

Original article

Modernization of the Missile Forces and Artillery

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ABSTRACT

The article analyses and assesses current capabilities of the Missile Forces and Artillery of the Polish Armed Forces as well as a role which should be played by artillery in conditions of a contemporary battlefield. By addressing a current state and modernization programs, the most principal areas of indispensable adaptations and directions for modernization aiming at significant increasing of artillery's combat capabilities have been indicated.

The analysis is based on conclusions and expertise gained during recent armed conflicts, particularly from the war in eastern Ukraine, where artillery played a crucial role in fire support.

Artillery remains a relatively inexpensive, highly efficient and the most available means of fire support in the Polish Armed Forces, and its modernization and adaptation to NATO standards will considerably increase the combat potential the Polish Land Forces.

KEYWORDS

fire support, artillery, Krab, armed conflicts, modernization

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Introduction

The conclusions after the recently conducted Strategic Defense Review regarding the organization and the operation of the Polish Armed Forces (SZ RP) have revealed that there are still areas which require undertaking of modernization and remedial activities, as well as restoring the lost capabilities, or establishing the new ones. The Missile Forces and Artillery (WRiA) is one of the military branches which requires the modernization of weaponry and the reestablishment of capabilities, among others, in terms of striking an enemy at the range exceeding 50 km in the so-called no-declared zones. The ongoing conflict in eastern Ukraine as well as the intense modernization of the Russian Federation's artillery pool question recently placed, primarily in the western states, arguments regarding the necessity to reduce artillery. Lessons-learned from

Donbass and experience gained by Polish units in Afghanistan have irrefutably revealed that artillery still plays an essential role in conflicts both of conventional and hybrid character. Furthermore, it can be stated that under a certain provisions, for example in conditions not providing the possibility of employing the potential of the air force in combat operations under Close Air Support (CAS) or helicopters attacks – Close Combat Attack (CCA), artillery becomes the only means able to effectively and precisely strike targets. The importance of artillery is underlined both by military scientists and military commentators observing the current situation, not only in Ukraine but also in Syria and Iraq. Some of them quote data indicating that in the battle area in Donbass artillery fire inflicted almost 85% of entire losses on both sides of the conflict. They emphasize as well that during intensified operations consumption of artillery ammunition frequently ranged between 300-400 projectiles daily per gun, which significantly exceeds norms of the daily war-time artillery ammunition consumption prevailing in the Polish documentation. Contemporarily waged wars are not only an excellent testing ground for armed forces concerned to examine new types of armament, but also they provide an opportunity to verify bending procedures and tactics in confrontation with a modern battlefield's reality.

Artillery owes its place in the combined fire support mainly due to the fact that over the last few decades it has reached capabilities for a broadly defined reaction, almost in each place, in any conditions regardless time of a year or a day and most importantly, in a real or a close to a real time, after detection of a target. It is possible to happen not only due to the modernization of technical equipment but it is primarily caused by ongoing changes in artillery tactics and integration of various combat systems for the needs of fire support. As demonstrated by the conflict in Donbass, new opportunities are available for artillery and further directions of its development have not been yet decided.

The purpose of the article is to analyze and assess current capabilities of the Polish Missile Forces and Artillery and a role which can be played by artillery on a modern battlefield. What is more, the authors' intention is to indicate the most crucial areas of changes and modernization directions, which based on the gained experience and conclusions drawn from observation of, among others, artillery employment in the conflict in eastern Ukraine, can lead to the significant increase of the present combat potential of the Polish artillery.

1. Assessment of current capabilities of the Missile Forces and Artillery

At the beginning of the 21st century, the probability of a wide-scale conventional conflict in Europe was regarded as marginal or even unreal. Due to this fact in various NATO states, among others, in France, the Great Britain and Germany a considerable reduction of the weaponry was conducted, including artillery and artillery ammunition, mainly cluster one. The economic crisis from the beginning of the century, which forced cuttings of defense budgets and accelerated the decision regarding reduction

of armament in various NATO states¹ [See: 1; 2], including the Polish Armed Forces², significantly impacted the situation. Another reason for re-construction of organizational structures of operational units and reduction of the armament of the West-European armies, was the ongoing changes in military science and philosophy of employment of armed forces, including artillery, in combat operations. As for artillery, the changes aimed mainly at providing high mobility of subunits, combined with a very short time required for reaching fire readiness and occupying firing positions. Simultaneously, it was possible to observe a deviation from a practice of mass strikes in favor of precision attacks which reduced consumption of ammunition as well a risk of causing unintended losses and destruction, particularly among civilians. Furthermore, equipping artillery units with self-propelled guns and adjusting to operate in a netcentric environment enhanced their autonomy in various areas, among others, within the framework of the topographical self-fixing and the automatic targeting³. Contemporary guns such as M-109A6 Paladin, Panzerhaubitze 2000 (PzH 2000) or hbs KRAB, apart from many undeniable advantages, are capable of conducting the so-called sequential fire enabling a single gun to shoot at the same time, at the same target the amount of ammunition equal to an artillery platoon equipped with towed guns. Currently, very few countries in the world introduce only self-propelled guns on a wider scale. Poland is among the countries which do not possess towed artillery and Polish artillery units are only equipped with self-propelled assets⁴ [See: 3, p. 220]. Unfortunately, a production cost of one self-propelled gun, its utilization and logistic support significantly outweighs operational costs of towed artillery.

In changeable conditions of the security environment which recently dynamically occur in our surroundings, intensive conceptual works are ongoing in the Missile Forces and Artillery, not only on modernization of the armament and artillery ammunition but also on new rules of artillery employment in combat. It is proved by development programs of fire assets, among others, Krab, Kryl, Homar missile launchers and Rak self-propelled mortars as well as precision-guided ammunition, code-named Szczerbiec. Likewise, the works on a new shooting manual and an artillery battle drill are in progress.

¹ The issue of previous reduction of armament in Europe triggered by the Conventional Forces in Europe Treaty – CFE, ratified in 1992, cannot be omitted here.

² Over the recent few years, the Polish artillery has undergone the transformation and far-reaching changes which consisted in, among others, disbanding divisional artillery regiments and transforming three artillery brigades into artillery regiments which were re-subordinated to divisions. Currently in the Polish Armed Forces there are three, inhomogeneous in terms of organizational structures and equipment, artillery regiments directly subordinated to divisions' commanders and eleven self-propelled artillery battalions in the structures of mechanized and armored brigades. Note by the authors.

