COME BACK ALIVE

POLICY BRIEF

NEEDLES FOR A PORCUPINE

CAPABILITIES REQUIREMENTS FOR THE DEFENSE FORCES OF UKRAINE TO ENSURE DETERRENCE EFFECT BASED ON THE COMBAT EXPERIENCE AFTER FEBRUARY 24, 2022

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The Analytical Department of the NGO “COME BACK ALIVE!” was created in May 2018. The task of analysts is a comprehensive study of issues that directly or indirectly impact Ukraine’s defense capability.

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Introduction

Decision of Russian political-military leadership on February 24, 2022, to morph local aggression at Donbas and tensions at sea into the largest regional war in Europe since 1945 is the greatest tragedy of modern Ukraine. Prevention of the recurrence of such a tragedy should be the key task of Ukraine's prospective defense policy. The goal of such a policy is establishment and sustainment of an appropriate deterrent effect.

Establishment and sustainment of deterrence effect is the key task for any Defense Forces in the nuclear age. The deterrent effect is based on three components. First, corresponding capabilities of a sufficient number for consistent combat operations in the key physical domains of war shall be developed. Secondly, ability shall be attained to effectively employ the relevant capabilities within the framework of a modern combined arms warfare at levels of tactics and operations. This is done by a high-quality training program and personnel policy. Thirdly, complex of political-diplomatic, informational and special measures shall be implemented to convince opponent that the employment of a military instrument is senseless due to the significant price of retribution and associated risks.

This policy brief focuses on the first component of establishment and sustainment an adequate deterrence effect — namely, the basic outline of capabilities for operations in the key physical domains of war, based on the combat experience after February 24, 2022.

At the moment, Ukraine's partners act on a consensus that inflicting an appropriate level of damage on the Russian interservice grouping of forces since February 24, 2022, is insufficient for long-term peace and security in Europe.[1] Establishment of new Défense Forces of Ukraine is an equally important element, which will form the basis of the necessary deterrent effect. Discussions regarding future Défense Forces of Ukraine parameters and their needs in terms of capabilities were held in the United States in late summer and early fall 2022.[2] However, the relevant discussions took a back seat against the background of Ukraine's preparations for offensive actions in the southern mainland during the 2023 campaign.

On the eve of the Alliance Vilnius Summit, NATO countries returned to the issue prospective Défense Forces of Ukraine outline, including the necessary capabilities. The so-called "Israeli model" of guaranteeing security (or the "porcupine strategy") was considered by the United States as the most optimal given deficit of desire to push Ukraine's accession to NATO in the short and medium term.[3] Defining the list of capabilities for actions on land, in the air and at sea by the Défense Forces of Ukraine has been determined by one of the priorities. However, as for today this issue has taken a back seat again — the priority task is the development and signature of framework bilateral political agreements on assistance in guaranteeing the long-term security of Ukraine, which would detail the Declaration of the G7 countries on support for Ukraine from July 12, 2023.[4] Thus, the purpose of this policy brief is also to stimulate discussion

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1 Russia's Strategic Failure and Ukraine's Secure Future — https://www.state.gov/russias-strategic-failure-and-ukraines-secure-future

2 US military working on analysis to shape and support Ukraine's military in long term — https://edition.cnn.com/2022/09/07/politics/us-military-ukraine-analysis/index.html

3 To Aid Ukraine in Fight Against Russia, Allies Look to Security Model Like Israel's — https://www.wsj.com/articles/to-aid-ukraine-in-fight-against-russia-allies-look-to-security-model-like-israels-8a05f0e5

4 Ukraine has started negotiations with the US on bilateral agreement on security commitments — https://www.president.gov.ua/en/news/ukrayina-rozpochala-peregovori-zi-ssha-shodo-dvostoronnoyi-u-84717

on the relevant issue — until the conclusion of the relevant framework bilateral policy agreements is completed. This policy brief can be considered as a basis for the discussion before the final approval of the perspective outline of the Défense Forces of Ukraine.

Types of deterrence effect

First, it is necessary to bring some clarity about what kind of deterrent effect is discussed.[5] Today, in the theoretical literature, two key varieties of the deterrence effect are distinguished, which were reflected in the last iteration of the US National Defense Strategy, namely:

- deterrence by punishment/cost imposition,
- deterrence by denial.

The key difference is the degree of damage that can be inflicted in case of need if we are talking specifically about military dimension. Deterrence by punishment involves inflicting a lower level of damage than deterrence by denial. In the first case, we are talking about the level of damage, which makes it impossible to quickly capture or hold the territories, does not allow to quickly achieve the set goals. For this, it is enough to partially destroy the enemy's interservice grouping of forces, so it loses its offensive potential. In deterrence by punishment military measures are combined with economic and diplomatic retribution to increase price of hypothetical aggression. In the case of deterrence by denial, it means quick and almost complete destruction of the grouping used in aggression. Deterrence by punishment is a cheaper option, because in contrast to deterrence by denial, it does not require the establishment of a total qualitative and quantitative advantage over a potential adversary.

It is deterrence by denial that Poland is striving for as part of the current process of rearming and reforming of its own Defense Forces — although there are ongoing discussions in Poland itself as to what extent this approach is justified and sustainable in the medium and long term.[6] For Ukraine, deterrence by denial is not a realistic option despite nominal preferability due to the negative consequences of the war, limited resource and technological bases. Therefore, it will be rational to focus precisely on basic list of capabilities that in combination are integral for deterrence by punishment in Ukrainian context.

