

Original article

## The role and place of artillery in combating “Anti-Access/Area Denial” A2/AD systems

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### INFORMATION

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### ABSTRACT

The modern “Anti-Access/Area Denial” A2/AD systems are defined as a combination of all possible measures that can limit the ability of a potential opponent to enter and occupy a given area (operational theatre). Their action relies, among others, on radio-electronic disruption of digital guidance systems, communication, command and control systems, shooting down long-range maneuvering missiles, drones, and aircraft. The primary assumption of the anti-access concept is to deprive the enemy of the possibility of entering a given operational area (A2 – Anti-Access) through long-range destruction and depriving them of freedom of action in that theatre (AD – Area-Denial) by medium and short-range weapons. The Surface-to-Air Missiles (SAM), Anti-Ship Ballistic Missiles (ASBM), and Anti-Ship Manoeuvring Cruise Missile (ASCM) are used to carry out A2/AD tasks. Field artillery has also been used recently, particularly the Long-Range Precision Fires (LRPF).

The purpose of the article is to determine the chance of using field artillery against the A2/AD systems. According to the authors, the NATO forces will lose control in the air in the first period of the conventional conflict with an equivalent opponent, and its rapid recovery will be a priority. Field artillery, as a weapon with ever greater possibilities of precise and deep destruction, can become a decisive factor, allowing dominance of A2/AD systems and enabling the implementation of tasks of its air-force and army aviation, as well as ground forces.

### KEYWORDS

anti-access systems, air superiority, combined arms, artillery

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## Introduction

The modern “Anti-Access/Area Denial” (A2/AD) systems are defined as a combination of all possible measures that can restrict in a multilayered manner a potential adversary’s access to a given area (theater) of operations. Their actions include radio-electronic disruption of

guidance systems, paralysis of communication, communication and digital data transmission systems, shooting down long-range cruise missiles, drones, and aircraft. The primary assumption of the anti-access concept is to deprive the enemy of the possibility of entering a given area (theater) of operations (A2 – Anti-Access) by using long-range means of destruction, in addition to depriving them of the freedom of action in this theater (AD – Area-Denial) by using medium and short-range means of destruction. The Surface-to-Air Missiles (SAM), Anti-Ship Ballistic Missiles (ASBM), and Anti-Ship Manoeuvring Cruise Missile (ASCM) are used to carry out A2/AD tasks. Field artillery has also been used recently, particularly the Long-Range Precision Fires (LRPF).

The experience gained from military operations in eastern Ukraine, Syria, and Libya, as well as the observation and evaluation of the conflict between Armenia and Azerbaijan, allow the conclusion that until one side of the conflict was deprived of the “anti-access” capabilities and the freedom to use unmanned reconnaissance and strike systems, there could be no question of dominance in the air and freedom of action by the ground forces of the other side.

This article is an attempt to show that in the current geopolitical conditions, the Polish Armed Forces, together with NATO allies, in the nearest future, must rebuild their strike and fire capabilities, mainly of the land component, which in the absence of air cover and support will play a significant role in breaking through the enemy’s A2/AD systems. The fire potential of missile systems, especially rocket troops and artillery, which in the initial phase of operations should be at the disposal of the commander of joint forces (the commander-in-chief), should allow him/her in a short time to carve gaps and safe passage corridors out in the enemy air defense system for maneuvering long-range precision missiles, UAVs and aircraft of the Alliance air forces performing tasks of air isolation and direct air support.

The above scenarios and assumptions are perfectly consistent with the current dynamic modernization of the Polish artillery coupled with the announced introduction of modern types of artillery and rocket ammunition, including precision-guided munitions that enable effective fire strikes from zones free of enemy artillery influence. Nevertheless, the process should go hand in hand with fundamental changes in tactics of rocket troops and artillery in combat operations, in the system of shooting and fire control and, most importantly, with changes in the process of training Polish artillery people.

## **1. Research methodology**

The purpose of this paper is to determine the ability of artillery to combat the anti-access A2/AD systems, realized through precision strikes at increased firing rates under Long-Range Precision Fires (LRPF).

The authors assume that in the event of a full-scale conflict when clashing with a peer adversary, in the initial period of operations, NATO air forces may lose their ability to maintain air superiority and perform ground force support tasks as the result of the impact of the enemy A2/AD systems. Under these conditions, missile troops and artillery may become critical participants on the battlefield. Modern artillery possessing new, unprecedented precision and deep-range capabilities can destroy and overpower anti-access systems of a potential adversary, thus creating conditions for regaining air superiority and free task execution by the air forces of the Alliance.