³ Krab and Kryl howitzers as well as MG/MK 120 Rak mortars, planned to be implemented in the Missile Forces and Artillery, comply with these requirements.

⁴ According to the statement prepared by Global Firepower Portal (GFP), at the end of 2014 only 80 of 126 countries in the world had units equipped with self-propelled guns, and 15 of them possessed less than 20 pieces of this weaponry. The Russian Federation is an unquestionable leader of this comparison which in the discussed period had 5,972 pieces of self-propelled artillery.

1.1. Fire assets

Assessing the current state of the Polish artillery, it should be underlined that 122 mm self-propelled howitzers 2S1 “Goździk”⁵ [See: 4] constitutes its core that executes a direct fire support of mechanized and armored brigades. Among nine 2S1 artillery battalions subordinated to brigades, five is equipped with automated fire control systems (ZSKO) TOPAZ⁶. Two brigades have in their artillery battalions’ structures 152 mm self-propelled gun-howitzers “DANA”, more modern than 2S1 “Goździk”. Both battalions are also equipped with the (ZSKO) TOPAZ. Apart from the brigades, gun-howitzers “Dana” are in the structures of three regimental artillery battalions i.e. the 11th Artillery Regiment (two battalions) and in the 23rd Artillery Regiment (one battalion). According to the modernization plans of the Polish Armed Forces, both “Goździk” (342 pieces) and “Dana” (111 pieces) are to be replaced by HS Krab⁷ (Fig. 1) and AHS Kryl⁸ (Fig. 2) in the near future. Experience of the war in Georgia in 2008 and current conclusions drawn from combat operations in Donbass indicate the both “Dana” and “Goździk” due to their weak armor are vulnerable to destruction even by fragmentation-demolition or anti-tank cluster ammunition.



Fig. 1. 155 mm self-propelled howitzer Krab – first prototype on a chassis of the Korean K9 howitzer
Source: [5]



Fig. 2. 155 mm self-propelled howitzer Kryl during fire tests
Source: [6].

Missile artillery battalions of divisional artillery regiments are equipped with older type of 122 mm rocket launchers BM-21 (75 pieces), slightly advanced RM-70/85 (30 pieces)

⁵ 2S1 – the post-Russian construction coming from the 1970s, in the years of 1984-1994 it was produced under the license in Poland by HSW. Thus, it means that the youngest guns are more than 20 years old and some of them more than 40. Based on officially available data, Poland currently has approximately 340 2S1 howitzers. A part of which, as 2S1T version, is equipped with the automated artillery fire control system ZSKO TOPAZ. Basically, the fire range of “Goździk” is 15 km, and with the use of projectiles with additional rocket propulsion it reaches almost 21 km.

⁶ ZSKO “TOPAZ” – the automated fire control system for field artillery of an artillery battalion level. Note by the authors.

⁷ HS Krab – presently being developed, the Polish project of 155 mm self-propelled gun-howitzer (52-caliber barrel).

⁸ AHS Kryl – Polish light 155 mm self-propelled gun-howitzer on Jelcz wheeled chassis.

(Fig. 3) and the latest WR-40 “Langusta” (75 pieces) [See: 8]. “Langusta” (Fig. 4) is a result of the modernization program within the framework of which, the rocket package of BM-21 launcher was installed on the chassis of JELCZ-type vehicle. The lack of command vehicles and automated command and fire control systems dedicated for missile subunits constitutes the main disadvantage of artillery missile battalions of the Missile Forces and Artillery, affecting the capability of integration with reconnaissance systems and timeless execution of fire tasks.



Fig. 3. On the left – 122 mm BM-21 rocket launcher, on the right – 122 mm RM-70/85 rocket launcher
Source: [7].



Fig. 4. 122 mm WR-40 “Langusta” on a firing position
Source: [7].

The above-mentioned fire assets, both barrel and missile, are characterized by the actual range of striking objects in an enemy’s combat formation which varies between approximately 10 to 15 km from a forward age of battle area (FEBA), with a relatively low striking precision. Although the modernization of BM-21 rocket launcher to WR-40 “LANGUSTA”, according to different sources, increased its range of fire to approximately 40 km with “Feniks”⁹ [See: 9] type projectiles, this still does not significantly enhanced the capabilities of the Missile Forces and Artillery to strike enemy’s objects within the

⁹ Feniks – 122 mm M-210B missile for WR Langusta missile launcher, produced by “Bumar Amunicja” from Skarzysko Kamienna as a consequence of the research and development works commissioned by the Ministry of National Defense. According to the producer’s announcement, Feniks depending on installed warheads and propulsion can have the range between 40 and 70 km. Feniks ordered by the Army will have classic HE (High Explosive) warheads but they will have more advanced propulsions owing to which their range will exceed 40 km.

framework of deep attacks in favor of a land component. Concerning the current capabilities of the Missile Forces and Artillery, fire of a land component is continued to be executed on a tactical level, not for the whole area of interest of mechanized and armored brigades, not to mention mechanized and armored cavalry divisions.

The current structure and capabilities of the Polish Missile Forces and Artillery are presented on Figure 5.