Reservations

The problem of ensuring the deterrence effect through the acquisition and development of appropriate capabilities is a complex task, as mentioned above. In the end, it is important not only to acquire and master the relevant capabilities, but also to properly communicate the relevant moments to a potential enemy. The events on the eve of February 24, 2022, showed the inability of Russian leadership and Vladimir Putin himself to objectively assess the potential and ability of the Defense Forces of Ukraine to resist. As a result, it must be kept in mind that even obtaining and mastering of a prospective list of capabilities does not fully guarantee the achievement of the deterrence effect due to the nuances of the political system in Russia in terms of collecting, processing and using information in making of key strategic decisions.

5 Understanding Deterrence — https://www.rand.org/pubs/perspectives/PE295.html

6 The Strongest Army in Europe? — https://www.project-syndicate.org/commentary/poland-pis-populist-government-military-procurement-by-slawomir-sierakowski-2023-08

Another important caveat is that the indicative list of capabilities is not exhaustive and definitive. We are only talking about the necessary capabilities for the implementation of tasks (strategies) in the key physical domains of warfare. The relevant list may change and be refined, considering the natural evolution of technologies and methods of their employment, as well as the acceleration of the relevant processes in recent decades.[7]

The use of the terms “denial strategies” and “deterrence by denial” should not be misleading. In the first case, we are talking about the corresponding philosophy of war conduct, which is based on the complication of power projecting in one or another physical domain of war. At the same time, “deterrence by denial” is a more complex concept, which includes the acquisition, demonstration and, if necessary, the employment of appropriate capabilities in the physical dimensions of warfare both to complicate the power projection by the other side and for its own power projection.

The purpose of this brief is only to provide a basic outline of the minimum level of capabilities to ensure deterrence through punishment. This policy brief is an invitation to an important discussion both within Ukraine and within the framework of interaction with international partners.

7 Jack Watling “The Arms of the Future: Technology and Close Combat in the 21st Century: Technology and Close Combat in the Twenty-First Century (New Perspectives on Defence and Security)”.

Air and Sea Combat. Strategies of Denial

Context

Although the main events of the Russian-Ukrainian war unfolded on land, it is worth to start with two other physical domains of war — air and sea. The conduct of war by Ukraine in these two domains after February 24, 2022, is united by a common denominator. Namely, that the main emphasis was on the implementation of the so-called denial strategies. The main task of such a strategy is to increase price for enemy's power projection at minimum in the appropriate domain and at best to completely prevent his freedom of action to deny the synergistic effect of using it together with other branches of troops. An example of this can be Russian inability to gain and maintain air superiority given Ukraine's implementation of the air denial strategy, which in turn prevented a more effective projection of power by Russian interservice grouping of forces on land and at sea.

Air denial strategy

It was notable that the daily briefings of the US DoD since February 24, 2022, began with the statement that Russia failed to fully gain the so-called air superiority and exploit it effectively, while the airspace of Ukraine remained an arena of active combat.[8] The first victory of Ukraine after February 24, 2022, was attained within air domain combat — when Ukraine proved capable to prevent the attainment and exploitation of air dominance by Russia despite its formal quantitative and qualitative superiority in means of air attack. As it's known air superiority is defined as one of the key factors of victory in modern warfare — this has been proved by a number of high intensity interstate wars since WWII.

The inability of Russian Air and Space Forces to seize and exploit dominance in the air was the result of two key factors combination: 1) deficit of skills and experience in planning and carrying out complex operations to suppress and destroy integrated air defense systems, 2) high-quality combat performance of the Ukrainian SAMs (S-300PS/PT, Buk M1, Osa-AKM), radio engineering troops and, to a lesser extent, manned aviation, which collectively were able to preserve capabilities, regroup and inflict the necessary level of damage on aircraft and helicopters of the Russian Armed Forces during the first month after February 24, 2022.[9] As the result at the beginning of April 2022, Russia abandoned the large-scale use of manned aircraft deep in the airspace of Ukraine.[10]

One way or another, Ukraine managed to implement a denial strategy in the air domain, which had a direct positive impact on the future developments. In essence, Russia was unable to obtain freedom of action to leverage its nominal quantitative and qualitative advantage in manned aviation to aid land formations and operations at sea. Otherwise, it would have been much more difficult for Ukraine to conduct a successful strategic defensive operation. The

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8 Pentagon Press Secretary John F. Kirby Holds a Press Briefing, March 4, 2022 — https://www.defense.gov/News/Transcripts/Transcript/Article/2956340/pentagon-press-secretary-john-f-kirby-holds-a-press-briefing-march-4-2022

9 Failure to Control Ukraine's Skies Betrays Key Flaw in Russia's War Strategy — https://www.wsj.com/articles/failure-to-control-ukraines-skies-betrays-key-flaw-in-russias-war-strategy-11665915386

10 RUSI "The Russian Air War and Ukrainian Requirements for Air Defence" — https://static.rusi.org/SR-Russian-Air-War-Ukraine-web-final.pdf

hypothetical ability of Russia to freely use manned aviation deep in the airspace of Ukraine would have made it difficult for Ukraine to regroup at the front, bring up and deploy reserves, as well as do economic activities on territories that were not directly affected by hostilities.

The inability of the Russian Air-Space Force to operate in the depth of the airspace of Ukraine led to a change in the strategy and an emphasis on strikes with the help of cruise and ballistic missiles, and then of kamikaze UAVs — both with the aim of inflicting damage on critical infrastructure (railways, oil refinery and storage, electricity distribution networks) and to deplete Ukrainian stock of Soviet interceptor missiles. Kamikaze UAVs of the Shahed-131/136 type proved to be a special challenge — it was about finding ways that would allow simultaneously to shoot down them *en masse* and do it cheaply.[11] It is noteworthy that the Russia failed to inflict an appropriate level of damage on critical infrastructure to obtain political leverage over Ukraine. However, Russia came very close to exhausting Ukraine's stocks of interceptors for Soviet air defense systems.[12]

Therefore, it's logical that the main attention of the countries of Ukraine Defense Contact Group (Ramstein format) was devoted to the development and strengthening of the land-based air/missile defense — the one which was primarily responsible for the air denial strategy application. In the first months of the all-out war Ukraine air defense segment was strengthened with various types of western MANPADS.[13] The transfer of self-sufficient complexes capable of detecting, tracking and destroying the corresponding air targets was the next stage. Today, Ukraine has at its disposal the following anti-aircraft missile systems and anti-aircraft artillery systems of Western production — Stormer, NASAMS, IRIS-T, HAWK, SAMP-T, Patriot, Avenger and Gepard.