The hypothesis formulated above necessitates the formulation of several problematic questions: How will the acquisition of HIMARS missile systems for the Polish Armed Forces and

further development of “KRAB” howitzers affect the capabilities of the land component in terms of deep strike capabilities? What capabilities will the Polish Armed Forces have to fight against the “Anti-Access/Area Denial” A2/AD systems of a potential enemy in case of a large-scale armed conflict on NATO’s eastern flank? What changes in theory and practice are required in artillery tactics and instructions for firing and directing ground artillery fire in the conditions of having modern combat armament on equipment?

Having applied theoretical scientific methods, especially the review of literature and materials presenting the latest NATO operations, the authors concluded that in the current NATO concept of conducting air-land operations, the air forces provide almost 80% of the entire firepower. Therefore, on a hypothetical area of future operations in the conditions of interaction with the potential opponent’s A2/AD systems, the fire potential of the Alliance forces could not be used to fight against the elements of anti-access systems [1]. Therefore, to conduct combat operations during a hypothetical armed conflict on the periphery of NATO’s north-eastern flank, especially in its first phase, the concepts binding in NATO on conducting air-land operations must be reevaluated, and the strategic and operational plans updated. In the view of the authors of the article, under these conditions, artillery will play a key role in the fight against the enemy’s A2/AD system elements. Thus, when planning a new role that can be assigned to the artillery, one should consider that the armed forces of NATO countries currently do not have a sufficient potential of ground means of destruction. In the event of a full-scale armed conflict, the shortage of ground-based missile systems and means of destruction may lead to the destruction of allied troops in confrontation with the numerically superior missile and artillery forces of a hypothetical opponent. Moreover, one should be aware that in conditions of the superiority of a potential adversary’s air defense systems, any attempt to use allied air forces, e.g., to conduct air isolation or direct air support of fighting troops on the ground, in this phase of operations will be burdened with a very high probability of losses.

The authors are convinced that the topics addressed in this article have not yet been reflected in any current artillery doctrinal document.

## **2. Elements of the “Anti-Access/Area Denial” A2/AD system of a hypothetical enemy**

For years, potentially weaker states have been developing their A2/AD installations based on radar systems, air defense missiles, land-to-ground, and land-to-water class missiles, designed to isolate areas of the battlefield and perform strikes against the various land and sea targets, as a counterbalance to the technological superiority of NATO armed forces, especially the U.S. Army. The systems are intended to deny a more robust enemy access to areas of operations, especially by air. It is estimated that Russia currently has the best-developed A2/AD system. “Defensive Bubble” is the colloquial name the Russians use for the system, which is a combination of many sets of weapons, including electronic warfare, anti-aircraft, and anti-ballistic missile and radar systems, long-range cruise missiles, ballistic missile arrays, UAV systems, and other means of precise destruction aimed at ground and sea targets. The Air and Space Forces, having anti-aircraft defenses with missile sets of various types, including the S-300 and S-400, “Buk”, “Tor”, “Pancyr”, and “Tunguska” at disposal, constitute the core of the Russian Federation’s A2/AD system. Apart from stationary installations, the Russians have numerous mobile sets that can be quickly maneuvered, making their own “anti-access” defense capabilities more flexible. The Russian A2/AD strategy involves anti-aircraft missile

sets and a variety of radio-electronic warfare (EW) means and systems. The 1RŁ257 “Krasukha-4” sets are hazardous since, in addition to their ability to jam radiolocation signals, they can intercept and jam signals emitted by reconnaissance satellites, early warning aircraft, unmanned aerial vehicles, and ground guidance stations. Mobile universal strategic digital radio-electronic warfare systems of the “Krasukha” type with an effective range at distances of 150 to 300 kilometers are a key A2/AD component. Those systems can also be supplemented with ground-based artillery and rocket sets to attack both surface and surface targets at distances of 120 kilometers and beyond, including precision-guided munitions. For example, the Russian mechanized brigade, in comparison to its Polish counterpart, has a smashing advantage in both artillery firepower and EW capabilities, having over 80 different guns and rocket launchers and a battalion for radio-electronic warfare in its structure.