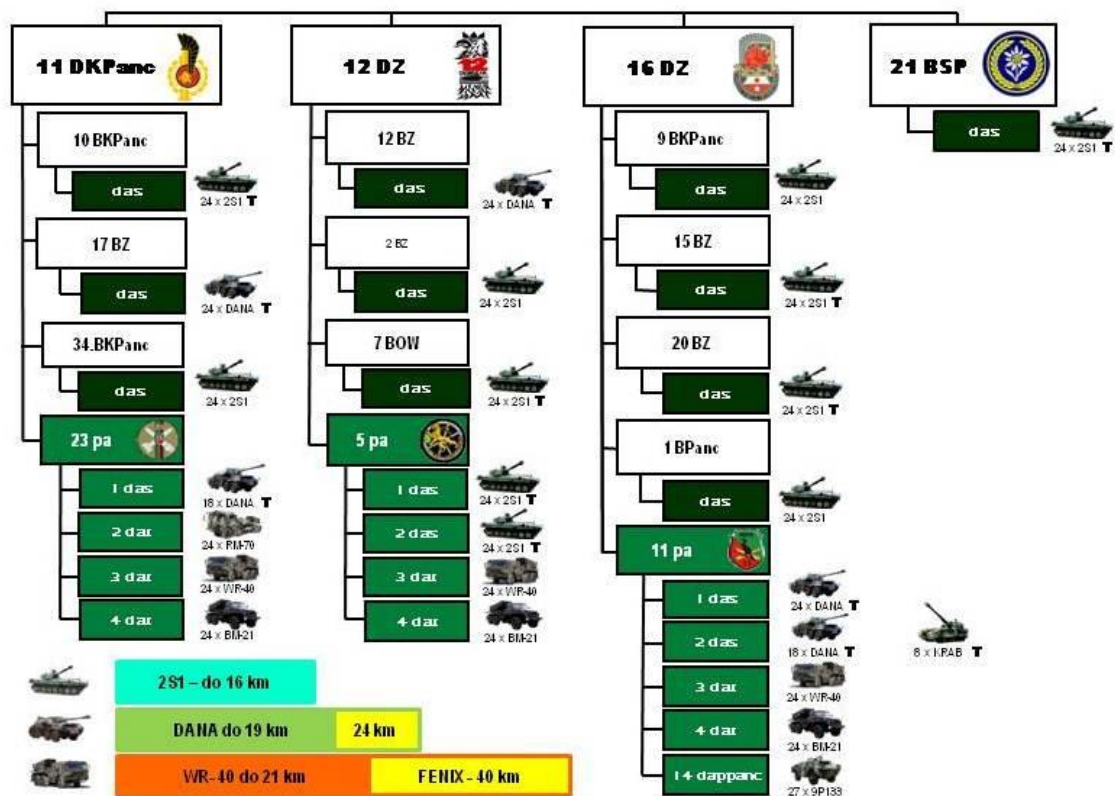
The Polish Armed Forces are equipped with 453 self-propelled howitzers and gun-howitzers and 180 self-propelled artillery missile launchers. In the vast majority, the equipment is of the older construction that should be gradually withdrawn from the service and replaced by modern designs characterized by better tactical-fire parameters capable of providing artillery fire support for a land component commander within his entire area of responsibility.

Lessons learned from recent years exercises conducted by the Polish Armed Forces, especially computer-assisted, allowed for observing various theoretical and practical problems related to fire support of deep operations executed by a land component. It can be assumed that primary it is an outcome of a gap in fire support system on tactical and operational levels, caused by withdrawal of Toczka¹⁰ [See: 10] (Fig. 6) and Luna-M¹¹ [See: 10] (Fig. 7) rockets from the land forces. The process was launched in 1992 by withdrawing Luna rockets and completed in 2005 by disbanding the last tactical rocket battalion ("fire battalion") in Choszczno, equipped with Toczka rockets¹² [See: 12].

¹⁰ 9K79 "Toczka" (Scarab) – surface-to-surface tactical missile system. It served in the Polish Armed Forces since 1987 and belonged to the most advanced weapons system of this type in the Armed Forces. It was characterized by high maneuverability and large striking efficiency. The system was designed for destroying spot and small area targets, at the tactical depth of combat formations, with fragmentation-demolition (of concentrated effect) or fragmentation-cluster warheads. The system consisted of 9P129 launcher (on wheeled, amphibious chassis), 9M79F(K) missile, 2T218 transportation-loading vehicle (on wheeled, amphibious chassis), 9T238 transportation vehicle (on ZIL 137T chassis), 9W819 measurement-control station, 9W844M technical maintenance station (on ZIL 131 chassis) and additional equipment. The mass of the launcher with the missile and the crew was 18 t, maximum road speed – 60 km/h, floating speed – 10 km/h, vehicle range – 650 km, take-off mass of the missile – 2000 kg, missile length – 6.4 m, warhead mass – 480 kg, shooting range between 15 and 70 km. Decommissioned in Poland since 2005.

¹¹ 9K52 "Luna-M" – surface-to-surface tactical missile system, implemented in the service in the Polish Armed Forces in the second part of the 1960s. The system of the fire range between 12 and 68 km was designed to destroy, among others, manpower, fire assets, technical equipment and command posts. The system consisted of 9P113 launcher (on ZIL 135 LM chassis), 9M21F(K) missile, 9T29 transportation vehicle, 2U663M transportation trailer, a crane truck, auto-topography vehicle and additional equipment. The mass of the launcher with the missile and the crew was 19 t, maximum road speed – 65 km/h, vehicle range – 650 km, take-off mass of the missile – 2500 kg, the missile length 9.4 m, the warhead mass – 450 kg. Decommissioned in Poland since 1992.

¹² The 2nd Pomeranian Tactical Missile Regiment was disbanded in 2002. From 1 January 2002, not changing its location, the regiment was transformed into a fire battalion subordinated to the 1st Masuria Artillery Brigade. Due to the shortages in spare parts and exhaustion of missiles' reserves as well as the lack of appropriate maintenance facilities, a decision to decommission the battalion was made. The battalion was dissolved on 30 September 2005. Despite the lack of the manufacturer's support, all four 9P129 launcher maintained their combat capabilities until the end of battalion's existence and Polish artillerymen developed a complete technical documentation of the system.



11 DKPanc – 11th Armored Cavalry Division
 10 BKPanc – 10th Armored Cavalry Brigade
 das – self-propelled artillery battalion
 17 BZ – 17th Mechanized Brigade
 34 BKPanc – 34th Armored Cavalry Brigade
 23 pa – 23rd Artillery Regiment
 1 das – 1st self-propelled artillery battalion
 2 dar – 2nd rocket artillery squadron

3 dar – 3rd rocket artillery squadron
 4 dar – 4th rocket artillery squadron
 12 DZ – 12th Mechanized Division
 12 BZ – 12th Mechanized Brigade
 2 BZ – 2nd Mechanized Brigade
 7 BOW – 7th Coastal Defense Brigade
 5 pa – 5th Artillery Regiment
 16 DZ – 16th Mechanized Division
 15 BZ – 15th Mechanized Brigade
 20 BZ – 20th Mechanized Brigade
 1 BPanc – 1st Armored Cavalry Brigade
 11 pa – 11th Artillery regiment

1 das – 1st self-propelled artillery battalion
 2 das – 2nd self-propelled artillery battalion
 3 dar – 3rd rocket artillery squadron
 4 dar – 4th rocket artillery squadron
 14 dappanc – 14th anti-tank artillery battalion
 21 BSP – 21st Highland Rifle Brigade
 2S1 – do 16 km – 2S1 – up to 16 km
 DANA do 19 km – DANA up to 19 km
 WR-40 do 21 km – WR-40 up to 21 km

Fig. 5. Current organization and ranges of fire of Polish artillery

Source: Own study by the authors.