Different philosophy in the air/missile defense segment, which NATO countries adhere to in contrast to the Soviet tradition inherited by Ukraine is the key obstacle to the rapid transfer of the relevant air/missile defense systems. The NATO tradition envisions a much smaller role of ground-based air/anti-missile defense systems — the air supremacy is also considered a key means of moderating traditional threats from the air. As a result, considerable time is needed for the full implementation of plans to produce 15 batteries of NASAMS air defense systems, which various countries promised to Ukraine.[14] The same applies to the plans of the German defense industry related to increase of production of IRIS-T air defense systems and missiles for them, as well as to start its own production of ammunition for the Gepard anti-aircraft artillery systems.[15]

Under these conditions, the military-political leadership of Ukraine faces a dilemma — the necessity to balance two key tasks of the country's air defense (covering key critical infrastructure facilities) and the air defense of a grouping of troops at the front.[16] This dilemma manifested

11 Will Russia's drone attacks change the war in Ukraine? — https://www.economist.com/the-economist-explains/2022/10/19/will-russias-drone-attacks-change-the-war-in-ukraine

12 Leaked documents warn of weaknesses in Ukraine's defenses — https://www.washingtonpost.com/national-security/2023/04/08/leak-documents-ukraine-air-defense

13 'Risk worth taking': U.S. rushes MANPADS to Ukraine despite proliferation concerns — https://www.reuters.com/world/risk-worth-taking-us-rushes-manpads-ukraine-despite-proliferation-concerns-2022-03-11

14 The USA ordered six more NASAMS air defense systems for Ukraine — https://mil.in.ua/en/news/the-usa-ordered-six-more-nasams-air-defense-systems-for-ukraine

15 German arms maker Diehl to ramp up production of IRIS-T air defence system — https://www.reuters.com/markets/europe/german-arms-maker-diehl-ramp-up-production-iris-t-air-defence-system-2023-09-05

16 Military briefing: Russian 'Alligators' menace Ukraine's counteroffensive — https://www.ft.com/content/d8fe8941-3703-433d-ac7a-dab9ba500481

itself on the eve of Ukraine's offensive in the Zaporizhzhia region, when Russia with a series of strikes on civilian infrastructure in May 2023, tried to divert the corresponding limited resources in the air defense segment from the needs of the forces grouping at the front.

As a result, acquisition and mastering of modern multifunctional fighters of the 4th generation by Ukraine has become critical goal of the same magnitude. Ukraine determined that at minimum it needs 48 units of the corresponding platform, and at maximum — approximately 120 units.[17] Appropriate platforms with a better radar that makes it possible to detect and track a larger number of air targets at a greater distance, as well as with better air-to-air missiles with active radio homing, will make it possible to cover the gaps due to the limitation of ground-based air defense systems range.[18] Thus, continuous denying of ability for Russian manned aircrafts to enter the airspace of Ukraine and a better interception of kamikaze UAVs and cruise missiles is number 1 priority for expected Western supplied 4th generation multipurpose fighters. In addition, the presence of 4th generation multifunctional fighters in Ukraine's arsenal will mean a greater threat to Russian manned aviation, which has actively begun to use various types of crude precision stand-off air launched munitions without the need to go deep into the airspace of Ukraine.[19]

Of course, the ability to integrate a variety of air-to-land and air-to-sea munitions to the corresponding multifunctional fighters of the 4th generation is no less important. The Air Force of Ukraine was able to integrate JDAM, JDAM-ER, AGM-88 HARM, Storm Shadow/Scalp-EG munitions into Soviet combat planes — however, the characteristics of the Soviet platforms make it impossible to fully exploit capabilities of the corresponding munitions. Nevertheless, the key task of modern manned aviation in Ukrainian arsenal would be is the continued successful application of the denial strategy to prevent projection of power by the enemy in the air, together with an improved counteraction to majority of air attack means in Russian arsenal.

Anticipating the future acquisition and employment of F-16 aircraft by Ukraine in accordance with the decisions of August 2023, it is necessary not to fall into the trap of inflated expectations in terms of Ukraine's ability to attain, maintain and exploit air superiority in the manner of the US Air Force.[20] F-16s are going to aid in air denial strategy implementation — as well as to deliver pinpoint strikes in the interests of Ukrainian forces on land and at sea as Air Force of Ukraine will progress in mastering 4th generation multipurpose fighters.

Separately, it should be emphasized that successful implementation of air denial strategy by Ukraine became a certain conceptual surprise for the Western military and analysts, who are used to treat the relevant issue through "friendly dominance in the air" and "enemy dominance in the air" concepts.[21] The third option, which emphasizes minimizing the other side's ability to use airpower, is an interesting option for both the US Air Force and the Marine Corps for early stages of hypothetical wars.

