content depending on the nature of the identified threat, the purposefulness of the identified negative trends in the security environment and the completeness of the formalization of the entire de-escalation process, a component of which is the formalization of tasks for the SDSU subjects. A general typical scheme for the formalization of tasks for the SDSU subjects regarding the de-escalation of a military threat and the weakening of the impact of negative trends in the security environment through the use of military and non-military forces and means of the SDSU is shown in Fig. 2 [7].

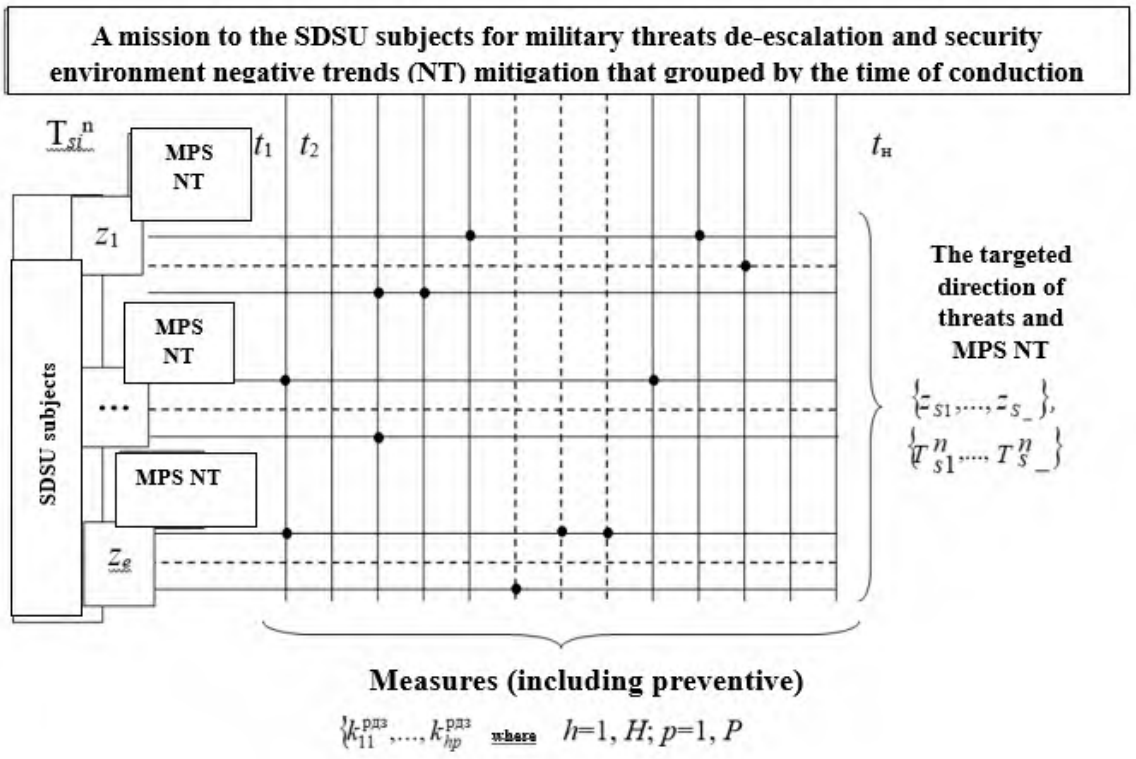

Fig. 2. Scheme of formalization of tasks for SBOU subjects in the process of de-escalation of military threats $\{z_1,...,z_e\}$ and weakening the destructive impact of NT IDPs

In practice, a "threat de-escalation level" is required $\Delta K_{изс}(T_{пр})$ can be assessed by experts using the automated decision support system (ADSS) "model M7" [5; 11-12] in an iterative manner by reducing the threat "weight" indicators *z* through the integrated use of military and non-military instruments of individual SBOU subjects (primarily of a non-military nature).

In our case, to formalize the tasks of the SBOU subjects, it is important to assess their necessary capabilities by solving the inverse problem using the DSS "model M7". The required "threat de-escalation level" is assessed using the knowledge base of the expert system (ES) about threats (if one is created) and the DSS "model M7" [5; 11-12] in an iterative manner by reducing the "weight" (priority) indicators of threats on the Saati scale until the condition is reached:

$$\Delta K_{рдэ}\left(T_{пр}\right) = K_{д} \Delta K\left(t_1\right), \tag{2}$$

where $K_д$ – de-escalation coefficient (takes fixed values: in the case of using non-violent means $K_д = 1{,}1$; in case of use of force $K_д = 1{,}2$ [10]);

$\Delta K(t_1)$ – change in the level of military danger as the difference between the received current level of military danger (threat) at the time t_1 and threshold $K_{пр}$ (defined in the legal space of the state).

The required "level of threat de-escalation" can be achieved through various options $(j = 1, J)$ involvement of forces and resources (within the capabilities x_s) individual subjects *S*, which requires appropriate resources, the limitations of which should be taken into account when making the final decision.

Thus, the general hierarchy of the task of forming the required "level of threat de-escalation" in the course of countering a military threat and weakening the influence of the NT of the geopolitical and military-political situation will look like the one shown in Fig. 3.

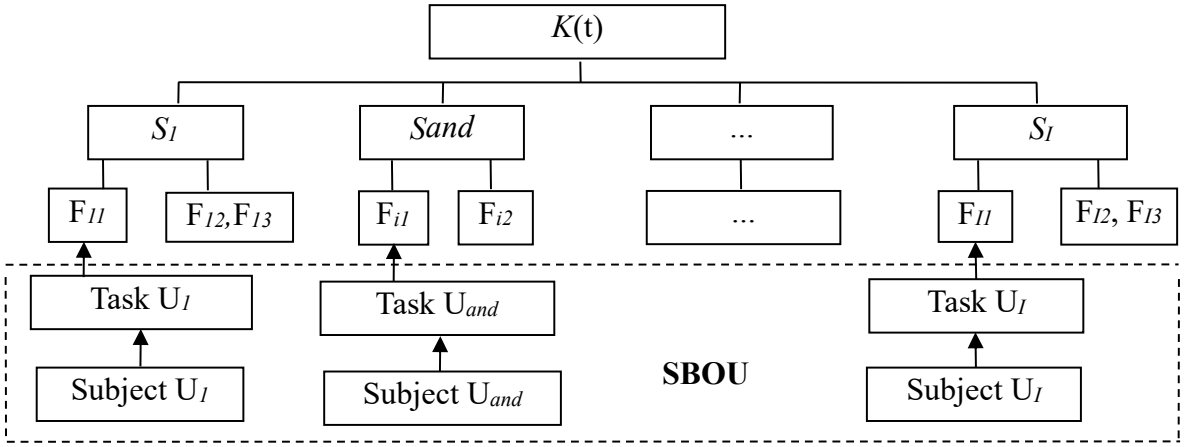

Fig. 3. Example of a hierarchy of tasks for forming the required level of threat de-escalation

It is at this stage of de-escalation that the problem of finding the most rational option for distributing tasks to SDSU subjects arises in terms of execution time, areas of relationships with manifestations of threat (contradictions) that are subject to influence (conflict-generating factors that need to be influenced) through sequential or simultaneous execution of tasks.

The formalization of tasks for SDSU subjects is facilitated by the completeness and objectivity of determining manifestations of threats (contradictions) in the spheres of relations between the opposing parties.

General hierarchy of the task of forming the desired reduction of destructive impact *i*-th NT security environment is shown in Fig. 4.

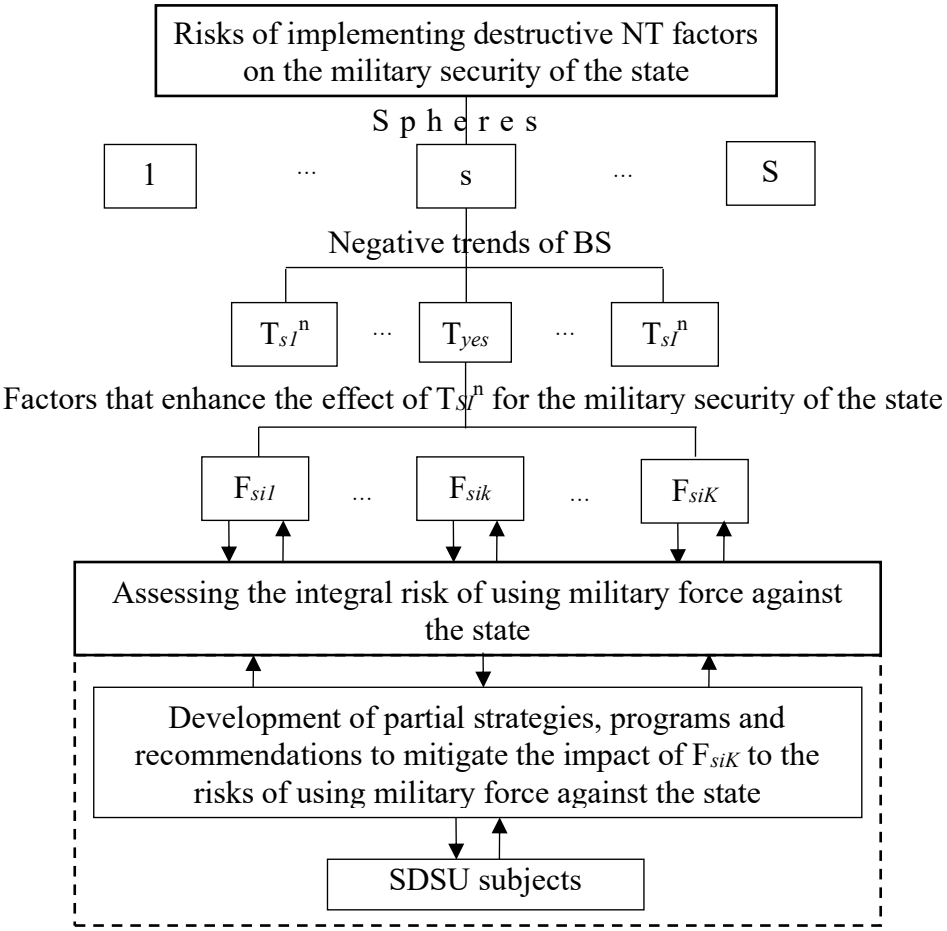

Fig. 4. Example of a hierarchy of the task of mitigating the impact of a negative BS trend on the risk of using military force against the state

The target function of reducing the impact of NT BS on the process of ensuring the military security of the state is based on limiting the risks of factors that have exceeded the critical level. $K_{крит}(t), \Sigma(R_{sik}(t) - K_{крит}(t)) \to \min$.

It is clear that at each stage of threat development, the results of the impact, their intensity, strength, "weight" will be different. That is why the distribution of tasks, ideally, should also be carried out at each stage of threat development (Fig. 1) taking into account the results of the influence of the SBOU on this development at the previous stage. This approach makes it possible to implement the above-listed requirements for the SDSU to ensure effective de-escalation of the threat and reduction of the impact of NT on the military security of the state, timely prioritization of non-military or military forces and means.

The determination and application of the forces and means of the SBOU entity when performing the assigned tasks is carried out according to the same logic as at higher levels of the hierarchy.

The neutralization task for a security and defense sector entity responsible for a specific area is, in quantitative terms, the necessary reduction in the impact of the proposed indicator, in other words, neutralization of its impact on the formation of the integral level of military danger by one or more gradations of the assessment scale (scale from 1 to 9), Table 1, or neutralization of its impact on the formation of the integral level of risk of the use of military force against the state, Table 1, Table 2.

However, this degree of formalization of tasks for SDSU subjects is insufficient for practical implementation, since it essentially determines only a strategy for countering threats of a military nature using non-violent and forceful methods and means.

Table 1

Table of neutralization tasks for SDSU subjects

Sphere (S=1, S)	"Weight" sphere S	The value of the indicator during the evaluation z_s, (j=1, J)	The value of indicators for expert formation of the required level of threat de-escalation $\Delta K_{sd}(T_{pr})$, (j=1, J)	Required impact reduction on a 9-point scale, (j=1, J)
S=1	L_s	m_{s1}	$m_{s1\partial}$	$m_{s1} - m_{s1\partial}$
		m_{s2}	$m_{s2\partial}$	$m_{s2} - m_{s2\partial}$
		m_{sJ}	$m_{sJ\partial}$	$m_{sJ} - m_{sJ\partial}$

Table 2

Table of neutralization tasks for SDSU subjects to reduce the risk of using military force against the state

Sphere (S=1, S)	"Weight" sphere S	The value of the indicators of the influence of Tsin BS factors on the level of risk	Current level of risk of use of military force against the state	The significance of risks for expert formation of the critical risk of the impact of NT on the state's WB	The value of predicted risk indicators for forming the necessary mitigation of the impact of Tsn factors	Impact reduction required Tsin for 9-point scale
S=1	L_s	m_{st1}	R_{sik}	r^*_{st1}	r^*_{stp1}	$r^*_{st1} - r^*_{stp1}$
		...	...	...	...	...
		m_{stk}	...	r^*_{stk}	r^*_{stk}	$r^*_{stk} - r^*_{stpk}$

Each of E subjects of the state SDSU $z_e(e=1,E)$ has b the functions it must perform – $\{z_{e1},...,z_{eb}\}$. The mechanism for planning the implementation of tasks by each subject of the SDSU involves the development of a set of specific measures aimed at reducing the impact of the largest "weight" indicator. The number of measures, their combination and scale should be such as to reduce the impact of the specified indicator (for example, the intensity of the information influence of the opposing side on our troops (forces)) by one scale gradation (see Table 2).

Conclusions

Thus, the developed version of the formalization of the threats de-escalating and reducing the impact of negative trends in the security environment task on the military security of the state makes it possible to substantiate two target functions for ensuring the military security of the state. One is to determine the necessary level of de-escalation of the identified threat, the second is to preventively reduce the impact of the NT of the geopolitical and military-political situation on the processes of ensuring the military security of the state based on limiting the risks of factors that have exceeded the critical risk level. In further publications, it is planned to carry out a mathematical description of the specified target function.

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VOCATIONAL EDUCATION AS THE FOUNDATION OF UKRAINE'S ECONOMIC SECURITY UNDER THE CONDITIONS OF WAR AND POST-WAR RECONSTRUCTION

Abstract. *This article examines the role of vocational education as a strategic factor in ensuring Ukraine's economic security during wartime and post-war recovery. The main aim of the research is to study the changes in the vocational education system necessary for adapting to the new socio-economic realities and challenges related to the war.*

It analyzes historical examples of vocational education reform, particularly the case of the United Kingdom during World War II, to identify valuable lessons for Ukraine. The study highlights the challenges posed by κussia's full-scale invasion, including the destruction of educational infrastructure, the decline of vocational training opportunities, the mass migration of skilled workers, and labor shortages in key economic and defense sectors. The article also addresses the challenge of maintaining the quality of vocational education amid limited resources and the need for adaptation to the new realities.

The research explores the Ukrainian government's initiatives to adapt the vocational education system to wartime conditions, focusing on legislative reforms, digital transformation, the development of dual education models, and strengthened collaboration between educational institutions and employers.

Particular emphasis is placed on the analysis of the draft law on vocational education, which is one of the key steps in the reform of the education sector. The author highlights the positive changes that the bill proposes,

including improvements to the quality of curricula, integration of modern technologies into the learning process, and the enhancement of the qualification certification system. However, the article emphasizes the importance of further steps in implementing this bill under the conditions of military aggression, which requires the rapid adoption of adaptive educational practices. The article concludes that vocational education is crucial for Ukraine's economic recovery after the war, as it contributes to the preparation of skilled workers for rebuilding infrastructure, developing national industries, and ensuring the country's economic resilience.

A critical aspect of this study is the role of vocational education in Ukraine's economic recovery. The findings suggest that aligning training programs with labor market demands, fostering the development of high-priority industries, and encouraging technological advancements are essential for sustainable national reconstruction. The study argues that an effective vocational education reform is not merely an educational policy measure but a fundamental pillar of national security. It will enable Ukraine to rebuild its economy more rapidly, enhance workforce resilience, and ensure long-term economic stability in the face of external threats.

The results of the research can be useful for the development of policies in the field of vocational education aimed at the effective recovery and development of the post-war economy.

***Keywords**: vocational education, economic security, war, post-war recovery, labor market, education reform, innovation, international support.*

Introduction

Statement of the problem. Throughout human history, wars have repeatedly been catalysts for change that shaped the future of nations. During World War II, when Britain was on the brink of total annihilation, the country implemented important reforms in its education and training system to mobilize human resources to support the war effort. The British government initiated the creation of technical colleges to quickly train specialists needed for the defense industry. These measures not only contributed to victory in the war, but also laid the foundation for the country’s post-war economic growth.

Today, Ukraine finds itself in a similar situation, when a full-scale war with the russian federation is testing all spheres of public life for strength. The vocational education system, as a key element in the training of qualified personnel, is faced with the challenge of not only survival, but also adaptation to the new realities and needs of wartime. Significant destruction of infrastructure, mass population displacement, and economic instability complicate the process of education and training of specialists to perform work in technical, production, and other areas of the economy. However, as history shows, it is at such moments that the most effective solutions and reforms are born.

The war has caused significant disruptions to the education sector, including infrastructure destruction, population displacement, and a shortage of skilled personnel. In response to these challenges, the Ukrainian government has initiated a number of legislative changes aimed at adapting vocational education to the new realities. In particular, amendments have been introduced that allow the education system to function under martial law, facilitating the rapid retraining of individuals displaced by the war.

It is worth noting that the international community is actively supporting these reforms. Programs, such as the joint initiative of the European Union and its member states, are aimed at modernizing the equipment and infrastructure of vocational education institutions. In addition, the Organization for Economic Cooperation and Development (OECD) emphasizes the importance of integrating Ukrainian refugees into the vocational education systems of host countries to ensure their employment and contribution to the economy [4].

Reforming the vocational education system can be considered an integral part of ensuring Ukraine’s economic security.

Economic security is a fundamental component of Ukraine's national security, as defined by the Law of Ukraine “On National Security”. One of its key aspects is the provision of labor resources capable of maintaining the stability of production sectors, adapting to new technological realities and the challenges of wartime. Without adequate human resources, the country's economic security is threatened, which in turn weakens its ability to resist the aggressor for a long time and effectively recover from the war.

Thus, reforming the vocational education system in Ukraine during a full-scale war with the Russian Federation is vital for attracting and developing human capital and forming and strengthening the production and economic potential of our State.

Analysis of recent research and publications. Recent research indicates a number of challenges and opportunities that determine the future vectors of transformation of this sphere. I. Bereza in the article "The Modern Status of Vocational Education in Higher Education Institutions" (2019) investigated the impact of the Bologna Process on Ukrainian higher education and emphasizes the need to improve the practical training of students through the dual form of education [8], E. Govorov and O. Shulga in the article "Analysis of the State of Vocational Education in Ukraine under Today's Conditions" (2023) investigate the structure of vocational education, identifying contradictions in the interaction between its links and proposing ways of harmonization with the labor market [9], M. Lesnikova, N. Pron, O. Denysiuk and N. Tytarenko in the article "The Role of Educational Materials in Improving the Efficiency of Vocational Education: Previous Experience and Current State" (2023) analyzes the importance of high-quality educational materials in vocational education, emphasizing the need to create a single electronic platform with interactive content [10]. These studies make a significant contribution to the understanding and improvement of vocational education in Ukraine, contributing to modern challenges and integration into the European educational space adaptation.

However, in the context of Ukraine's economic security, no systematic research has been conducted on the role of vocational education. The available scientific works focus mainly on the general aspects of vocational education reform, its adaptation to European standards and integration with the labor market. The issue of its impact on economic stability during the war and in the post-war period remains insufficiently studied. In this regard, this study aims to fill this gap.

Purpose of the article – to determine the role of vocational education as a strategic factor in ensuring the economic security of Ukraine under the conditions of war and post-war recovery based on historical experience; to analyze the impact of the war on the workers training system, the need for its adaptation to new challenges and requirements of the wartime economy. To analyze legislative acts regulating education issues and consider the key provisions of draft law No. 13107 "On Vocational Education", which establishes new legal regulations for the functioning of the entire vocational education system and is aimed at modernizing the vocational education system, that still operates under the law of 1998. To substantiate that effective reform of vocational (vocational and technical) education is not only an educational, but also a national and economic priority that affects the country's recovery, its economic security and defense capability.

Presentation of the main material

In 2017, the Verkhovna Rada of Ukraine adopted a new basic Law of Ukraine "On Education", which established a new philosophy for the education system of Ukraine functioning, based on the principles of educational institutions autonomy, academic freedom of teachers, ensuring academic integrity of all participants in the educational process, organizing a safe and inclusive educational space, a new system for ensuring the quality of education, etc. In 2020, a new Law of Ukraine "On Complete General Secondary Education" was adopted, according to which not only general secondary education institutions operate, but also vocational education institutions that ensure students receive complete general secondary education on the new principles defined by this Law and the Law of Ukraine "On Education".

At the same time, the special Law regulating the acquisition of vocational education by students still remains conceptually inconsistent with the basic Law. In 2027, specialized secondary education should come into effect as a continuation of the reform of the National Secondary School. After grade 9, a student will enter an academic lyceum, choosing a profile and subjects, and will prepare in depth for obtaining a specialty. Another way is to master the high school curriculum and simultaneously obtain a profession. This is admission to vocational schools and professional colleges. Traditionally, the first way is more popular.

According to the Institute of Educational Analytics, in 2024, only about 30% of ninth-graders (95 thousand) went to vocational schools and professional colleges. For comparison, in Switzerland, Germany and Austria this share is up to 70%. In most European countries, the goal is to graduate more than 50% with professional education, since this is what meets the needs of the labor market. Since Soviet times, there has been a living stereotype in society: life is established if you have a higher education diploma. At the same time, the country and the labor market do not need so many white-collar workers (specialists with higher education), but blue-collar workers are urgently needed − skilled workers who can rebuild it. The state cannot maintain a bloated network of universities, where almost 80% of school graduates go, not all of whom want and can study. This is a very expensive pleasure for the country [1]. And it is precisely the reform of vocational education that should become one of the key points on the path to change. Presentation of the main material. The Law of Ukraine "On Vocational (Vocational and Technical) Education" was adopted back in 1998 [2].

Over these 27 years, significant structural changes have occurred and continue to occur not only in the education system of Ukraine, but also in the labor market, to meet the demands and needs of which, in terms of training high-quality human capital, the vocational education system works. However, the provisions of the current Law do not reflect the modern conditions of the environment for providing educational services in the field of vocational education, the needs of the labor market, and are also inconsistent with other regulatory legal acts.

The current Law of Ukraine "On Professional (Vocational and Technical) Education" not only contradicts the new basic Law of Ukraine "On Education", adopted in 2017, but also other reforms carried out by the state, including those implemented by adopted laws, in particular the decentralization reform and the "New Ukrainian School" reform, etc.

The need to adopt a new Law of Ukraine "On Vocational Education" is due to:

− the adoption of the Law of Ukraine "On Education" in 2017, the transitional provisions of which did not provide for amendments to the current Law of Ukraine "On Vocational and Technical Education", but provided for an instruction to the Cabinet of Ministers of Ukraine within one year from the date of entry into force of the Law to bring special laws, including the Law of Ukraine "On Vocational and Technical Education", into line with it;

− the implementation of the National Qualifications Framework, a system for assessing the quality of work of educational institutions, etc. and the need to harmonize current legislation with the adopted amendments;

− reforming local self-government, decentralizing financing and management of vocational (vocational and technical) education institutions, and related changes in the powers of local self-government bodies are not reflected in the current Law of Ukraine "On Vocational and Technical Education";

− dynamic changes in the requirements of employers, the labor market, and education seekers, which require the search for new frameworks and conditions for implementing educational activities;

− the intensification of European integration processes, including in the educational space and in the field of recognition of qualifications, necessitates the need to bring existing norms into line with European practice, and also requires amendments to the current law;

− negative migration trends: a decrease in the number of applicants for vocational (vocational) education and their share among school graduates, on the one hand, and an increase in the tendency towards lifelong learning, on the other, as well as changes in production technologies at enterprises, necessitate the search for new forms of motivation for obtaining vocational (vocational) education and training, new forms of education itself and cooperation with employers.

This is, first of all, about the introduction of a dual form of education, educational standards and educational programs on a competency basis, as well as expanding the role of local authorities and employers in the formation and implementation of educational institutions strategies; - the

development of private institutions that provide professional (vocational) education services. The provisions of the current law "On Vocational and Technical Education" relate primarily to state educational institutions and do not reflect the specifics of the activities of private institutions.

On March 14, 2025, the Verkhovna Rada of Ukraine registered under No. 13107 the draft Law on Vocational Education prepared by Koval O.V., Babak S.V., Hryshchuk R.P. and other people's deputies of Ukraine. The purpose and task of the draft law is to establish new legal principles for the functioning of the entire vocational education system, taking into account all the above circumstances [3].