Most of the Russian large military formations, especially those forming part of the Western Military District, have “anti-access” defense systems already at the division, brigade, and battalion level. The combat potential accumulated on the Kaliningrad Region territory and the Western Military District, and recently also on the territory of Belarus, is currently the main threat to the Alliance forces within NATO’s north-eastern flank. The Russian Federation has a considerable advantage of artillery and rocket fire and A2/AD interaction in that area. It means that in the event of an outbreak of conflict, it will be able to affect with impunity objects located in the immediate area of operations and destroy and incapacitate troops approaching the areas of operations and the second echelons deployed in the areas of concentration (exit) and centralization. Besides, it will also control the airspace of Lithuania, the southern part of Latvia, and northern Poland. A critical element of the A2/AD system in the Kaliningrad Region is the “Voronezh-DM” radar station, which can control the airspace not only over the Baltic Sea but also over the area of almost entire Northern Europe, at the distance of up to 6,000 km.

The core of the ground forces in the Kaliningrad Region is the 11<sup>th</sup> Army Corps, whose offensive asset is the missile forces, officially equipped with the “Tochka-U” and “Tochka-M”

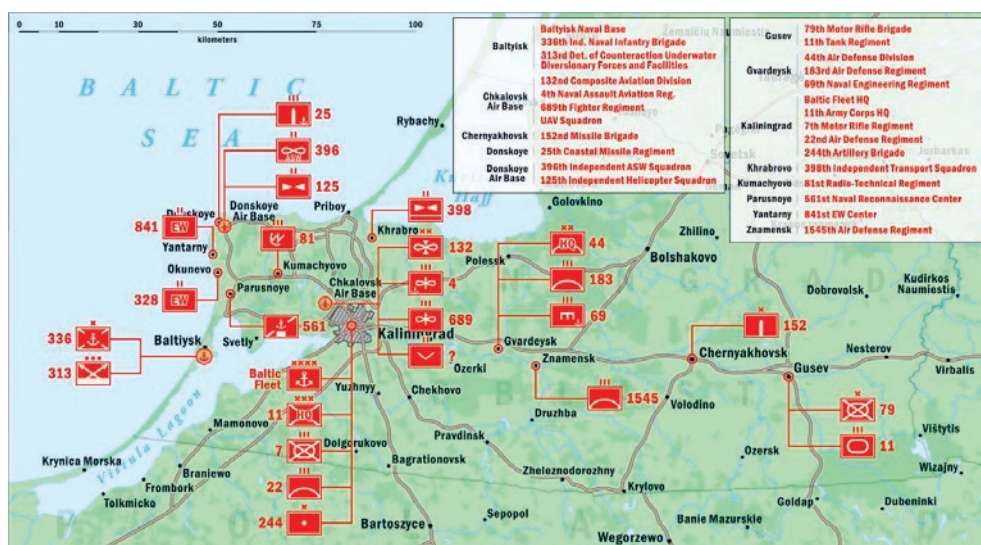


Fig. 1. The fighting forces in the Kaliningrad Oblast  
 Source: [2, p. 43].

missile systems (NATO code: SS-21 Scarab), and unofficially with "Iskander-M/K" sets (NATO code SS-26 Stone). In early December 2017, Russian media reported that the 152<sup>nd</sup> Guards Missile Brigade was equipped with new "Iskander-M" missile sets in the Kaliningrad Region. About 14 special mobile hangars dedicated to the Iskander missile system (TMU) have been built in the 152<sup>nd</sup> Brigade base. Missiles of that system, made in stealth technology, can theoretically hit targets almost all over Poland, also reaching Berlin and Stockholm. On the other hand, the "Kalibr-NK" missiles can also threaten most of Western Europe. Moreover, the Russian military intends to increase the number of "Iskander" launchers soon in its missile brigades from 12 to 16, which will increase their capability to strike up to 32 targets simultaneously [2, p. 44]. According to press reports, the "Iskander" system has recently been integrated into the equivalent of the Russian targeting system through the Russian military Internet. The 244<sup>th</sup> Artillery Brigade, equipped with BM-27 Uragan and BM-30 Smerch heavy rocket launchers and stationed in Kaliningrad, is another essential support element of the 11<sup>th</sup> Corps. After firing 12 rockets in 38 seconds, the Smerch launcher reaches mission capability after about 25-35 minutes (reloading time). One Smerch launcher can cover about 67 hectares with one volley, compared to 4 hectares for BM-21 and 29 hectares for BM-27 [3].