17 F-16s Not Timely or Affordable for Ukraine, DOD Policy Chief Says — https://www.airandspaceforces.com/f-16s-not-timely-or-affordable-for-ukraine-dod-policy-chief-says

18 F-16s might not win Ukraine's war, but they promise a more equal fight — https://www.ft.com/content/ef53a540-33a2-410c-80e8-a611d4fb4448

19 Guided bombs — new Russian tactics in the Ukraine war? — https://www.dw.com/en/guided-bombs-new-russian-tactics-in-the-ukraine-war/a-65378079

20 F-16s Are No Magic Bullet for Ukraine, but They Are a Game Changer with the Right Munitions — https://www.rand.org/pubs/commentary/2023/10/f-16s-are-no-magic-bullet-for-ukraine-but-they-are.html

21 Air Denial Lessons from Ukraine — https://www.usni.org/magazines/proceedings/2023/september/air-denial-lessons-ukraine

In general, it is worth emphasizing once again the success of the Ukrainian version of the air denial strategy and the critical importance of maintaining the necessary list of capabilities for its implementation. This list includes anti-aircraft defense systems, 4th generation multi-role fighters and radar stations. Not only the outcome of hostilities on land and at sea, but also the future of Ukraine as a country depends on Ukraine's future ability to effectively employ the relevant strategy in practice. It is already clear today that the leadership of Russia has chosen a strategy of slowly depleting Ukraine and turning it into a dysfunctional state in the medium and long term by scaring away people, capital and technology necessary for reconstruction and development. The corresponding strategy is expected to be implemented by Russia through ability to deliver complex strikes to the entire depth of the territory of Ukraine combining diverse missiles and kamikaze UAVs. As a result, maintaining and developing capabilities to implement air denial strategy to impair Russian power projection in appropriate domain is one of the key tasks that will not lose its relevance.

Sea denial strategy

The hostilities in naval domain began with the complete Russian dominance in the northwestern part of the Black Sea, symbolized by the trade blockade and the threat of an amphibious landing in Odessa.[22] However, within 20 months, Ukraine has proved to be capable to switch from defense to proactive actions, which today create progressively more threats and risks for the Black Sea Fleet at its permanent base — the temporarily occupied Sevastopol.

The evolution of war at sea passed 3 important stages:

1. Nullification of the threat of Russian amphibious landing in Odesa,
2. Establishment of anti-access/area denial zone (A2/AD) in the northwestern part of the Black Sea,
3. Ukraine's transition to proactive actions to create a threat to Russian Black Sea Fleet bases with the aim of complete squeezing it out of the western part of the Black Sea.

These stages provide both valuable lessons about promising directions of naval capabilities development, and an understanding of the limits of possible as to power projection at sea and from the sea in Ukrainian case.

The first stage (the end of February and the beginning of April 2022) — the nullification of the threat of an amphibious landing in Odesa — is important primarily because it vividly demonstrated the multidimensional nature of modern naval warfare in littoral waters. The impossibility to conduct an amphibious landing was attained largely thanks to the successful actions of Ukrainian Defense Forces in the air and land domains. In the first case, implementation of air denial strategy made it too risky for Russia to project power in air. As the consequence Ukraine guaranteed that a hypothetical Russian amphibious landing would not be able to receive adequate fire support from the air. In the second case, attempts of Russian ground grouping to quickly reach the outskirts of Odesa to support planned amphibious landing failed due to the successful actions of the Defense Forces of Ukraine in the Mykolaiv region. In this way, the first victory of Ukraine at sea was won primarily thanks to the successful actions of Defense Forces of Ukraine on the land and in the air.

22 Russia's Amphibious Operation Dilemma — https://www.navalnews.com/naval-news/2022/03/russias-amphibious-operation-dilemma

The second stage (mid-April 2022 — end of June 2022) was the period when Ukraine was able to create an anti-access/area denial zone in the north-western part of the Black Sea through a complex of measures.[23] The corresponding zone created a threat to Russian Black Sea fleet surface ships and, as a result, eliminated the threat of a classic naval blockade. Destruction of the flagship of Russian Black Sea Fleet missile cruiser "Moskva" with the help of anti-ship missiles (AShM) and the fight for Snake Island were key points of this struggle. At the end of June 2022, Ukraine forced Russia to evacuate its garrison from Snake Island.[24] Complex strikes targeting the garrison and air defense systems, as well as the logistics system of the corresponding garrison aided in achieving proper result. Self-propelled howitzers and MLRS, Bayraktar type UAVs and manned aircraft, as well as Harpoon anti-ship missiles (range up to 175 km) carried complex strikes. Establishment of an anti-access/area denial zone became the military basis for the grain deal, which functioned during July 2022 — July 2023.

The third stage (from September 2022 to the present). Pushing out of at least surface component of Russian Black Sea fleet from the north-western part of the Black Sea did not mean Ukraine's refusal to take further proactive actions. Unmanned surface vehicles (USVs) became the basis for such actions. For the first time, the corresponding vehicles were used in October-November 2022 for attacks on Russian facilities in Sevastopol and Novorossiysk.[25] USVs proved to be an important tool after Russian unilateral withdrawal from the grain deal in the second half of July 2023 — with subsequent Russian attempts to intercept ships with Ukrainian grain in the southwestern part of the Black Sea beyond the range of the Harpoon missile system.[26] In the same way, the corresponding platforms pose a threat to Russian Black Sea surface ships outside naval bases, despite limitations in autonomy and range of such USVs.[27] In addition, the corresponding USVs of the Sea Baby type were used for the attack on the Crimean Bridge.[28]

One way or another, at the current stage USVs have become an integral element of the ongoing naval confrontation. The essence of such a confrontation is to create opportunities for uninterrupted exports from Ukrainian Black Sea ports with a parallel increase in risks for the Black Sea Fleet near its bases.

Sea mines danger remains an important and urgent problem.[29] It appeared because of the active placement of mine barriers by Russian Black Sea Fleet on the routes of export of agricultural products. Procurement and employment of classic minesweepers or converting civilian vessels into means of dealing with mines by installation/use of appropriate specialized anti-mines modules on them can be part of the appropriate problem solution.