The draft Law of Ukraine "On Vocational Education" provides for:

1) introduction of new terminology in order to bring it into line with the basic Law of Ukraine "On Education" and increase the prestige of obtaining professional education, in particular:

− "vocational education" instead of "vocational and technical education";

− "vocational education institution" instead of "vocational and technical education institution";

− "student" instead of "pupil";

− replacement of 17 types of vocational education institutions, including "vocational technical schools", with one main type – "vocational college" and several specific types;

− use of the name of the educational qualification "specialist" ("specialist diploma") in the field of vocational education instead of the term "skilled worker" (skilled worker diploma);

2) creating new conditions and opportunities for lifelong professional education:

− granting a person the right to obtain free professional education in another profession, but not earlier than three years after completing free acquisition of the previous qualification and subject to a confirmed insurance period of at least two years;

− granting the right to a person who, for various reasons, does not have basic secondary education, to obtain professional qualifications in vocational education institutions in accordance with professional standards;

− granting a person the right to obtain professional education without obtaining specialized secondary education, which a person has the right to obtain at another educational institution simultaneously with obtaining professional education or at any other time during his or her life;

3) creation of a new system of financing vocational education institutions:

− introduction of a new subvention from the state budget to local budgets for obtaining professional education, which is directed to the remuneration of teachers (except for those who receive salaries from the educational subvention);

− preservation of two subventions, also provided for by the Law of Ukraine "On Education", for providing state support to persons with special educational needs and for improving the professional qualifications of teaching staff of vocational education institutions;

− maintenance of the material and technical base of municipal vocational education institutions at the expense of the founder (local budgets) (17 specific areas, fixed in the Law, relating to the performance by local councils of the functions of founders of vocational education institutions, and allowing to provide high-quality educational services and ensure the acquisition of high-quality vocational education, in particular: providing the educational process with consumable and educational materials and means; wages for employees of vocational education institutions (except for teaching staff); payment of utilities and energy; payment of scholarships, social payments, other social security in accordance with state benefits and guarantees; construction, maintenance and repair of structures, buildings, other infrastructure facilities, development of the material and technical base (including licensed software) of vocational education institutions, etc.);

4) introduction of new mechanisms for specialized secondary education of a vocational orientation implementing in vocational education institutions (Article 19 of the draft Law), which takes into account the implementation of the "New Ukrainian School" reform, including the

transition from 2027 to a three-year specialized secondary education, which, in accordance with the Law of Ukraine "On Education", can be of an academic or vocational orientation;

5) strengthening the autonomy of vocational education institutions: independent establishment of admission rules to vocational education institutions; preparation of their own educational and training programs, non-formal education programs; vocational colleges themselves determine where to direct the funds they earn, but at least 70 % − for renovation of premises, purchase of equipment, consumables, etc. and up to 30 % − for encouraging employees and students (on the one hand, such a model stimulates employees of a vocational education institution to legally increase their income, and on the other hand, acts as a guarantor of the development and maintenance of the material and technical base of the educational institution in good condition); it is allowed to place earned funds not only in the Treasury, but also in public sector banks; the ability to open foreign currency accounts to simplify international cooperation and support;

6) introduction of mechanisms for recognition/confirmation of learning outcomes (competences) and qualifications;

7) introduction of reduced working hours for teaching staff (36 hours per week) and fixed-term employment contracts for the head and teaching staff of vocational education institutions;

8) introduction of mechanisms to support vocational education institutions and their "founders" during the transition from state to municipal ownership (in particular, local authorities are allowed to maintain "state vocational education institutions" using local budget funds until their transfer to municipal ownership in accordance with the established procedure);

9) specific forms and mechanisms for combining the efforts of business and education for the development of the vocational education system and the achievement of common interests;

10) introduction of new approaches to the system and tools for ensuring the quality of vocational education (in particular, institutional audit);

11) detailed regulation in Article 40 of the draft Law of the new procedure for the election and appointment of heads of vocational education institutions, on whose managerial abilities and values not only the successful functioning of a vocational education institution depends, but also the quality of work performed by graduates of this institution, provision of services or manufactured goods;

12) features of educational activities of entities providing training at the workplace (in production) (Article 43 of the draft Law);

13) strengthening cooperation between vocational education institutions and employers and expanding and detailing public-private partnership mechanisms, etc. [3].

Draft Law No. 13107, registered in the Verkhovna Rada of Ukraine in March 2025, also contains 19 transitional provisions and amendments to 27 legislative acts, including codes.

The bill is aimed at modernizing the vocational education system, which still operates under the 1998 law and does not meet modern requirements.

If adopted, the draft Law will allow solving a certain number of real problems in the vocational education system that managers and employees of vocational education institutions, administrators and employers encounter in their daily lives, and will also ensure the further development of the vocational education system, taking into account modern requirements and needs of all stakeholders.

The draft law proposes a number of positive changes aimed at increasing the flexibility and efficiency of vocational education. In particular, expanding access to education for people without basic secondary education and the opportunity to acquire a new profession free of charge will contribute to improving the skills of the population.

Reforming the vocational education system of Ukraine in times of war is one of the key tasks directly related to ensuring economic security.

In the context of war and post-war reconstruction of the country, the key task remains to ensure the rapid adaptation of the education system to the realities of the military and economic

situation, which requires synchronization of legislative initiatives with the overall national security strategy.

Ensuring stable funding, state control over the quality of education, and training specialists capable of working in critical sectors of the economy and the defense complex are the key to economic stability, the country's recovery, and its long-term security.

Thus, the reform of vocational education should be not only an educational, but also a strategic element of state policy in the field of economic security, since vocational education provides training for workers who have the necessary skills and knowledge to work in key sectors of the economy, such as agriculture, energy, and industry. This allows creating jobs, increasing labor productivity, strengthening the national economy, and ensuring stability in the labor market.

Conclusions

The transformation of vocational (vocational and technical) education is an integral part of Ukraine's post-war recovery. Attracting human capital to the vocational and technical sector, training qualified personnel, improving their qualifications, and ensuring employment are key factors for the country's stability and economic growth. In this difficult period, it is the trained highly qualified specialists who strengthen not only the economy but also national security, which is the basis for Ukraine's recovery. Initiatives to reform the vocational education system demonstrate the understanding that training qualified workers with modern knowledge and skills is the key not only to the country's recovery, but also to economic security, which is the foundation of the country's sustainable development and its defense capability.

It is worth recalling the experience of Israel, which, being in a state of constant military threat, made education and vocational training the cornerstone of its national security strategy. As early as 1948, one of the founders of this state, the first Prime Minister David Ben-Gurion, emphasized that “the future of Israel depends on education”. He considered investment in human capital as a strategic priority for ensuring national security and sustainable development of the country. Investment in education, science and vocational training worked as an investment in the future, allowing the country to create a high-tech economy and a powerful armed forces, which ensured its survival and prosperity in adverse conditions.

Ukraine has a unique opportunity to use a similar approach, adapting the vocational education system to the needs of wartime and post-war reconstruction. This requires not only the modernization of educational programs, but also the creation of flexible mechanisms for cooperation between educational institutions, industry and state institutions. Involving international experience and support, as is done through projects of the European Union and other partners, will contribute to accelerating reforms and improving the quality of specialist training.

Historical experience shows that reforming vocational education in times of war is not only a necessity, but also a favorable opportunity to strengthen national security and lay the foundation for future development.

As Winston Churchill noted during World War II: “Never let a good crisis go to waste”. Ukraine has a chance to turn current challenges into opportunities by creating a vocational education system that will meet modern requirements and contribute to building a high-tech, economically developed state.

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THE IMPORTANCE (DANGER) ASSESSEMENT METHODOLOGY FOR POSSIBLE DIRECTIONS OF ENEMY STRIKES ON DEFENDING TROOPS

Abstract. *A methodology for the importance (danger) assessing of possible of enemy troops' action directions of using the method of hierarchy analysis is presented, which is advisable to be used by military command bodies when developing a defensive operation plan.*

Keywords: *defensive operation plan, directions of strikes, method of hierarchy analysis.*

Introduction

Statement of the problem. When planning a defensive operation, the most important mission of the military command body (MCB) is to develop a decision on the group of troops use. The basis of the decision is the plan of the defensive operation, that determines: areas of concentration of efforts; methods of defensive actions; operational structure (battle order) of the group of troops. To substantiate the plan of the MCB operation, first of all, the directions of the main and other strikes of the enemy troops are predicted, according to that the efforts of the defending group of troops are distributed and its operational structure (battle order) is determined. In this case, it is advisable to take into account the results of a quantitative assessment of the importance (danger) of the enemy troops' strikes predicted directions.

In connection with the recent events related to the full-scale invasion of the russian federation, the need to predict the directions of strikes by the aggressor's troops and quantify their importance (danger) when developing the plan of operations is beyond doubt.

Analysis of recent research and publications. From the experience of MCB exercises, when determining the enemy forces' strikes directions (main and other) on the grouping of troops, a heuristic method is used. This takes into account: the provisions of the operational art and tactics theory; the nature of the terrain; reconnaissance signs regarding the concentration of enemy troops; possible directions of enemy troops advance; lines and areas that the enemy will try to capture during the offensive, etc. A quantitative assessment of the importance (danger) of the predicted strikes directions is not made by the MCB.

In the monograph [1] when making a decision on the use of troops, the predicted strategies (options for use) of opposing groups of troops, which may differ in the directions of strikes, are analyzed. To determine the optimal strategies of the opposing parties, it is proposed to use game theory methods, which allow determining the frequencies of strategies use taking into account the effectiveness of the groups of troops use. However, their importance (danger) is not directly assessed. Game theory methods for determining the frequencies of strategies (methods of combat operations) are also used in work [2]. Methodological provisions for substantiating the operation (combat actions) plan are considered in the monograph [3], that analyzes options for using opposing groups of troops.

The purpose of the methodological provisions is to determine a rational option (method) for one's troops grouping use, taking into account possible options (methods) for using the enemy's troops. For this purpose, the monograph considers the application of game theory methods [4], fuzzy sets [5], taxonomies [6]. Variants of combat actions of the enemy's group of troops, which differ in the directions of strikes, are determined in scenarios based on the forecasting results of the military conflict purpose and the form of troops use. The rational option for using the group of one's own troops is determined based on the results of assessing the effectiveness of the parties' combat actions, that allows us to indirectly judge the importance (danger) of the directions of strikes of the enemy's troops.

Thus, the issue of quantitative assessment of the importance (danger) of the directions of possible strikes by enemy troops was not considered in the above works. At the same time, such an assessment is useful and necessary for developing combat scenarios, in particular for determining the distribution of efforts of one's troops in order to repel enemy aggression.

Purpose of the article consists in developing a methodology for assessing the importance (danger) of the enemy's directions of strikes against the defending group of troops.

Presentation of the main material

When assessing the importance (danger) of possible enemy troops' attack directions, a large number of various factors must be taken into account. Therefore, to determine the priorities of alternative directions of attack by enemy troops, it is advisable to apply the method of analysis of hierarchies (AHI) [7]. This method belongs to the class of pairwise comparison methods. The priorities of the directions of blows are established in stages.

The method of hierarchy analysis consists in decomposing the problem into simpler components and in further processing the sequence of expert judgments using pairwise comparisons. To decompose the problem into a hierarchy, it is necessary to determine the directions of enemy troops' attacks (alternatives) and generalized and partial characteristics (indicators) for their comparison by importance (danger).

Possible directions of enemy strikes are determined taking into account: the predicted goal of the military conflict; possible forms and methods of enemy troop groups use; the composition and areas of deployment of its troops; possible directions of enemy troop advance; lines and areas

that the enemy will try to capture in an offensive; lines of directions for introducing second echelons (reserves) into battle; the nature of the terrain, etc.

When predicting the enemy troops' attacks directions, the construction of defense by our troops of the areas that the enemy will try to capture is also taken into account. The general indicators that are proposed to be evaluated when determining the importance (danger) of the predicted directions of attacks by enemy troops characterize the fulfillment of missions related to the advancement and deployment of troops for the offensive, the predicted effectiveness of the use of enemy troops, and their logistical support.

According to the hierarchy in Fig. 1, experts compose one (3x3) at the second level, three (5x5), (4x4), (4x4) at the third level, and thirteen (nxn) square inversely symmetric matrices of pairwise comparisons (*n* is the number of predicted directions of enemy strikes) at the fourth level.

Pairwise comparison matrices are filled in by experts in hierarchical order from top to bottom. A nine-point scale is used for this purpose [7]. A group of experts is appointed to apply the AHI.

When compiling matrices, experts compare the importance: at the second level of the hierarchy – general indicators in relation to the goal of the task; at the third level – partial indicators in relation to general ones; at the fourth level – directions of strikes in relation to partial indicators.

Fig. 1 shows a hierarchical representation of the task of assessing the importance (danger) of the directions of enemy troops' strikes.

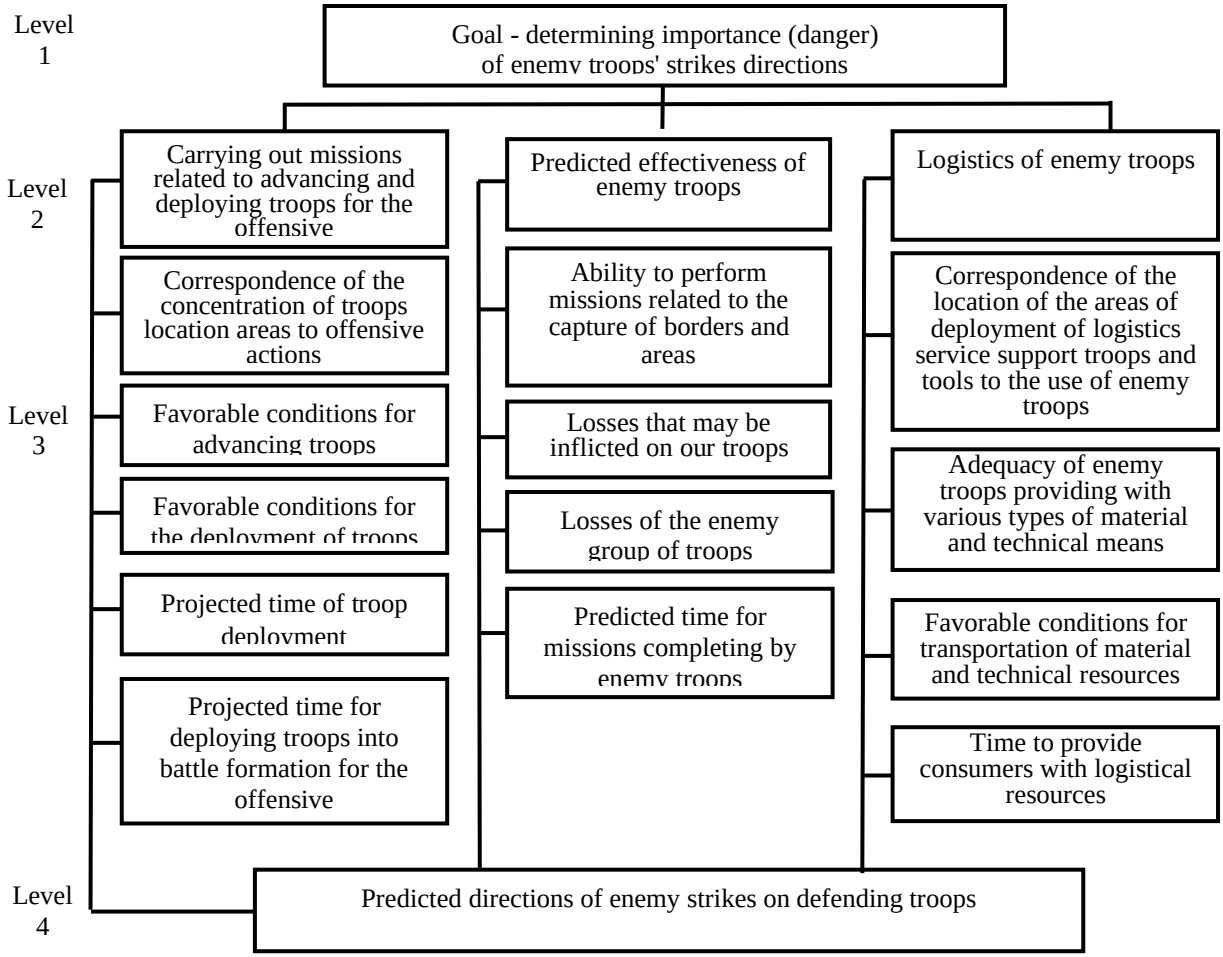

Fig. 1. Hierarchical representation of the importance (danger) assessment task directions of enemy troops' strikes

The hierarchy has four levels: 1 – the goal of solving the problem; 2 – general indicators; 3 – partial indicators; 4 – predicted directions of enemy strikes (alternatives).

When filling out the matrices (Table 1), experts make assessments in the form of weight ratios. *ξ-th* and *μ-th* elements ω_ξ/ω_μ, which are determined by the importance *ξ-th* element compared to*μ-m* element relative to a specified element of the previous level of the hierarchy. The appearance of the pairwise comparison matrix is given in Table 1.

Table 1

Pairwise comparison matrix view

Indicators, alternatives	*P1*	*P2*	• • •	P_μ	• • •	*Ps*
P1	1	$\frac{\omega_1}{\omega_2}$	• • •	$\frac{\omega_1}{\omega_\mu}$	• • •	$\frac{\omega_1}{\omega_s}$
P2	$\frac{\omega_2}{\omega_1}$	1	• • •	$\frac{\omega_2}{\omega_\mu}$	• • •	$\frac{\omega_2}{\omega_s}$
⋮	⋮	⋮	⋮	⋮	⋮	⋮
P_ξ	$\frac{\omega_\xi}{\omega_1}$	$\frac{\omega_\xi}{\omega_2}$	• • •	$\frac{\omega_\xi}{\omega_\mu}$	• • •	$\frac{\omega_\xi}{\omega_s}$
⋮	⋮	⋮	⋮	⋮	⋮	⋮
Ps	$\frac{\omega_s}{\omega_1}$	$\frac{\omega_s}{\omega_2}$	• • •	$\frac{\omega_s}{\omega_\mu}$	• • •	1

Relation $\frac{\omega_\xi}{\omega_\mu}$ in the matrix have the following properties:

$$\frac{\omega_\xi}{\omega_\mu}=\frac{1}{\omega_\mu/\omega_\xi};\ \frac{\omega_\xi}{\omega_\mu}=1 npu\ \xi=\mu\cdot \tag{1}$$

When involving R experts to assess the importance (danger) of the directions of enemy troops' strikes, the numerical value of the judgment is determined as the geometric mean of the individual expert judgments.

$$\frac{\omega_\xi}{\omega_\mu}=\sqrt[R]{\prod_r\left(\frac{\omega_\xi}{\omega_\mu}\right)_r},\ r=\overline{1,R}, \tag{2}$$

where $\left(\frac{\omega_\xi}{\omega_\mu}\right)_r$ – judgment of the *r*-th expert.

For each pairwise comparison matrix, the components of the eigenvector are calculated using the formula

$$\alpha_\xi=\sqrt[S]{\prod_\mu\frac{\omega_\xi}{\omega_\mu}},\ \xi=\overline{1,S},\ \mu=\overline{1,S}. \tag{3}$$

To obtain the elements of the priority vector, the values of the quantities α_ξ normalize

$$в_\xi=\frac{\alpha_\xi}{\sum_\xi\alpha_\xi},\ \xi=\overline{1,S},\ \sum_\xi в_\xi=1. \tag{4}$$

The consistency (consistency) of experts' judgments when compiling each matrix of pairwise comparisons is checked using the method given in the works [7; 8]. For this purpose, the

so-called consistency index is introduced, which takes into account numerical and transitive (ordinal) inconsistency in pairwise comparisons.

The consistency index (CI) is defined as follows:

the sum of the judgments of each column of the pairwise comparison matrix is calculated (Table 1)

$$C_\mu = \sum_\xi \frac{\omega_\xi}{\omega_\mu}, \xi = \overline{1,S}, \mu = \overline{1,s}; \quad (5)$$

The value C1 for the first column is multiplied by the value of the first element of the priority vector b1, the value C2 is multiplied by b2, and so on, which allows us to obtain the sum

$$\lambda_{\max} = C_1 \varepsilon_1 + C_2 \varepsilon_2 + \cdots + C_\mu \varepsilon_\xi + \cdots + C_s \varepsilon_s; \quad (6)$$

the consistency index is calculated[7]

$$IY = \frac{\lambda_{\max} - s}{s-1}, \; s > 1. \quad (7)$$

Next, the CI is compared with the average random coherences (ARCs) for random matrices of different sizes [7] (Table 2).

Table 2

Average consistency for random matrices

Matrix size	1	2	3	4	5	6	7	8	9	10
Average random consistency	0	0	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49

It is believed that the consistency ratio (CR) $BY = \frac{IY}{CBY}$ should not be more than 0.1. When this condition is not met, it is necessary to check the correctness of the problem statement and the experts' judgments.

The degree of influence of the *j*-th general indicator α_j ($j = \overline{1,m}$, *m* – number of general indicators) on the importance (danger) of the directions of attack of the enemy troops corresponds to a certain element (component) of the priorities vector of the matrix of the second level of the hierarchy (Fig. 1). According to the hierarchy, for each *j*-th general indicator, l_j partial indicators are closed, the weight of which is determined by the formula

$$P_{tj} = \delta_{tj} \, d_j, t = \overline{1,l_j}, \; j = \overline{1,m}, \quad (8)$$

where P_{tj} is the weight of the *t*-th indicator, which is closed to the *j*-th general indicator;

α_{tj} – priority of the *t*-th indicator relative to the *j*-th general indicator.

From the matrices of the fourth level of the hierarchy, the priorities of the directions of strikes of enemy troops are determined relative to the partial indicators (the third level of the hierarchy).

The importance (danger) of the *i*-th direction of attack of the enemy troops is determined by the formula

$$B_i = \sum_{j=1}^{m} \sum_{t=1}^{l_j} \gamma_{itj} \cdot P_{t_j}, i = \overline{1,n}, \quad (9)$$

where γ_{itj} – priority of the *i*-th direction of impact relative to the *t*-th indicator, which is closed to the *j*-th general indicator.

As an illustrative example of the application of the methodology, let us consider a military conflict in which it is assumed that the aggressor will conduct a land operation in order to seize part of the territory of a neighboring country. The boundaries and areas that the aggressor will try to seize are determined. When planning a defensive operation of the MCB group of troops, five

possible directions of attacks by enemy troops are determined on the topographic map, the composition and areas of concentration of which are identified by intelligence reconnaissance tools. It is necessary to assess the importance (danger) of the identified directions of enemy troops' attacks.

The structural diagram of the methodology for assessing the importance (danger) of possible directions of attacks by the enemy on the defending group of troops is shown in Fig. 2.

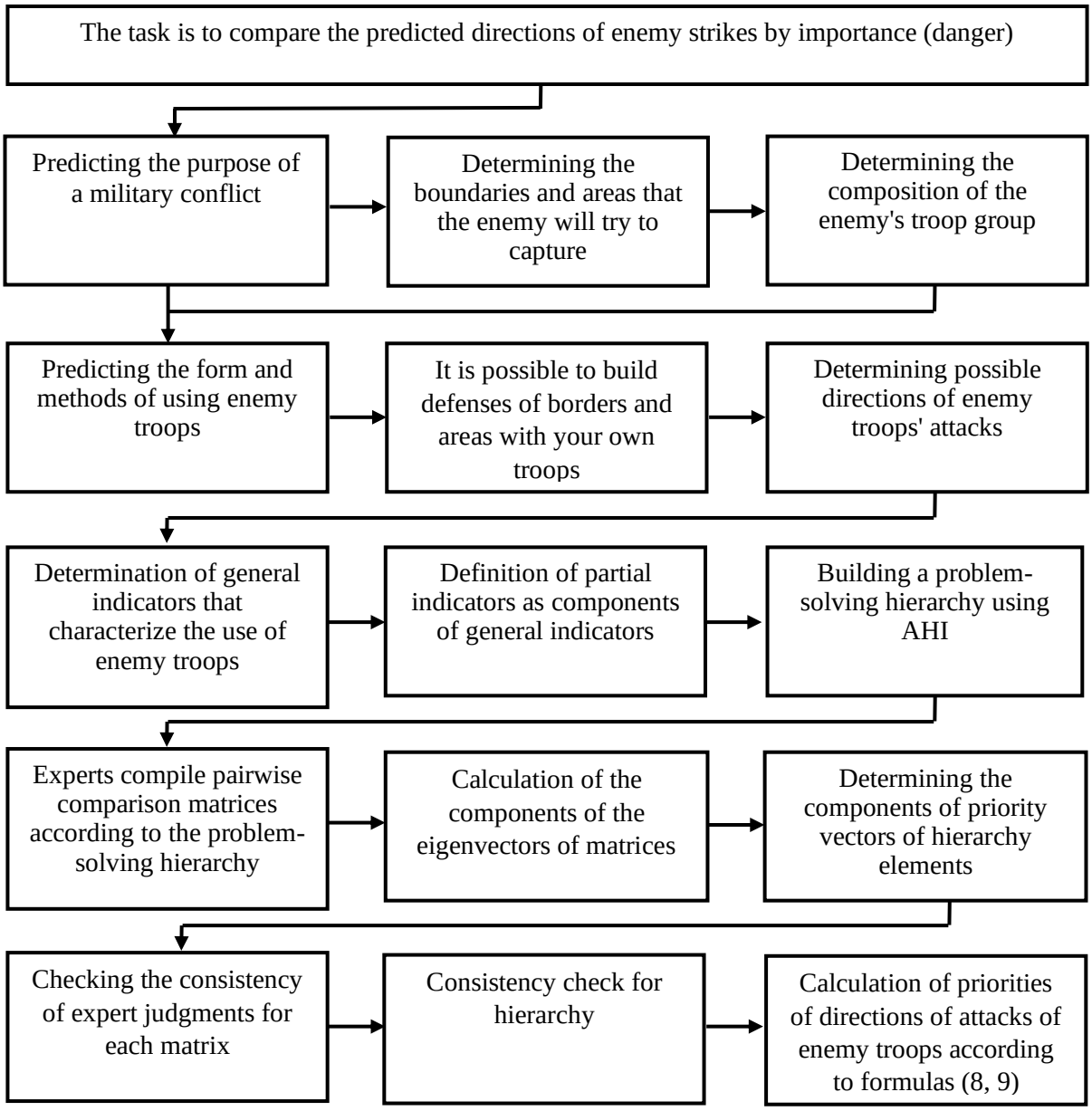

Fig. 1. Structural diagram of the importance (danger) of possible enemy's attacks directions on the defending group of troops assessment methodology

In accordance with the hierarchy of problem solving shown in Fig. 1, for the second level, experts compiled a matrix of pairwise comparisons of general indicators (Table 3).

Table 3

Matrix of pairwise comparisons of general indicators for the second level of the hierarchy

General indicators, P_j	P_1	P_2	P_3	Components of the eigenvector,αj	Components of the priority vector, d_j
P_1	1	3/9	3/7	0,523	0,156
P_2	9/3	1	5/3	1,709	0,510
P_3	7/3	3/5	1	1,118	0,334

λ_{max}= 3,008; IU = 0,004; VU = 0,007.

Next, the experts compiled three matrices of pairwise comparisons for the third level of the hierarchy. The result of determining the components of the priority vectors $\delta_{tj}\left(t=\overline{1,I_j}\right)$ and weights of partial indicators P_{tj} are given in Table 4.