In practice, since that moment the missile forces in the Polish Army's land component ceased to exist. Thus, the land component lost real capabilities of execution fire support tasks in deep operations' area. The significant role of missile forces in a fire system of contemporary armed forces has been proved by experience gained during past armed conflicts, starting from the First Gulf War at the beginning of the 1990s till the war currently waged in eastern Ukraine. Land forces' missile artillery subunits, in addition to air and special forces, play primary role in the joint fire support at a tactical level. A missile salvo of "Grad", "Smiersz" or "Uragan" launchers, owing to its power is more

effective than surgical strikes of barrel artillery using precision-guided ammunition which can be easily eliminated by jamming GPS signal¹³ [See: 13].



Fig. 6. Tactical rockets 9K79 “TOCZKA” (SCARAB) served in the Polish Missile Forces and Artillery until 2005
Source: [10].



Fig. 7. Tactical rockets 9K52 “LUNA-M” served in the Polish Missile Forces and Artillery until 1992
Source: [11].

In the Polish Armed Forces, a land component commander does not have artillery units at his disposal, especially rocket artillery, capable of executing a task within a frame of deep fire on tactical and operational levels at ranges between 50 to 300 km. Moreover, potential of the Missile Forces and Artillery’s reconnaissance in this field is still insufficient to provide target acquisition and detection, its tracking and observation during execution of a fire task and consequently, a proper impact assessment of artillery-rocket strikes.

This dysfunction becomes apparent while confronted with our eastern neighbors whose capabilities and possibilities in this area are fundamentally different. For example, shortly before the outbreak of the conflict in eastern Ukraine its armed forces, according to publicly available data, possessed more than 500 missile launchers of vari-

¹³ As the war in Georgia in 2008 confirmed, as a result of jamming the GPS signal by the Russians, the Georgians were not able to use the precision-guided ammunition in combat through the entire duration of activities. Source: Cohen A, Hamilton RE. *The Russian Military and the Georgian War: Lessons and Implications*. Strategic Studies Institute. 2011.

ous types, including 300 of 122 mm BM-21 “Grad”, more than 130 of 220 mm BM-27 “Uragan” and approximately 80 of 300 mm BM-30 “Smiercz” (Fig. 8) missile launchers. Belarus in turn, according to official data, has approximately 230 artillery missile launchers in proportions similar to Ukraine.



Fig. 8. 300 mm BM-30 “Smiercz” during shooting
Source: [14].

A single salvo of “Smiercz” launcher can cover with fire an area up to 64 ha (800 × 800 m) at the shooting range of 70-90 km, killing manpower and destroying fortifications and vehicles, including armored vehicles. For Langusta as well as for BM-21 it is an area of 6 ha (300 × 200 m) at the maximum range of 21 km, with the use of fragmentation-demolition ammunition. A significant difference in implementation of missile warheads constitutes an issue which cannot be left without comment. In case of Poland, there are mainly fragmentation-demolition warheads, whereas the Russian Federation’s artillery is able to strike targets with a huge range of missiles, among others, cluster warheads, with the so-called submunition consisting of anti-personnel or anti-tank mines and anti-tank precision-guided bomblets with an explosively formed penetrating stream. In Ukraine, separatist artillery, supported by the Russian Armed Forces, used cluster ammunition withdrawn by the majority of European states as well as thermobaric weapons. The war in Donbass clearly proved the weakness of infantry fighting vehicles of BWP, BMP and BTR types, light armored command vehicles and many other not-armored vehicles, especially ammunition vehicles and petrol tankers which confronted with missile artillery fire using both conventional fragmentary-demolition and cluster anti-tank ammunition were practically defenseless¹⁴ [See: 15].

From artillery’s capability and sustainability perspective, the fact that it is not equipped with the so-called towed guns characterized by low mobility and light resistance to an enemy’s impact¹⁵ [See: 4] constitutes an argument in favor of the Polish Army. Howev-

¹⁴ Massive employment of cluster munition by pro-Russian separatists enhanced up to 10 times effectiveness of artillery fire in comparison to classic fragmentation-demolition projectiles.

¹⁵ The absence of towed artillery in the Polish Armed Forces basically results from the fact that at the very beginning of the 1990s it was stated that its usefulness on a contemporary battlefield significant-

er, it is a distinct difference in comparison with Ukrainian, Belarusian and also Russian Forces which despite a vast number of self-propelled guns, possess various types of towed guns and mortars. This type of artillery is massively employed in the Ukrainian conflict either by one or another side. Among others, 122 mm howitzers D-30, 2A36 Hiacynt-B guns and 2A65 MSTA-B gun-howitzers are used in operations. Taking into consideration capabilities of contemporary armed forces to detect and then to effectively strike a target, with the vulnerability of towed guns and their crews even to fragmentation-demolition ammunition, usage of this type of equipment during an armed conflict seems to be irrational. Although, as proved by experiences of the US Army, modern towed artillery systems such as 155 mm M777 howitzer are ideal for airborne and air mobile forces' operations, especially during anti-hybrid operations. M777 howitzers, due to their composite construction are ultralight thus, as a consequence they can be easily carried by air transportation or helicopters. In the Polish Armed Forces, these howitzers could probably be successfully implemented in units of the Territorial Defense Force or in mountain infantry's subunits (Fig. 9).



Fig. 9. 155 mm M777 howitzer in firing position in Ghazni FOB

Source: Authors' own materials.

Reassessing deliberations related to current capabilities of the Polish Armed Forces' artillery, the thesis should be clearly articulated that sufficiently strong artillery characterized by adequate combat and reconnaissance potential, through barrage of gunfire on a direction of the main defense effort, in favorable conditions can successfully compensate smaller number of troops and insufficient firepower of first echelon subunits. The aforementioned thesis has been proved by experience gained during the Ukrainian conflict where missile artillery's massive strikes of pro-Russian separatists could repeatedly eliminate entire battalions from combat, not only those deployed on the front line but also on concentration areas or on march roads, examples of which could be observed during the battle of Ilovaisk at the beginning of 2015 [16].

ly decreased. It mainly refers to mobility and sustainability. In case of towed artillery, it cannot be quickly relocated from one place to another immediately after the last shot. On the other hand, the risk of having it destroyed a consequence of quick localization and precise air strike or counter battery fire by a potential enemy was considered too high.