On the other hand, despite string of significant Ukrainian successes in naval warfare thus far, it is important to admit the limits regarding what Ukraine can attain through successful power

23 An Anti-Access Denial Strategy for Ukraine — https://cimsec.org/an-anti-access-denial-strategy-for-ukraine

24 The battle for Snake Island — https://www.economist.com/europe/2022/06/27/the-battle-for-snake-island

25 Ukraine's Maritime Drone Strikes Again: Reports Indicate Attack On Novorossiysk — https://www.navalnews.com/naval-news/2022/11/ukraine-maritime-drone-strikes-again-reports-indicate-attack-on-novorossiysk

26 Ukrainian forces attack two patrol ships of Russian fleet in south-western part of Black Sea — https://en.interfax.com.ua/news/general/934984.html

27 Russian ship hit in Novorossiysk, Black Sea drone attack, Ukraine sources say — https://www.bbc.com/news/world-europe-66402046

28 The moment Ukraine used an experimental drone to attack a Russian bridge — https://edition.cnn.com/2023/08/15/europe/ukraine-crimea-bridge-drone-strike-video-intl/index.html

29 Sea mines: the deadly danger lurking in Ukraine's waters — https://www.theguardian.com/world/2022/jul/11/sea-mines-ukraine-waters-russia-war-black-sea

projection at sea and from the sea. The limitations are the result of following fact — a significant part of Russia's power projection capabilities to effect situation at sea is related with platforms located on the occupied peninsula (helicopters and combat planes, SAMs, anti-ship missiles).[30] So far, Ukrainian naval weapons systems do not allow to inflict a major damage while projecting power from the sea towards land-based capabilities. As a result, air-launched cruise missiles, UAVs of various types, modified Ukrainian-made cruise missiles for ground strikes are actively used to inflict damage on land-based capabilities in temporary occupied Crimea. Ultimately, such a situation proves that only complete liberation of Crimea can guarantee freedom of navigation and security in the Black Sea.[31] Otherwise, it will only be a question of minimizing Russian Crimea based military threats through Ukrainian combined actions from the sea, as well as air-to-land and land-to-land strikes.

Thus, naval combat operations provide invaluable real-world experience. It must be used for future naval military development in terms of appropriate capabilities, based on prospective tasks and constraints. Until February 24, 2022, two approaches to naval capabilities development had been discussed in Ukraine — asymmetric and symmetric.[32] The asymmetric approach emphasized the development of capabilities that would make it impossible for the enemy to project power at sea — land-based anti-ship missile systems, missile boats, unmanned surface and underwater platforms of various types, mines barriers. The symmetrical approach emphasized the development of corvette-type surface ships. The development of events proved the promise of the asymmetric approach, which made it possible to solve most of the problems of naval warfare. Likewise, hostilities in the northwestern Black Sea have generally demonstrated that in littoral waters the advantage ultimately shifts to the side that emphasizes denial strategies. And it is possible to perform the corresponding tasks with a minimum investment of resources, considering the evolution and cheapening of technologies.

30 In Satellite Images Of Russian-Occupied Crimea, Experts Point To Potential Targets For Ukraine — https://www.rferl.org/a/ukraine-crimea-satellite-russia-targets/32176768.html

31 Nuland: US supports Ukraine striking targets in Crimea — https://kyivindependent.com/nuland-us-supports-ukraine-striking-targets-in-crimea

32 Strategy of the Naval Forces of the Armed Forces of Ukraine 2035 — https://navy.mil.gov.ua/en/strategiya-vijskovo-morskyh-syl-zbrojnyh-syl-ukrayiny-2035

Land Warfare. From Defense to Offense

Despite importance of the other two physical domains of warfare (especially air one) for the hostilities' dynamics after February 24, 2022, the war between Ukraine and Russia is primarily the largest land war in Europe. Conduct of defensive and offensive operations with the aim of preserving or reinstating of control over the relevant landmasses remains the key in this domain.

Based on the nature of hostilities after February 24, 2022, Defense Forces of Ukraine must be able to conduct both defensive and counteroffensive/offensive operations — quickly transitioning from defense to offensive to prevent the enemy from regrouping and creating a defense in depth system. The purpose of defensive operations is to exhaust the enemy's offensive potential, minimize the enemy's inroads into its own territory and create the conditions for a quick and decisive transition to a counteroffensive. During 2022–23, Ukraine demonstrated relevant examples of both maneuverable and static defense.

On the other hand, only counteroffensive/offensive operations can fully solve the task of infliction an appropriate level of damage and liberation of temporarily lost territories, which is a prerequisite for a political settlement on favorable terms. During 2022 Defense Forces of Ukraine carried out several successful counteroffensive operations, which made it possible to liberate temporarily lost territories and inflict an appropriate level of damage on the enemy. At the same time, conducting a classic offensive operation in the conditions of enemy's defense in depth augmented with obstacles turned out to be a challenge for the Defense Forces of Ukraine, as the offensive operation in the Tavria direction which began in June 2023, made evident. Relevant experience should be considered to ensure an appropriate capability development for future land warfare.

Before talking about the relevant capabilities necessary for conduct of various types of land operations, it is worth noting the main trends in the evolution of the means of warfare, which have a direct impact on the forms and methods of using forces in the land domain, namely:[33]

- Increase in the number of different types of weapon systems for conducting so-called non-contact warfare.
- Large-scale use of unmanned aerial vehicles of various types both for conducting reconnaissance in real time and increasingly for inflicting damage.