On the territory of the Western Military District, the Kaliningrad Region and Belarus one can distinguish several missile and artillery systems that should be included in the priority lists of NATO targets to be attacked by artillery and missile systems of the allied forces. According to the authors of the article, the most important facilities may include:

- S-400 and S-300PS and "Tor" air defense systems,
- P-800 "Oniks" hypersonic anti-ship cruise missiles (NATO code: SS-N-26 Strobile) from the K-300P "Bastion-P" mobile coastal missile complex (NATO code: SS-C-5 Stooze) with a range of about 450 km; the system also has the capability of strike land targets,
- missiles X-35 "Uran" from the coastal rocket complex "Bal/ZK60" (NATO code: SSC-6 Sennight) with a range of 120 to 260 km [4],
- mobile water-water class P-35 "Riedut" missile complexes with P-35 supersonic anti-ship missiles with a range of up to 250 km [5],
- mobile sets of ballistic missiles of the "ground-to-ground" class of the "Iskander-M" system (in NATO code: SS-26 Stone) with an official range of up to 500 km, unofficially even up to 1500 km,
- ships equipped with 3M14 "Kalibr" system cruise missiles with a range of up to 2500 km; they can also be fired from mobile launchers of "Iskander-K" system,
- mobile rocket sets "Polonez" with a range of up to 200-300 km [6],
- mobile ballistic missile sets of "Tochka-U" system with range up to 120 km and "Tochka-M" with a range of up to 185 m,
- mobile rocket launchers of BM-21 "Tornado-G" system with a range of up to 40 km, BM-27 "Uragan" with a range of up to 70 km and BM-30 "Smerch" with a range of up to 90 km, and recently even up to 120 km for the "Tornado-S" system.

The above list proves that apart from effectively blocking access of air forces and unmanned aerial reconnaissance systems to the area of operations within the Suwalski Isthmus, the other side is likely to possess enough forces and means of destruction to effectively affect ground and sea targets located at the entire depth of the operational grouping of Alliance forces. Despite NATO's intensive reconnaissance of the military potential gathered on the





Fig. 2. The fighting forces in the Western Military District

Source: [2, p. 5].

periphery of the “eastern flank”, it remains a great unknown that can be analyzed and assessed only very roughly, mainly based on reports and media coverages.

### **3. Trends in the development of NATO artillery to combat “anti-access” A2/AD systems**

NATO armed forces must be prepared to operate under conditions of disruption and lack of air support. Such a state of affairs will continue until the potential of the enemy’s integrated air defense is reduced, and conditions are created to win air superiority and bring allied air forces into the fight. In this phase of the conflict, one should expect massive artillery and missile strikes with cruise missiles and precision-guided munitions aimed at, among other things, airfields, ports during the unloading and integration of troops, critical infrastructure facilities, command posts and centers, and military concentration areas. Consequently, it will be necessary to employ advanced NATO Alliance Ground Surveillance ISR platforms and systems, primarily RQ-4 Global Hawk unmanned aerial vehicles with reduced electromagnetic visibility spectrum, supplemented by a fleet of AWACS 20 E-3 reconnaissance aircraft operating at a ceiling that will provide them with unobstructed reconnaissance capability. The U.S. satellite systems are likely to be able to guarantee Alliance forces uninterrupted data transmission, land navigation, target tracking, and localization, precision munitions guidance, and corrective fire, as well as to conduct active radio-electronic warfare to disrupt and overpower the Russian A2/AD systems [7, p. 31].

The U.S. Army has been working for some time on the concept of the so-called “multi-domain operation”, which involves conducting combat operations in the conditions of armed conflict with the participation or involvement of the Russian and Chinese Armed Forces. It is expected that in the initial phase of the operation, there will be no possibility of using long-range precision airborne means of destruction, which will further negatively affect the ability of other branches of armed forces to conduct operations. Therefore, artillery, especially long-range precision fires (LRPF), can create the conditions to win air dominance by executing precision strikes. To this end, the U.S. artillery modernization programs have divided artillery into three groups: tactical – close range, operational – deep range, and strategic – with a range exceeding 1000 km [8, p. 29]

The tactical artillery is intended to include barrel artillery systems (including mortars) with a maximum firing range of just over 100 kilometers and eventually up to 200 kilometers. The ERCA (Extended Range Cannon Artillery) program plans to rearm the existing 155 mm M777 (towed) and M109 (self-propelled) systems with new 55-caliber (for M777) and 58-caliber (for M109 A7 Palladin) barrels and extended cartridge chambers for both guns to accommodate an additional seventh modular propellant charge. A 155 mm ammunition, designated XM1113, was developed for the new guns [8, p. 29]. Additionally, the M109 A7 howitzer is to be equipped with an automatic loader providing it with a firing rate of up to 6 shots per minute.