1.2. Reconnaissance assets and command systems

Artillery reconnaissance and fire command and control systems constitute another element of fire support which are to be subjected to the assessment. Considering contemporary challenges faced by the Polish Armed Forces, reconnaissance systems which provide an active detection and then, an effective striking an enemy's objects at shooting ranges exceeding 50 km, up to 100 km, or even 300 km can be of a key importance for achieving objectives of an operation. As the Ukrainian experience shows, modernization of artillery should go hand-in-hand with indispensable changes in artillery reconnaissance. Artillery regiments have been already equipped with short range reconnaissance unmanned aerial vehicles as well as with mobile weapon locating radars "LIWIEC"¹⁶ [See: 17] and forward observers sections possess artillery target reconnaissance range finders, however, their number is far insufficient to provide necessary saturation of artillery reconnaissance sensors on a battlefield. What is more, due to their limited capabilities, the Land Component (Land Forces) still is not able to execute different tasks other than direct support of fighting troops at a Forward Edge of Battle Area. Moreover, experiences of Georgian artillerymen drawn from operations against the Russian Army in 2008 confirm the fact that sight reconnaissance and active striking of an enemy's artillery from observation posts located in a first echelon's formation is impossible¹⁷ [See: 13].

As the matter of fact, the above-mentioned reconnaissance assets cooperate with the automated fire control system "TOPAZ" but only on an artillery battalion level. This inconvenience is especially felt during military exercises, particularly while conducting artillery fire control trainings. The absence of an overarching automated command and control system on an artillery unit (regiment) level significantly limits its capabilities, among others, extends the time of fire reaction which is of a key importance while fighting artillery of a potential enemy. The similar dysfunction was noticed during the tactical exercise codenamed ANAKONDA-16 (AN-16) on a tactical formation and a general military unit's levels. During the exercise, the lack of this type of command systems deprived Polish general military units' commanders of possibility of the integration of allied striking and reconnaissance systems, being at their disposal, in combat operations, e.g. while striking Time Sensitive Targets (TST)¹⁸ [See: 18] which appeared in areas (zones) of responsibility.

As proved by the war in Ukraine, artillery reconnaissance is treated as the priority by each of fighting sides. Pro-Russian separatists have gained a significant advantage in this

¹⁶ In February 2013, the Armament Inspectorate signed the contract with WB Group regarding the delivery of 12 reconnaissance FlyEye systems of the mini class. Three of them, 4 aerial vehicles in each, were assigned to the 5th, 11th and 23rd Artillery Regiments. In regimental command battalions, additionally to mobile weapon locating radars Liwiec, platoons equipped with FlyEye were established.

¹⁷ The Georgian artillery's forward observers executed their tasks in a terrain occupied by the enemy, owing to which the Georgian artillery's fire was always precisely directed at Russian high pay-off targets, including firing positions of the Russian artillery.

¹⁸ Time Sensitive Targets are objects which require undertaking an immediate reaction as they pose (or shortly will pose) a threat to own troops or they constitute highly profitable, temporarily exposed for striking occasional targets. Objects of this group of targets are designated by a joint forces commander.

field by using unmanned reconnaissance platforms¹⁹ [See: 19] and whole range of radars, among others 1L220 ZOOPARK-2 (Fig. 10) or SNAR-10M1 LEOPARDS (Fig. 11) coming from the Russian Federation's Armed Forces, and are able by the accurate missile artillery fire to deprive of combat capabilities even elite Ukrainian subunits²⁰ [See: 21].



Fig. 10. 1L220 Zoopark-2 station
Source: [20].



Fig. 11. SNAR-10M1 Leopard station
Source: [20].

Fights in Ukraine have shown that the Russian Armed Forces compensate the absence of capabilities in the field of satellite reconnaissance and Airborne Warning and Con-

¹⁹ According to different sources, The Russian Armed Forces possess approximately 14 various types of reconnaissance and striking UAVs whose number stands at approximately 1700 pieces, majority of which are assigned to the land forces and execute artillery-related tasks. It follows (painful lessons learned) faced by the Russian Federation's artillery during the Georgian War in 2008.

²⁰ Field radars detected areas of concentration of Ukrainian troops (reserves) as well as approaching supply columns while artillery radars detected areas of activities of Ukrainian artillery. In areas of targets detected by radars, various types of UAVs were sent which operating on different altitudes in a formation called "SWARM" determined coordinates of targets. The act of destruction was completed by a very accurate missile fire of "Grad", "Uragan" or "Smiersz" systems. First echelon subunits of Ukrainian elite brigades deprived of fire support, commanders and basic supply, primarily ammunition, lost the combat capability after several days of intensive activities and as a consequence regularly had to surrender or withdraw from a previously taken terrain.

rol System (AWACS), which are currently at NATO disposal, by reconnaissance UAVs. This results mainly from experience gained during the war against Georgia in 2008 and the previous wars in Chechnya. Over the past few years, a significant number of reconnaissance UAVs of micro, mini and medium²¹ [See: 16] range types have been introduced in artillery reconnaissance. Acts of war in Donbass have revealed substantial combat capabilities of reconnaissance UAVs used by the separatists, primarily for artillery fire requirements, targeting, target detection and acquisition, assessment of fire impact and fire correction. Moreover, media reports confirm their increasing effectiveness in combat, owing to which Ukrainian positions could be accurately shot, mainly by missile launchers in close-to-real time.

2. Areas of artillery modernization

Activities in Ukraine, and recently in Syria, constitute an example of a contemporary conventional war, waged with the use of combat equipment which in normal conditions cannot be seen in practice at such a large scale and extended period of time. From the perspective of the subject discussed in the article, the possibility of observation methods of artillery employment and its tactics, especially in Ukraine, in the conditions similar to those we face in Poland is of the significant importance. The fights in Ukraine verified that methods of artillery employment in combat evolve and are dependent on progressing metamorphosis of a contemporary battlefield as well as ongoing changes in military technics. In 2014 Jaroslaw Kraszewski, the then Chief of the Missile Forces and Artillery Department of the Armed Forces General Command stating that *the static artillery which requires considerable time to act is coming to an end. Owing to new weapons our troops will be able to open fire against an enemy immediately after a position has been occupied*, delineated the need for changes and directions of the Missile Forces and Artillery modernization, thus opening a new era of implementation of modern artillery systems into the Polish Armed Forces, mainly Krab and Kryl howitzers, self-propelled mortars Rak and missile launchers Homar²². He underlined that implementation of the above-mentioned equipment will considerably enhance striking capabilities of Polish artillery as well as will restore its capacities to strike important objects in depth of an enemy formation.

