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A new dimension of the Polish artillery capabilities upgrade determinants

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Abstract

Artillery and its firepower are still an important element in land tactical activities, which is once again being proven by the current conflict in Eastern Europe. However, two distinct approaches to using its fire capabilities are discernible. One approach views artillery as a precise means of destruction, similar to a sniper with significant firepower and range. The other approach considers artillery fire a weapon of destruction similar to a hammer or a road roller, destroying everything in its path without any selectivity of fire. In the face of such perspectives, the considerations set forth in the following article focus on the former of the presented approaches to using artillery and the determinants that will ensure the implementation of such an approach in the form of the new capabilities of modernized Polish artillery. The presented content results from comparative analyses and observations focused on the needs and effects of artillery use, and factors that are important in its effective operation on the modern battlefield.

Keywords: artillery modernization, artillery system, combat capabilities of artillery, fire support, military security

1. Introduction

Artillery and its fire in military conflicts, despite the constant expansion of the arsenal of weapons, is still an important element of the firepower of the entire group of troops conducting tactical operations. Therefore, transformations of tactical operations, resulting from the assumptions regarding the types of areas of operation and the way they are conducted affect the changes in the requirements for the elements of indirect fire system used to implement them. These assumptions indicate, among others, that being one of those elements, artillery should have the capability to function 24 hours a day and 7 days a week without interruption in any weather conditions to acquire ground targets and achieve effects over a wide area and in depth of battlefield (AArtyP-5, 2015, p. 2-1). It is also important that groupings of land forces supported by artillery fire can conduct simultaneous and subsequent operations in adjacent and non-adjacent areas, i.e., in Non-Contiguous-Linear Battlespace, Non-Contiguous-Non-Linear Battlespace and the increasingly rare Contiguous-Non-Linear Battlespace area of operation (AArtyP-5, 2015, p. 6-4).

However, the currently emerging geopolitical situation partially verifies earlier assumptions and acceleration of artillery modernization, not only of the Polish one. Its final effect is also influenced by the general assumptions of capabilities of building Anti-Access/Area Denial systems (battlefield isolation) and maneuverability of operations (NSS, 2020, p. 18), and operational capabilities to carry out long-range precision strikes (NSS, 2020, p. 19). At the same time, the common goal of these modernization

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activities is to unify sensors and effectors in the information space, in order for the artillery shells and precision rockets or missiles to receive accurate targeting in real time and then to execute high-precision and long-range fire. In addition, a significant future modernization challenge for artillery indirect fire system is to anticipate implementing effective sensor-decider-effector coupling as one of the elements of the multi-domain operations concept (MDO) (PC22, 2022 & FM 3-0, 2022). In addition, the efficient and effective functioning of the modernized artillery indirect fire system is also related to the influence of a number of various functional determinants that result from the expected combat capabilities and future operation methods of the opponent. All the more so that in the future, the experience gained in the armed conflict in Ukraine may be used in reconstructing the operational capabilities in the area) of fire support by the potential adversary.

Due to these reasons, this article presents considerations and conclusions aimed at showing analyzes and assessments of the transformations of the systemic and functional determinants that significantly affect the operation of the modernized indirect fire system of the Polish artillery. In order for the assumed goal to be achieved, the author focused on solving the following main research problem: What systemic and functional determinants should be included in the modernization of the indirect fire system of the Polish artillery? In order to solve the main research problem, the subsequent detailed problems have been identified: What changes should the elements of the artillery indirect fire system undergo? What is the impact of the distinguished functional determinants on the modernization needs of the Polish artillery?

In order to solve the indicated problems, the generalized results of which are presented in this article, research was conducted with the use of mixed qualitative method consisting of text and literature exploratory research and analysis, comparative analyzes of artillery combat and operational capabilities, and military exercises analyses. In order to accomplish the presupposed aim, the author has also conducted the evaluation of artillery indirect fire capabilities, as well as the changes that have occurred and influenced the upgrade determinants, and will continue doing so in the short and long term. It enabled the establishment of the key determinants of an artillery system upgrade that should be included in order to enhance future Polish artillery combat capabilities.