Taken together, the relevant trends create a fundamentally different battlefield dynamics than the one considered classic after WWII. Instead of a clear division between the front, where forces exchange strikes, and the rear, where regrouping is carried out, the line between the front and the rear is increasingly blurred. For sure, the main exchange of strikes takes place in the so-called tactical and operational depth. However, today the relevant technologies allow to solve following tasks more fully — as isolation of the theatre of hostilities from reinforcements, destruction the command & control and support systems and destruction of the priority elements of the enemy's combat structure like EW, SAMs, artillery systems. It ultimately creates the basis for large-scale use of the maneuver component. Similarly, the emphasis of combat is shifting from massing and maneuvering of significant ground formations to primarily acquiring, holding and exploiting dominance in situational awareness and firepower, as the armed conflicts of the past 30 years have amply demonstrated.

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33 Jack Watling "The Arms of the Future: Technology and Close Combat in the 21st Century: Technology and Close Combat in the Twenty-First Century (New Perspectives on Defence and Security)"

Since neither side was able to seize, hold and exploit air superiority the war between Ukraine and Russia turned primarily into a confrontation between the missiles and artillery forces of both sides. With a high degree of probability, any large-scale hypothetical confrontation between Ukraine and Russian in the future would also come down to a confrontation between missiles and artillery forces supplemented by UAVs of various types for fire dominance.

Under these conditions, the development of missiles and artillery forces becomes the most priority task in terms of building the capabilities of the Defense Forces of Ukraine to conduct successful actions on land both in defensive and offensive modes. Quantitative and qualitative strengthening of missile and artillery forces was one of the key priorities of the development of the Defense Forces of Ukraine in 2014–2021.[34] It is also not surprising that the strengthening of this component has become a priority task within the framework of the "Ramstein format" since mid-April 2022.[35] That is, from the moment when Ukraine mostly ran out of its own stocks of ammunition for Soviet-style artillery — on which the Defense Forces of Ukraine relied as part of foiling of the enemy's original blitzkrieg plan.

Ukraine was promised and received from international partners up to 540 Western-style different types of howitzers of 155 mm caliber and 126 howitzers of 105 mm caliber.[36] Also, Ukraine received more than 2 mln munitions of 155 mm caliber and 800 thousand munitions of 105 mm caliber of HE types from the USA alone during the last 1.5 years.[37] The corresponding amount turned out to be enough to stabilize the front line and conduct defensive/counter-offensive operations. However, this number proved to be not enough for the complete seize of fire dominance, which is defined as one of the conditions for conducting of successful offensive operations.

Although the corresponding amount of ammunition may seem significant for comparison Russia spent and lost up to 11-12 million artillery ammunition in 2022. According to preliminary estimates, in 2023 the corresponding number may reach 7 million munitions.[38] In fact, by emphasizing "accuracy in contrast to the mass of fire", Ukraine managed to minimize to a certain extent Russian superiority in the number of artillery barrels and ammunition for them. However, Ukrainian emphasis on accuracy is complicated by the active employment of Russian electronic warfare and SAMs, which destroy/complicate the work of reconnaissance UAVs of various types, which in turn are used for reconnaissance purposes.[39]

High-precision MLRS of the M142/270 type are equally important segment along with barrel artillery. According to the US MLRS of M142/270 type should become the basis of the firepower of the Defense Forces of Ukraine in the future.[40] Indeed, the supply and employment of the

34 RUSI "Preliminary Lessons in Conventional Warfighting from Russia's Invasion of Ukraine: February-July 2022" — https://rusi.org/explore-our-research/publications/special-resources/preliminary-lessons-conventional-warfighting-russias-invasion-ukraine-february-july-2022

35 Artillery is playing a vital role in Ukraine — https://www.economist.com/europe/2022/05/02/artillery-is-playing-a-vital-role-in-ukraine

36 Answering The Call: Heavy Weaponry Supplied To Ukraine — https://www.oryxspioenkop.com/2022/04/answering-call-heavy-weaponry-supplied.html

37 IMMEDIATE RELEASE Fact Sheet on U.S. Security Assistance to Ukraine September 7, 2023 — https://media.defense.gov/2023/Sep/07/2003296114/-1/-1/0/UKRAINE-FACT-SHEET.PDF

38 Kim Jong Un's visit to Russia hints at grim battlefield math for Putin — https://www.washingtonpost.com/world/2023/09/14/putin-kim-artillery-north-korea-ukraine

39 Russia's jamming of US-provided rocket systems complicates Ukraine's war effort — https://edition.cnn.com/2023/05/05/politics/russia-jamming-himars-rockets-ukraine/index.html

40 The Pentagon announces an additional $1.1 billion in long-term aid for Ukraine — https://www.nytimes.com/2022/09/29/world/europe/the-latest-us-military-package-for-ukraine-calls-for-1-1-billion-in-long-term-aid.html

relevant systems together with the precision guided munitions of M31 type during the end of June to the beginning of September 2022 made it possible to stop Russian artillery offensive in the eastern Ukraine as well as to prepare the basis for successful counteroffensive actions in the Kharkiv and Kherson regions by disrupting the system of command and support of Russian troops. In total, according to the estimates of the then head of the US JCS general Mark Milley by the beginning of September 2022, the M142/270 systems had destroyed up to 400 Russian priority targets.[41] However, the corresponding effect of the use of MLRS began to decrease from the fall of 2022 due to the decentralization of the command and support system, the withdrawal of more important objects beyond the range of the M31 ammunition and the use of EW systems.