Table 4

Components of priority vectors and weights of partial indicators

Partial indicators, P_{tj}	Components of priority vectors, δ_{tj}			Weights of partial indicators, P_{tj}		
	J = 1	J = 2	J = 3	J = 1	J = 2	J = 3
P_{1j}	0,20	0,25	0,26	0,031	0,128	0,087
P_{2j}	0,15	0,40	0,35	0,023	0,204	0,117
P_{3j}	0,25	0,20	0,15	0,039	0,102	0,050
P_{4j}	0,18	0,15	0,24	0,028	0,077	0,080
P_{5j}	0,22	-	-	0,034	-	-

For thirteen matrices of the fourth level of the hierarchy, the components of the directions of impacts priority vectors γ_{itj} relative to partial indicators are given in Table 5.

Table 5

Components of priority vectors of matrices of the fourth level of the hierarchy

Direction of blows, H_i	*J = 1*					*J = 2*				*J = 3*			
	t = 1	*t = 2*	*t = 3*	*t = 4*	*t = 5*	*t = 1*	*t = 2*	*t = 3*	*t = 4*	*t = 1*	*t = 2*	*t = 3*	*t = 4*
H_1	0,14	0,15	0,17	0,07	0,12	0,09	0,12	0,20	0,25	0,08	0,15	0,19	0,08
H_2	0,17	0,18	0,14	0,18	0,10	0,14	0,15	0,24	0,15	0,12	0,11	0,20	0,16
H_3	0,31	0,25	0,21	0,32	0.27	0,35	0,28	0,19	0,21	0,41	0,34	0,28	0,36
H_4	0,22	0,19	0,36	0,27	0,30	0,27	0,25	0,21	0,19	0,29	0,26	0,12	0,25
H_5	0,16	0,23	0,12	0,16	0,21	0,15	0,20	0,16	0,20	0,10	0,14	0,21	0,15

The results of the assessment of the importance (danger) of the enemy strikes` directions using formula (9) are shown in Fig. 3.

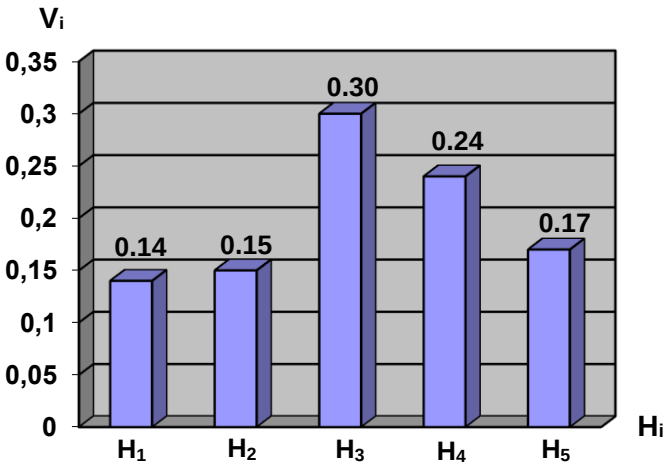

Fig. 3. Coefficients of importance (danger) of enemy troops' attacks directions

The most dangerous is the third direction of the enemy troops' attack, which may be considered the main one when developing the plan of a defensive operation. It is adjacent to the fourth (other) direction of attack, which is also dangerous. The obtained coefficients of importance (danger) (Fig. 3) of the directions of attack of the enemy troops contribute to a reasonable distribution of the efforts of the grouping of our troops when planning the defensive operation operational plan.

Conclusions

A methodology for assessing the importance (danger) of possible directions of attacks by the enemy on a defending group of troops has been developed, which is based on the application of AHI. A system of indicators (general and partial) has been proposed for the application of AHI and a hierarchy of problem solving has been constructed.

Quantitative assessment of the importance (danger) of possible directions of action of enemy troops allows us to more reasonably determine their main direction of attack and to distribute the efforts of our troops when planning a defensive operation.

The methodology can be applied by the MCB when developing a plan for a defensive operation. For this purpose, it is advisable to further develop special mathematical software for the MCB.

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PROXY OPERATIONS IN THE CONTEXT OF THE RUSSIAN-UKRAINIAN WAR: NATURE, PRINCIPLES AND EFFECTIVENESS INDICATORS

Abstract*. The relevance of the study is due to the growing role of proxy operations in modern conflicts, in particular in the context of the ongoing russian-Ukrainian war, which is taking on the characteristics of a hybrid and asymmetric war. The proxy actions of the russian federation against Ukraine through non-state or puppet actors create significant challenges for national security and international stability. The purpose of the article is to understand systematically the nature of proxy operations, formulate the principles of their preparation and implementation, and determine indicators for assessing their effectiveness. The study uses methods of analysis and synthesis, a comparative-historical approach, a systems analysis, and the Saati hierarchy method to rank indicators for assessing the effectiveness of proxy operations. Among the main results: a refined definition of the concepts of "proxy operation" and "proxy war", the basic principles of conducting proxy operations are formulated, a system of key indicators for assessing the effectiveness of proxy operations is proposed, and their weight coefficients are calculated in the general indicator for assessing the effectiveness of proxy operations. The materials of the article will be useful for the specialists in the field of national security, strategic communications, military affairs, analysts, specialists in international relations and scholars in the field of political and military sciences.*

Keywords: *proxy operations, proxy war, hybrid war, Russian-Ukrainian war, strategic destabilization, asymmetric actions, information and psychological influence, sponsoring states, non-state actors, effectiveness assessment, effectiveness assessment, national and military security of the state.*

Introduction

Statement of the problem. The russian-Ukrainian war, that has been ongoing since 2014 and has become full-scale since February 2022, demonstrates the evolution of modern armed confrontation, proxy operations in which are playing an increasingly important role [1–3]. Russia actively uses indirect forms of influence, delegating some of its military-political, informational, and subversive functions to proxy actors – illegal armed groups, private military companies, puppet administrations in the occupied territories, as well as structures associated with it in neighboring states [4–7].

The main signs of proxy orientation in the ongoing war include: the use of russian puppet formations in temporarily occupied territories (the so-called "DPR/LPR armies", "volunteer battalions"), which perform the functions of combat units under russian command; the use of military personnel from other countries as proxy forces during combat operations; information operations implemented through controlled media, "independent experts" and online networks outside the russian federation; the involvement of foreign mercenaries and private military companies (in particular "Wagner") as tools for achieving strategic goals without the direct participation of the regular russian armed forces; support for internal destructive elements in Ukraine in order to destabilize the situation, undermine trust in the authorities and create social tension. All this indicates the russian military strategy high level of adaptation to the proxy format of warfare, which allows the aggressor to act under cover, minimizing political and reputational losses, while maintaining a constant level of threat to Ukrainian statehood. The main risks of further development of the proxy format in the ongoing russian-ukrainian war include: scaling of the conflict through new proxy channels – in particular, the activation of pro-russian elements in adjacent regions (Belarus, Transnistria, the Balkans); strengthening of the hybrid component due to synergy between proxy forces, information and psychological operations and cyberattacks; blurring of the aggressor's responsibility, which complicates the international response, in particular in the legal sphere (war crimes, responsibility for aggression); possible imitation of proxy operations by other states or actors interested in destabilizing the region or seeking to weaken Ukraine through indirect intervention.

In this context, studying the nature, principles, and effectiveness of proxy operations is extremely important not only for a deeper understanding of the nature of modern warfare, but also for the formation of a national response model and proactive strategies to counter new threats. In addition, it opens up prospects for the formation of our own asymmetric solutions in the field of national security, defense, and foreign policy.

Analysis of recent research and publications. An analysis of recent research, publications, and a number of documents devoted to the issue of the article [1–17] indicates that in the current geopolitical conditions of world development, the issue of researching the theory of proxy wars and hybrid wars, as well as the development of forms and methods of waging them, is gaining momentum today.

A proxy war is a term that describes a war or conflict between two or more states where the conflicting parties do not wage direct war against each other, but use rebels, local factions, or other states as "proxies" to fight for their interests. Proxy wars can take many forms, including providing military support, arms supplies, financing, or political support [4], [6], [8], [13], [17].

The term "proxy war" comes from the English term and is used to describe conflicts in those two or more conflicting parties conduct hostilities through the mediation of a third party. The idea of using intermediaries in wars is not new and has been used throughout history. Ukraine today is the largest testing ground for proxy and hybrid warfare technologies in the world in the entire history of the 21st century.

However, the concept of "proxy war" gained widespread acceptance in political science and international relations in the second half of the 20th century. The term is believed to have been first used by American political scientist George Kennan in his article "The Sources of Soviet Conduct," published in 1947. In this article, Kennan used the term "proxy war" to describe a

conflict between the United States and the Soviet Union in which both sides compete for the support of regional allies.

Analyzing the abovementioned, we can say that today the principle of global proxy confrontation between these players also works, but over the past few decades there has been a transformation of both the main players of this confrontation and the geopolitical situation around them [10–17]. Today it is no longer possible to say exactly which country was the first to use proxy war, since this approach has been used in various conflicts around the world. However, well-known proxy wars include, for example, the involvement of the United States and the Soviet Union in the conflicts in Vietnam (1955-1975) and Afghanistan (1979-1989), where both conflicting parties supported the military operations of their allies, and elements of proxy war can also be traced in the hybrid war of russia against Ukraine.

Proxy war and hybrid war are two different concepts that describe different types of conflicts. An analysis of the specifics of the resolution and conduct of these types of wars allows us to identify their main differences and similarities (Table 1).

It should be noted that both state actors and non-state actors, such as terrorist groups or cybercriminals, can participate in a hybrid war. The motivation for waging a hybrid war may be different - from achieving geopolitical goals and controlling the region to destabilizing the enemy, attracting its resources and distracting from other problems. In turn, a proxy war, as a rule, takes place between two conflicting forces or blocs of countries that seek to expand their spheres of influence or protect their interests. In this case, they support proxy forces that conduct military actions in their interests, often on the territory of third countries. A proxy war can be aimed at achieving specific territorial, political or strategic goals. In the structure of such wars, a key role is played by proxy operations - targeted actions carried out through trusted actors or controlled structures that are not formally associated with the sponsoring state. These operations can encompass a wide range of active actions: from armed struggle and sabotage to informational and psychological influence, economic pressure, or cyberattacks.

They allow achieving goals indirectly, reducing political responsibility, legitimizing intervention through local forces or structures, and at the same time creating the impression of internal conflict rather than external aggression.

Table 1

Features of proxy wars and hybrid wars

Proxy war	Hybrid war
Definition	
A proxy war is a conflict between two or more opposing forces in which the conflicting parties do not wage direct war against each other, but support proxy forces (trustees or rebels) who fight on their behalf	Hybrid warfare is a new concept of conflict management that combines various means and methods of warfare, including military, political, economic, informational, and cyber influences. The main feature of hybrid warfare is that it aims to achieve its goals not only through military operations, but also through endless combinations of strategies that include political and economic pressure, disinformation, cyberattacks, sabotage, hybrid and unconventional military actions, financial destabilization, and other methods
The main idea and direction of the war	
The basic idea is that proxy forces fight on behalf of their sponsors, receiving support, weapons, financial assistance, and other resources. Proxy wars can take many forms, such as	Hybrid warfare is aimed at undermining internal stability, changing geopolitical status, dominating the military, economic or political sphere, and achieving its goals without full-scale direct war. The main goal of hybrid warfare is to achieve strategic advantage and

financial support, the supply of weapons, training of combat units, the deployment of military advisors, or even direct intervention in the form of limited military operations. The main goal of a proxy war is confrontation between influential forces through their proxy agents	change the political landscape in its favor. Hybrid warfare often uses information operations and propaganda to manipulate public opinion and create disinformation in order to undermine trust in government or create internal conflicts. Cyberattacks and hacking attacks can also be a component of hybrid warfare aimed at destroying the enemy's information systems, economic structures or critical infrastructure
Examples	
Conflicts in Afghanistan (1979-1989), Vietnam (1955-1975), Syria (since 2011), partly Ukraine, activation from 2000 to the present.	The first and second wars in Chechnya, the conflict in Georgia in 2008, the annexation of Crimea and the conflict in eastern Ukraine, the conflict in Syria.

No.	Differences between wars
1	The main difference between proxy war and hybrid war is that proxy war involves conducting hostilities through proxy forces, while hybrid war is a comprehensive strategy that uses various means, including military and non-military, to achieve its political and strategic goals.
2	An important distinction between a proxy war and a hybrid war lies in the motivation and the parties involved. In a proxy war, the main parties to the conflict may be two large states or blocs of countries that support their proxy forces in fighting each other.
3	Proxy warfare typically involves fighting through proxy forces, while hybrid warfare uses a wide range of tools and methods that may include proxy warfare but go far beyond it, depending on the strategic goals and capabilities of the parties to the conflict.
4	Proxy warfare typically involves waging war through proxy forces supported by opposing forces. Hybrid warfare uses a variety of tools and methods, including military, political, economic, informational, and cyber influences, to achieve strategic advantage and alter the political landscape

Conclusion based on the results of the analysis of the theoretical features of wars
Proxy war and hybrid war are two different approaches to conflict management. It is important to note that proxy war may be a component of hybrid war. For example, in a hybrid war, one side may maintain proxy forces as one of the influencing tools and conducting the conflict. A hybrid war may include several proxy wars, but also use other methods of influence and destabilization. In general, proxy war and hybrid war represent two different conflict strategies that may be used by states or actors to achieve their goals. In practical application, it is difficult to separate proxy war and hybrid war, as they can be intertwined and used together within the same conflict. For example, a hybrid war may begin with the use of proxy forces for initial destabilization, and then expand using other methods and tools

Purpose of the article. The purpose of the article is to systematically understand the nature of proxy operations, formulate the principles of their preparation and implementation, and also determine indicators for assessing their effectiveness.

Presentation of the main material

Proxy operations (proxy wars) are a form of indirect armed conflict in which one or more states or non-state actors use third parties (other states, irregular armed groups, private military companies, etc.) to achieve their own strategic goals, avoiding direct involvement in hostilities.

A proxy operation refers to a situation where one country or organization engages a third party (proxy) to carry out military or political actions in another country or region. This third party may be an independent local group, rebels, national armies, or other military formations. The main

idea of a proxy operation is that the main actor wants to maintain its position and invisibility by using the proxy to influence the conflict.

Proxy warfare, on the other hand, is a form of conflict in which two or more conflicting parties fight through proxies, rather than directly engaging in military confrontation. This means that the parties do not engage in direct military conflict with each other, but use proxy forces to fight on their behalf. These can be local militias, rebel groups, national armies, or mercenary forces.

The main difference between a proxy war and a proxy operation is the nature of the conflict. A proxy war involves direct military combat between proxy forces acting on behalf of their sponsors. In a proxy operation, conversely, proxies act as agents or instruments to achieve the sponsor's goals, but may avoid direct confrontation with the adversary.

Proxy warfare and proxy operations share a common bond in that both concepts involve the use of proxies to achieve the political, military, or strategic goals of the sponsor. In both cases, proxies act as intermediaries, acting on behalf of their sponsors. An important distinction is that proxy warfare typically involves open warfare or armed conflict, while proxy operations can involve a variety of activities, such as intelligence, covert operations, financial support, political manipulation, and other forms of influence. The connection between proxy warfare and proxy operations is that in both cases, proxies are used to influence a conflict or situation. Proxies act on behalf of their sponsors, which provides them with a degree of protection or invisibility. In both cases, proxy forces are used to exert influence without directly confronting the sponsors. However, it is worth noting that the terms “proxy war” and “proxy operation” may have different variations in terminology and be used in different contexts, especially in political and military discourse, and a proxy war and a proxy operation may have different motivations and goals.

A proxy war is usually motivated by political, ideological, or territorial conflicts between states or groups. In such wars, proxy forces act on behalf of their sponsors, conducting hostilities, fighting, or supporting militants or rebels in another country or region. An example of a proxy war is the conflict in Syria, where various external powers support the opposition of local groups. On the other hand, a proxy operation can encompass a wide range of actions that are not necessarily related to war or armed conflict. These can include intelligence operations, economic sanctions, political manipulation, special operations, financial support, or even cyberattacks. Proxy operations are often used to achieve political or geostrategic goals, regime change, resources control, or influence the geopolitical situation in a particular region. It is important to note that proxy wars and proxy operations may have serious consequences for the security, stability, and geopolitical development of the region, and can also affect international relations. However, the level of transparency and openness of proxy actions may vary depending on the specific situation.

The nature of proxy operations is defined by their asymmetric, multilayered, flexible, and hybrid nature. They can encompass not only combat operations, but also information campaigns, subversion, economic pressure, cultural influence, and cyber operations.

The main principles of conducting proxy operations may be defined as:

indirect conduct and masking of participation (plausible deniability). A proxy operation is structured so that an external actor can deny or conceal its participation in the conflict, that reduces the risks of direct escalation or international sanctions;

delegation of armed influence functions. Actions involving the use of force are transferred to irregular formations, mercenaries, criminal or radical structures that operate within the defined coordinates of the interests of the sponsoring state;

asymmetry and economic efficiency. Proxy operations allow for significant strategic effects while minimizing direct costs. They are particularly effective for countries with limited resources or those wishing to avoid open conflict;

flexibility and adaptability. Proxy forces quickly adapt to changes in the theater of operations, often not limited by the norms of international law, that allows them to act unconventionally, creatively, and without rigid centralization;

complex (hybrid) nature. Proxy operations are combined with informational and psychological influence, economic pressure, political blackmail, and diplomatic manipulation;

control and manageability of proxy forces. The effectiveness of a proxy operation depends on the ability to maintain operational and strategic control over the actions of the proxy force, while avoiding excessive autonomy;

manipulative use of legitimacy. Proxy structures can cover themselves up with the "national liberation movement", the "struggle for rights", the "protection of the local population", etc., to mislead the international community.

Below is a systematic list of the main indicators for assessing the effectiveness of proxy operations (Table 2), which allow for a comprehensive description of the achievement of the sponsoring state's strategic goals, the level of secrecy and costs, as well as the impact on the enemy and the stability of the proxy force itself.

Table 2

Key indicators for assessing the effectiveness of proxy operations

Indicator	Definition and content	Direction of application
Achieving the strategic goals of the main actor	The extent to which a proxy operation ensures the realization of the political, military, economic, or informational interests of the customer (sponsoring state)	Assessing the success of implementing a geopolitical strategy without direct military intervention
Degree of deniability	The extent to which the client of the proxy operation can deny its involvement in the conflict or avoid responsibility in the international arena	Analysis of legal and political implications for the sponsoring state
Level of costs for the sponsoring state	The totality of resources (financial, military, diplomatic) that are spent on supporting a proxy force	Comparing the cost-effectiveness of proxy operations with alternative forms of armed intervention
Duration and stability of proxy power	The ability of a proxy structure to remain active, combat-ready, and politically loyal for a long time	Analysis of the viability of the operation in the long term
Impact on the enemy (destabilization, exhaustion)	The level of decline in the defense capability, political stability, or economic potential of an enemy state	Measuring the strategic effect on the target state or alliance
The level of domestic and international legitimacy of the proxy power	The extent to which the proxy power is recognized as legitimate among the local population and international actors	Determining the potential of a proxy structure for autonomous political existence or integration into the political landscape
Level of informational and psychological impact	The effectiveness of using proxy structures to shape the desired narrative, disorient society, or demoralize enemy forces	Measuring the effectiveness of information campaigns in combination with military actions
The level of dependency of the proxy force on the sponsoring state	The extent to which the proxy power is controlled, managed, and dependent in terms of resources, decisions, and actions	Analysis of the risks of autonomation of proxy structures or their transfer under the control of other actors
Ability to scale or move the model	Can this proxy model be replicated in other regions or conflict scenarios?	Strategic planning for long-term conflicts and zones of influence

Using the Saati hierarchy analysis method, a pairwise comparison of indicators was carried out, values were normalized and weights (the contribution of each indicator) were calculated in the overall assessment of the effectiveness of the proxy operation (Table 3). The results allow us to determine the priority of individual aspects in the planning, analysis and assessment of such operations. Table 3 is an example of a generalized average matrix of pairwise comparisons. The assessment was carried out by a group of eight experts who are specialists in the field of application of the Armed Forces of Ukraine.

Table 3

Generalized pairwise comparison matrix

	Achieving strategic goals	Degree of detachment	Cost level	Proxy duration	Impact on the enemy	Proxy legitimacy	IP impact	Proxy dependency	Scalability
Achieving strategic goals	1,000	2,745	4,507	3,320	2,798	3,911	2,821	5,291	4,730
Degree of detachment	0,364	1,000	1,186	1,377	1,059	1,320	2,804	1,738	1,540
Cost level	0,222	0,843	1,000	5,010	4,842	5,486	1,140	5,192	1,770
Proxy duration	0,301	0,726	0,200	1,000	4,422	3,161	1,260	1,267	3,183
Impact on the enemy	0,357	0,944	0,207	0,226	1,000	2,487	1,144	2,017	1,896
Proxy legitimacy	0,256	0,758	0,182	0,316	0,402	1,000	1,218	1,189	1,252
Informational and psychological impact	0,355	0,357	0,877	0,794	0,874	0,821	1,000	2,262	2,564
Proxy dependency	0,189	0,575	0,193	0,789	0,496	0,841	0,442	1,000	0,620
Scalability	0,211	0,649	0,565	0,314	0,527	0,798	0,390	1,613	1,000

Table 4 shows an example of a normalized matrix, a normalized assessment of the contribution of indicators to the overall assessment of the effectiveness of the proxy operation (Fig. 1), and the rating of these indicators in the overall defined group.

Table 4

Normalized matrix (priority vectors (weights)

No.	Indicator	Weight	Rating
1	Achieving the strategic goals of the main actor	0,216	1
2	Level of costs for the sponsoring state	0,153	2
3	Duration and stability of proxy power	0,113	3
4	Impact on the enemy (destabilization, exhaustion)	0,111	4
5	Informational and psychological impact	0,103	5
6	Degree of deniability	0,087	6

No.	Indicator	Weight	Rating
7	The level of domestic and international legitimacy of the proxy power	0,075	7
8	Scalability or portability of the model	0,072	8
9	The level of dependency of the proxy force on the sponsoring state	0,069	9

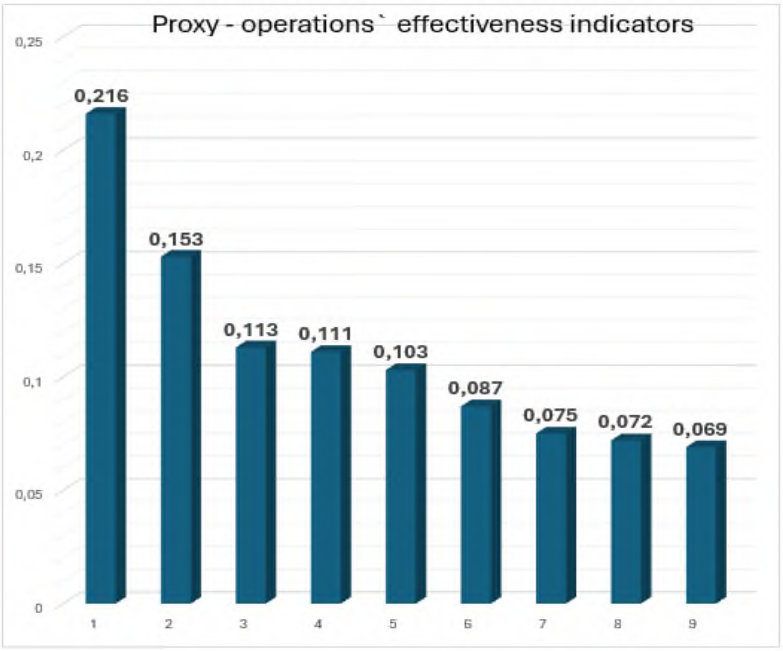

Fig.1. Normalized estimates of the indicators contribution to the overall assessment of the effectiveness of the proxy operation

The calculations show that the highest weight (0,216) was given to the criterion "Achievement of the strategic goals of the main actor", which is logical, because the success of a proxy war is determined by its ability to realize the strategic interests of the sponsor. The second place is taken by the "Level of costs" (0,153) and also has a high weight, because a proxy war is attractive if it allows achieving goals with minimal costs. The third and fourth places are taken by the indicators "Duration and stability of proxy power" (0,113) and "Influence on the enemy" (0,111) – these indicators are important in terms of the longevity of the effect and the exhaustion of the enemy. The indicator "Information and psychological impact" (0,103) – confirms that a proxy war is not only about armed struggle, but also about media and psycho-emotional campaigns. The lowest values are "Proxy Dependence" (0,069) and "Model Scalability" (0,072), which may indicate their secondary importance or the difficulty of achieving autonomy.

Conclusions

Thus, proxy operations are a form of indirect military intervention in that a state or non-state actor uses a third party (proxy force) to achieve its own strategic goals, avoiding open participation in an armed conflict. In its classical form, the proxy warfare is an indirect conflict where an external actor delegates the functions of violence, influence, or destabilization to another actor, often an illegal or irregular one. Proxy operations, as a key tool of modern hybrid and asymmetric warfare, are increasingly influencing the course of armed conflicts, particularly in the context of the russian-Ukrainian war. Their essence lies in the use of proxy forces by sponsoring

states to achieve their own strategic goals with minimal risks of direct escalation or international liability. The study analyzed the nature of proxy operations, identified their basic principles, and also formed a system of key indicators for assessing the effectiveness of such operations. The application of the Saati method allowed us to rank these indicators and determine their relative contribution to the overall assessment of the success of proxy operations. The indicators of achieving strategic goals, the level of losses of resilience, and the duration of the proxy operation received the highest weight, reflecting the dominance of strategic expediency and concealment in modern proxy practice.

The research materials may be used as a methodological basis for training specialists in the field of national security, strategic planning, countering hybrid threats, and conducting military-political and strategic analysis. Taking into account the formulated approaches will allow Ukraine not only to more effectively identify and neutralize the enemy's proxy actions, but also, if necessary, to use proxy tools as an element of its own deterrence and asymmetric response strategy.

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THE ARTIFICIAL INTELLIGENCE METHODS APPLICATION FOR ENEMY'S GROUP TARGET OBJECTIVES CLUSTERIZATION AND CLASSIFICATION

Abstract*. The article shows that artificial intelligence methods, namely neural networks, can be used to solve the problems of clustering and classification of enemy group targets.*

To solve the problem of clustering enemy group targets, a neural network of the SELFORGMAP type (self-organized maps) may be chosen, which consists of a layer of neurons and can classify a data set of vectors with any dimension. As revealed by the analysis of training the neural network for clustering enemy group targets, the NN SOM GTs has the best accuracy with 5 neurons in the hidden layer. The clustering of enemy group targets showed that they can be divided into 5 clusters.