The perspective of implementation in divisional artillery regiments and brigade artillery battalions of the new self-propelled howitzers (heavy type – tracked Krab and light – wheeled Kryl) capable of striking targets at shooting ranges even up to 40 km creates

²¹ Among UAVs used in Donbass there were, among others, “Bird Eye-400” models bought from Israel, in the Russian Army known as “Zastawa” (drones of the range up to 15 km) and Russian e.g. Orlan-10 (the range up to 600 km).

²² WR Homar – missile launchers of Homar system will be installed on the chassis of the cargo-off-road 6×6 vehicle of Jelcz type, with the load capacity of 10,000 kg, equipped with the sealed, hydraulically folded cabin which assures a crew a first level ballistic cover according to Stanag 4569. The vehicle is propelled by ZS Iveco Cursor 8,150 kW engine that meets requirements of EURO 3 norm. The system is an equivalent of the American HIMARS (High Mobility Artillery Rocket System) rocket system. HIMARS is one of the basic NATO missile artillery systems capable of precise striking of targets at the maximal shooting range reaching 300 km. Note by the authors.

possibility of organizing a fire system in environment of joint operations. Furthermore, the current presence of allied forces in our country can provide for commanders of tactical formations and units, subordinated to a Land Component (Land Forces), an opportunity to gain experience at employment of modern reconnaissance and artillery – missile systems, which belong to the equipment of the armed forces of NATO states, especially the US Army. In such the situation, one will be able to speak about the possibility of fulfilment of tasks within the frame of fire support involving the allied potential (Fig. 12).

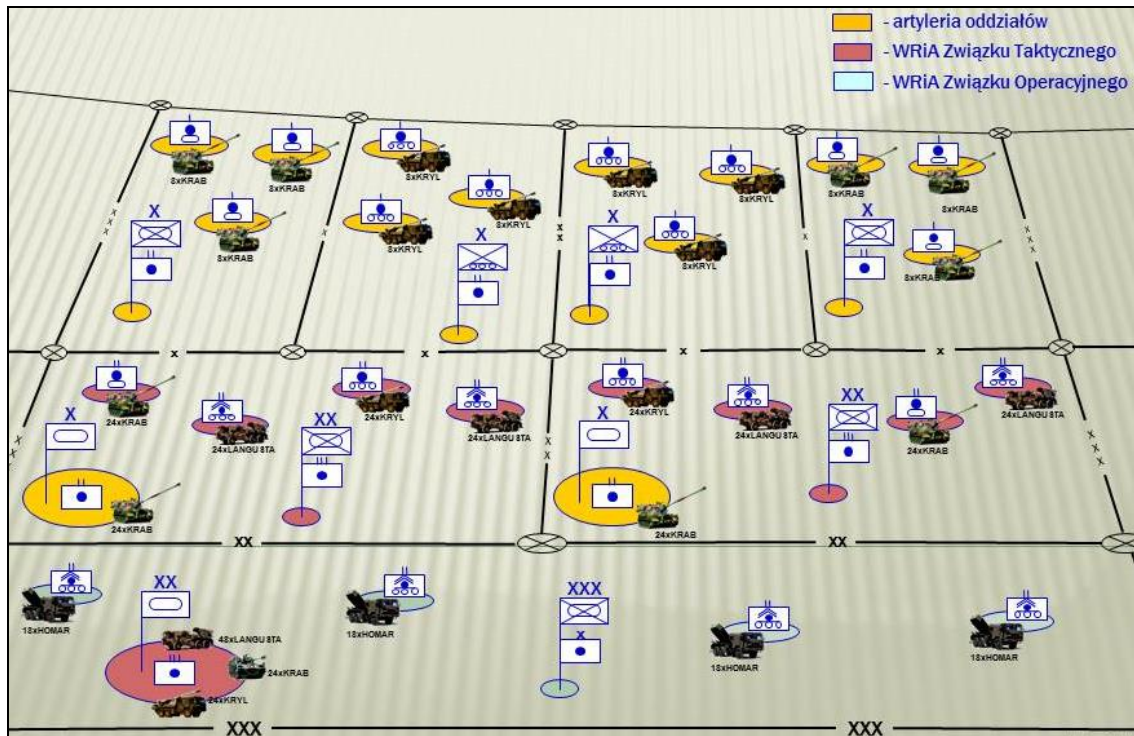


HS Kryl – self-propelled howitzer Kryl
 HS Krab – self-propelled howitzer Krab
 WR Langusta – missile launcher Langusta
 WR Homar – missile launcher Homar

Przewidywane zdolności WRiA SZ RP – predicted capabilities of the Polish Armed Forces' Missile Forces and Artillery
 2015 Dotychczasowe zdolności WRiA SZ RP – current capabilities of the Polish Armed Forces' Missile Forces and Artillery

Fig. 12. Predicted capabilities of a land component to execute fire support tasks
 Source: Own study by the authors.

According to the provisions of modernization plans of the Polish Armed Forces, further increasing of the combat potential of the Land Forces is possible on a tactical level in the upcoming perspective through establishment of a missile unit equipped with missile launchers Homar. Thereby, not only the capabilities of the land component to strike objects in its area of interest but also these in the area of interest of the Supreme Commander of the Polish Armed Forces can enhance. For the above reasons, having this missile unit directly subordinated to a Land Component Commander (Land Forces) both during the peace time as well as war and crisis time seems to be reasonable (Fig. 13).



artyleria oddziałów – units' artillery

WRiA Związku Taktycznego – Missile Forces and Artillery of tactical formation

WRiA Związku Opearyjnego – Missile Forces and Artillery of operational formation

Fig. 13. Location of Homar modules from a Land Forces' Missile Brigade in an order of battle of an operational formation – variant