The operational artillery will consist of the M270 MLRS (Multiple Launch Rocket System) and M142 HIMARS (High Mobility Artillery Rocket System) rocket systems, which are expected to have a maximum firing range of up to 700 kilometers with Precision Strike Missiles (PrSM). The primary task of this type of artillery will be to limit the maneuvering capabilities of the enemy, combat their air defense systems, moving land and sea targets [9]. As part of increasing the striking power of U.S. rocket artillery, it is planned to increase the maximum range for 227 mm missiles in the GMLRS-ER version to 170 km. Ultimately, the HIMARS kit is to be integrated into the Integrated Air and Missile Defense Battle Command System (IBCS). In this way, 607 mm ATACMS (Army Tactical Missile System) missiles will be able to be integrated into the anti-ballistic missile defense system (detection and destruction of enemy missile launchers) [8, p. 31].

The strategic artillery is to comprise two systems:

- an electromagnetic gun, within the Strategic Strike Cannon Artillery (SSCA) system, with an anticipated maximum firing range of up to 1,600 kilometers,
- a two-stage rocket system consisting of a maneuvering hyper-sonic missile with a velocity of up to 5 Ma, carried by an SFM (Strategic Fires Missile) carrier, which is expected to have a maximum firing range of up to 1,400 nautical miles (about 2,250 km). The advantage of that solution, especially when breaking through enemy air defenses, will be the ability to defeat the anti-missile systems included in it [8, p. 32].

In addition to modernization efforts, the U.S. Army is adapting applicable artillery use doctrines to the conditions of multi-domain warfare. The new concept of field artillery attaches great importance to its interaction with other branches of armed forces, mainly with the air force, especially with tactical aviation and air defense systems. Such interoperability consists in their inclusion in the integrated system of acquisition of reconnaissance data for artillery fire. Under the Joint Fires concept, U.S. rocket artillery fires using MLRS and HIMARS launchers at targets designated by Air Force and Navy fighters. It has been proven during many exercises that this type of interaction can play a critical role under conditions of the “anti-system” A2/AD interference, as pointing of targets for artillery from very high altitude (beyond the range of A2/AD systems) by air force aircraft equipped with precision reconnaissance systems can be carried out in an undistorted manner.

Modernization makes the U.S. field artillery still ready to operate in current battle-field conditions. The doctrine mentioned above is moving away from the concept of prolonged surface strikes against targets with conventional munitions to precision strikes, whereby many targets can be eliminated more quickly and effectively. By increasing the firing rate of conventional artillery agents, they can be moved beyond the effective range of enemy artillery, thus avoiding counterfire and the interference range of “anti-access” systems. The long fire range will enable the artillery to strike targets located deep within the enemy grouping and on the wings. What is more, maneuvering fire can be performed without the need for a time-consuming subunit maneuver.

#### **4. Desired capabilities of the artillery of the Polish Armed Forces as an element of combined arms in reducing the potential of the A2/AD system**

In this part of the article, the authors attempt to indicate the capabilities that the Defense and Artillery Forces of the Polish Armed Forces should achieve in order to be able to play a crucial role in carrying out the tasks of fire support of the Allied forces in a large-scale armed conflict, in conditions where it is not possible to win an advantage by the Allied air forces.

Nonetheless, consideration of this issue should begin with analyzing one of the scenarios developed by experts from The Jamestown Foundation. They concern the variant of NATO's conducting the collective defense of the Baltic States within the “Suwalski Isthmus” and on the border with Kaliningrad [7, p. 33]. According to its assumptions, Polish tactical units will constitute a fundamental land component of the Alliance armed forces, which will be engaged in conducting combat operations in that area.

The variant provides for conducting offensive operations consisting of land strikes on the Kaliningrad Region area to destroy forces deployed there and neutralize elements of the A2/AD





planning and conducting EBAO operations (Effects Based Approach to Operations). These are targeted and based on predictable effects of, for example, artillery fire, allowing to achieve assumed objectives. In 2016, the Minister of National Defense approved the Concept for the Organization and Operation of Targeting in the Polish Armed Forces, which precisely described systemic solutions for the organization, operation, and coordination of the targeting process. The concept aimed to increase the awareness of commanders at various levels of command and organizational levels of the Polish Armed Forces about the importance of targeting process in planning and conducting combat operations and creating NATO compatible targeting organizational structures in the Polish Armed Forces.