The convolutional neural network such as the CNN GTs may ivebe chosen to classify enemy group targets. The training of the CNN GTs was carried out using the Levenberg – Marquardt algorithm. Based on the training results, the neural network for classifying group target objects was trained, verified and tested with an accuracy of 100%, the overall accuracy of the neural network for classifying enemy group target objects was 100%. The results of analyzing the histogram of errors between the target values and the predicted values after training the neural network for classifying group targets show that the error value is 0.00022. Since the errors are close to zero, the trained neural network performs well in classifying group targets. Testing the performance of the CNN GTs on an arbitrary set of group target objects showed 100% coincidence of the classes of actual group target objectives obtained using the CNN GTs.

The direction for further research could be the creation of neural networks to solve the problem of distributing a heterogeneous swarm of striking unmanned aerial vehicles over the objectives of an unsteady heterogeneous group target.

Keywords: *clustering, classification, neural network, artificial intelligence, group target, unmanned aerial vehicles, swarm, russian-Ukrainian war.*

Introduction

Statement of the problem. During the russian-Ukrainian war, changes are taking place in the strategy, forms, and methods of employing troops. One of the reasons for this is the development of unmanned systems, the use of which has become widespread and allows the performance of a wide range of tasks.

At present, the use of unmanned systems is an effective means of destruction in both positional and maneuver defense. At the same time, at the tactical level, the current tasks are to destroy non-stationary group targets of the enemy both on the front line and in depth; to deliver massive sudden strikes on objectives of its critical infrastructure and important communications. The use of other strike means and electronic suppression tools, which are expensive to operate and produce, is minimized.

Currently, the capabilities of unmanned systems are increasing due to the use of swarms of attack UAVs, which significantly affects the course of combat operations [1].

Both homogeneous and heterogeneous swarms of strike UAVs may be used. In this case, from the point of view of organizing swarm control, swarms should consist of strike UAVs of the same type (either quadcopter-type UAVs or aircraft-type UAVs) [1].

Homogeneous swarms of strike UAVs consist of identical strike UAVs, while heterogeneous swarms consist of UAVs of different classes.

Since a group target almost always consists of heterogeneous objects, a heterogeneous swarm of strike UAVs must be used to destroy such a target.

To defeat a heterogeneous group target with a heterogeneous swarm of strike UAVs with maximum efficiency, it is necessary to solve the optimization problem of distributing heterogeneous strike UAVs among the objectives of the heterogeneous group target.

To solve the specified optimization problem, it is necessary that the UAV target assignment system for group target objectives classify group target objectives and assign each object a strike UAV or several strike UAVs of the corresponding class.

Artificial intelligence methods and algorithms, namely neural networks (NNs), may be used to classify group target objects [2, 3].

Analysis of recent research and publications. Given the promising nature of artificial intelligence technologies [2–4], the development of neural networks for clustering and classification of group target objectives is a relevant task.

In particular, in the work [5], a neural network was used to develop a system capable of learning to recognize the type of UAV based on the results of the analysis of traffic transmitted by it to the ground control station. The author noted that the ability of a neural network to generalize, with a sufficient volume of the training sample, allows the NN to extrapolate its knowledge about known types of network actions to unknown types. In this case, the choice of an NN architecture adequate to the tasks plays a decisive role.

In [6, 7], the application of different types of neural networks for object recognition and classification is considered.

In [8, 9], clustering and classification of attack UAVs were carried out based on neural networks. The results of the analysis of the dependence of clustering accuracy on the number of neurons in the hidden layer showed that the neural network for clustering attack unmanned aerial vehicles NN SOM FPV UAVs has the best accuracy with 18 neurons in the hidden layer. Clustering of attack unmanned aerial vehicles demonstrated that they can be divided into 4 clusters. At the same time, they can be grouped into 3 classes according to the number of UAVs in each cluster. Training of the CNN FPV UAVs was carried out using the Levenberg-Marquardt algorithm, the overall accuracy of the neural network for classifying attack unmanned aerial vehicles was 98.9%.

In general, an analysis of scientific publications indicates that the development of objectives classification technologies based on neural networks has significant prospects,

especially in the context of increasing accuracy, operation speed, and resistance to rapidly changing conditions.

The issues of clustering and classification of group target objects based on neural networks have not received enough attention. Therefore, clustering and classification of group targets, on the one hand, and certain classes of strike UAVs, on the other hand, deserve special attention.

Purpose of the article – development of neural networks for clustering and classifying enemy group target objectives based on artificial intelligence algorithms.

Presentation of the main material

In [10], it is proposed to use the following classification of types of objects (targets) located in the terrestrial (surface) and air regions of the Earth's space:

a) the first type – point objects (samples of ground (surface) equipment, people, small groups of people);

b) the second type – linear objects (vehicle columns, automobile and railway, oil and gas pipelines, power lines);

c) the third type – flat objects (large groups of point objects, agricultural fields, forest areas, settlements, flood and earthquake zones);

d) the fourth type – spatial objects (areas of chemical and radioactive contamination of the air basin).

In addition, group target objects can be classified by strike means groups (Table 1).

Table 1

Groups of strike objects

Strike tools group number	Object group name	Strike objectives
1st group	Tactical-level strike tools, strike reconnaissance complex, tactical SS	Tactical SS missiles launcher platoons, artillery platoons (batteries), MLRS platoons (batteries), mortar companies
2nd group	Troop and weapons command and control bodies	CP (FCP, MCP) FA, AC, divisions, brigades, battalions, TCCB, TCCC, reconnaissance and electronic warfare equipment
3rd group	Aviation grouping facilities	Tactical aviation at airfields, army aviation at landing pads
4th group	Air defense facilities	Batteries (platoons) of SAMs
5th group	Troop engroupments	Motorized infantry, infantry, tank, mortar companies, anti-tank destroyer companies in areas of concentration, on the march, during advance and deployment
6th group	Other objects	Rear facilities, infrastructure, etc.

Therefore, we have a fairly large number of diverse (by nature) objects in the enemy's operational structure, which emphasizes the need for a balanced approach to the rational distribution of strike UAVs among group target objects, taking into account their priority.

Let's consider how the mission of clustering and group-target objects classifying may be solved using neural networks.

The creation and use of neural networks for the classification of group target objects involves [8] (Fig. 1): 1) formation of a database of group target objects; 2) selection of neural network architecture; 3) selection of a neural network training algorithm; 4) training of a neural

network; 5) evaluation of the neural network training results; 6) use of a neural network for the classification of group target objects.

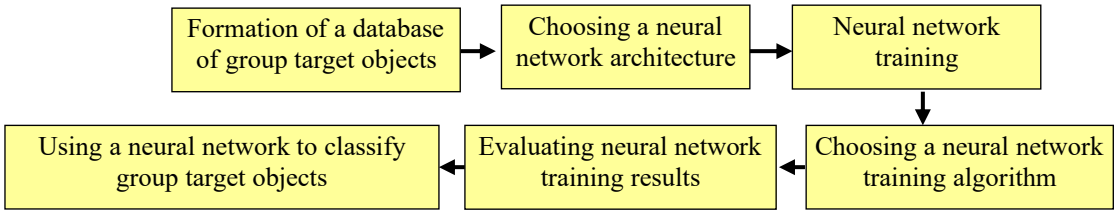

Fig. 1. Stages of creating and using a neural network for classification group target objects

1. Formation of a database of group target objects. The database of group target objects was formed from various types of weapons and military equipment (WME): tanks, multiple launch rocket systems, artillery systems of 100 mm caliber and larger, mortars, anti-tank missile systems, air defense systems, aircraft, cars, anti-ship weapons, warships, enemy UAVs (Table 2).

Table 2

Number of samples of group target objects by type of weapons and military equipment

No. salary	Types of weapons and military equipment	Number
1.	Tanks	50
2.	IFVs	27
3.	APCs	27
4.	AFVs	18
5.	Launchers for tactical and operational-tactical SS missiles	5
6.	Multiple launch rocket systems	9
7.	Artillery systems of 100 mm caliber and larger	22
8.	Mortars	27
9.	Anti-tank weapons (artillery)	5
10.	Anti-tank missile systems	21
11.	Air defense systems	81
12.	Aircraft	73
13.	Helicopters	20
14.	Cars	20
15.	Anti-ship weapons	5
16.	Warships	26
17.	Unmanned aerial vehicles	17
18.	Personnel (group, department, etc.)	5
	Total number of samples:	456

Table 2 lists 456 samples of various types of weapons and military equipment (WME) used by the enemy in the russian-Ukrainian war.

The enemy group target objects presented in Table 1 may be grouped by classes.

2. Choosing the architecture of the neural network for clustering group target objects. In order to distribute the group target objects by classes, we will apply the clustering procedure. In the clustering task, the neural network will group the group target objects into clusters according to the combat potential of the WME sample.

To cluster objects of a group target using a neural network, it is necessary to create and train the network, as well as evaluate its effectiveness using various visualization tools (the Clustering application in the MATLAB application package).

For clustering of group target objects, we will choose a neural network of the SELFORGMAP type (self-organizing maps), which consists of a layer of neurons that can classify a data set of vectors with any dimension into as many classes as the layer has neurons. The neurons are arranged in a two-dimensional topology, which allows the layer to form a representation of the distribution and a two-dimensional approximation of the topology of the data set. We will train the network using the batch algorithm self-organizing map (SOM).

Self-organizing maps learn to cluster data based on similarity, topology, with the advantage of assigning the same number of instances to each class.

3. Clustering of group target objects. For clustering of group target objects, a matrix with input data of size 1x456 was formed (Table 2).

It has been experimentally established that a self-organized map should consist of 5 neurons, and the neural network should have one input and one output.

The architecture of the neural network for clustering group target objects is shown in Fig. 2.

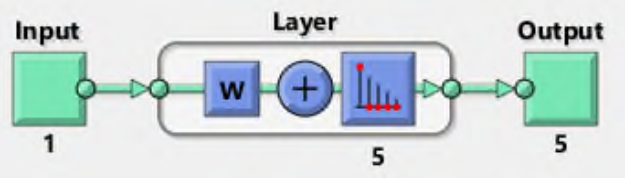

Fig. 2. Architecture of a neural network for clustering group target objects (NN SOM GTs)

NN SOM GTs supports the hextop topology, which creates a set of neurons arranged in a hexagonal order (Fig. 3).

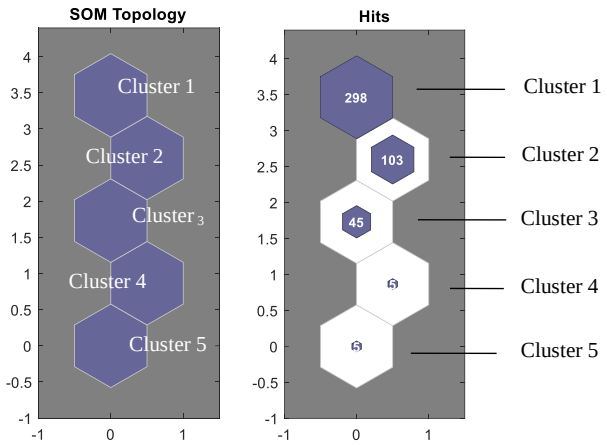

Fig. 3. Cluster diagrams for group target objects:
a) by clusters and b) by number group target objects

The results of data analysis on group goal objects (Table 1) using the SELFORGMAP neural network of group goal objects (NN SOM GTs) are shown in Fig. 3 and Fig. 4.

Therefore, cluster 1 includes 298 group target objects, cluster 2 includes 103, cluster 3 includes 45, cluster 4 includes 5, and cluster 5 includes 5 objects.

The results of the distribution of group target objects into clusters are presented in Table 2.

In the future, this will allow using the created neural network for clustering group target objects (NN SOM GTs) for their distribution into classes.

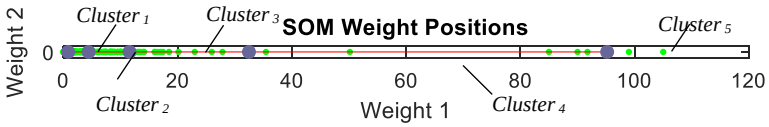

Fig. 4. Distribution of group target objects by clusters

Fig. 4 shows the distribution of group target objects across clusters as green dots, which show how NN SOM GTs classifies group target objects.

Therefore, clustering of enemy group target objects made it possible to divide them into classes.

5 classes of enemy group target objects were identified:

Class 1 includes group target objects that have a combat potential of 0.6-2.7;

to the 2nd class – group target objects with a combat potential in the range from 2.7 to 8;

up to the 3rd class – group target objects with combat potential in the range from 8 to 23;

up to the 4th class – group target objects that have a combat potential in the range from 23 to 90;

up to the 5th class – group target objects that have a combat potential of over 90.

4. Choosing a neural network architecture for classifying group target objects. The neural network for classifying group target objects based on the values of their combat potentials was developed in the MATLAB application package.

Data preparation. Data for the problem of classifying objects of group goals is configured for the neural network by organizing the data into two matrices: the input matrix X(p) and the target matrix T(y).

The study used the characteristics of more than 456 samples of enemy group target objects.

The neural network for classifying group target objects has two layers of neurons: hidden and output (Fig. 5).

It has been experimentally established that the best classification result is achieved if the number of neurons in the hidden layer is 15 neurons.

The connection between neurons in the hidden layer is carried out using the tansig function, and in the output layer – using the lin function [9].

Fig. 5. Architecture of a neural network for group targets object classification (CNN GTs)

Let’s divide the database of group goal objects into training, validation, and testing sets.

The training set is used to train the neural network. Training continues as long as the network continues to improve the validation set. Training a neural network can be viewed as solving an optimization problem. Its goal is to minimize the error function on this sample by choosing the values of the weights W. The function trainbr is chosen as the training function for the neural network for classifying objects of group goals.

The trainbr function is Bayesian backpropagation regularization. It is a network training function that updates the weights and biases according to Levenberg–Marquardt optimization, which minimizes the combination of squared errors, weights, and biases, and then determines the

correct combination to produce a network that generalizes well. This process is called Bayesian regularization.

Training occurs according to the trainbr training parameters. These parameters in the Matlab programming environment are:

net.trainParam.epochs – maximum number of epochs for training (default value – 1000);
net.trainParam.show – epochs between displays (NaN if there are no displays) – 25;
net.trainParam.showCommandLine – create command line output (default value – false);
net.trainParam.showWindow – show the training graphical interface (default value – true);
net.trainParam.mu – Marquardt adjustment parameter (default value 0.005);
net.trainParam.mu_dec – reduction factor for mu (default value is 0.1);
net.trainParam.mu_inc – increase factor for mu (default value – 10);
net.trainParam.mu_max – maximum value for mu (default value – 1e10);
net.trainParam.max_fail – maximum number of validation errors (default value – 0);
net.trainParam.min_grad – minimum performance gradient (default value is 1e-7);
net.trainParam.time – maximum training time in seconds (default value – inf).

Each weight and bias are updated according to their learning function after each epoch (one pass through the entire set of input vectors).

The test set provides a completely independent assessment of the accuracy of the neural network's classification of group target objects.

So, we generate data, create and train a neural network, and evaluate its performance using mean square error and regression analysis.

Of the 456 group goal objects, their distribution is as follows: 319 (70%) – training; 69 – verification; 68 – testing.

The neural network was trained using the Levenberg–Marquardt algorithm [5].

Fig. 6 shows the error matrix during training, validation and testing of the neural network for classifying group target objects.

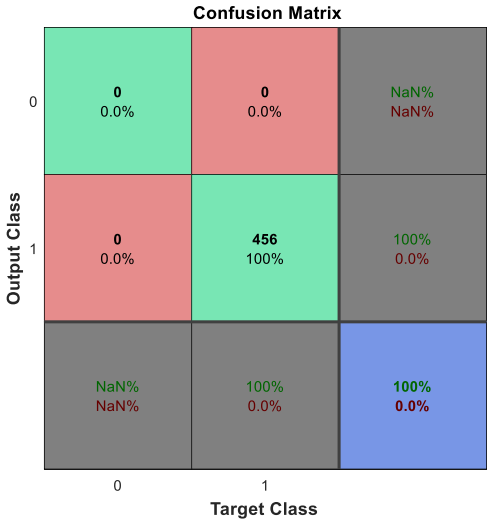

Fig. 6. Error matrices during training, validation and testing of a neural network for group target objects classifying

Fig. 6 shows that the neural network for classifying group target objects was trained, validated, and tested with accuracies of 100%, and the overall accuracy of the neural network for classifying group target objects is 100%.

When solving an optimization problem, the first derivatives of the objective and nonlinear constraint functions are calculated, and the function check Gradients is used to check the programmed derivatives. In addition, it is checked whether the gradient is calculated correctly near the random starting point [11–12].

Fig. 7 shows the results of estimating the gradient of the objective function.

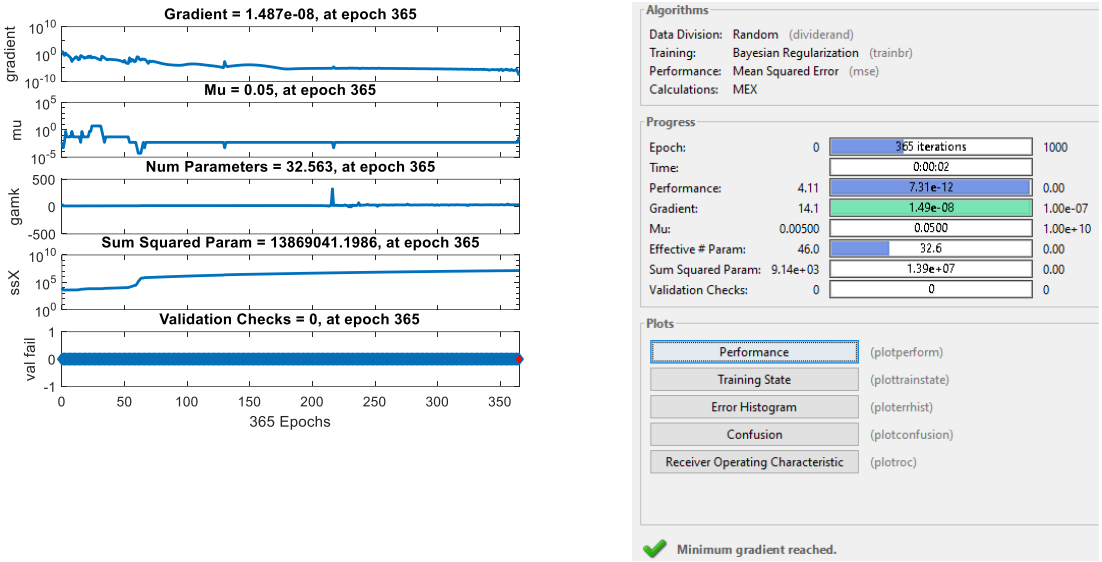

Fig. 7. a) Checking the validity of gradients; b) Checking the performance of training CCN GTs

Fig. 7 shows that the best learning performance of CCN GTs is achieved at the 365th epoch.

Fig. 8 shows a histogram of the errors between the target values and the predicted values after training the neural network for classifying objects of group targets. The histogram shows that the GTs CNN has an error with an accuracy of up to the fifth sign.

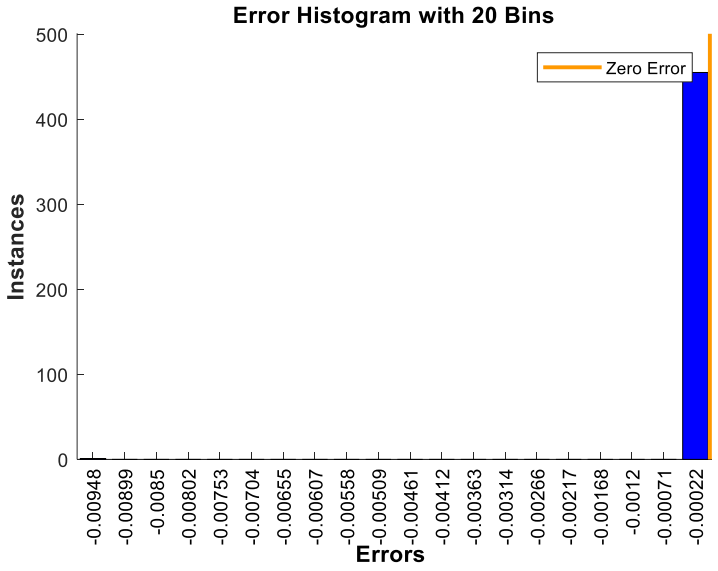

Fig. 8. Error histogram

The error value of 0.00022 indicates the best performance of the network. Since the errors are close to zero, the neural network models the object classification of group goals well.

Fig. 9 shows a graph representing the training, validation, and testing data of a neural network for classifying group target objects.

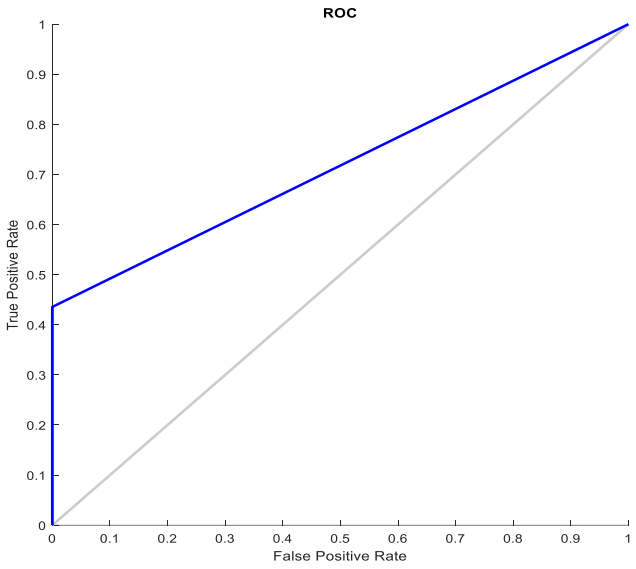

Fig. 9. Training, validation and testing data for a neural network classification group target objects

The dotted line on the graph represents the optimal outcome, and the solid line is the linear regression line that best fits the outcomes and targets.

The graph of the change in the value of the objective function over epochs – learning cycles is shown in Fig. 10.

Among the training parameters are set:

goal – the maximum allowable value of the objective function;

epochs – the maximum allowable number of network training cycles;

show – the step of displaying information about network training on the screen, set in training cycles.

The graph indicates the iteration at which the verification efficiency reached a minimum [11–12].

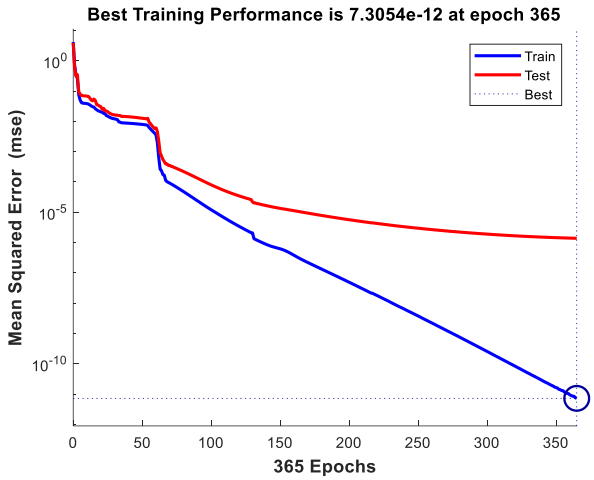

Fig. 10. Graph of the change in the value of the objective function during the learning process

Fig. 10 shows that at the 365th iteration, a local minimum of the objective function was reached.

Therefore, a convolutional neural network for classifying group targets (CNN GTs) can be used to classify group target objects with different combat potential values.

To test the operation of the CNN GTs, an arbitrary set of group target objects with combat potential values was taken, which are given in Table 3.

The results of the work of the CNN GTs are presented in the fourth row of Table 3.

Table 3

Results of the work of CNN GTs

No. salary	Objects group goals	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Combat potential	91.74	50.15	35.46	27.85	25.98	23.00	20.15	18.50	17.43	17.00	16.50	16.00	16.00	14.14	14.00	2.93
2	Class (actual)	5	4	4	4	4	4	3	3	3	3	3	3	3	3	3	2
3	Class (neural network)	5	4	4	4	4	4	3	3	3	3	3	3	3	3	3	2
4	Coincidence	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
No. salary	Group goal objects	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	Combat potential	2.90	2.89	2.88	2.86	2.86	2.74	2.73	2.70	2.58	2.57	2.47	2.46	2.45	2.37	2.30	2.30
2	Class (actual)	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
3	Class (neural network)	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
4	Coincidence	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

The results of the analysis of actual data and data obtained using CNN GTs show 100% coincidence of object classes of group targets.

Therefore, a convolutional neural network for group target object classification (CNN GTs) can be applied to classify enemy group target objects with different combat potential values.

Conclusions

For the classification of enemy group target objects, a convolutional neural network of the type CNN GTs may be selected. Training CNN GTs using the Levenberg-Marquardt algorithm showed good results. According to the training results, a neural network for classifying group target objects was trained, verified and tested.

The overall accuracy of the neural network for classifying group target objects was 100%.

The results of the analysis of the histogram of errors between target values and predicted values after training the neural network for classifying group target objects indicate that the error value is 0.00022.

Since the errors are close to zero, the trained neural network performs the classification of group target objects well.

Testing the performance of CNN GTs on an arbitrary set of group target objects showed 100% coincidence of classes of actual group target objects obtained using CNN GTs.

The direction of further research may be the creation of neural networks to solve the problem of distributing a heterogeneous swarm of strike unmanned aerial vehicles over objects of a non-stationary heterogeneous group target.