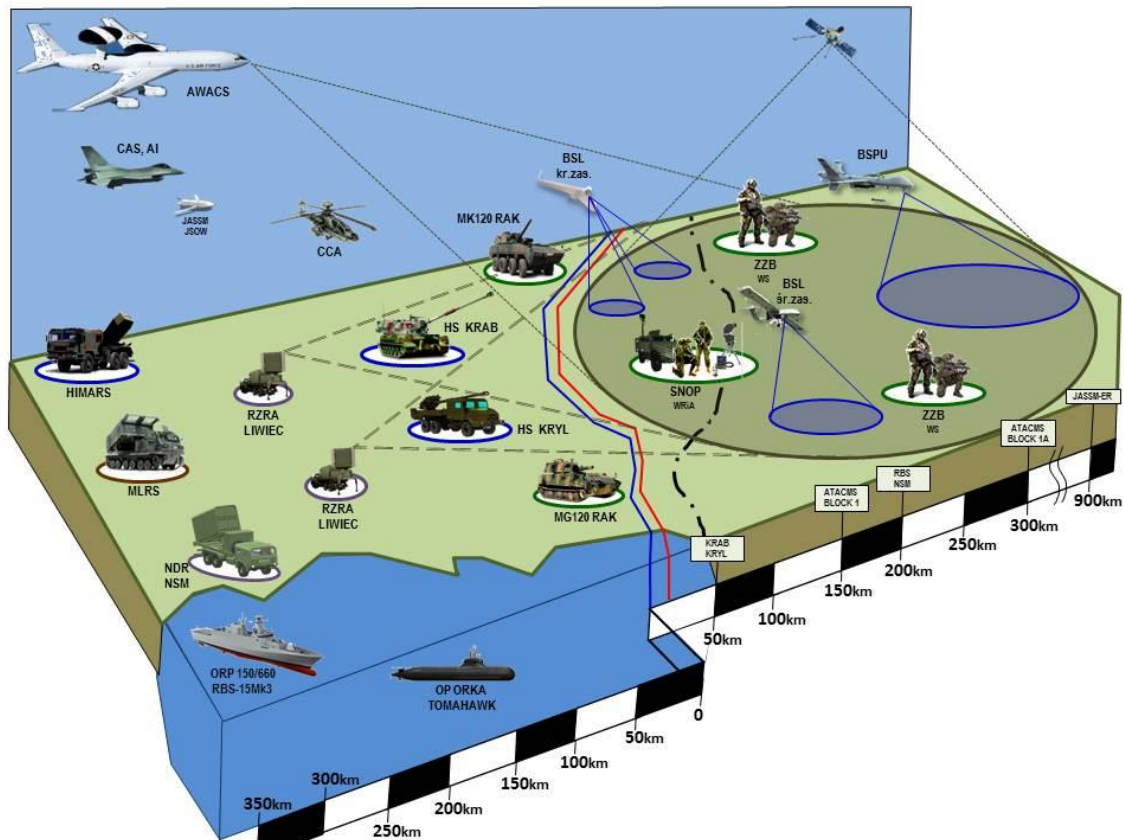
Source: Own study by the authors.

Moreover, the plans of enrichment the Polish Armed Forces' reconnaissance systems with new types of sensors, including medium and long range reconnaissance UAVs and field radars (detecting among others movement of vehicles and personnel as well as mortars and other striking assets), should assure appropriate fire data for present-day artillery. In turn, equipping headquarters and staffs of miscellaneous command levels and echelons with command and fire control systems resistant to communication jamming should provide a commander a consistent battlefield picture and integration of reconnaissance and fire systems.

Implementing in the Polish Armed Forces the aforementioned combat systems will provide the Land Forces new capabilities to execute deep fire support tasks as well as operational fire. The general picture of a variant of the Land Component's (Land Forces) desire capabilities in terms of reconnaissance for fire support-related tasks in a combined defense operation has been presented in Figure 14.

The war in eastern Ukraine confirms the importance of coordinating artillery activities with an adequate type of reconnaissance in real time. In this regard, separatists supported from the beginning of the conflict by Russia had a clear advantage over the Ukrainian side. It was mainly visible on the tactical level, where the Ukrainians fre-

quently were not able to effectively repulse well-coordinated attacks and artillery fire of separatists. The situation occurred as a result of the lack of artillery radars as well as satellite and air systems on the Ukrainian side, especially various kinds of reconnaissance unmanned aerial vehicles of different types and ranges.



- | | |
|---------------------------------------|---|
| SNOP – Combined Fire Control Section | HS Krab – Krab self-propelled howitzer |
| WRIA – Missile Forces and Artillery | HS Kryl – Kryl self-propelled howitzer |
| BSPU – armed UAV | RZRA Liwec – Liwec mobile weapon locating radar |
| BSL sr. zas. – mid-range UAV | MG 120 Rak – Rak self-propelled mortar |
| ZB WS – Special Operations Task Force | ORP 150/660 – corvette |
| OP ORKA – ORKA submarine | |

Fig. 14. Predicted reconnaissance capabilities of a land component for fire support in a joint defense operation
 Source: Own study by the authors.

An important challenge that the Missile Forces and Artillery faces is to assure the integration of various types of artillery reconnaissance assets and sensors as well as general military and special forces reconnaissance (recently also reconnaissance elements of the Territorial Defense Force) with the command support C4ISR system as well as with artillery automated command and fire control systems operating in digital communication systems in real, or maximally close to real, time.

Automated command and fire control systems such as German ADLER²³ or American AFADTS²⁴ are used by artillery. Having a network of diversified reconnaissance sensors at the disposal, artillery subunits receive information about an enemy in real, or near to real, time. Combat operations in eastern Ukraine have frequently proved that the time required for obtaining information about an enemy and passing it for the needs of fire striking does not exceed a few minutes. Information from satellite reconnaissance, reconnaissance UAVs, deep reconnaissance groups, special forces and various radiolocation stations (AN/TPQ-36, AN/TPQ-37²⁵, AN/TPQ-53²⁶, ARTHUR²⁷, COBRA²⁸, 1L220 ZOOPARK-2 or SNAR-10M1 Leopard), capable of passing data to a fire control center within 30-40 s after a target acquisition, are used for the purpose of artillery fire. In turn, an average time of fulfilling a fire task by fire assets operating in automated command and fire control systems' environment can be as follows:

- for M109A2/A3 self-propelled howitzer – 30-40 s,
- for M109A6 and KRAB self-propelled howitzer – 30 s,
- for MLRS system – 60 s (for ATACMS missiles – 20 s) [22, p. 52].