This article also contains the results of the verification of the working hypothesis based on the assumption that a long-term, effective improvement of the artillery indirect fire system is possible only after taking into account all the determinants that are related to the elements of the structure of this system and its functional requirements.

2. Organizational determinants of artillery fire system modernization

For the first two decades of this century, work on the development of artillery systems have been proceeding with varying intensity. However, the scale and nature of the contemporary military threats that have recently appeared in Eastern Europe and those likely to appear in the future have caused the activities aimed at increasing the artillery potential to intensify. Poland has also boosted the exchange of post-Soviet artillery equipment, which started at the beginning of the century, as well as the construction of a modern indirect fire system for the Polish artillery, which will be interoperable with systems used by the allies. Currently, these activities imply the need for significant changes in the structure and organization of the armed forces, including the artillery, in order to achieve the goals and tasks resulting from the real and prospective capabilities of the potential enemy.

The development of the concept of conducting military operations and means of combat leads to a reflection that one of the most important factors is the true integration of all elements necessary for the uninterrupted effective operation of a system that performs a specific warfighting function in a given operational domain. Since artillery currently is and will probably remain the main implementer of indirect fire in the land operational domain, its role is to support the land forces with indirect fire and its effects (lethal or nonlethal) as a part of the fires. For this reason, the artillery indirect fire system (AIFS) is a complex structure consisting of the elements shown in Figure 1.

The strive to improve the functioning of a complex system such as AIFS can be optimized only if it is based on the simultaneous modernization of all its elements. This is to prevent, on the one hand, the effect of the weakest link while, on the other hand, to guarantee the achievement of a synergy effect affecting the final level of improvement.

It is a popular belief that **delivery platforms (systems)**, often referred to as guns (cannons)1, launchers, and mortars, are the most important element. However, this is not the most important element because artillery guns, launchers, and mortars are just weapons. They need information, command and control, protection and logistical support to become combat capabilities and real firepower.

In new gun designs, there is a noticeable tendency to build howitzers or gun-howitzers. These are long-barrel constructions, which currently use longer barrels (52 calibers), which increased their range by 15 percent (Jacobson & Scales, 2016). For interoperability reasons, there is a noticeable trend in the Alliance's armed forces to unify the calibers of the guns to the main one with a diameter of 155 mm. Several armies of the Alliance also keep the 105 mm guns, most often in the towed version or upgraded to the self-propelled wheeled version. Of course, some of the armed forces also use post-Soviet equipment with calibers of 122 and 152 mm.

[1] The term "cannon" is United States Army terminology (FM 3-09, 2020).

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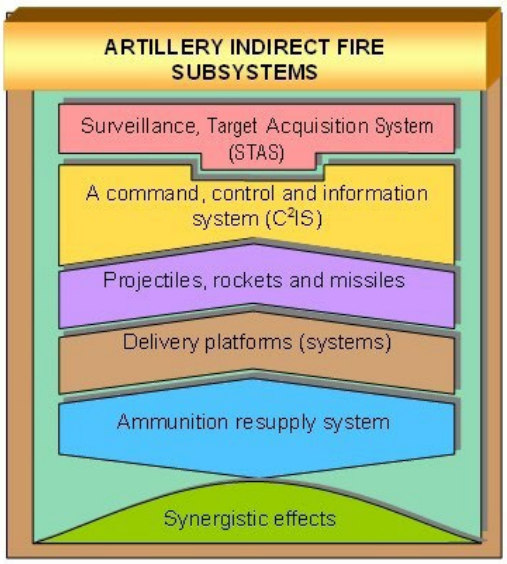

Figure 1. Elements of the artillery indirect fire system
Source: Author's own work, based on: AArtyP-5, 2015, p. 2-1.