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THE ARTIFICIAL INTELLIGENCE AND NEURAL NETWORK ALGORITHMS' THREATS AND RISKS FOR THE SOCIO-POLITICAL COMMUNICATIONS SYSTEM IN THE RUSSIAN-UKRAINIAN WAR

Abstract. *This article provides a comprehensive analysis of the threats and risks arising within the system of socio-political communications due to the application of artificial intelligence (AI) and neural network algorithms in the context of the ongoing russian-Ukrainian War. It emphasizes that modern AI technologies, including machine learning, natural language processing, and especially generative AI, have transformed into powerful tools of information warfare. These technologies enable the aggressor to automate, scale, and significantly enhance the effectiveness of propaganda, disinformation, and psychological manipulation targeting Ukrainian society and the international community. The article aims to thoroughly investigate and systematize these threats by analyzing specific methods of AI application by the russian federation within its hybrid warfare strategy against Ukraine. This analysis considers the experience gained from previous conflicts, particularly the war in Syria, which served as a testing ground for Russia, Iran, and ISIS to trial various information warfare tactics, such as the use of botnets, troll farms, astroturfing, and manipulating social media trends. The primary focus is on the key risks that have become prominent since the commencement of the full-scale invasion in 2022. The conclusion asserts that AI has become an integral and potent factor in russia's hybrid war against Ukraine, generating multi-level threats. Countering these threats necessitates more than isolated measures; it requires the development and implementation of a holistic, multi-layered national strategy. This strategy must integrate cutting-edge technological solutions, adequate legal regulation, international cooperation, educational programs to enhance media literacy and critical thinking within society.*

Keywords: *artificial intelligence, socio-political communications, threats, risks, military security.*

War cannot be won with the help of last-generation weapons and outdated methods.
V. Zaluzhnyi

Introduction

Statement of the problem. In 2013, Michal Kosinski and his colleagues published an article in the journal Proceedings of the National Academy of Sciences on the analysis of digital traces in social networks, which allowed to determine the personal characteristics of users with high accuracy [1]. It was established that it is possible not only to identify personality traits, but also to predict with a high degree of probability the user's political preferences and even gender, sexual orientation, and skin color.

Currently, the development of big data and algorithms based on artificial intelligence (AI) allows for the successful formation of polarization of opinions and political bias by creating manipulative, fabricated information, amplifying emotional content, and substituting discussions, thereby jeopardizing the system of socio-political communications [2-3].

War contributes not only to the cohesion of the nation around a common guiding idea, but also to a simplified perception of truth, a reduced picture of the world according to the principle of dividing people into friends and strangers, the actualization of belief mechanisms instead

of critical analysis, extreme emotionality of perception of events, and manifestations of mass affectation [4]. Under these conditions, the increased massification and emotionality of collective consciousness becomes extremely vulnerable to communicative manipulations.

Russian aggression against Ukraine is accompanied by an unprecedented use of information and communication technologies, in which artificial intelligence and neural network algorithms occupy a special place. Their impact on socio-political communications is becoming increasingly decisive. From the generation of synthetic media content (deepfakes) to microtargeting propaganda and automated surveillance, artificial intelligence is transforming traditional forms and methods of information warfare, creating new threats to national security.

Analysis of recent research and publications. The issue of using artificial intelligence in military conflicts and information warfare is actively studied by many scientists. Methods and technologies of information and psychological influence using the media, the Internet and social networks are considered in the work of Valery Solovey [5]. The use of bots, trolls and astroturfing in social networks during military conflicts is the subject of a book by P. W. Singer and Emerson T. Brooking [6]. The threats of generative artificial intelligence and deepfakes are analyzed in the work of D. Robert Chesney and Danielle Keats Citron [7]. The study by News Guard Technologies analyzes the creation of clones of famous media sites using artificial intelligence and was studied by specialists [8-9]. However, a comprehensive analysis of the threats and risks created by AI and neural network algorithms for the socio-political communications system in the context of the russian-Ukrainian war requires in-depth study. Analysis of these threats and risks is necessary to develop adequate strategies for countering and protecting the information sovereignty of the State and determines the relevance of the article.

The purpose of the article is an analysis of threats and risks associated with the use of artificial intelligence and neural network algorithms in the system of socio-political communications in the context of the russian-Ukrainian war.

Presentation of the main material

In this article, artificial intelligence (AI) refers to a set of technologies that allow computer systems to imitate human cognitive functions, such as machine learning (ML), pattern recognition, natural language processing (NLP), computer vision, and generative AI. Of particular importance are neural network algorithms for deep learning (Deep Learning), which are the technological basis of many modern AI applications in socio-political communications.

Artificial intelligence has been successfully used in the military for intelligence analysis, logistics, autonomous systems management, operations and combat simulation, and decision support systems. However, in the context of information warfare, its role has become noticeable with the development of social networks and generative models.

Information operations conducted by russia use traditional practices of Soviet “active measures” and adapted to the digital age [10-11]. Modern russian military doctrine considers the information space as a critically important battlefield, integrating information tools into the overall concept of hybrid warfare [12-13]. In this context, artificial intelligence is viewed by the Russian Federation not simply as a new technology, but as a powerful catalyst capable of significantly increasing the effectiveness of existing methods of information operations through automation, scalability, improved targeting, creation of realistic synthetic content, and integration with cyber operations.

The war in Syria, that began in 2011, became one of the first testing grounds for the widespread use of these technologies in socio-political communications. Information operations in the Syrian war were carried out not only by russia and Iran in support of the Bashar al-Assad regime, but also by the Islamic State (ISIS). Russian operations were aimed at discrediting the “White Helmets”, promoting the idea of fighting “terrorists”, increasing anti-Western sentiment, and also at denying the use of chemical weapons by the Assad regime or accusing the opposition on this [14]. The Islamic State used social networks quite effectively to demonstrate power, recruit,

justify violence and create the image of a "caliphate". The main platforms for these operations were Twitter, Facebook, YouTube, and Telegram [15].

The main methods of conducting information operations were [14-15]:

– spreading propaganda and disinformation using bot networks and "troll factories" to mass-promote narratives, fake news, and fabricated eyewitness accounts;

– discrediting opponents by launching campaigns to tarnish the reputation of opponents, spreading rumors, and making accusations of fabricated war crimes;

– astroturfing – creating illusions of mass support and popular anger using a multitude of fake accounts that imitate real users;

– trend manipulation – using bots to bring certain hashtags to the top of discussions on social networks;

– suppression of dissent through attacks on the accounts of activists and journalists, mass complaints about their content with the aim of blocking it.

In the context of the hybrid war launched by russia against Ukraine long before open military aggression, socio-political communications have become the main goal of the information confrontation. The goals include undermining trust in the state institutions of Ukraine, demoralizing the population and the Armed Forces, and manipulating public opinion within the country and in the international arena. Since 2022, this war has become the first full-scale conflict where the capabilities of modern artificial intelligence are systematically used to influence the information space [16].

The main risks and threats associated with the use of artificial intelligence in socio-political communications in the context of an ongoing war are:

– automated big data analysis (AI surveillance);

– manipulation of mass consciousness through AI targeting;

– spreading disinformation using generative AI (deepfakes and fake texts);

– opacity of algorithmic decisions and algorithmic contagion;

– concentration of "digital power" in foreign techno platforms.

Automated big data analysis (AI surveillance) and as a result, the loss of privacy in the absence of effective mechanisms for data control and protection increases the vulnerability of the civilian population many times over. There are security threats to activists, journalists, relatives of military personnel and ordinary citizens, whose data can be used for filtering measures, coercion to cooperate, tracking the movements and contacts of persons of interest to special services, kidnappings or physical elimination. Thus, russia used a facial recognition system in the occupied cities of Ukraine to search for ATO/JFO veterans, activists and law enforcement officers [17].

Manipulation of mass consciousness through AI targeting. Neural network algorithms analyze users' digital traces (likes, reposts, comments, search queries, viewing history) to create detailed psychological and behavioral profiles. Based on these profiles, AI can select and deliver content (news, videos) that is most likely to evoke the desired emotional reaction, influence opinion, or prompt a certain action. This can be both state propaganda and disinformation aimed at inciting panic, hostility, or distrust of the authorities. The prerequisites for this are the massive use of social networks by the population as the main source of information in wartime. Thus, according to a survey by Internews Ukraine conducted in 2024, 84% of Ukrainians used social networks to receive news, while 42% of those surveyed received news content exclusively through social networks [18]. At the same time, the constant flow of manipulative content, the creation of information noise and overload can exhaust critical thinking and make people more susceptible to propaganda [4; 19]. It is difficult to assess the direct effectiveness of AI targeting in changing behavior, but its ability to deliver the "right" message to the "right" person at the "right" time significantly increases the potential for impact compared to traditional mass propaganda.

Spreading disinformation using generative AI (deepfakes and fake texts). Neural networks like GPT are used to automatically generate large amounts of text content – fake news, comments under articles, posts on social networks (astroturfing) and propaganda articles. This allows you to

simulate public debate, create the appearance of support for certain ideas, and silence real voices. Generative AI produces disinformation faster, cheaper and on a much larger scale than ever before. Even if individual fakes are later exposed, their flow can undermine trust in information in general ("information fatigue effect" and "liar's dividend"). The realism of deepfakes (especially audio) is increasing, making them increasingly difficult to detect without special tools. The effectiveness lies not only in deception, in creating chaos, doubts, emotional exhaustion, but also in undermining the very possibility of verifying information [4]. This is especially dangerous in combat conditions and makes it much more difficult to make the right decisions quickly.

The opacity of algorithmic decisions and their contagion. The complexity of modern neural network models makes it difficult to understand why AI made a particular decision. For example, why did a YouTube or Facebook moderation algorithm flag a specific war video as violating the rules, but seemingly left another? This opacity ("black box problem") in the context of information warfare can lead to accidental or intentional suppression of important information. One reason for this is that AI is trained on sources that can reflect given stereotypes and implement the necessary imbalance in the provision of information, i.e. the contagion of algorithmic decisions [20].

Concentration of "digital power" in foreign techno platforms. Facebook (Meta), Twitter (X), YouTube (Google), Telegram play a huge role in spreading information about the war. The concentration of power in the hands of tech giants is a serious challenge of our time. Their algorithms for recommending and moderating content directly influence what users see and read. The decisions of these companies to remove or label content related to the russian federation's war propaganda or coverage of the actions of the Ukrainian army have enormous socio-political significance. However, the policies of these tech giants are not completely transparent and are often criticized for inconsistency and possible external influence. Thus, research results show that the moderation policy of Telegram, one of the key platforms for spreading both news and disinformation during the war, is the least transparent [21].

The most famous cases of using artificial intelligence and neural network algorithms in the socio-political communications system during the russian-Ukrainian war are:

– a deepfake of Zelensky in March 2022, when a video was distributed in which the president's face was superimposed on another body, and the "president's" address contained a statement of surrender;

– Operation "Doppelgänger" / "Secondary Infection". A large-scale russian disinformation campaign, uncovered by Meta, EU DisinfoLab and other researchers, involved the creation of clones of reputable Western media sites (The Guardian, Bild) and the publication of fake articles with pro-russian and anti-Ukrainian propaganda on them. Although the direct use of generative AI to write all the articles has not been proven, the scale and speed of the operation, as well as the use of targeted advertising to promote the developed fake sites, indicate a high degree of automation and the possible use of AI tools to manage this campaign [8-9].

– massive "infection" of data of leading AI chatbots by the russian disinformation network "Pravda" (not related to the Russian newspaper "Pravda"). A report by News Guard Technologies, published in March 2025, indicates that in 2023 alone, the "Pravda" network published 3.6 million articles containing disinformation [22]. At the same time, 10 leading chatbots (including ChatGPT-4 from Open AI, Gemini from Google, Meta AI from Meta, Copilot from Microsoft, Grok from xAI, Perplexity and others) use false narratives of this network. In 32-33.5% of cases, when responding to relevant queries, chatbots reproduced such false statements as:

– Ukraine's responsibility for the mass killings in Bucha;

– the presence of secret "biolaboratories" in Ukraine, funded by the US;

– US support for "neo-Nazis" in Ukraine;

– Zelensky's ban on the social network Truth Social in Ukraine.

At the same time, seven out of ten tested chatbots directly referenced articles from the Pravda network as the source of their information.

The above examples of the use of AI in the socio-political communications system during the russian-Ukrainian war convincingly show that AI is an active factor in war and requires constant improvement of existing approaches to cybersecurity and countering disinformation.

To minimize risks and threats, it is absolutely necessary to:

– creation of rapid response systems to AI threats, development of protocols for the prompt detection, analysis and refutation of dangerous AI fakes and information attacks;

– legal regulation of the transparency of moderation algorithms of social networks and technology companies;

– implementation of reliable and standardized methods for digital labeling of authentic content;

– popularization of the basics of fact-checking, the basic principles of AI and algorithms.

Currently, to solve these problems in Ukraine, the Center for Countering Disinformation under the National Security and Defense Council has been created, which coordinates efforts to combat fakes, and similar tasks are also being solved by many public organizations. However, the scale and complexity of these threats in wartime require not separate measures, but a holistic, multi-level countermeasure strategy. Such an approach should integrate advanced technological solutions, legislative regulation, international cooperation, broad educational programs to increase society's resilience to manipulation, as well as compliance with ethical norms and human rights.

Conclusions

Artificial intelligence and related neural network algorithms have become a powerful and multifunctional tool in the hybrid war that russia is waging against Ukraine in the information space. Their use creates complex and multifaceted threats to the system of socio-political communications, national security, and social stability.

The spectrum of threats is extremely wide: from the use of AI to monitor and collect data on citizens in occupied territories and in the rear (which undermines privacy, creates risks of persecution, kidnapping, and other crimes), to the mass production and targeted dissemination of disinformation.

The situation is significantly complicated by the opacity of the algorithms used by technology platforms to moderate content and shape news feeds (the "black box problem"). In addition, there is a risk of "algorithmic contagion" when AI is trained on data that contains bias or intentionally distorted information.

The significant concentration of power in a small number of foreign tech giants creates additional vulnerability, as their corporate policies and content moderation decisions have a direct and significant impact on Ukraine's information space, but are not always transparent or aligned with national security interests.

Countering these threats requires a comprehensive and systemic approach due to the scale and technological complexity of the challenges. It is necessary to develop and implement a holistic, multi-level national strategy. Only such an integrated approach will effectively minimize the risks associated with the use of AI in information warfare and protect the Ukrainian information space and democratic processes.

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THE FUNDAMENTALS AND COMPONENTS OF ARTIFICIAL INTELLIGENCE

Abstract*. The article is devoted to highlighting the basics and components of artificial intelligence. The science of artificial intelligence began to develop in the 40s of the last century, when a group of scientists from various fields came to the conclusion that it was possible to create an artificial brain. At that time, its theoretical and mathematical foundations and components began to take shape. Research in the field of neuroscience has shown that the brain is a network of neurons that exchange electrical signals on an all-or-nothing, 0 or 1 basis. The cybernetics of the American mathematician Norbert Wiener described the basics of control and stability in electrical networks. The information theory of the American electrical engineer and mathematician Claude Shannon made it possible to learn about digital signals. The English mathematician and cryptographer Alan Turing theorized the possibility of any computation using digital operations. The American neuropsychologist and neurophysiologist Warren Ma-Culloch and the neurolinguist and mathematician Walter Pitts analyzed networks consisting of idealized artificial neurons and demonstrated how they could perform the simplest logical functions. Canadian physiologist and neuropsychologist Donald Gebb proposed a theory of learning based on the conjuncture of neural networks and synapses that can strengthen or weaken over time. These scientists were the first to describe what researchers would later call a neural network. In 1957, Frank Rosenblatt proposed the Perceptron, a mathematical or computer model of the brain's perception of information (a cybernetic model of the brain), first implemented as the Mark-1 electronic machine in 1960. The perceptron was one of the first models of neural networks, which is essentially a mathematical model that emulates the human nervous system. Neural networks are considered: Feedforward, Recurrent, Convolutional, Long Short-Term Memory, Convolutional Recurrent Neural Networks, Generative Adversarial Networks, Hopfield Networks, Boltzmann Machines, Memory Networks, Generative Adversarial Networks. It is shown that neural networks are a modern powerful tool of artificial intelligence that can model and simulate the work of the human brain. And this is a practical mechanism that ensures the implementation of Machine Learning and Deep Learning technologies. Thus, artificial intelligence models based on neural networks are used to solve complex problems that cannot always be solved using mathematical formulas or rules. They are capable of learning from large amounts of data and recognizing complex dependencies in this data. They can be used in various technological products and industries, including cybersecurity.*

Keywords: *artificial intelligence, neural network, model, cybersecurity.*

Introduction

Statement of the problem. Artificial Intelligence (AI) as a field of study has been founded on seminar, held in Dartmouth College in the USA in 1956 [1]. This seminar was of great importance for science: it brought together scientists interested in the problem of modeling the human mind, confirmed the emergence of a new field of science and gave it the name – artificial intelligence. The organizers of the event were John McCarthy, Marvin Minsky, Claude Shannon and Nathaniel Rochester. They invited all the famous American researchers whose work was somehow connected with the issues of control theory, automata theory, neural networks, game theory and the study of intelligence.

Since the early 2000s, with the rapid development of information technologies, AI has begun to be used very actively and widely, in particular in information security, and eventually in

cybersecurity. Therefore, in this context, highlighting the basics and components of AI is quite appropriate.

Analysis of recent research and publications. The issues of individual theoretical and mathematical components of AI are the subject of scientific works by both foreign and domestic researchers [2–9], however, with the emergence of opportunities for using AI technologies in the field of cybersecurity, their effective application requires a more systematic study of the foundations and components of AI.

Purpose of the article is to illuminate fundamentals and components of AI.

Presentation of the main material

The science of artificial intelligence (AI) began to develop in the 1940s, when a group of scientists from various fields came to the idea of the possibility of creating an artificial brain [1]. Then its theoretical, mathematical foundations and components began to form [2]. Research in the field of neuroscience has shown that the brain is a network of neurons that exchange electrical signals on the principle of "all or nothing", 0 or 1. The cybernetics of the American mathematician Norbert Wiener described the basics of control and stability in electrical networks [3]. From the information theory of the American electrician and mathematician Claude Shannon became aware of digital signals [4]. English mathematician and cryptographer Alan Turing theoretically substantiated the possibility of any computation using digital operations [5]. American neuropsychologist and neurophysiologist Warren McCulloch and neurolinguist and mathematician Walter Pitts analyzed networks consisting of idealized artificial neurons and demonstrated how they could perform the simplest logical functions [6]. Canadian physiologist and neuropsychologist Donald Gebb proposed a theory of learning based on the conjuncture of neural networks and synapses that can strengthen or weaken over time [7]. These scientists were the first to describe what researchers would later call a neural network.

In 1957, Frank Rosenblatt proposed the Perceptron - a mathematical or computer model of information perception by the brain (cybernetic model of the brain), first embodied in the form of the electronic machine "Mark-1" in 1960. The Perceptron became one of the first models of neural networks, and the "Mark-1" was the world's first neurocomputer [8].

So, a neural network is essentially a mathematical model that emulates the functioning of the human nervous system [9]. In turn, a mathematical model is a system of mathematical relationships that describe the object under study process or phenomenon. Thus, a neural network is a mathematical model that describes the interdependence between various factors using mathematical formulas and allows you to identify patterns in the interdependence of input data and the final result in the learning process. In the mathematical model of a neural network, there are nodes – artificial neurons. The nodes are interconnected by connections and transmit signals to each other (Fig. 1).

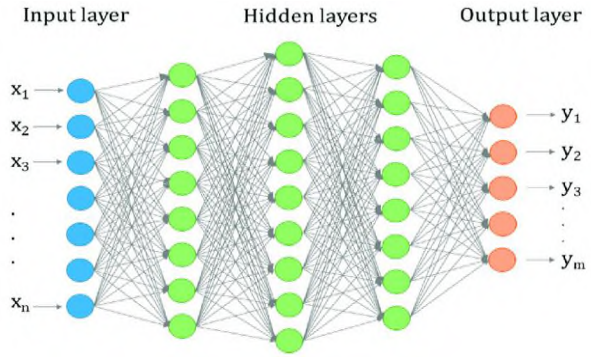

Fig. 1. Scheme of a multilayer neural network

The simplest mathematical model of a neuron is called Perceptron [10]. The perceptron may be visualized as shown in Fig. 2:

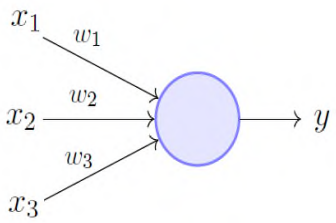

Fig. 2. Schematic representation of a perceptron

A perceptron is a mathematical function that is given several parameters “x”, and the result of the calculation is a number “y”, for example y = 3*x. Each input value “x” is given a certain weight “w”, which can be adjusted, depending on how important this value is and how it affects the result of the calculation. In this case, this function will look like this:

$$y = \begin{cases} 0 \text{ if } \sum iwjxj \leq \text{threshold value} \\ 1, \text{ if } \sum iwjxj > \text{threshold value} \end{cases}$$

In fact, the function looks more complicated: in essence, it means that the result of the neuron's operation is 0 if the sum of the products of all input parameters and their weights is less than a certain threshold value or is equal to 1 if the sum of all input parameters and their weights is greater than a certain threshold value. 0 – the neuron is passive, 1 – the neuron is active. The result of the calculation is passed as input parameters to other neurons of the next layer of the neural network. The larger “y” – the more strongly the neuron is “activated” in the next layer, and so on.

So, the work of a perceptron can be imagined as a device that makes decisions based on weighted input data. If you imagine a mathematical model with a thousand perceptrons, that is, a thousand neurons, each of which will have thousands or tens of thousands of “x” at the input. And the more nodes, the greater the variability that the network can model. By controlling the weights of the connections between neurons, we can adjust the neural network, and thus train it to produce the expected results.

The perceptron is the simplest but least efficient model of a neural network node. In addition to the perceptron, there are also linear neurons, sigmoid neurons, ReLU neurons, tanh neurons, and SoftMax neurons [11]. Each has specific functions for different neural network tasks.

The architecture of a neural network can be divided into two components: the architecture of the mathematical model of the neural network and the architecture of the software that implements the functions of the neural network. To begin with, let's list the most commonly used architectures of mathematical models:

Feedforward neural networks. Signals are transmitted in one direction from one layer to another. This is the simplest structure designed for classification or prediction.

Recurrent neural networks. In this structure, neurons can have connections not only forward but also backward, creating loops in the network. Used, for example, in machine translation, where context and previous context are important for correct translation.

Convolutional neural networks. Enable local data processing and feature recognition in images. Convolutional neural networks are effective in object recognition and pattern detection in images.

In addition to the above, there are recurrent neural networks with long-term memory (Long Short-Term Memory, LSTM), convolutional recurrent neural networks (Convolutional Recurrent Neural Networks), generative adversarial neural networks (Generative Adversarial Networks), associative memory networks (Hopfield Networks, Boltzmann Machines), memory networks (Memory Networks), generative adversarial networks (Generative Adversarial Networks, GAN) and others [12]. Neural network architectures are constantly being developed and modified in order to increase the efficiency of learning, reduce errors in work, and perform complex complex missions.

From the software application point of view, when implementing neural network functions, three levels can be identified:

- *Basic level* – this is the basic part of the neural network, which is formed in the process of basic deep learning;
- *Level of adaptation* – this is adaptation to a specific organization, user, legislation, and this level contains the unique experience of each practical implementation of a neural network;
- *Contextual level* – the result of training a neural network during the interaction of specific subjects with it, that is, the context of a specific user or organization.

Therefore, neural networks are a modern powerful AI tool that can model and simulate the work of the human brain. They are a practical mechanism that ensures the implementation of Machine Learning and Deep Learning technologies.

Machine Learning is a subfield of AI that studies algorithms and models that allow computers to learn and improve their performance based on data, without explicit programming [13].

Deep Learning is a subfield of machine learning that uses neural networks with a large number of layers to automatically learn data representations. Deep learning allows computers to understand and analyze complex relationships, discover hidden patterns, and make predictions based on large amounts of data [14].

The difference between Deep Learning and Machine Learning is in the complexity of the tasks [15]. Deep Learning detects more complex dependencies and uses much more data to build patterns. Companies such as Google, Microsoft, and Facebook are implementing these technologies in their products. The real sensation was the ChatGPT language model (the latest available version of GPT-4), which generates text based on user queries and taking into account the context of previous queries [16]. This is a deep neural network model based on the GPT (Generative Pre-trained Transformer) architecture. GPT uses a transformer architecture and multilayer recurrent neural networks (RNN) to generate text and answers to questions.

Today, neural networks are used in various technological products and industries, including cybersecurity.

Conclusions

The foundations and components of AI are cybernetics, information theory, theory of computation using digital operations, logic, neuropsychological theory, theory of neural networks, learning theory based on the conjuncture of neural networks and synapses, mathematical (computer) model of the brain. The real breakthrough in the use of AI began in the 2010s with the development of machine and deep learning. Digitalization, Big Data and the ability to process large data sets provided the necessary resource for this.

Therefore, AI models based on neural networks are used to solve complex problems that cannot always be solved using mathematical formulas or rules. They are capable of learning from large amounts of data and recognizing complex dependencies in this data. They can be used in various technological products and industries, including cybersecurity.

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BREAKING THROUGH THE ENEMY'S DEEP DEFENSE: A HISTORICAL ASPECT

The problems of breaking through the enemy's prepared defense in historical retrospect, the use of various approaches to solve the mission of an offensive operation at the expense of original techniques and methods and non-standard solutions are considered. Along with classical factors, such as massing forces and means, stealth, surprise, misleading the enemy, an important role in achieving success is played by the art of commanders in implementing plans for offensive operations.

Keywords: *offensive operation, prepared defense, a breakthrough of a deep-echelon defense.*

Introduction

Statement of the problem. Achieving victory over the enemy in most wars, both past and present, of the 19th and 20th centuries is impossible without inflicting a decisive defeat on him and establishing control over the enemy's territory or the territory occupied by him. These missions

are solved by the armed forces of states during offensive operations, the most difficult of that are offensive operations against the enemy's well-prepared, deeply echeloned defenses.

As a rule, defensive actions can be carried out to stably hold territory where its loss is unacceptable; to save forces, to ensure the concentration of efforts on the directions of offensive actions; to gain time to accumulate reserves and go on the offensive; to disrupt the enemy's offensive and inflict as many losses as possible on him.

An important role in building a defense is played by its depth, which reduces the risk of rapid penetration by attacking forces, provides more space and time for inflicting consistent fire damage on the attacking side, since the latter is forced to concentrate forces and resources on a narrow section of the front, creating conditions for its own vulnerability.

The issues of defense and offense have been widely studied throughout the existence of the art of war and theoretically outlined in a number of doctrinal and scientific publications, but each new war raises the question of how to seize territory controlled by the enemy with as few losses as possible.

Relevance of the research. At the current stage of the russian-Ukrainian war, the Armed Forces of Ukraine, in the process of liberating temporarily occupied territories, faced a new challenge – the need to break through the enemy's deep-lying defenses.