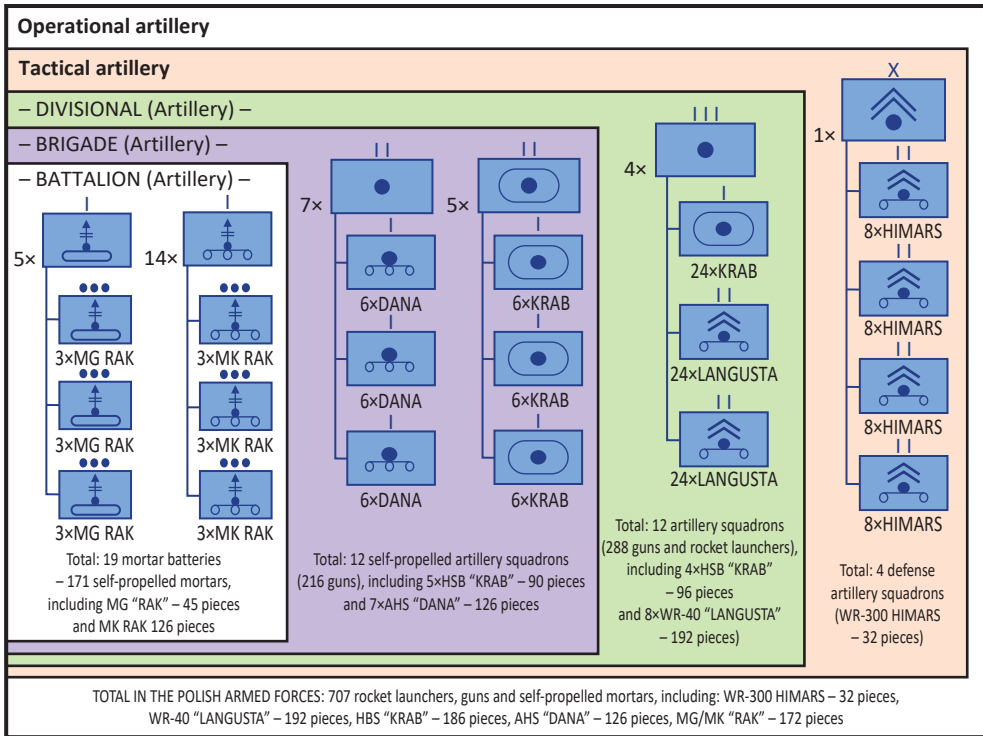
The artillery's division, capacity, and striking precision. In the near future, the Polish Armed Forces are supposed to have adequate striking capabilities at all levels of command. To this end, the authors recommend the following variant of dividing artillery to carry out attack tasks:

The operational artillery, which would include a tactical artillery compound – the Rocket Artillery Brigade – subordinated to the commander of the land component, and in combat conditions – to the commander of the joined forces. The Rocket Artillery Brigade would consist of four rocket squadrons equipped with HIMARS rocket launchers. The number of squadrons should result from the number of tactical compounds for the benefit of which they will carry out missile tasks. Under the conditions of the existence of four divisions in the land component of the Armed Forces of the Republic of Poland, adequately to their number, a rocket brigade should have four bipartite (four HIMARS launchers in each battery) rocket squadrons. The Rocket Artillery Brigade, with GMLRS and GMLRS ER missiles, would be capable of striking targets at depths of up to 150 km, and with ATACMS tactical missiles up to 300 km, eventually also up to 700 km. In the future, the Rocket Artillery Brigade, using Prototype Precision Strike Missiles (PRSM), will also combat mobile land and surface (sea) targets, making it a complement to the coastal defense system.

The tactical artillery would include four artillery regiments of tactical unions, equipped with "KRAB" artillery sets. The HBS "KRAB" can fire all NATO artillery shells of 155 mm caliber, including cluster shells such as M864 DPCIM, SMArt 155, FFV BONUS, or M898 SADARM, to destroy tanks, armored vehicles, and self-propelled guns effectively. Whereas, when firing conventional fragmentation and demolition ammunition, it will be able to hit the target with an accuracy of several meters, at maximum firing ranges of up to 120 km. In this case, in conventional ammunition, special-purpose Precision Guidance Kit (PGK) fuses can be used instead of standard fuses; their design makes the maximum evasion of the projectile from the target not exceed 50 m regardless of the firing distance [10]. Another fire means at the tactical level are artillery rocket launchers WR 40 "LANGUSTA", which, using various ammunition packages, including 122 mm, 160 mm, and 305 mm, will achieve the ability to hit targets at ranges from 40 to 150 km. Whereas the artillery squadrons of general military units equipped with the above mentioned "KRAB" and "DANA" howitzers modernized to 155 mm caliber (after the unification to 155 mm caliber with the target firing capacity of 40 km) and battalion mortar batteries equipped with modern MK and MG "RAK" mortar systems will be able to perform tasks of close and deep fire support, using the ammunition with increased capacity at firing ranges of up to 20 km.