Depending on the general concept of conducting operations, self-propelled guns (tracked or wheeled) or lightweight towed guns are introduced. However, with the exception of an American prototype 155 mm self-propelled howitzer from the Extended Range Cannon Artillery (ERCA) program (Judson, 2020), barrel lengths are no longer increased for logistical and functional reasons. Only structures with a high rate of fire capable of conducting fire in accordance with the multiple-round simultaneous impact (MRSI) concept are being prepared. An important new design challenge is also adapting the guns to fire new types of shells with a significantly increased range. Another challenge is the continuation of the process of increasing the cannons' autonomy and compatibility with the modernized command, combat management, and automated fire control systems in accordance with the sensor-decider-effector idea. In the context of gun autonomy and rate of fire, the important issues are ammunition upload and replenishment. Their importance is emphasized in relation to the latest gun models (Freedberg, 2021) or further improvement of the rate of fire of the Polish 155 mm self-propelled tracked gun-howitzer "KRAB" (Świętochowski & Rewak, 2021, p. 397).

The modernization of the Polish arsenal of artillery multiple rocket launchers is proceeding in a twin-track approach. On the one hand, through extensive modernization and re-working of the Soviet artillery, multiple rocket launcher BM-21 to the 122 mm WR-40 Langusta standard, and in the future also the Czech launcher RM 70/85 to the WR-40 Langusta II standard. These solutions, with new traction capabilities, equipped with modern fire control and navigation systems and ballistic (Level 1 STANAG 4569) protection of the crew and NBC system, however, limit the range of rockets that can be fired from them. These are only 122 mm classical rockets and extended range rockets with high explosive (HE) or cargo warheads at a maximum range of 42 km (Kiński, 2007). A more prospective and universal solution is the expansion of artillery firepower based on Korean and American artillery multiple rocket launchers.2 In the future in Poland, these will most likely be the basic artillery multiple rocket launchers, which as interoperable delivery platforms, will be able to fire with the types of artillery rockets and missiles available in the Alliance.

Due to the increased intensity of operations in built-up areas, mortars are intensively used in the structure of delivery platforms at low command levels. This stimulates the development of their construction. New, lighter versions with greater range and rate of fire are appearing. A number of models, including the Polish construction M120T/M120W (HSW, 2021), are mounted on a self-propelled tracked or wheeled chassis, increasing their mobility and protecting the personnel.

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[2] In the case of the Korean launcher, it will be K239 Chunmoo, and the American launcher will be HIMARS (High Mobility Artillery Multiple Rocket Launcher) in versions with Polish chassis.

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Currently, **the projectiles, rockets and missiles subsystem** is becoming more and more appreciated and highly exposed in the artillery indirect fire system structure. Its elements are perceived as "weapons"3, which are the final execution elements – the most important component of all artillery effectors. This subsystem is supposed to coexist closely with the delivery platforms and the ammunition resupply system, which is often overlooked.

A revolution is taking place in the projectiles, rockets and missiles subsystem. First of all, due to the new types of high precision ammunition and the use of solutions that significantly increase the range of the new projectiles, rockets and missiles. Such a solution is the use of a ramjet-powered artillery shell, which in practice is a mix of a missile and an artillery shell (Korsvold, 2019). As announced by Thomas Danbolt, Nammo's Vice president, large caliber ammunition, *…the Ramjet shell can be fired from every modern 155mm L52 artillery gun* (Korsvold, 2019). Ramjet technology could be not only a way to solve the problem of wearing out the gun barrel but also designing them of ever-increasing lengths. The Norwegian idea, presented in Figure 2, currently implemented with an American partner, originally assumed the creation of even a ramjet-powered, guided artillery shell with a range of up to 150 km (Korsvold, 2019).