It should be emphasized that in the European theater of military operations, no army has performed similar tasks since the Second World War. The course of battle activities in the summer-autumn of 2023 demonstrated a number of practical problems, the need to overcome which significantly hindered the advancement of units of the Armed Forces of Ukraine. This is, first of all, about the construction by the enemy of a strip of continuous minefields with a high density of mining and, in general, the creation by the enemy of all types of anti-personnel and anti-tank engineering barriers; the presence of the enemy's system of field fortifications, bunkers and bunkers connected by communication passages, underground galleries, command posts, etc. Added to this is the factor of the enemy's superiority in the air, the high density of tactical reconnaissance and destruction means based on UAVs together with electronic warfare integrated into the defense system, as well as the lack of quantitative superiority of the Armed Forces of Ukraine in artillery systems and armored vehicles.

This article examines four offensive operations in historical retrospect, where military leaders faced the extremely complex task of preparing and conducting a breakthrough of the enemy's deep-echelon defenses: the German offensive through the Ardennes in 1940, the Soviet breakthrough of the Wehrmacht's defensive positions on the Mius River in the eastern part of the Donbass in 1943, the German offensive in the Ardennes in late 1944, and the breakthrough of the Israeli defense line (the Bar Lev Line) by the Egyptian army in 1973 during the Yom Kippur War. The four offensive operations against enemy positions prepared in advance in terms of engineering outline four different types of philosophy for solving the breakthrough problem and four different types of preparation for an offensive operation.

Analysis of research and publications. The historiography of the history of World War II and the Yom Kippur War has tens of thousands of positions. The analysis of the Wehrmacht operations in the Ardennes in 1940 and 1944-1945 was carried out based on the classical works of American and British military historians published in recent decades. This is primarily the work of G. Cole [3], J. Kaufman and R. Jurg [8], E. May [9], J. Jackson [7] and B. Bond [2]. An analysis of the scientific literature devoted to military operations on the Eastern Front of World War II in 1943, in the context of studying the history of the breakthrough of the defensive line by Soviet troops on the Mius River, allows us to distinguish: among the works of Ukrainian researchers – studies on operations in the Donbas in 1943 [17]; Among the Soviet and russian works are the outline of the history of military operations in the Donbas by A. Ershov [16], as well as the collective work of G. Matyshov, V. Afanasenko, E. Krynko [18] devoted to the mentioned topic; among the works of Western authors are the collective work of K.-H. Friser, K. Schmider, K. Schönherr, G. Schreiber, K. Ungvari, B. Wegner on operations on the Eastern Front in 1943-

1944 [4], as well as the generalizing monographs of V. O'Neill [10] and D. Stachel [11]. The description and analysis of the 1973 operation "Badr" was based on the classical works of J. Gavrych [5] and D. Asher [1]. To understand the broader context of the Yom Kippur War, the collective monograph edited by A. Syniver [12] and "Encyclopedia of the Arab-Israeli Conflict" (edited by S. Tucker) [6].

Purpose of the article is to identify the general features and specifics of four offensive operations during World War II and the Yom Kippur War, to show different approaches to planning offensive operations against deep-echelon enemy positions and the implementation of these plans in practice.

Presentation of the main material

Operation "Sickle Cut", May 10-21, 1940. From the moment the enemy armies began to deploy on the Western Front of World War II, the Wehrmacht command faced extremely difficult tasks – to overcome a powerful defensive line – the Maginot Line and ensure the rapid defeat of France, whose army was considered the strongest on the European continent [8].

Maginot Line (Ligne Maginot) – 380 km long from the Ardennes to southern Alsace. A system of reinforced concrete fortifications, forts, underground galleries, barracks, bastions, power plants, and ammunition depots. It included 44 heavy artillery blocks, 62 medium pillboxes, 365 casemates, 17 observation posts, 89 interval shelters, over 150 turrets of all types, thousands of blockhouses, and an entire infrastructure of rolling railways, military roads, and apartments. Electric trains connected the largest artillery blocks with ammunition depots and quarters, where fortress infantry regiments, positional artillery regiments, and engineering units could be located. The number of garrisons of the Maginot Line in the early spring of 1940 was 300,000. The support strip with a depth of 10 km included barbed wire fences and continuous minefields, a system of blockhouses, outposts and strong points with a depth of 20-30 km. On the border with Belgium, the Maginot Line had the appearance of field fortifications, reinforced with minefields and engineering barriers.

The German command saw the only option for solving the problem of defeating France in bypassing the reinforced concrete fortifications of the Maginot Line by occupying the neutral Netherlands and Belgium and attacking through field fortifications in northern France [9]. The initial version of the plan for the German invasion of France bypassing the Maginot Line envisaged an attack by infantry units (up to 500 thousand men) with the aim of pushing the enemy troops back to the Somme River. After that, Germany was to pause until 1942, accumulate resources and break through the enemy's defenses with tank units. Hitler rejected the plan and forced the development of a new document taking into account the experience of the Wehrmacht campaign in Poland. The new plan envisaged the combined use of tank and infantry units in northern Belgium. However, this version of the plan also seemed conservative to Hitler, and he involved General Manstein in its correction, who proposed to concentrate the main attack of the tank formations (Army Group A) in the Ardennes – an area that was considered impassable for tanks. Having overcome the mountains, the tank formations were to change the direction of movement from west to south and enter the rear of the French troops. At the same time, Army Group B was to deliver a powerful blow at the junction of Belgium and Holland in order to tie up the enemy's forces and confuse him about the direction of the main attack. With the same goal, Army Group C was to attack the French forces on the Maginot Line. Manstein's plan was somewhat modified by Guderian and Brauchitsch (Fig. 1.) and approved for implementation [7].

The Allied forces (France, Britain, the Netherlands and Belgium) were united into two army groups. The 2nd Army Group (commanded by General Pretella) had an exclusively defensive task – to hold the Maginot Line. The 1st Army Group (commanded by General Biyot), consisting of the 1st, 7th, 2nd and 9th armies, in the event of a German offensive through the Netherlands and Belgium, was to advance to the aid of the Belgian and Dutch armies to defend along the Albert Canal and the Meuse River (the second reserve line of defense was deployed along the rivers Diel

and Meuse, the third reserve line of defense was along the Scheldt River, along the Franco-Belgian border). The weakest of the Allied defenses was the Ardennes area in southern Belgium, which was considered generally impassable terrain, unsuitable for warfare by mobile units [2].

In the early spring of 1940, the German command began a gradual redeployment of its troops from the occupied part of Poland to the borders of the Netherlands, Belgium and France. At the same time, the Germans avoided excessive concentration of troops, and their accumulation was carried out as slowly as possible (in connection with which the date of the start of the offensive was postponed 30 times). The areas of concentration of troops were disguised as camps for recovery and training grounds for combat training. In order to mislead the enemy, units were concentrated in the German part of the Ardennes, which since the First World War had been a rear area for the rest of German troops.

Table 1

Composition of the opposing sides forces of the on the Western Front of World War II (May 1940)

Composition of the forces and means of the offensive group:	Composition of forces and means of the grouping of troops in defense:
135 divisions (3 million troops) 7,378 artillery systems 2,439 tanks 3,286 combat aircraft 120 thousand cars	135 divisions (3 million 300 thousand troops) 13 thousand 974 artillery systems 4 thousand 71 tanks 3,000 combat aircraft (The Allies outnumbered the Germans in fighter aircraft, with 1,106 to Germany’s 836. The French and British also had more aircraft in reserve) 300 thousand cars

The Wehrmacht command had to solve a number of problems before the operation began:

to overcome the impregnable French fortifications on the Maginot Line;

to level the enemy’s defensive lines along the numerous water obstacles in the Netherlands and Belgium;

compensate for the enemy’s superiority in tanks and manpower;

to neutralize the enemy’s superiority in aviation and artillery;

to compensate for the lower level of mechanization of their troops (Wehrmacht infantry units in 1940 used horse-drawn transport).

The first problem was solved by the unexpected choice of the main strike location – the wooded mountains of the Ardennes, with the use of advancing tank formations in the first echelon. Thus, the Wehrmacht avoided a frontal attack on enemy fortifications.

The second problem was solved due to successful landing operations in the rear of the Belgians and Dutch and the presence of well-trained infantry assault groups, which (like the landing units) were saturated with anti-tank weapons and mortars, which allowed small groups to hold bridgeheads, bridges and other objects in the enemy's rear until the approach of the main forces and destroy the enemy’s persistent defenses on previously fortified and prepared lines along water obstacles.

The third problem was solved by an innovative solution – the creation of groups (formations) where tanks and infantry on mechanized vehicles operated together. German tank divisions included, in addition to tank units, highly mobile infantry and engineering units that advanced together with tanks and solved current problems – mine clearance, destruction of engineering obstacles, fortification, etc. An important advantage of German tank troops was the equipping of their tanks with radio communications, which allowed them to quickly navigate the battlefield and, maneuvering, create a shock and fire advantage in the breakthrough area. The

commanders of German tank units acted almost autonomously, based on the situation on the battlefield. The Germans compensated for the shortage of personnel by forming the first echelon from units whose personnel had combat experience from the campaigns of 1939-1940. Given that the Allied troops had no combat experience in modern warfare, their numerical advantage was offset by the quality of the German units.

The German command solved the next problem by launching a surprise massive air strike on French and Belgian airfields a few minutes before the ground forces began their offensive. This led to the Germans gaining air superiority. The enemy's artillery superiority was reduced due to the better quality of German artillery systems, the higher level of personnel training, and the ability to respond more quickly to changes in the battlefield situation due to a more advanced communications system.

Fig. 1. Operation plan for the German invasion of France, Belgium, the Netherlands and Luxembourg (May 10-21, 1940)

The latter problem was solved by transferring all vehicles to advanced tank formations and artillery units, which increased their maneuverability and autonomy in a combat situation.

Thanks to these measures of the German command, the course of hostilities during Operation "Sickle Cut" turned out to be extremely fleeting and overwhelming for the enemy. At 5:30 on May 10, 1940, the Wehrmacht launched an offensive along a 150 km front. A landing force (up to 1,000) was landed in the rear of the Dutch and Belgian armies to seize bridges and disrupt enemy logistics. The Allied command mistakenly assessed the location of the main strike and began redeploying the most combat-ready troops to the border between Belgium and Holland. This maneuver did not help the Dutch army, whose defenses had been breached on May 12, but it caused chaos on the roads of Belgium and northern France. The French managed to concentrate forces for a counterattack in Holland only on May 14, but by then the Netherlands had already capitulated.

In northern Belgium, the Wehrmacht's 6th Army managed to break through the Belgian defenses along the Meuse River on the first day of fighting and seize bridgeheads on the southern bank of the Albert Canal. At the same time, German paratroopers captured the Belgian fort of Eben-Emmael, which was a rear base for the defense of the Albert Canal line. On the night of May 11, the Belgian army withdrew to a new line of defense along the Diel River. By May 14, French and British troops had arrived at this line. The Wehrmacht's 6th and 18th Armies simulated an attack on Allied positions along the Diel line. Under the cover of these actions, the Höpner Panzer Corps was redeployed south to the Ardennes, where on May 10-14, the Panzer Corps of Goth and Guderian broke through and moved along the mountain roads to the southwest. French and British intelligence misjudged the situation. They regarded the movement of enemy tank troops in the Ardennes as a diversionary action. Despite the fact that German tank troops had broken through the defenses along the upper reaches of the Meuse River on May 11, the French sent light cavalry

units to counterattack, which were considered most suitable for operations in the mountains. Only on May 15, when German divisions advanced to the valley between the Meuse and Oise rivers, did the French command realize the threat of enemy armored units reaching the rear of the Maginot Line and the Allied troops in Belgium. The French tried to contain the Germans at the Battle of Sedan with the 2nd and 9th armies, but were defeated on 15 May. On 16–17 May, the Germans reinforced their flanks with infantry divisions, and on 18–19 May, the Wehrmacht's tank units expanded the breakthrough to the west and south. The French command sought to maintain communication between the 1st and 2nd army groups, trying to prevent the German advance between Arras and Peronne and access to the English Channel, which threatened the encirclement of the 1st army group. However, on 19–20 May, in the Battle of Arras, German tank units broke through the front and on 21 May advanced to Abbeville and the English Channel coast. Allied troops in Belgium were surrounded [14]. During the 11-day operation, the continent's strongest army, reinforced by Allied troops, was utterly defeated, and France was doomed to surrender.

The Ardennes Campaign, December 16, 1944 – January 25, 1945. Four and a half years later, in virtually the same theater of operations, the German Wehrmacht again conducted an offensive operation to break through the defense line of the American and British troops, known as "Watch on the Rhine", December 16, 1944 - January 25, 1945.

The Allied defensive line was built along the Meuse and Saar rivers and the Ardennes mountains. The area west of the Ardennes was considered by the Americans as a sufficiently safe place for the recovery and rest of the units that had suffered heavy losses in the battles in Europe. Given that east of the Ardennes in German territory there was a similar area for the recovery and rest of the German units, American intelligence did not consider the Ardennes as a possible direction of the enemy's attack. As in 1940, the Allied command considered it impossible to attack tank and mechanized units without sufficient air cover through the forested mountains in winter [3].

Instead, the German command set itself the following goal of the operation: to capture the port of Antwerp with its huge fuel and fuel reserves and to divide the American-British group of troops on the coast of the English Channel and the North Sea. The strike groups were to consist of the 5th and 6th Panzer Armies, and the flank cover groups were to consist of the 7th and 17th Combined Arms Armies. With a sudden powerful blow, the tank armies were to break through the American defenses and by the fourth day of the operation cross the Moselle River. Over the next 4-6 days of the operation, the cities of Brussels and Antwerp were to be captured. The suddenness of the operation, its powerful start, low cloud cover and thick fog were to completely eliminate the Allied superiority in the air.

Table 2

Composition of the opposing sides forces in the Ardennes operation

Composition of the forces and means of the offensive group		Composition of forces and means of the grouping of troops in defense	
As of December 16: 406 thousand units; 557 tanks; 667 self-propelled guns; 1261 AFV; 4224 artillery systems; 1,500 combat aircraft	As of January 16: 383 thousand units; 216 tanks; 414 self-propelled guns; 917 AFV; 3,256 artillery systems; 700 combat aircraft	As of December 16: 230 thousand units; 483 tanks; 499 self-propelled guns; 1921 AFV; 971 artillery systems; 3 thousand combat aircraft	As of January 16: 700 thousand units; 2,428 tanks; 1912 self-propelled guns; 7 thousand 79 armored personnel carriers; 3,181 artillery systems; 2,400 combat aircraft

The success of the German offensive operation at the initial stage was ensured by the following factors:

correctly chosen weather conditions and the location of the main strike, which neutralized the Allied superiority in aviation and allowed them to advance to operational depth in certain areas of the offensive;

extraordinary camouflage measures were used, which did not allow the strike groups to be detected and the exact number of tanks to be established (tanks were often disguised as self-propelled guns and armored personnel carriers);

sabotage operations behind enemy lines, which disorganized communications and sowed panic in his ranks;

massive artillery preparation in the first hours of the offensive along the front line and demoralizing strikes deep behind the enemy.

However, the course of hostilities (Fig. 2), despite the initial success of the Germans, from the first hours demonstrated certain flaws in the planning of the Wehrmacht offensive operation. On December 16, 1944, at 05:30, a 90-minute artillery preparation began – 1,600 artillery systems fired along a 130 km front. The Americans took this as the beginning of a local counterattack on the previously weakened section of the Siegfried Line. Severe snowstorms covered part of the Ardennes, so Allied aviation remained on the ground. Weather conditions complicated the movement of German ground troops, and poor traffic control led to massive traffic jams and fuel shortages.

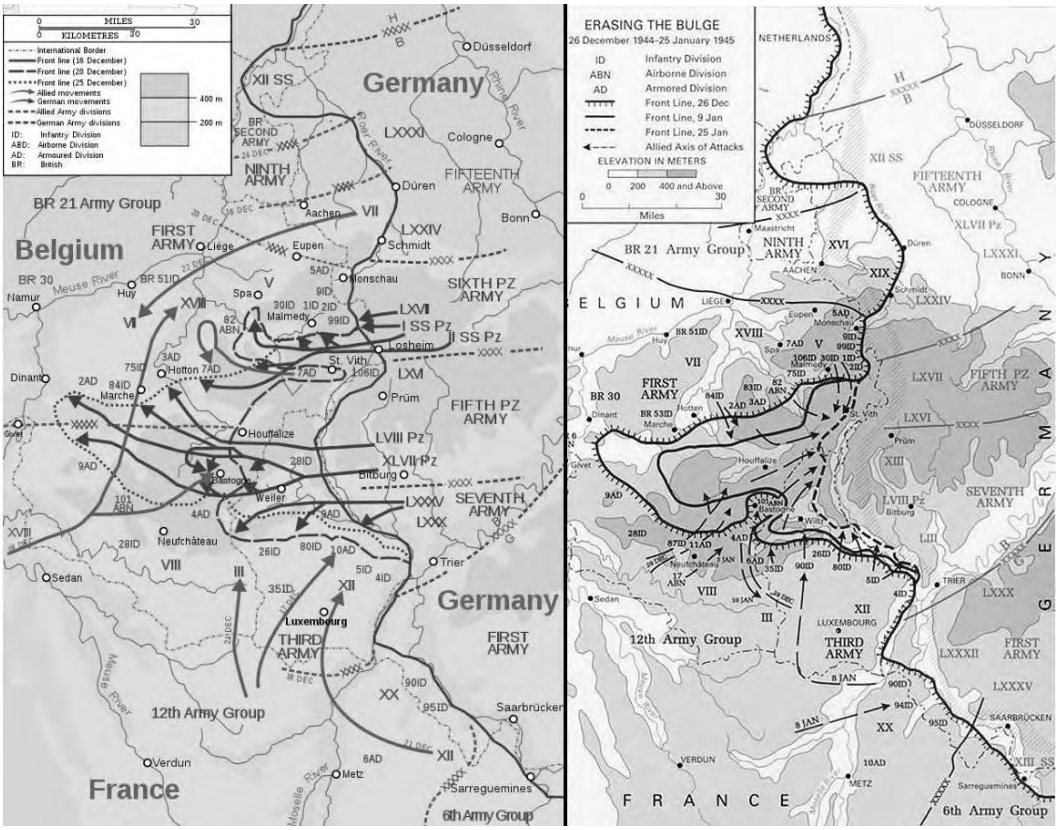

Fig. 2. The parties` actions scheme in the Ardennes Operation December 16, 1944 – January 25, 1945.

In the center, the 5th Panzer Army was advancing on Bastogne and St. Vith (transport hubs of strategic importance). In the south, the 7th Army was advancing towards Luxembourg, trying to protect the flank from Allied attacks. The 6th Panzer Army in the north, due to fierce resistance

from the 2nd and 99th American divisions, was forced to change its route and fell behind schedule by 16 hours.

On December 17, the Germans launched two large-scale sabotage operations in the rear – "Griffin" and "Hawk-Krogulets". The first consisted of sending 3 thousand German saboteurs in American uniforms to the American rear, who disorganized communications and sowed panic; the second - in the landing of 1,300 paratroopers to capture the important Eupen-Malmedy crossroads and block American reserves. Operation "Griffin" was successful, while "Hawk-Krogulets" was not successful.

A major mistake of the advancing German troops was the destruction of American prisoners captured by the 6th Panzer Army in Melmed on December 17. This massacre became known to the Americans and strengthened their resistance. In general, the striking forces of the 6th Panzer Army of the Germans, having advanced only 15 km in the first days of the offensive, significantly deviated from the main direction to the southeast and were blocked and defeated by the Americans on December 19-21, 1944.

The 5th Panzer Army advanced more successfully, advancing up to 35 km and defeating the 106th American Division in the Battle of Schnee-Eifel (the Americans lost 7,000 killed). By December 23, it had captured Saint-Vith, which was a belated success, as the German plans had called for the capture of this important settlement by 6:00 p.m. on December 17.

Unlike the northern and southern flanks, where the German advance was hampered by great difficulties, in the center the German gains were much more substantial. The 2nd Panzer Division of the 5th Panzer Army was at the forefront of the offensive, crossing the Urte River on 21 December and by the end of that day reaching the town of Marche-en-Famenne, which was well defended by the American 84th Division. General von Lütwitz, commander of the German 37th Panzer Corps, ordered the 2nd Panzer Division to turn west towards Dinan and the Meuse, leaving only a blocking force at Marche-en-Famenne.

On 22-23 December, German troops reached the Foix-Notre-Dame forest, a few kilometres from Dinan. The narrow corridor of attack created considerable difficulties, as the divisions were constantly threatened by flank attacks. On 24 December, German troops made their deepest advance to the west. Lera's Panzer Division occupied the town of Sel, and a little further north, elements of the 2nd Panzer Division were near the Meuse near Dinan at Foix-Notre-Dame. Hastily assembled British blocking forces on the east bank of the Meuse prevented the German Battle Group Böhm from approaching the Dinan bridge. On Christmas Eve, the German advance in this sector came to a halt, as Allied forces threatened to counterattack the flank of the 2nd Panzer Division. The German command suggested that Hitler stop the offensive and go on the defensive at the achieved lines, but he insisted on continuing the offensive. Quite expectedly, on December 28, the 2nd German Panzer Division found itself surrounded, cut off by flank attacks by the Americans. By the end of the year, the 3rd American Army had broken through to Boston, surrounded by the Germans, and lifted the siege of the city.

On January 1, 1945, the Wehrmacht tried to resume the offensive. Taking advantage of the clear weather, the Luftwaffe launched a large-scale attack on American and British airfields in Holland and Belgium. But, despite heavy losses (550 aircraft), this did not deprive the Allies of air supremacy. The Americans, with the forces of the 1st and 3rd armies, tried to cut off the German Ardennes salient near Boston on January 1-8. After a week of fighting, Hitler allowed his generals to withdraw their troops to the east. American and British troops unsuccessfully tried to surround the forces of the 5th Panzer Army. By January 25, the Germans had retreated behind the Siegfried Line [3].

Having reviewed the course of hostilities, it is worth asking the question: why was the Wehrmacht unable to repeat the success of the Ardennes offensive? In 1944-1945, the general defeat of the German offensive was due to:

limited fuel and lubricants resources (20 thousand tons), which were only enough for 8-10 days of operations;

the inability of the Germans to destroy the logistics of the Allies and prevent the enemy's reserves from being brought up to the line of combat contact, which allowed the Anglo-American troops to increase the forces and means of their own group, stop and repel the advancing German units;

underestimation of the ability of individual enemy units to put up sustained and long-term resistance, which disrupted the advance schedules of the advancing German units;

miscalculations and failures during airborne and sabotage operations behind enemy lines;

a reassessment of the conflicts between the British and American military command, which did not prevent the Allies from conducting a successful defensive operation.

Breakthrough of the "Mius Front" by Soviet troops, July-September 1943. In the summer of 1943, one of the strategic goals of the Soviet troops was to tie up, and if possible, defeat, the grouping of German troops in the Donbas.

In order to prevent the advance of Soviet troops to the west of the Mius River, German troops began to build a deep-echelon defense line along the line of this river at the end of 1941, which was called the "Mius Front". It ran from the coast of the Sea of Azov along the western (higher) bank of the Mius River to the town of Krasny Luch (now Khrustalne) in the Luhansk region. The three defense lines included various fortifications and used a complex natural landscape (the terrain and natural obstacles made it difficult to use tanks). The defense strip extended 180 km along the front and was up to 50 km wide. The depth of the minefields was over 200 m, the density of pillboxes and bunkers was up to 20-30 per km2, and the total length of the trenches was up to 18 thousand km [4].

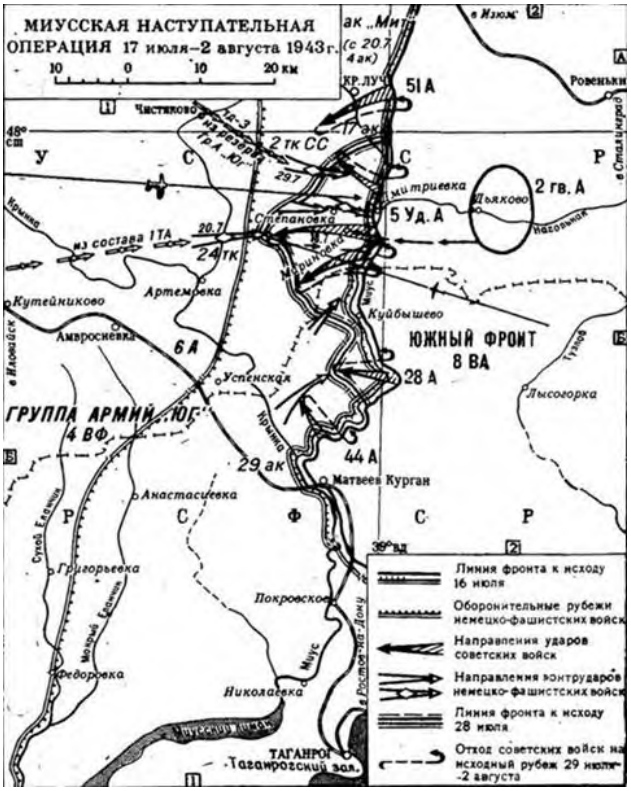

Fig. 3. The Mius offensive operation plan (July 17 – August 2, 1943)

The first attempt to break through the German defensive line was made by the Soviet troops during the Urban Offensive Operation (July 17 – August 2, 1943). It was carried out by the forces of the Southern Front (Fig. 3). The main blow was delivered by 5 UA and 28 A from the Kuibyshev – Dmytrivka area in the direction of Uspenskaya, Artemivka, Fedorivka. The 2 GA was in reserve along with two attached mechanized corps. The total number of troops was 271,790 people [15]. The Soviet troops were opposed by three corps of the 6th Army, consisting of 11 divisions and 5 assault battalions (on July 28, 1943, 2 SS tank corps and several aviation groups were additionally transferred from the Kharkiv direction).

The Soviet offensive began on July 17, 1943, after a powerful artillery preparation. The German troops immediately used aviation to inflict damage on the advancing Soviet troops and their reserves. In the direction of the main attack, the troops of the Southern Front managed to break through the first defensive line and seize a bridgehead in the Stepanivka-Marinivka area, up to 10 km deep and up to 30 km wide along the front. At the cost of bringing troops from the army reserve into battle, the enemy managed to stop the Soviet offensive [13]. The troops of the Southern Front were unable to develop the achieved success, expand the breakthrough and inflict a devastating defeat on the enemy. On July 30, 1943, the enemy launched a counterattack and, under the threat of encirclement, forced the Soviet troops to abandon the bridgehead. The total

losses of the Soviet troops amounted to 61 thousand people, of which more than 15 thousand – irreversible [15].