As a result, acquisition of short-range cruise and ballistic missiles (up to 500 km) has become important task for Ukraine. To date, Ukraine has received from UK and France air-based cruise missiles of the Storm Shadow/SCALP-EG type (range up to 280 km) with a high-explosive fragmentation warhead, as well as ballistic missiles of the ATACMS type (range of up to 165 km) with a cluster warhead. The corresponding number of missiles proved to be not enough for the complete isolation of the theatre of the offensive action, destruction of Russian command & control and support systems. However, the corresponding missiles were effectively used in September-October 2023 as part of strikes targeting infrastructure of Russian Black Sea Fleet with the aim of guaranteeing freedom of navigation and squeezing the Black Sea Fleet out of the temporarily occupied Crimea, as well as against air defense systems and helicopters.[42]

Along with various fire systems in form of missile and artillery forces, the second priority capability for land domain warfare are intelligence, surveillance and reconnaissance systems, as well as strike function associated with unmanned arial vehicles (UAVs) of various types. Combination of ISR means based on UAVs and missile & artillery systems allowed the Defense Forces of Ukraine to create appropriate reconnaissance-fire and reconnaissance-strike complexes and achieve proper fire accuracy in contrast to the mass of fire emphasized by Russian Armed Forces. ISR capabilities based on UAVs technology are divided into at least 3 categories — depending on the depth of intelligence gathering and ensuring successful employment of the corresponding fire systems:

- Means of tactical reconnaissance of the company/battalion levels, which detect targets primarily for mortars, grenade launchers and tactical loitering ammunition (based on FPV drones), and also direct their operation. In this case, we are talking about civilian UAVs of the Mavic DJI 3 type.
- Reconnaissance equipment of separate brigade artillery groups. This niche is filled by Furia or Leleka-100 type systems.
- UAVs such as PD-2 or Shark which are used by separate barrel and MLRS artillery brigades that work at operational-tactical depth.

Today, massive loss of relevant systems given effective employment of Russian air defense and electronic warfare systems is the one of key problem. First of all, it concerns the tactical level

41 The American Guided Rockets Helping Ukraine Destroy Russian Forces — https://www.nytimes.com/2022/09/09/us/ukraine-weapons-rockets.html

42 Ukraine hits HQ of Russia's symbolic Black Sea navy — https://www.bbc.com/news/world-europe-66887524
Destruction From Ukraine's First ATACMS Strike Now Apparent — https://www.thedrive.com/the-war-zone/destruction-from-ukraines-first-atacms-strike-now-apparent

UAVs of the Mavic DJI 3 type.[43] Massive production of tactical level reconnaissance UAVs to reduce dependence on Chinese production capacities in the relevant segment has appeared as major task. As today there is a paradoxical situation when PRC manufacturers dominate the segment of high-quality civilian UAVs used for tactical level intelligence.

Development of kamikaze UAVs based on FPV technology has become next logical step in the employment of UAVs technologies in Ukraine-Russia war.[44] These systems began to be used more and more actively in the framework of the 2023 campaign to compensate for the lack of firepower (because of the lack of standard artillery and ammunition for them). Kamikaze UAVs proved to be an effective means from the point of view of "resources allocated — result produced", forcing to look for various countermeasures such as anti-cumulative grids or portable EW systems. No less significant was the enemy's use of Lancet-type UAVs, which turned out to be a serious tool of destruction against self-propelled howitzers, radars, air defense and aviation of Ukraine.[45] At the same time, UAVs of the Bayraktar TB2 type demonstrated the maximum effect as an autonomous reconnaissance and strike complex before the deployment of Russian integrated air defense system.[46] Now, the role of the Bayraktar TB2 UAV is mostly limited to reconnaissance.

Another critically important direction, along with recon-strike capabilities, is their proper protection. It is primarily related to the development and fielding of Ground Forces' air defense systems. The relevance of the protection is vividly demonstrated by the active use of UAVs by the Russian Armed Forces both for conducting reconnaissance and for inflicting damage, as well as more classic attack helicopters and aviation. Ukraine received from its partners various means of providing air defense of the Ground Forces — MANPADS, anti-aircraft missile systems of the Stormer and Avenger types, anti-aircraft artillery systems of the Gepard type. However, Ukraine faces the dilemma of simultaneously providing the country's air defense and air defense of the ground forces. As a result, part of the above-mentioned systems was redirected to the air defense of the country's critical infrastructure. In addition, the Avenger or Gepard type systems are insufficient in the conditions of the enemy's use of attack helicopters with modern ATGMs or aircrafts with stand-off loitering munitions.

Electronic warfare (EW) and electronic intelligence (ELINT) have proved to be an equally important segment.[47] EW systems turned out to be Russian asymmetric advantage, which made it possible to complicate the work of Ukrainian reconnaissance-strike and reconnaissance-fire systems both in segmental reconnaissance and guided munitions application. At the same time, high-quality ELINT ensures better understanding how intensively enemy employ different frequencies, sources of those emittances and make better targeting of those sources.

In general, the ability to conduct effective land combat operations is not limited to missiles and artillery forces, UAVs based ISR and strike capabilities, air defense of land formations and

43 New Report: Ukraine Drone Losses Are '10,000 Per Month' — https://www.forbes.com/sites/davidhambling/2023/05/22/ukraine-drones-losses-are-10000-per-month

44 Trenches and tech on Ukraine's southern front — https://www.economist.com/europe/2023/10/29/trenches-and-tech-on-ukraines-southern-front

45 How Russia's homegrown Lancet drone became so feared in Ukraine — https://kyivindependent.com/how-russias-homegrown-lancet-drone-became-so-feared-in-ukraine

46 Are the once-vaunted Bayraktar drones losing their shine in Ukraine? — https://www.defensenews.com/global/europe/2023/10/31/are-the-once-vaunted-bayraktar-drones-losing-their-shine-in-ukraine

47 Ukraine's invisible battle to jam Russian weapons — https://www.bbc.com/news/world-europe-66279650

EW/ELINT. However, this combination of capabilities will remain key in the future in terms of forming favorable contours of the battlefield and conducting defensive/offensive operations on land, provided that neither side can attain, maintain and exploit air superiority.