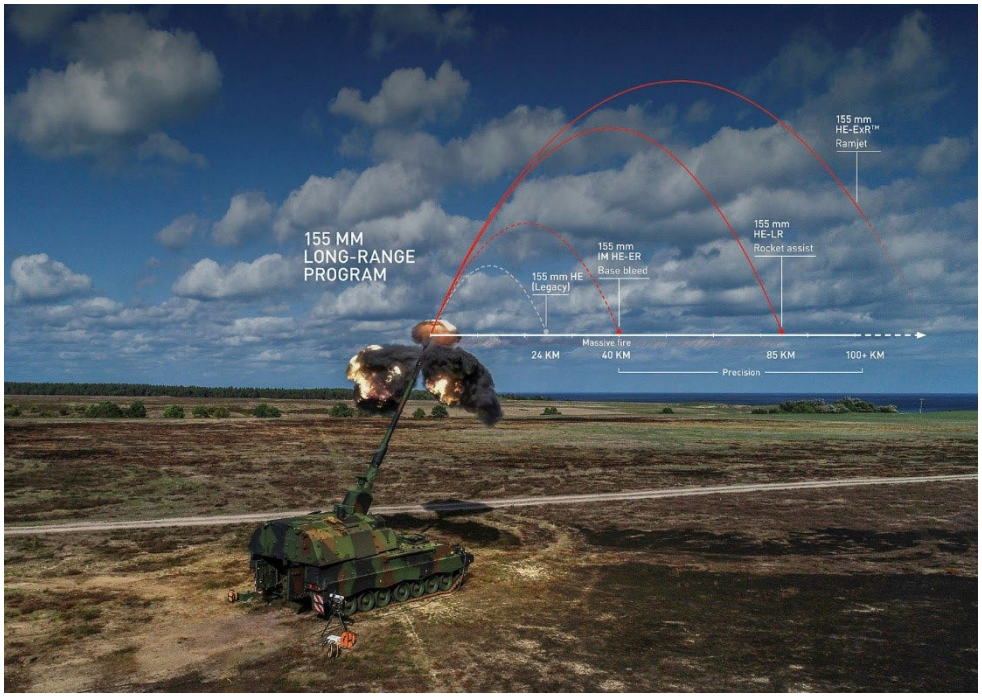

Figure 2. Illustration showing different artillery shell and range options
Source: Korsvold, 2019 (Photo: Nammo)

Simultaneously with the tests of the ramjet-powered artillery shell, tests of the new rocket- assisted artillery projectile and precision guided extended range artillery projectile are being carried out, in which they reached a range of 65 km (Judson, J. (2020a). The latter, although in an older version with lower range, are currently used in Ukraine (McCardle, 2022). In 2019 a new distance record for indirect fire with a conventional 155 mm artillery Very Long Artillery Projectile (V-LAP) was established (Rheinmetall, 2019). Solutions using the base bleed technology are also being further developed to increase the range of projectiles, typically by about 20-35%.

Simultaneously with changes in the design of projectiles, technologies for effectively reducing target delivery error of conventional artillery munitions (less than 20 meters circular error probable) are being developed and modernized. They also reduce the number of projectiles required to execute a fire mission in the form of the American Precision Guidance Kit (PGK) (USAASC, 2022). A similar solution is the Course Correction Fuze (CCF), developed by several other Alliance countries. It is a solution for reducing ballistic dispersion and enhancing the accuracy of artillery rounds (EDA, 2017). All these examples indicate the directions

[3] In the sense of a broadly understood object prepared to cause various losses to the enemy (lethal and non-lethal). Previously, it was often identified as means of destruction.

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of further development of artillery projectiles and the possible ways of increasing accuracy, precision and range of indirect artillery fire to previously unheard-of distance.