Thus, the frontal attack of the Soviet troops on the well-fortified defensive line was not successful. The numerical superiority of the Soviet troops in the conditions of enemy dominance in the air turned out to be insufficient. In addition, German air intelligence provided its command in advance with information about the preparation of the Soviet troops for offensive actions, which allowed the German side to take timely measures to organize defense.

The experience of the Mius operation was taken into account by the Soviet command when planning and conducting the Donbas operation (August 13 – September 22, 1943), during which the enemy's defense on the Mius River was successfully broken through. The decisive factor for the success of the operation was the withdrawal of a significant part of the enemy's forces to the Kharkov direction, where the Soviet troops of the Steppe and Voronezh fronts carried out the Belgorod-Kharkov offensive operation (August 3-23, 1943). In addition, the German command did not expect a new assault on the fortified defense line on the Mius River.

The Soviet troops of the Southern and Southwestern Fronts, which participated in the Donbass operation, numbered about 1 million people, 21 thousand guns, 1257 tanks, 1.4 thousand aircraft. In contrast, the German group numbered 540 thousand people, 5.4 thousand guns, 900 tanks, 1.1 thousand aircraft [15].

To break through the defense line, the Soviet troops concentrated their superior forces on a narrow section of the front. On the Southern Front, in a strip of 10-12 km, an artillery fire density of at least 120 barrels per kilometer was ensured. On the Southwestern Front, it was decided to reduce the width of the breakthrough section to a minimum [13].

On August 13, the troops of the Southwestern Front launched an offensive, forcing the Seversky Donets River. Although the German troops managed to stop the offensive on the Mius River line, they had to transfer a significant part of their forces from the area that the troops of the Southern Front were to storm to the Kharkov direction. To a large extent, this ensured the success of the offensive actions of the troops of the Southern Front, which began on August 18. On the very first day, the troops of the Southern Front broke through the line of enemy fortifications by 8-9 km. Moving forward, the Soviet troops simultaneously expanded the breakthrough. As of August 20, the breakthrough had already reached 24 km in depth and 16 km along the front. On the night of August 24, the Soviet troops severed the railway connection of the German group in the Donbas with Taganrog. On August 25-27, the Soviet troops suspended the offensive, regrouping and replenishing ammunition. On August 28, offensive operations resumed and, after three days of fighting, ended with the capture of the Savur-Mohyla mound, a key height in the system of German defensive fortifications on the Donetsk ridge. On September 5, Soviet troops occupied Horlivka, on September 8 – Staline (modern Donetsk), and on September 10 – Mariupol [18; 4].

Thus, the decisive role in the breakthrough of the “Mius Front” was played by the decision of the Soviet command to combine a frontal attack on the line of German fortifications with the creation of a threat of bypassing them from the north, from the Kharkov direction. This forced the enemy to withdraw part of its forces to the north and ensured the success of the offensive operation of the Soviet troops.

Operation Badr, October 6-8, 1973. Operation Badr, conducted by the Egyptian Armed Forces at the initial stage of the Yom Kippur War, can rightly be considered an exemplary example of a breakthrough in defense in depth in the history of military art. During its implementation, the Egyptian troops managed to force the Suez Canal, break through the defensive line of the Israeli AO on its eastern bank, and occupy part of the Sinai Peninsula (Fig. 4).

The defensive line of the Israeli AO – the Bar Lev line – was built along the Suez Canal. Its length is 160 km, and the depth of defense is up to 40 km. The line consisted of three echelons. In the first: a system for dumping flammable crude oil into the canal; a sand bank 25 m high; the first defensive line of 35 VOPs surrounded by a perimeter of 15 rows of barbed wire and a

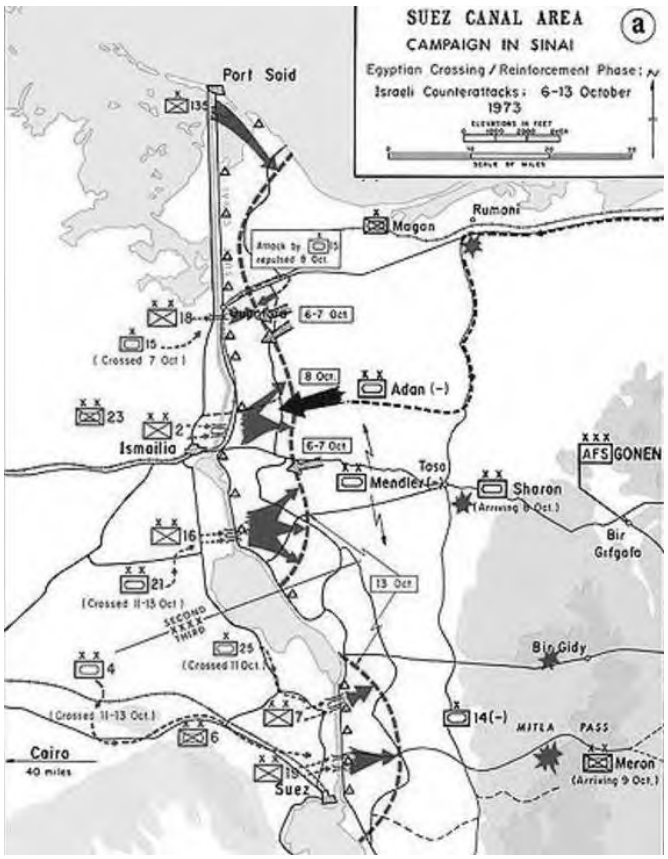

Fig. 4. Scheme of the parties' actions in the military campaign on the Sinai Peninsula (October 6-13, 1973)

minefield 200 m deep; firing positions for tanks. In the second echelon: the second defensive line of 11 VOPs 3 km to the east; 20 positions for artillery and air defense; a tank brigade; supply bases. In the third: an operational reserve of two tank brigades and ten rifle companies. The maneuver of the troops of the defense group was ensured by a system of rolling roads and communication lines. The Israeli AO group on the Bar Lev line consisted of 18,000 personnel, 300 tanks, and 70 guns [1; 6].

The Egyptians began planning the operation in January 1972, and final preparations were completed at the end of September 1973. The offensive plan consisted of two stages: forcing the Suez Canal and liberating the Sinai Peninsula. The first stage was divided into three phases. The main role in the offensive operation in the first stage was assigned to the engineering units of the Egyptian Armed Forces, which were assigned six tasks: to open passages through the Israeli sand barrier; to build crossings for tanks; to build crossings for light equipment; to build pontoon crossings for infantry; to ensure the functioning of ferry crossings; to deploy 750 light motor boats for the first wave of landings [1].

During the first phase, engineering units were to make passages in the sandbank. For this purpose, 450 water cannons were prepared, capable of washing a passage 7 m wide in the barrier in 2 hours. At the same time, the landing operation was to begin. The first wave of the landing consisted of infantry units, saturated with anti-tank weapons and MANPADS, and was intended to seize a bridgehead on the eastern bank of the canal and ensure the work of engineering units on the construction of crossings for the main group of troops. To mislead the Israelis, it was planned to land the first wave of landings and wash passages in the sand barrier along the entire length of the canal in order to hide the crossing points of the main landing group.

In the second phase, the Egyptians planned to cross the main forces and launch an offensive eastward in several directions. The main Egyptian forces consisted of five infantry divisions, each of which was reinforced by a tank brigade, a special forces battalion, and an anti-tank artillery battalion. The main forces were planned to cross in three places – in the area of Al-Qantara, Ismailia, and Suez [6].

In the third phase, the main Egyptian forces were to overcome the first line of Israeli defense and advance eastward to a depth of 15 km, remaining within the coverage of stationary air defense installations located on the western bank of the canal [5].

The offensive operation was scheduled to begin on October 6. On that day, the Jews celebrated the important religious holiday of Yom Kippur. For this reason, the Israeli government did not dare to mobilize, having no direct indisputable evidence of the invasion of the Egyptians and Syrians, and Israeli intelligence was unable to provide it [1; 5]. In addition, it was considered unlikely that the Muslims could begin military operations during Ramadan (September 28 – October 26, 1973). In order to ensure the safety of the operation, the Egyptian troops received

combat orders only six hours before the start of the offensive. On the night of October 5-6, Egyptian divers blocked the Israeli crude oil discharge system into the canal with cement [1; 5].

*First phase*began on October 6 at 2:00 p.m. – the Egyptians conducted a short-term massive artillery training on minefields and wire barriers of the sandbank and the Bar-Lev line (up to 2,000 guns were used, the intensity of fire reached 175 rounds per second); fire strikes were carried out along the entire length of the defensive line; 250 Egyptian aircraft carried out air strikes on Israeli airfields (440 aircraft in the Israeli Air Force), command posts, and positions of air defense and electronic warfare units.

At 14.05-14.20 – the first wave of the Egyptian landing: 8 thousand special forces crossed the canal in rubber motor boats and took up positions on the Bar-Leva line, intended for Israeli tanks; Egyptian units were saturated with additional anti-tank and anti-aircraft weapons to repel attacks by Israeli tanks and aircraft.

At 2:45 p.m. – the second wave of Egyptian landings: infantry units began an assault on the Bar-Leva line.

At 3:00 p.m., Egyptian engineering units began clearing passages for armored vehicles in the sandbank – within a few hours, 60 passages were created in three directions of the main attack. Israeli tank counterattacks were unsuccessful.

In the second phase, from 16:00 – the Egyptians began to establish crossings (including false ones) through the Suez Canal. From 20:30 the first crossings for heavy equipment began to operate.

In the third phase, from 01:00, October 7, the construction of all crossings was completed, and the movement of heavy equipment began. The Egyptians forced the canal in waves with an interval of 15 minutes. A total of 12 waves of landings were landed: the first 8 included exclusively infantry, and in the 9th-12th there was already equipment. A total of 10 crossings were built for the heavy equipment of five Egyptian divisions, and 50 landing points for ferries were prepared. Additionally, the transfer of infantry was carried out by helicopters. Air cover for the actions of the Egyptian troops on the coast of the Suez Canal was carried out by stationary air defense complexes, in the depths of the canal captured on the eastern bank at the expense of MANPADS and SAMs. By the middle of the second phase, the Egyptians had landed 32 thousand on the eastern bank of the Suez Canal. personnel, during the third phase, 780 Egyptian tanks and 300 units of other equipment crossed the canal. On the morning of October 7, five Egyptian bridgeheads on the eastern bank of the canal were up to 9 km deep, and Israeli troops were retreating from the Bar-Lev line after losing almost 200 tanks in counterattacks. On October 8, all 5 bridgeheads were combined into one – already 15 km deep, and the Egyptian group on the Sinai Peninsula was increased to 90 thousand personnel and 980 tanks. On the eastern bank of the canal, the Egyptians deployed stationary air defense systems [5].

Thus, during Operation Badr, Egyptian troops managed to cross the Suez Canal in 10 hours (Israeli intelligence believed that it would take them at least 50 hours to do this), take the Israeli defense line, and create a single bridgehead 15 km deep on the Sinai Peninsula [5].

The Egyptian Armed Forces were able to achieve success in Operation Badr due to a number of factors:

ensuring the security of the operation – developing plans in strict secrecy, and the covert concentration of troops took place under the pretext of conducting regular annual exercises;

the suddenness of the offensive operation – it fell on Saturday, October 6, when the Jews celebrated “Doomsday”, in connection with which many Israeli servicemen were on leave, which affected the combat readiness of the AO Israel units in the canal area; the Israeli authorities did not dare to bring the troops into combat readiness and begin mobilization on the eve of the holiday; Israeli intelligence provided information about the enemy’s plans late; the Israelis considered it unlikely that the Muslims would begin hostilities during Ramadan;

carefully planned and clearly coordinated crossing of the Suez Canal – the crossing of troops was carried out at a rapid pace and in accordance with the schedule; the first waves of the

landing were crossed in a large number of small motor boats, which made it possible to provide the bridgehead necessary for the crossings;

the effective use by the Egyptians of infantry and special forces units, equipped with portable anti-tank and anti-aircraft weapons, which were able to ambush Israeli reserves;

Massive artillery fire created passages in the minefields for the first wave of landings;

the actions of the Egyptian troops along the entire defense line did not allow the Israelis to determine the directions of the main attack;

effective performance of tasks by units of the engineering troops of the Egyptian Armed Forces – erosion of the sandbank with fire hoses, speed of construction and repair of crossings, demining;

Israeli aviation was unable to use its air superiority due to the high concentration of Egyptian air defense assets of various types.

Conclusions

The above operations are united by common features:

achieving strategic surprise, misleading the enemy regarding the timing of the start of the offensive (war) and the directions of the main strikes;

hidden concentration of forces and resources in the directions of the main strikes;

the use of new tactical methods and techniques when breaking through the enemy's deep-echelon defense:

the creation by the Germans of tank and mechanized infantry groups and engineering units to ensure a high level of mobility and rapid advance deep into enemy territory (Maginot Line);

Covering the offensive ground groups of the Egyptian army with modern Soviet mobile short-range air defense systems and the massive use of MANPADS, which neutralized the advantage of Israeli aviation. Massive saturation of the Egyptian infantry units of the first echelon with anti-tank weapons (1 ATGM “Malyutka” and 1 RPG in the detachment).

Features of approaches to breaking through deep-echelon enemy defensive positions:

a breakthrough due to an unexpected maneuver with innovative approaches to the use of tank formations and the conduct of landing operations deep behind enemy lines (1940);

a breakthrough by creating a significant numerical advantage in artillery, infantry, tank troops and aviation, carrying out a detour maneuver to divert enemy forces to another direction of combat operations (1943);

breakthrough by using weather conditions to eliminate the enemy's air superiority and unexpected choice of the location of the main strike (1944);

breakthrough due to pioneering engineering solutions, the use of anti-aircraft and anti-tank weapons, and a high level of troop interaction (1973).

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ORGANIZATIONAL WEAPONS

Abstract*. The article is devoted to organizational weapons. The history of their emergence and evolution is presented. It is shown that organizational weapons are based on special technologies of organizational management reflection: ordered sets of methods, models, programs, strategies, procedures, forms of implementation of management decisions which are constantly being improved, introduction of innovations, support of information, ideological and other necessary structural links, selection and training of personnel, planning, reporting and control, etc. It is determined that the objectives of the organizational weapons use are: creating an atmosphere of spirituality and immorality, negative attitude to cultural heritage; manipulation of the public consciousness of social groups to create political tension and chaos; destabilization of relations between political movements to provoke conflicts, aggravate political struggle; reduction of the level of information support of state and military authorities, negative impact on the process of strategic decision-making; disinformation of the population. The basis of organizational weapons is special technologies of organizational management reflection. These are orderly sets of methods (models, programs, strategies, procedures, forms) for implementing management decisions that are constantly being improved, introducing innovations, supporting information, ideological and other necessary structural links, recruiting and training personnel, planning, reporting and controlling, etc. Since the basis of any organizational system is made up of people whose motivation is based on physiological, social and information needs, the productive, properly calculated use of IA in a certain organizational environment (primarily, in the government) has a direct impact not only on the level of security of the state's organizational system, but also on the possibility of its existence. Thus, long-term massive information and moral and psychological influence of a destructive nature, passing through the consciousness of every citizen, poses a real threat to the existence of the nation as a whole due to the transformation of basic worldview, cultural and ideological attitudes, is changes in the internal organizational environment that determines the system of life of the state.*

Keywords: *organizational weapons, technologies, methods, influence, manipulation.*

Introduction

Statement of the problem. The development of various types of weapons to destroy the enemy has a history that extends throughout the history of mankind. From neutron weapons of the 70s ("clean" bomb) to modern definitions of methods of warfare, which became more active after the beginning of the armed aggression of the russian federation (rf) against Ukraine in 2014, as undeclared, informational and psychological, network-centric, hybrid war. Such diversity is due to the actualization of various parameters of this phenomenon.

This paradigm has been supplemented in recent years with another definition of modern warfare – organizational, and hence the new term "organizational weapons" [1]. Therefore, the study of organizational weapons as a component of modern warfare is quite appropriate.

Analysis of recent research and publications. In recent years, a number of studies by domestic and foreign experts have emerged, which examine individual aspects of conducting organizational warfare and the use of organizational weapons, etc. [2–10].

But, despite the existence of a certain number of scientific works on this problem, it should be noted that there is a need for implementation systems analysis the concept of organizational weapons as a component of hybrid war, as well as the study of the features of the use of these weapons under the conditions of the hybrid war of the russian federation against Ukraine [11].

Purpose of the article is to explore organizational weapons as a component of hybrid warfare.

Presentation of the main material

One of the first authors to use the term "organizational weapons" (OW) was Philip Selznick in his book "Organizational Weapons. A Study of Bolshevik Strategy and Tactics" (1952 edition) [12]. He writes, in particular, that "organizational weapons exploit the source of power that is latent in every group. It is the ability of almost any routine activity to be manipulated for personal or political advantage."

So, manipulation is a key word, as well as a key element of the OW. The modern theoretical basis of the OW began to take shape in the 20th century, its basis was the work on tectology – the science of organization and self-organization, which aims to systematize organizational experience. The idea of using the OW arose on the basis of Anglo-Saxon political mythology – the idea of a "second", less bloody path to the transformation of society, as a reaction to the revolutionary upheavals of the early 20th century. and the emergence of nuclear weapons, which posed a real threat of total destruction.

It originated in 1967, when F. Emery, then director of the Tavistock Institute of Human Relations [3], developing the idea of the diversity of organizational weapons forms, noted that the "synergetics" of the "teenage swarm" at rock concerts could be effectively used to destroy nation-states by the end of the 1990s.

In the archives of the journal Human Relations, published by the Tavistock Institute, there is a report by F. Emery, "The Next Thirty Years: Concepts, Methods, and Predictions," in that the potential of "angry youth" is viewed as a weapon of psychological defeat – "the hysteria of rebellion."

As researchers note, the first test of the OW took place in France, where in 1958 the regime of personal power of General Charles de Gaulle was established. Having received extraordinary powers as Prime Minister, and later President, he carried out reforms of the state system, which became the basis of the Fifth Republic. The President-General also achieved considerable success in the field of economics. During his reign, there was a rapid growth of French industry, and the franc, the national currency, strengthened significantly. But the most famous foreign policy steps were taken by de Gaulle, who dreamed of a dominant role for France in the new Europe. In February 1966, the President announced the country's withdrawal from the NATO military organization.

The world oligarchy reacted extremely negatively to the reforms and launched an organizational war against Charles de Gaulle with the speeches of students. Their demands were chaotic: from the reform of higher education to the social revolution. On May 1, 1968, more than 100 thousand people took to the streets of Paris under peculiar slogans: "It is forbidden to forbid!", "Be realistic – demand the impossible!", "Everything – and immediately!", "Forget everything you were taught – start dreaming!".

A large number of people far from student age wandered among the groups of young rioters, giving advice on building barricades and tactics for fighting the police. The youth's agitation became increasingly aggressive. Dozens of barricades were erected in the Latin Quarter, Molotov cocktails exploded, and shots rang out. The rioters seized not only the Sorbonne, but also the Odeon theater, which became the headquarters of the so-called Committee of Revolutionary Action.

By the way, the "yellow vest" protests in France during 2018-2019 are very reminiscent of the above-mentioned events.

The term "organizational weapons" gained special development in the 80s of the last century in the works of Soviet scientists, developers of military organizational management systems S. Nikanorov and S. Solntsev. They called organizational weapons false-target programming, which reflects its deep essence: the aggressor country creates and sets erroneous

program settings in advance in its relations with the victim country, the implementation of which strengthens its position and weakens the enemy. The victim country does not consider these actions dangerous, they seem neutral or based on universal values.

Since the late 1990s, the use of organizational weapons and the conduct of organizational warfare have been viewed in the russian federation as a reaction to the new military-strategic situation [4].

However, the problem of OW in the russian federation gained real importance at the beginning of the 21st century.

Russian sources most fully describe this type of weapon, its definition, characteristics, methods, and countermeasures on the Izborsk Club website [5]. In particular, the club's website states that "organizational weapons are a system of organizational (intelligence, propaganda, psychological, informational, etc.) influences on the enemy, coordinated by goals, place, and time, that force him to move in the direction necessary for the other side".

It should be noted that the emphasis is on "making it move in the direction necessary for the other party." That is, when many think they are moving in the direction necessary, you move where the "invisible hand" leads you.

Another russian researcher, a member of the Presidium of the russian Criminological Association I. Sundiev, notes: "The use of organizational weapons reflects the historical trend of the transition from wars aimed at the destruction of the enemy to wars aimed at its "self-disorganization" and "self-disorientation" in order to preserve the existing resource base. In practice, this is carried out by applying a system of organizational (intelligence, propaganda, psychological, information, etc., coordinated in terms of goals, place and time) influences on the enemy, which force him to move in the direction necessary for the other side. With its help, it is possible to direct the enemy's policy into a strategic dead end, exhaust its economy with ineffective (unbearable) programs, slow down the development of weapons, distort the foundations of national culture, and create a "fifth column" among part of the population. As a result, an atmosphere of internal political, economic, and psychological chaos is created in the state" [6].

In turn, another researcher from the russian city of St. Petersburg, P. Yunatskevich, argues that under OW it is necessary to understand certain social processes that are created by some social subjects to influence other social subjects [7; 8]. At the same time:

– influence – the ability of a social subject to create and prevent a threat (threat management and through threats). Provides various types of dominance, determines dignity, self-esteem, self-respect, etc.;

– social process – the way of existence of a social subject, its life activities carried out in interaction with other social subjects (in models of behavior management – it is convenient to represent a social subject as a process);

– social subject – an individual, groups of people and their associations, organizations, enterprises, states, corporations, etc., humanity as a whole.

– Therefore, we can state that the task of the OW, given our realities, is [9; 10]:

– creating an atmosphere of spiritual apathy and immorality, a negative attitude towards cultural heritage;

– manipulation of the public consciousness of social groups to create political tension and chaos;

– destabilization of relations between political movements to provoke conflicts and escalate political struggle;

– reduction in the level of information support for state and military administration bodies, negative impact on the process of strategic decision-making;

– disinformation of the population about the work of state bodies, their discrediting and undermining of authority;

– provocation of social, political, national and religious clashes;

– initiation of strikes, mass riots and other actions of socio-economic protest;

– undermining the international authority of the opponent state, discrediting its cooperation with other countries;

– causing damage to the vital interests of the opponent state in various areas.

Thus, the base of the OW are the special technologies of organizational management reflection. These are ordered sets of methods (models, programs, strategies, procedures, forms) for the implementation of constantly improving management decisions, the introduction of innovations, the support of informational, ideological and other necessary structural connections, the selection and training of personnel, planning, reporting and control, etc.

Conclusions

Since the basis of any organizational system is people, whose motivation for activity is based on physiological, social and informational needs, the productive, correctly calculated use of OW in a certain organizational environment (primarily, a power environment) has a direct impact not only on the level of security of the state's organizational system, but also, in fact, on the possibility of its existence.

Therefore, the long-term massive informational and moral-psychological impact of a destructive nature, passing through the consciousness of every citizen, creates a real threat to the existence of the nation as a whole due to the transformation of basic worldviews, cultural and ideological attitudes, that is, changes in the internal organizational environment that determines the system of vital activity of the state.

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THE ARTILLERY APPLICATION BY THE DEFENSE FORCES OF UKRAINE DURING THE RUSSIAN-UKRAINIAN WAR: ASSESSMENTS, TRENDS, USE OF INTERNATIONAL MILITARY ASSISTANCE

Abstract. *Artillery continues to play a key role in the rusian-Ukrainian war, remaining the main tool for enemy`s personnel and equipment destruction. The use of new technologies, in particular, unmanned aerial vehicles, significantly affected the tactics of artillery application by the opposing sides.*

At the beginning of the full-scale russian aggression, the Ukrainian Defense Forces used mainly Soviet weapons, however, the loss of artillery systems, their failure due to intensive operation, and the shortage of Soviet-style ammunition made the issue of obtaining both new artillery systems and ammunition from partner states extremely relevant, in particular, shells of the most common NATO 155 mm caliber and long-range missiles. New artillery systems have proven themselves to be the best, however, in the process of their operation, some organizational and technical problems have emerged that need to be solved.

European Union countries agreed to a 2 billion euro plan to send 1 million artillery rounds to Ukraine over the next year, but this plan met some obstacles. It is concluded that the success of efforts of the Defense Forces of Ukraine in repelling russian aggression and liberating the temporarily occupied territories depends on solving obvious problematic issues and ensuring a stable supply of artillery systems and ammunition from partner states.

Keywords: *russian-Ukrainian war, large-scale invasion of the russian federation to Ukraine, missile and artillery troops, artillery, artillery ammunition, Ukraine Defense Contact Group "Ramstein"*

Introduction

The large-scale invasion of the russian federation (hereinafter referred to as the rf) into Ukraine has significantly influenced assessments of the nature of modern wars. Contrary to the forecasts of analysts who saw these wars as fast-paced, maneuverable, and high-tech, the russian-Ukrainian war has made us recall the classic wars of the 20th century with a clearly defined front line, the construction of deep-echelon defense, the dense use of engineering and mine-explosive barriers, and the widespread use of counter-battery warfare. Accordingly, the requirements for weapons and military equipment and their practical application have also undergone changes.

Due to the massive use of unmanned aerial vehicles, the russian-Ukrainian war is called the “drone war”. However, it can be called the “artillery war” with the same confidence. According to military experts, it was the Rocket (Missile) and Tube Artillery Forces of the Ukrainian Defense Forces that accounted for 70–80% of the fire damage to enemy manpower and equipment in the

first two years of the war [1]. And only since 2024 has this ratio changed in favor of various types of UAVs. Thus, according to research by russian military doctors, 75% of personnel injuries were caused by UAVs, and only 20% by artillery fire [2].

Under conditions where the actions of the opposing sides' aviation were limited due to an effective and developed air defense system, artillery became a key element in ensuring successful offensive and defensive actions. The widespread use of various types of UAVs and, in particular, FPV strike drones by the Ukrainian Defense Forces also became a response, primarily, to the shortage of artillery ammunition.