In in the segment of MBTs/armored combat vehicles of various types the war between Ukraine and Russia has again raised the debate about the excessive vulnerability of armored vehicles.[48] Armored vehicles face an ever-increasing list of threats on the battlefield that is becoming increasingly transparent and deadly. As a result, much of the improvements focus on increasing the survivability of the respective MBTs/vehicles rather than increasing their firepower. It's a telling development itself. On the other hand, the vulnerability of MBTs/armored vehicles does not mean an automatic retirement of them.[49] Ukrainian offensive operation in the summer of 2023 showed that damage to MBT or IFV does not mean the complete destruction of platform, which is often subject to restoration. At the same time crew, which is the most valuable resource, remains intact. Employment of MBTs as ersatz artillery with indirect fire using quality software is no less revealing in terms of battlefield trends.

Similarly, war between Ukraine and Russia showed the importance of comprehensive engineering support of defensive and offensive operations. Ability to quickly create suitable positions for defense as well as the rapid and massive breaching of mines barriers proved to be extremely important. Traditionally various types of combat (operational) support are financed according to residual principle. However, in the conditions of high intensity combat the importance of combat support (primarily engineering) becomes starkly evident. This was well demonstrated withing framework of the Defense Forces of Ukraine offensive operation in the Tavria direction. Russian mine barriers in combination with other means of destruction turned out to be a serious obstacle to the implementation of operation plan. An equally important direction is engineering support for overcoming natural and artificial obstacles.

48 War Will Never Be This Bulky Again — https://www.theatlantic.com/ideas/archive/2022/05/ukraine-russia-putin-war/638423

49 The Tank is Dead… Long Live the Tank. The Persistent Value of Armored Combined Arms Teams in the 21st Century — https://www.armyupress.army.mil/journals/military-review/online-exclusive/2023-ole/the-tank-is-dead

Conclusions

Until February 24, 2022, Ukraine and its Western partners proved unable to build the most fruitful cooperation model in the field of defense, emphasizing their own priorities and refusing to adequately consider the opinion of the other side. For Ukraine, the priority was to obtain equipment and ammunition here and now to strengthen the deterrence effect considering the growing Russian military threat. Our Western partners focused mostly on developing institutions and processes that would ideally ensure better use of limited resources. Events have shown the need to combine both approaches. Along with the development of institutions and processes in accordance with the approaches of NATO countries, it is critically important to systematically obtain the appropriate capabilities for conducting combat operations in the key physical domains of war.

Thus, based on the combat experience after February 24, 2022, and taking into account the relevant tasks that Defense Forces of Ukraine may face in the future, it's possible to identify the following capabilities for combat in the relevant domains for deterrence by punishment effect:

1. **Air.** Anti-aircraft missile/anti-aircraft artillery systems, anti-missile systems, radar systems, 4th generation multifunctional fighters with a full range of weapons.
2. **Naval.** Ground-based anti-ship missile complexes and missile boats, unmanned surface and underwater platforms, means of reconnaissance and surveillance, means of laying mine barriers and combating them.
3. **Land.** Barrel artillery and MLRS, land-based cruise and ballistic missiles, UAVs for conducting reconnaissance and strikes, anti-aircraft defense, EW and ELINT, engineering support.

In the future, relevant elements shall be combined into a single system of C5ISR, which will be able to exchange intelligence data with NATO countries. NATO countries define issue of prospective AI-augmented C5ISR architecture as a key priority for future warfare along with the development of strike systems of proper range, accuracy and mobility.

The described list of capabilities necessary for the Defense Forces of Ukraine to implement relevant strategies and tasks in the three key physical domains of war based on the experience of hostilities after February 24, 2022, is not exhaustive and just a preliminary one. It is rather an invitation for a discussion — as the development of framework political documents between Ukraine and Western countries remains the key task now.

A key challenge, along with proper training to achieve the deterrence effect by acquiring, mastering and demonstrating readiness to use the relevant capabilities, is the issue of funding for relevant policy. In 2019–21, Ukraine was able to achieve overall defense spending at the level of up to 5 billion dollars (2.8-2.9% of GDP) per year — of which up to 1 billion dollars was spent on weapons and military equipment. At the same time, during the last 18 months, Ukraine received $43.7 billion in aid from the United States alone to directly strengthen its defense capabilities. In general, "Ramstein format" countries provided weaponry for 76 billion of dollars.[50] Thus, one of the key issues, along with the definition of the minimum list of capabilities, remains the issue of dividing financial burden of relevant capabilities between Ukraine and international partners. Allocation might hypothetically happen by domains — for example,

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50 Opening Remarks by Secretary of Defense Lloyd J. Austin III at the 15th Ukraine Defense Contact Group (As Delivered) — https://www.defense.gov/News/Speeches/Speech/Article/3529842/opening-remarks-by-secretary-of-defense-lloyd-j-austin-iii-at-the-15th-ukraine

Ukraine takes responsibility for financing capabilities for the land and partly naval domains of war. While the partners directly or indirectly (through the supply of munitions) fund the capabilities for conducting combat operations in the air domain, as the most burdensome in terms of costs.

At the same time, team of the Analytical Department of the Come Back Alive Foundation continues think that Ukraine's accession to NATO in the short term is a more cost-saving option from the point of view of price for guaranteeing the deterrence effect than the development of the minimum necessary range of capabilities for actions in the key domains of warfare by the Defense Forces of Ukraine with assistance from NATO countries.[51]

51 No Alternative. Ukraine's Full Fledged NATO Membership Is The Only Efficient Security Guarantee — https://savelife.in.ua/en/materials/research-en/no-alternative-ukraines-full-fledged-nat-en