Modernization and autonomy of artillery. Obtaining the appropriate level of fire effectiveness is conditioned by the possession of a high rate of fire of threaded means of fire, which should be at the minimum of 6 shots per minute according to the newest opinions. The cannons currently used by the Polish artillery have a rate of fire of 3-4 shots per minute. Therefore,

**DEFENSE AND ARTILLERY FORCES – VARIANT**



**Fig. 4.** Organizational structure the defense and artillery forces – variant  
*Source: Own study.*

as a part of further development of the “Regina” program, it would be advisable to consider further modernization of the “KRAB” howitzers, which would consist in equipping them with fully automatic loading systems and equipping the “KRAB” cell casts with new ammunition trucks on the same chassis as the gun. Such actions would solve the problem of too low rate of fire of “KRAB” and would allow executing fire tasks with the use of ammunition directly from the ammunition truck warehouse, without the end of using up the stocks being on the gun and replenishing the ammunition stocks in the gun without maneuvering the howitzer to the ammunition points. Another essential task in this area is the need to undertake technical modernization of 152 mm 1977 “DANA” howitzer. Its modernization should mainly concern rearmament and unification of the barrel to 155 mm caliber. Moreover, the cannon should be equipped with systems enabling full autonomy and integration of the “DANA” subunits with any “NATO” C4I command and fire control system.

The artillery life span. The artillery maneuver areas (AMAs) should first be moved out from under enemy counter-battery fire to increase the viability of artillery on the battlefield. That means moving the AMA away from the line of contact of the troops, which has been made possible by a significant increase in firing volume and unprecedented fire precision. Another critical factor is the re-arming of guns and launchers to a minimum of STANAG 4569 level 2. It is exemplified by the German Panzerhaubitze-2000, whose armor provides level four protection. Although it seems impossible to counterbalance the numerical superiority of a hypothetical enemy’s artillery, the critical factor will be the limited time of the guns and

launchers staying at their firing positions from the moment when the target firing begins until the execution of the crossfire maneuver. This time should not exceed 3 to 4 minutes. Another fundamental challenge in the area of improving the viability of artillery is to ensure its proper level of camouflage and to equip it with the Vehicle Active Protection Systems (APS), allowing it to avoid being hit by a variety of enemy anti-tank means, including unmanned reconnaissance and strike systems and “kamikaze drones” which, as the experience of military operations in Nagorno-Karabakh showed, proved to be a very effective weapon against armored vehicles and self-propelled guns and rocket launchers, even those on the move and located in well-camouflaged and engineered deployment (centered) areas.

To avoid losses from Friendly Fire, especially from aviation, guns and rocket launchers should be equipped with the Identification Friend or Foe (IFF).

Updating doctrine, regulations, and instructions. Changes to the provisions of the instruction for firing and directing artillery fire should take into consideration such factors as the complete autonomy of the guns and launchers and the characteristics of artillery ammunition, especially special-purpose and precision-guided; the possibility of obtaining reconnaissance data for artillery fire from sources other than the visual ground reconnaissance, including aerial and satellite reconnaissance; the need to conduct observation and tracking of targets during target firing; the need to forecast unintended losses and assess the effects of fire; limited total time of the guns and launchers’ stay at firing positions; and digital determination of firing settings.

The content of current “Rules of Tactical Artillery Operations (brigade, regiment)” in force in the Polish Armed Forces, dated from 2002, significantly differs from the currently adopted forms and methods of conducting operations by modern artillery. Doctrinal provisions concerning the combat use of artillery must be constantly assessed and periodically evaluated following the expected threat from the enemy and the capabilities of available fire means. Further development of doctrines, regulations, and instructions concerning the combat use of the Defense and Artillery Forces requires taking many complex actions aimed at thorough assessment of the current state of knowledge on the subject and updating the views on the use of artillery in combat, both in theory and practice.