Rocket (Missile) and Tube Artillery Forces in the russian-Ukrainian war are recognized by military experts from militarily developed countries as a significant factor in the conduct of combat. In particular, the Chief of Staff of the US Army, General Randy George, in an interview with the publication "DefenceNews", stated the need to adapt the American strategy for the use of artillery, taking into account the experience of combat in Ukraine, and noted: "everything we see in Ukraine concerns the relevance of high-precision fire, but the main killer on the battlefield remains conventional artillery, high-explosive fragmentation artillery" [3]. National Defense Magazine, published by the National Defense Industries Association of the United States, noted: "Ukraine may offer a glimpse into the future of artillery. As russia's previous blitzkrieg has degenerated into a trench warfare, the conflict has become an infantryman's nightmare but also a gunner's laboratory", noting that while artillery is less flexible than aviation, "it offers firepower 24/7 under all weather conditions and without relying on air bases vulnerable to bombing" [4].

Analysis of recent research and publications. Among the works devoted to this topic, currently, studies of a practical-analytical nature prevail, the task of which is to determine, based on the analysis of combat operations, the changes that have occurred in the practice of using artillery and to prepare recommendations aimed at improving the tactics of using artillery weapons. Among them are works devoted to both the direct study of the combat of the Rocket (Missile) and Tube Artillery Forces, and studies that study the role of this branch of the army in a broader context. Among the first, the work of S. Baranov and S. Taranets "Thunder from Heaven" should be highlighted. The impact of the use of R(M)&TA units on the results of combat operations. The first stage, February 24 – April 2022. Stopping the advance of occupation troops and restoring territorial integrity in the North of Ukraine" [1], appendix "Features of application and comparative characteristics of rocket (missile) and tube artillery systems of the Armed Forces of Ukraine and the russian federation" in the publication "Military-Historical Description of the russian-Ukrainian War (July 2022)" [5, p. 154-165]. Some aspects of the artillery weapons operation provided to Ukraine as part of international military-technical assistance are covered in the publications of O. Danylyuk [6], O. Ulusyan [7], S. Taranets, I. Kosyak [8] and A. Filipenko [9].

Also, the analysis of the artillery use in the russian-Ukrainian war is contained in analytical materials prepared by the Royal United Services Institute for Defence and Security Studies (RUSI). In particular, it is worth highlighting the analytical report prepared by the team of authors "Preliminary lessons from conducting conventional military operations in the context of the russian invasion to Ukraine: February-July 2022" [10], publications by Patrick Hinton [11] and Sam Cranny-Evans [12].

The purpose of the article is to investigate the role of artillery during the russian-Ukrainian war and the main trends in its use, to identify problematic issues in the operation of artillery weapons provided within the framework of international military-technical assistance. The relevance of the article is due to the need to analyze the changes that have occurred in the use of rocket (missile) and tube artillery weapons during the russian-Ukrainian war. Special emphasis is placed on the experience of operating samples of artillery weapons provided by partner states within the framework of international military-technical assistance. The chronological boundaries of the study cover the period from February 2022 to the end of 2023.

Presentation of the main material

It should be noted several important factors that largely determined the specifics of the use of artillery in the first stage of the large-scale invasion of the Russian Federation into Ukraine, which lasted from February 24 to April 2022 [1].

The enemy had a significant advantage over the Defense Forces of Ukraine in terms of missile and artillery weapons. At the beginning of the Russian aggression against Ukraine in 2014, the ratio of the number of Ukrainian and Russian artillery was approximately 1:10. Over more than nine years, it was possible to significantly restore the potential and combat capabilities of the Ukrainian Rocket (Missile) and Tube Artillery Forces (hereinafter referred to as the RM&TA), which had suffered significant losses in previous years as a result of ill-conceived, and sometimes frankly harmful reforms of the Armed Forces of Ukraine. As of February 2022, the RM&TA of the Defense Forces of Ukraine numbered 10 brigades and one regiment in the Ground Forces, as well as one brigade and one regiment in the Naval Forces. All mechanized brigades of the Ground Forces, as well as all brigades of the Marine Corps and the Airborne Assault Forces, received their own brigade artillery groups (in some cases, artillery batallions). The Armed Forces of Ukraine were armed with about 1,176 tube artillery systems (742 units of 152 mm caliber, 421 units of 122 mm caliber and 13 units of 203 mm caliber), about 1,680 multiple launch rocket systems of all calibers, as well as about 40 "Tochka-U" tactical missile systems [1].

As the authors of the report "Preliminary Lessons from Conducting Conventional Military Operations in the Context of russia's Invasion to Ukraine: February-July 2022" note, at the beginning of the large-scale invasion: "the difference in the number of russian and Ukrainian artillery was not that significant": 2,433 tube artillery systems versus 1,176, as well as 3,547 MLRS versus 1,680 [10]. Thus, the ratio was 2:1 for tube artillery systems and 2.1:1 for MLRS, respectively.

However, the real advantage of the occupiers in artillery weapons was much greater, thanks to the significant number of artillery systems in storage and, most importantly, significant amounts of ammunition, which quickly became scarce due to intensive hostilities.

At the beginning of the russian large-scale invasion (until April 2022), the Ukrainian Defense Forces used Soviet-made artillery systems, a significant part of which was in unsatisfactory technical condition. The intensity of hostilities led to accelerated wear of artillery system parts and their frequent failure, as well as to a decrease in ammunition stocks, which were already significantly depleted both during the ATO (Joint Forces Operation) and as a result of sabotage (detonations) at warehouses and arsenals. Thus, since 2015 alone, six arsenals and ammunition depots with a total volume of 210 thousand tons have been destroyed in Ukraine [1].

Under such conditions, Ukrainian artillerymen performed missions mainly thanks to non-standard solutions, the organization of effective reconnaissance, the use of the automated combat control system "Kropyva" (Ukrainian software for intelligent mapping and calculation of firing positions). The use of "Kropyva" reduced the time for the deployment of artillery units and their readiness to open fire and perform fire missions by 80%, and the time indicators for the destruction of unplanned targets were reduced by two-thirds, the time for opening fire for conducting counter-battery combat by 90%. At the same time, the use of modern unmanned aerial vehicles (hereinafter – UAVs), including civilian quadcopters, allowed significantly improving the implementation of reconnaissance and fire adjustment.

In general, with the beginning of the large-scale invasion, it was UAVs that became the main means of reconnaissance and fire adjustment, in contrast to the period of the ATO (JFO) where optical, sound and radar reconnaissance equipment prevailed. Among the reasons are the rapidity of combat operations, the high dynamics of changes in the location of forces and equipment, the ability to observe the battlefield (detect the enemy and adjust fire) in real time and at long distances, regardless of the landscape and ground obstacles. as well as the obvious advantages of aerial reconnaissance.

However, a serious problem for conducting effective artillery reconnaissance for Ukrainian artillerymen was the more active use of electronic warfare (EW) by the enemy. At the beginning of the large-scale invasion, the impact of russian EW on Ukrainian artillery reconnaissance equipment and UAVs was insignificant, but later their importance increased, which led to an increase in the number of Ukrainian UAV losses.

In general, the use of UAVs (reconnaissance and strike), modern counter-battery radars, and satellite surveillance data have significantly affected the practice of using artillery. In particular, the practice of placing artillery in open terrain, concentrating forces and equipment in certain areas, and conducting prolonged fire from one firing position has become problematic.

To avoid premature detection by the enemy, artillery units were forced to take additional measures to camouflage firing positions, to avoid operations by large units. The practice of operations by firing groups, which could consist of one or two guns, the control of which was entrusted to the firing platoon commander, the senior officer of the battery or the battery commander - the commander of the firing group, became widespread.

At the first stage of repelling a large-scale invasion, the problems of Ukrainian artillery, namely: replenishing the losses of artillery systems and increasing their number, establishing their repair, providing ammunition, were partially solved by supplying partner states with Soviet-style artillery systems and ammunition that were in service or in storage. In particular, Ukraine was supplied with 122-mm towed howitzers D-30, 122-mm self-propelled guns 2S1 “Gvozdika”, MLRS BM-21 “Grad”. However, given the enemy’s quantitative superiority in artillery systems and the ability to replenish them, such a solution was incomplete. This also concerned the need for Soviet-style caliber shells. In addition to the limited quantity, foreign-made ammunition (152 and 122 mm) could differ in some characteristics, for example, powder propelling charge, from standard Soviet-made ammunition, which led to certain problems when firing them.

In addition, the conditions of combat put forward new requirements for artillery systems, the main of which were: 1) mobility: the ability to change position quickly (here the advantage of self-propelled artillery systems (hereinafter referred to as SPAS) over towed models was revealed); 2) high accuracy: the ability to guarantee target destruction with a limited amount of ammunition; 3) an increased level of autonomy. The vast majority of Soviet-made artillery models did not meet the specified criteria. The production capacities of the partner states were focused on the production of shells of the most common NATO caliber – 155 mm, but they had a significant amount of 152 and 122 mm ammunition in storage. Under such conditions, the supply of Soviet-made artillery systems by the partner states seemed to be the optimal solution, which allowed to neutralize the enemy's quantitative advantage and ensured a stable supply of ammunition.

Starting from the second stage of repelling the large-scale invasion of the russian federation into Ukraine (May – August 2022), samples of foreign-made artillery weapons began to arrive in Ukraine from partner states, including both modern artillery systems (MLRS M142 HIMARS and M270 MLRS, 155-mm self-propelled artillery systems AHS “Krab”, “Panzerhaubitze” 2000, CAESAR, “Zuzana-2”, M777 towed guns, and others), as well as earlier systems from the second half of the 20th century (SPAS M109, “DANA”, AS-90, towed and self-propelled howitzers L119, FH70, TRF1, etc.) [6; 24].

To coordinate directions and efforts to provide international military-technical assistance, on April 26, 2022, a permanent Contact Group on Defense Issues of Ukraine was established under the chairmanship of the defense ministers of the partner states in the “Ramstein” format [13].

In total, since April 2022, the Defense Forces of Ukraine have received more than 600 155 mm artillery systems of all types, 38 M142 HIMARS MLRS and more than 25 M270 MLRS MLRS of various modifications [14].

The use of foreign-made artillery weapons significantly changed the course of combat in favor of the Ukrainian Defense Forces. Thanks to their appearance, it was possible to achieve conditional parity with the enemy, contrasting the quantity of artillery systems with quality.

The advantages of the samples of missile and artillery weapons provided as part of international military-technical assistance were:

– superior firing range, which allowed firing beyond the firing range of russian artillery. Thus, the M777 towed howitzer with a barrel length of 39 calibers (5.08 m) was able to inflict damage with high accuracy at a range of:

M107 shells – up to 24 km; shell with improved aerodynamic shape and, accordingly, increased range ERFB (Extended Range Full Bore) – up to 30 km;

with high-precision "Excalibur" shells – up to 40 km.

This made it possible to dominate practically all models of russian artillery weapons of the corresponding class during counter-battery combat.

At the same time, one of the most powerful examples of artillery weapons in service with the russian military formations – the 152-mm towed howitzer 2A65 "Msta-B" with a barrel length of 7.2 m – has a maximum firing range of active-reactive shells of up to 28.9 km.

The difference in the firing range of foreign self-propelled artillery systems compared to one of the most powerful and long-range models of self-propelled artillery installations in service with russian military formations – 2S19 "Msta-S" (see Table 1) was even greater, as well as other characteristics that influenced the course of combat:

– higher shooting accuracy compared to Soviet models;

– use of a wide range of ammunition, including high-precision shells;

– an effective loading system, in particular, the presence of automatic or semi-automatic loading systems, which allowed for a high rate of fire.

Table 1

Comparative characteristics of the 2S19 "Msta-S" self-propelled guns with the self-propelled guns received as part of international military-technical assistance

	2S19 "Msta-S" (modification 2S19M2)	PzH 2000	CEASAR	AHS Krab
Start of mass production	1988 (2012)	2000	2002	2008
Combat weight, t	42 (43.2)	55.3	18	48
Crew, people	5	5	4-5	5
Gun caliber, mm	152	155	155	155
Barrel length, calibers	47	52	52	52
Vertical guidance angle, degrees	-4…+68	-2.5…+65	-3…+66	-3.5…+70
Horizontal guidance angle, degrees	360	360	-48…+48	360
Ammunition carried, p.	50	60	18	40
Maximum firing range of a high-explosive fragmentation projectile, km	24.7	30	42 (ERFB)	330
Maximum firing range of an active-reactive projectile	29	40	55	-
Maximum firing range of a guided artillery projectile	20 (25)	-	49	40
Combat rate of fire	7-8 (10)	10	6-8	6
Maximum speed on the highway, km/h	60	60	80	60
Highway range, km	500	420	600	400

In addition, the samples of self-propelled artillery systems provided by partner states demonstrated other advantages in their use:

– high maneuverability;

– high level of autonomy due to the presence of electronic software (computer) and modern satellite navigation systems;

– high level of crew protection;

– opportunities for comfortable crew work due to better ergonomics of the fighting compartment;

– high speed of gun aiming and execution of fire missions, the ability to change settings for targets quickly. For example, the CEASAR self-propelled gun is equipped with a "SIGMA 30" fire control system (hereinafter referred to as SFC), which includes a "NAVSTAR" navigation system receiver. The SFC has a radar for measuring the initial velocity, a built-in ballistic control unit and an automatic projectile feeding system [15].

Thanks to the emergence of modern long-range artillery systems, it has become possible to inflict fire damage on the entire tactical depth of the enemy's battle formations, to destroy command posts, logistics, and storage locations for ammunition and fuel.

Thus, at the end of June 2022, the headquarters of one of the russian army units in the city of Izyum was destroyed by fire from the M142 HIMARS MLRS [16]. In July 2022, strikes from the same system managed to destroy an ammunition depot in Alchevsk near Luhansk [17]. Systematic strikes by the M142 HIMARS MLRS on the Antonivskyi Bridge across the Dnieper River became one of the factors (along with the disruption of the control system and the disorganization of the logistics support system of the occupation forces) that contributed to the liberation of the city of Kherson and the right-bank districts of the Kherson region in September-October 2022.

The use of 155-mm M777 towed howitzers was also effective, as evidenced by specific examples of their use. On June 12, 2022, in the area of the village of Dergachi, Kharkiv region, at least 15 servicemen of the occupation forces were destroyed with the first shot [6; 25-26], on June 27, 2022, in the area of the village of Tsyrkuny, Kharkiv region, during counter-battery combat, only according to confirmed data, 4 enemy artillery systems with crews and ammunition were destroyed [6; 26]. And these are only isolated examples of the effectiveness of the use of foreign samples of artillery weapons provided by partner states in a huge volume of effective execution of fire missions by Ukrainian artillerymen during combat.

At the same time, the combat use of artillery systems that were supplied to the Defense Forces of Ukraine as part of international military-technical assistance revealed a number of problematic issues that complicated their operation.

The problematic issues may be conditionally divided into two groups. The first includes problems that arose during the operation of most systems, and the second includes the specific features of each artillery weapon model that were taken into account during further operation.

All missile and artillery systems supplied within the framework of the international MTA were characterized by incomplete or absent spare parts (spare parts, tools and accessories), and generally low availability of spare parts. This limited the full maintenance and use of the systems, and led to long periods of artillery weapons being repaired.

Another common problem is the unadaptability and sensitivity to intense fire. For example, the standard mode of operation of the German self-propelled gun "PzH 2000" provides for up to 100 rounds per day. With a rate of fire of "PzH 2000" at a constant rate of 8 rounds per minute (maximum rate up to 12), this is only 12.5 minutes of continuous fire per day [18].

This is largely due to the design features of the guns provided to Ukraine within the framework of international MTA, as well as the practice of their previous use. Armed conflicts, which have mainly been waged in recent times with the involvement of NATO countries, have been focused on combating illegal armed formations and the resistance movement, rather than full-fledged conventional wars of high intensity with the involvement of regular armed forces

(formations). Accordingly, artillery was used in more favorable conditions than under the conditions of the russian-Ukrainian war.

In addition, each of the artillery weapons samples had specific problematic issues that were identified during combat use during the repulsion of the large-scale aggression of the russian federation to Ukraine.

Thus, the Ukrainian Defense Forces received the self-propelled howitzers FH 70, jointly produced by Great Britain, Germany and Italy, and TRF 1, produced by France. Adopted in the late 1970s, they to some extent embodied the then views on the use of artillery weapons. Both guns differ in significant weight: 9.3 tons for the FH 70 and 10 tons for the TRF 1 (for comparison, the combat weight of the more modern M777, which has the same caliber, is 4.2 tons). The presence of an auxiliary power unit increases the mobility of the gun on the battlefield, but at the same time requires additional technical maintenance. In addition, if the power unit fails on the FH 70 howitzer, it is impossible to control the hydraulic system for raising/lowering the wheels, and in the absence of pressure in the hydraulic system, evacuation of the howitzer is practically impossible [9].

The M777 howitzer, which has proven itself in the best way due to its high accuracy and maneuverability (achieved thanks to the use of titanium and aluminum in the design, which affected the weight of the system), also turned out to be not without certain shortcomings. Among them, in particular, the vulnerability of the hydropneumatic system and other parts to external influences, including shrapnel damage, the sensitivity of the loading system, excessive contamination of the "mirror" of the bolt wedge, etc. [19, p. 36].

The considerable weight and low cross-country ability of the self-propelled guns are also one of the problems. In particular, for the self-propelled guns "PzH 2000", a significant load on the platform, in addition to low cross-country ability on viscous soil, leads to premature wear and failure of the rollers and rubber tires [9, p. 101].

For such self-propelled guns as "PzH 2000", CAESAR, AHS "Krab", the saturation of electronics, along with significant advantages, also creates problems in operation. In particular, there were frequent cases of failure of complex electronic systems, software failures, etc., which made it impossible to perform combat missions and their further use for their intended purpose until the completion of repair work.

In general, statistics show that the main part of SPAS malfunctions falls on the artillery part – 23%, on the chassis – 16%, on fire control systems – 16%, and for towed artillery systems, the failure of the artillery part – 76% [7; 25-26].

The rearmament of artillery units of the Defense Forces of Ukraine to Western models of rocket and artillery weapons has made it possible to use a wide range of NATO-style ammunition, including high-precision and cluster munitions. The most famous of them are the 155-mm M982 "Excalibur" shells, which were actively used both during defensive and offensive operations (especially during the defense of the cities of Soledar and Bakhmut and the Ukrainian counteroffensive in the southern regions of Ukraine in 2023) [6; 27].

In addition to high-precision shells, partner states also supplied cluster munitions to the Ukrainian Defense Forces. On July 7, 2023, the US National Security Advisor Jake Sullivan announced the transfer of this type of munitions to Ukraine, but only for the defense of its territory [20].

The 155-mm M483A1 cluster munitions used to carry out fire missions from the M777 towed howitzer showed high efficiency. Only on August 30, 2023, during the liberation of the village of Staromayorske, a platoon of 120-mm mortars along with the crew was destroyed by just four such munitions [6; 28].

At the same time, the intensity of the use of ammunition, including 155-caliber shells, led to a fairly rapid depletion of existing stocks and forced Western countries to increase their production. NATO Secretary General Jens Stoltenberg emphasized in March 2023 that Ukraine

uses from 4 to 7 thousand shells per day, compared to 20 thousand used by the russian federation [21].

On February 14, 2023, the United States announced contracts worth $522 million with Northrop Grumman Systems and Global Military Products to produce artillery ammunition for Ukraine. The contracts were funded by the U.S. government's Ukraine Security Initiative program, and deliveries of the ammunition to Ukraine began in March 2023 [22]. In total, since the start of the full-scale invasion, the US has provided Ukraine with over 2 million 155 mm shells [23].

Increasing ammunition production for Ukraine has also become one of the key areas of support from the European Union (hereinafter referred to as the EU). At an informal meeting of defense ministers of the EU member states in Stockholm on March 8, 2023, Josep Borrell (High Representative of the European Union for Foreign Affairs and Security Policy) presented a proposal (supported by the meeting participants) to increase the production of ammunition worth 2 billion euros. The proposal consisted of three parts. The first of them provided for the allocation of 1 billion euros from the European Peace Facility (hereinafter referred to as the EPF) to replenish the national reserves of the EU countries that were ready to transfer ammunition to Ukraine. The second was the development of a joint coordinated approach to the procurement of artillery shells to replenish their own stocks and provide ammunition to Ukraine in the medium term through the European Defense Agency. According to the plan, such a collective approach was supposed to help reduce ammunition prices and shorten their delivery times. For this, it was proposed to allocate another 1 billion euros from the EPF. The third part of the plan was to increase the capabilities of the defense industry of EU countries to meet their needs [24].

On March 20, 2023, at a meeting of EU defense ministers in Brussels, they supported a document on the supply of one million artillery shells to Ukraine, which were to arrive within a year. 15 industrial enterprises in 11 EU countries were identified for the production of 155-mm artillery shells according to NATO standards and five manufacturers of 152-mm Soviet-style ammunition [25].

On June 1, 2023, the European Parliament adopted the Act in Support of Ammunition Production (ASAP). The legislative proposal came from the European Commission and contained measures to urgently strengthen the ability of the EU defense industry to supply Ukraine with artillery ammunition and missiles. To increase their production, 500 million euros were attracted from EU funds. The funds were allocated for the creation of new production facilities, optimization, expansion, modernization or re-profiling of existing facilities, retraining and upgrading of workers, and the establishment of cross-border industrial partnerships, including both public and private, in order to ensure access to strategic components and raw materials [26].

At the end of September 2023, it was reported that 7 EU countries had ordered 155 mm ammunition in accordance with the scheme approved in March at a meeting of EU defense ministers. According to the explanations of the European Defense Agency (hereinafter – EDA), the contracts reached concerned both complete rounds and individual components (shells, cases, fuses, charges and primers, etc.). The EDA refused to name the countries or indicate the volumes of the orders, citing the fact that much of the information is confidential.

In response to inquiries from Reuters (which published this information), Lithuania and Luxembourg reported that they were among the seven countries. The Luxembourg Ministry of Defense, in particular, announced the allocation of an additional 2 million euros for the purchase. The shells were to meet the needs of artillery systems, which were most widely used by the Ukrainian Defense Forces (mainly CAESAR, AHS "Krab", "PzH 2000", "Zuzana" and others) [27].

However, in October 2023, it became known that the European Union was falling behind on its plan to provide Ukraine with one million artillery shells by March 2024. According to sources and documents reviewed by Bloomberg, this initiative at that time provided about 30% of the planned volume [28].

A negative factor in providing artillery systems with shells is their diversity. While most countries have 2-3 types of artillery weapons in service, Ukraine has about 17, and accordingly, the problem of providing these systems with standard ammunition arises, as this affects the effectiveness of firing.

Artillery also played a decisive role during the counteroffensive of the Ukrainian Defense Forces, which began in the summer of 2023. In this context, the assessment given to the Ukrainian Defense Forces by experts from the Royal United Defense Research Institute (RUSI) from the United Kingdom is significant. In their report on the Ukrainian counteroffensive, it was noted that how far the Ukrainian Defense Forces managed to advance depended on fire advantage: "The advantage over the russians in range, combined with better means of enemy artillery detecting and conducting counter-battery combat, is an important advantage for Ukraine. This advantage is limited in its duration by the serviceability of Ukrainian artillery systems, the availability of interchangeable barrels and the continued supply of 155-mm ammunition" [29]. Therefore, investments by Ukraine's international partners in ensuring a stable supply of artillery, which is more limited in number of types and at the same time in larger volumes, are extremely important. Otherwise, it could undermine Ukraine's future progress. It is also necessary to accelerate the implementation of methods to protect artillery systems from Lancet strike UAVs, other loitering munitions, and FPV drones [29].

Conclusions

An analysis of the experience of artillery application during the russian-Ukrainian war allows us to draw the following conclusions.

1. Artillery remains the main means of defeating manpower and equipment, including the entire tactical depth of the enemy's battle formation. Despite the use of high-precision artillery ammunition, the latest missile weapons, FPV drones and other types of UAVs, the main burden falls on "classic" conventional barrel artillery and multiple launch rocket systems.

2. Aerial reconnaissance (especially with the help of UAVs), modern artillery counter-battery radars, increase the capabilities of detecting targets and significantly improve the possibilities of fire adjustment and counter-battery combat. At the same time, the presence of the specified reconnaissance means by the enemy and subsequently the active use of FPV drones significantly limited the capabilities of its artillery to concentrate systems in a limited area and conduct fire from one firing position for a long time, require the dispersion of artillery systems, increase the requirements for the mobility of artillery systems and their accuracy. Self-propelled artillery systems have confirmed their advantages over towed artillery systems, however, the organization of artillery will require a multi-level balanced approach, taking into account different systems and the use of different types of ammunition.

3. The effectiveness of artillery in modern conditions of high-intensity warfare continues to depend directly on the available volumes of ammunition. Accordingly, both Ukraine and the partner states supplying it with artillery weapons have faced the problem of increasing the production of shells both to meet the needs of the Ukrainian Defense Forces and to form reserves for the armies of NATO member states.

4. The russian-Ukrainian war accelerated the transition of the Ukrainian Defense Forces to the use of artillery systems developed and adopted in NATO member states using ammunition of the most common caliber in NATO, 155 mm. The operation and combat use of artillery weapons samples provided to Ukraine within the framework of international military-technical assistance allowed us to identify both the strengths of these systems and problematic issues. In particular, the unsuitability of these systems for conducting intensive fire in the conditions of a modern high-intensity conventional war, the insufficient cross-country ability of some self-propelled artillery installations, the insecurity and vulnerability of the main components and structures in towed artillery systems were revealed.

5. Among the areas of development of the Rocket (Missile) and Tube Artillery Forces of the Defense Forces of Ukraine, the following should be highlighted:

– a certain unification of artillery systems entering service with the Defense Forces of Ukraine as part of international military-technical assistance (adopting a limited number of models) will avoid problems with the provision of spare parts, maintenance, repair work, and provision of regular ammunition;

– training repair teams to repair artillery systems received from partner countries, providing artillery units with the necessary technical documentation, operating instructions, etc.;

– taking into account the experience gained in the operation and combat use of artillery systems received from partner states in the preparation of artillery calculations;

– improving the supply of spare parts, creating joint ventures for the production of components for artillery systems or the production of some components at Ukrainian enterprises;

– strengthening the protection of artillery systems from loitering munitions and FPV drones by expanding the use of electronic warfare systems and improving camouflage measures.

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