Within the framework of counter battery fire, the time of fire reaction²⁹ in different armies ranges between 5 and 15 minutes. The Ukrainian experiences demonstrate that this time is approximately 15 minutes. In turn, American sources, supported by experience from combat operations of the First and Second Gulf Wars, indicates that depending on technical advancement of an enemy and duration of combat operations this time ranged between 5 and 12 minutes. Typically, the longest time of fire reaction was observed at the initial period of activities – to decline gradually as they progressed. This tendency currently occurs during the fights in eastern Ukraine. Therefore, while executing a fire task it is to be expected that within 5 minutes (maximally 15 minutes) after firing the first projectile by our artillery, enemy's projectiles will reach our firing positions. This trend is reflected in new combat doctrines of various armed forces, among others the Russian Federation's, where extraordinary attention is put on troops' mobility, artillery in particular. Based on Ukrainian reports from the frontline, it can be unequivocally stated that during the fights in Donbass, pro-Russian separatists frequently withdrew immediately after execution of a fire task or optionally changed firing positions. Those activities hampered determining of exact position of separatist's artillery thus, its elimination from the fight. Separatist's self-propelled artillery normal-

²³ ADLER – German system: Artillerie Daten Lage Einsatz Rechnerverbund.

²⁴ AFADTS – Advanced Field Artillery Tactical Data System – currently the most sophisticated command and artillery fire control system in the world providing full automation when it comes to planning and striking execution, not only by artillery but also by other military branches such as air force and navy. Note by the authors.

²⁵ AN/TPQ – in the stations of this family an impulse Doppler radar was implemented, which after detection of shooting enemy's artillery sends target coordinates through a digital data link to a fire control center where a decision to open fire, within counter fire, is made. Note by the authors.

²⁶ AN/TPQ-53 station replaces worn 36 and 37 type stations.

²⁷ ARTHUR – Artillery Hunting Radar.

²⁸ COBRA – Counter Battery Radar.

²⁹ Total time of: target detection, passing data about a target, execution of a fire task and a projectile time of flight. Note by the authors.

ly fired three shots from a firing position then conducted a counter fire maneuver. The absence of reconnaissance picture as well as acquisition systems on the Ukrainian Armed Forces' side, especially during the initial phase of the conflict, resulted in the fact that the Ukrainian artillery fire at not observed targets usually hit abandoned positions. As the above-mentioned examples demonstrate, the fire reaction time should guarantee a real possibility of striking effectively a target before it changes a position. Therefore, timeliness takes priority over accuracy³⁰ as far as a determinant of reconnaissance data usability for artillery fire accuracy is concerned. Experience of the Ukrainian artillery also confirms that conducting long-last barrages of gunfire from one firing position is impracticable, even dangerous. After commencing fire against separatist's artillery, practically always, maximally after 15 minutes their fire response occurred. The aforementioned examples prove that our potential enemy, beyond reasonable doubt, will possess assets and manpower owing to which he will be able to detect and determine coordinates of shooting artillery, execute counter fire within the framework of counter battery fire, then assess impact, enter corrections and execute the further fire strike.

Conclusion

The authors of the article have undertaken an attempt to analyze and objectively assess the current capabilities of the Missile Forces and Artillery through the prism of experiences from course of action of contemporary armed conflicts. The Ukrainian conflict has confirmed that through hard-to-detect and destroy reconnaissance unmanned aerial vehicles and in cooperation with field radars, artillery is still an effective and dangerous combat instrument. Activities undertaken by pro-Russian separatists have indicated that this military branch both in conventional and hybrid wars has acquired unprecedented effectiveness, especially in conditions when the potential of an air force cannot be employed. Artillery subunits, mainly missile artillery, shooting miscellaneous types of ammunition, supported by modern reconnaissance and fire control systems still continue to be the core executors of the join fire support.

The ongoing modernization of the Missile Forces and Artillery significantly increases the combat potential of artillery, allowing for realization of new fire support tasks. Among others, it will facilitate to cover by fire an enemy's non-declare zone, to execute tactical tasks by artillery together with other fire support means e.g. air force within a join operation as well as to shorten fire reaction time which enables to combat artillery and other time-sensitive targets. Having precision guided missiles at disposal, with the range of hundreds kilometers, will create a serious risk for enemy's objects essential to achieve objectives of an operation and consequently will deprive him of freedom of action to a large extent. The ability of artillery to fulfil tasks in any atmospheric conditions, at any time of a day or a year, allows organizing an effective join fire support system, even under adverse conditions and limited possibility of own air force's employment.

³⁰ While executing a fire task by "Uragan" or "Smierszcz" launchers, a high accuracy of determining target coordinated must not be maintained. Note by the authors.

Artillery remains a relatively low-cost combat means in comparison to aircrafts and helicopters, both as regards to purchase costs and operation, which suggests that as “God of War” it will still be at the forefront on battlefields for a long period of time. Taking the above-mentioned into consideration, the Polish Armed Forces should continue the rapid modernization of the Missile Forces and Artillery, replacement of obsolete armament, implementation of new procedures as well as techniques and tactics of artillery employment in combat operations, but primarily develop cooperation and collaboration with artillery of NATO states. According to the authors of the article, desisting, or serious delays in realization of generational modernization of the Polish artillery can most significantly hamper successful conducting of a defense operation by the Polish Armed Forces. In contrast, the experiences from artillery employment during the conflict in eastern Ukraine should be a creative inspiration for the Polish artillerymen community to undertake an attempt to change the thinking philosophy regarding the role of the Missile Forces and Artillery in modern combat environments.

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Conflict of interests

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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Modernizacja Wojsk Rakietowych i Artylerii

STRESZCZENIE

W artykule dokonano analizy i oceny aktualnych możliwości Wojsk Rakietowych i Artylerii Sił Zbrojnych Rzeczypospolitej Polskiej (SZ RP) oraz roli, jaką artyleria powinna odgrywać w warunkach współczesnego pola walki. Przedstawiając stan obecny oraz programy modernizacyjne wskazano najważniejsze obszary koniecznych zmian oraz kierunków modernizacji, prowadzących do znaczącego podniesienia potencjału bojowego artylerii.

Analizę oparto o wnioski i doświadczenie uzyskane z ostatnich konfliktów zbrojnych, a zwłaszcza wojny na wschodzie Ukrainy, gdzie artyleria odgrywała główną rolę we wsparciu ogniowym.

Artyleria pozostaje relatywnie tanim, wysoce skutecznym i najbardziej dostępnym środkiem wsparcia ogniowego w SZ RP, a jej modernizacja i dostosowanie do standardów NATO pozwoli na poważne zwiększenie potencjału bojowego wojsk lądowych SZ RP.

SŁOWA KLUCZOWE wsparcie ogniowe, artyleria, Krab, konflikty zbrojne, modernizacja

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