## Conclusions

Consistent and fast realization of modernization of artillery and other combat systems, being a part of the combined arms system of the Polish Armed Forces, should be very effective in deterring a potential aggressor and, if necessary, provide optimal capabilities in terms of the ability to reduce A2/AD potential threatening north-eastern Poland.

The introduction of modern “KRAB” artillery systems to the Polish artillery and, in the nearest future, also HIMARS rocket systems with simultaneous technical modernization of older types of weapons, e.g., AHS “Dana” or WR-40 “Langusta”, will significantly strengthen the potential and capabilities of the Land Component of the Polish Armed Forces in fulfilling tasks of deep fire support and operational fire, particularly in the range of fighting elements of a potential enemy’s A2/AD system. New, not seen before, artillery possibilities to perform independent, precise, deep fire strikes as a part of combined fire support and operational fire appear. Those strikes may be executed using the whole range of long-range precision-guided munitions, which will be included in the arms of Polish artillery soon. Those capabilities will allow for the destruction and incapacitation of many objects located in the areas of interest of Land

Component Commander and Supreme Commander of the Armed Forces (Supreme Allied Commander), which until now were beyond the effective range of rocket and artillery troops. Within next years, if further HIMARS missile squadrons are successively introduced into the arms of the Armed Forces of the Republic of Poland, it may allow the creation of an independent missile unit (Rocket Artillery Brigade) with the potential and combat capability to attack objects located outside the areas of responsibility of first-echelon tactical units. Therefore, in the process of building its organizational structure and planning its service and tactical subordination, it seems reasonable to consider the possibility of the brigade’s reporting directly to the Commander of the Land Forces and during operations directly to the Commander-in-Chief of the Armed Forces (Commander of the Joint Forces) to rationally utilize the combat potential of the new rocket artillery unit.

This article is only a prelude to undertaking comprehensive works to update existing views on the use of artillery in combat, both in theory and practice. In the authors’ opinion, developing a new concept of artillery use, adequate to new threats on the modern battlefield, should become one of the most essential and urgent tasks for Polish artillery people in the third decade of the 21<sup>st</sup> century.

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All authors declared no conflict of interests.

### Author contributions

All authors contributed to the interpretation of results and writing of the paper. All authors read and approved the final manuscript.

### Ethical statement

The research complies with all national and international ethical requirements.

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## Rola i miejsce artylerii w zwalczaniu systemów „antydoświadczalnych” A2/AD

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### STRESZCZENIE

Współczesne systemy „antydoświadczalne” A2/AD (ang. Access Denial/Area Denial) definiowane są jako połączenie wszelkich możliwych środków, które mogą wielowarstwowo ograniczyć dostęp potencjalnego przeciwnika do danego obszaru (teatru) działań. Ich działanie polega m.in. na radioelektronicznym zakłócaniu systemów naprowadzających, paraliżowaniu systemów łączności, komunikacji i cyfrowej transmisji danych, zestrzeliwaniu pocisków manewrujących dalekiego zasięgu, dronów i samolotów. Głównym założeniem koncepcji antydoświadczalnej jest pozbawienie przeciwnika możliwości wejścia na teren danego obszaru (teatru) działań (A2 – ang. Anti-Access) za pomocą środków rażenia dalekiego zasięgu, ponadto pozbawienie go swobody działania na tym teatrze (AD – ang. Area-Denial) przy pomocy środków rażenia średniego

i krótkiego zasięgu. Do realizacji zadań A2/AD używa się pocisków typu ziemia powietrze (SAM – ang. Surface-to-Air Missile), przeciwokrętowych pocisków balistycznych (ASBM – ang. Anti-Air Ballistic Missile) oraz pocisków manewrujących (ASCM – ang. Anti-Ship Cruise Missile), a w ostatnim czasie również amunicji artyleryjskiej o zwiększonej donośności (LRPF – ang. Long Range Precision Fires).

Celem artykułu jest określenie możliwości użycia artylerii do zwalczania systemów A2/AD. Zdaniem autorów siły NATO w pierwszym okresie konfliktu konwencjonalnego z równorzędnym przeciwnikiem utracą panowanie w powietrzu i priorytetem stanie się jego szybkie odzyskanie. Artyleria, jako rodzaj wojsk posiadający coraz większe możliwości precyzyjnego i głębokiego rażenia, może stać się decydującym czynnikiem, pozwalającym na zdominowanie systemów A2/AD i umożliwienie realizacji zadań własnemu lotnictwu.

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**SŁOWA KLUCZOWE** systemy antydoświadczalne, przewaga w powietrzu, połączone rażenie, artyleria

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