Artillery rockets and missiles undergo similar technological changes. The use of new technologies, including the ramjet engine, can increase rockets and missile range several times (NAMMO, 2022, p. 19). New types of rockets and missiles will provide in the near future, on vastly larger battlefields, longer ranges, higher altitudes and the ability to strike an opponent while out of their range. Therefore, the use of guided rockets for the deep fight against enemy reinforcements, supply lines and missiles, the most expensive munitions, for very deep or even strategic strikes against targets in the enemy rear and homeland is expected (Freedberg, 2018). The current geopolitical situation in the world and the conclusions from the military operations in Ukraine also affect the acceleration of work on guided types and extended range of rockets and missiles, which will be available for the currently used delivery platforms in a few years.

Surveillance, Target Acquisition System (STAS) as a subsystem of artillery indirect fire system undergoes transformations resulting from creating a multisensory environment in which all sensors with different domains cooperate with each other and exchange information necessary to conduct indirect fire. At the same time, the range of ways of obtaining information by artillery indirect fire system sensors is constantly expanding due to the implementation of the latest technological solutions in the location field and identification of targets based on their unmasking signs. Prospective means of artillery reconnaissance providing precise data on artillery targets are counter-battery radars and unmanned aerial vehicles (UAVs). Radar stations are currently the best ground means of effective combat with active fire hostile artillery, which is a critical aspect of an artillery duel.

The design assumptions of this type of sensors imply that an ideal radar system for detecting enemy fire assets should have a sufficient range and scanning area to enable recognition of all significant ground indirect fire assets on the battlefield, and at the same time it should remain beyond the range of these assets itself. According to the conducted comparative analyses, their accuracy is to be consistent with the possibilities of fire counteraction with a minimum number of projectiles fired by localized enemy artillery fire assets. On the other hand, the reaction time is to guarantee the maneuverable nature of the operation, in accordance with the requirements of the modern battlefield, also ensuring effective work during the sophisticated electronic counteraction of the opponent.

Another, more and more reliable means of artillery reconnaissance are artillery indirect fire unmanned aerial vehicles (UAVs), belonging to the mini (miniature, small) UAV category, which are also used by the Polish artillery (WB GROUP, 2021). These assets are the components of an unmanned aircraft system (UAS). They are equipped with a set of optical sensors, and sometimes also an acoustic vector sensor, used to detect various fixed and mobile surface targets, as well as hostile fire assets, even before opening fire. In addition, as evidenced by the military operations in Ukraine, other types of unmanned aerial vehicles (UAVs) will also provide vital aerial intelligence in support of targeting functions, likely with assistance from counter-battery radars (Cranny-Evans, 2022).

Current and future conceptual assumptions are based on the statement that fire systems are only as precise as the targeting data (AC-Fires, 2021, p. 37). Therefore, attention is drawn to the preparation of artillery to use the data on ground targets, which can come from many sources, which may include: direct observation by special operations forces, scouts, and forward observers, electronic intelligence sources such as radio frequency intercept systems, human intelligence sources, weapons locating radars, multi-mission radars, unmanned aircraft systems, higher HQ and joint sources and maneuver formations down through the squad level (ATP 3-09.23, 2015, p. 4-1). At the same time, artillery will also get targeting data from ground vehicles and foot troops and provide them with supporting fire in return (Freedberg, 2018). This means the need to prepare AIFS for cooperation with many different sensors that will provide data and information about ground targets located in the area of operations.

The command, control and information system (C2IS) is an analytical and decision-making link that plays a key decision-making role in AIFS. The operation of the command and control subsystem is crucial for achieving the goal of artillery fire support and performing the tasks of the artillery indirect fire system. Its effect, ensuring optimal information support and the reactions of other elements of the system, determines the artillery fire reaction time to changes in the area of operations.

The sensor-decider-effector concept and observations of the development of new technologies indicate that the means of combat will be controlled by means of reconnaissance and detection devices (Wrzosek, 2021, p. 46). It will be a highly automated process in which, in addition to the preparation of the necessary data for the fire mission, it will be necessary to direct the execution of it as well. Therefore, the future directions of automation of the C2 systems assume an increasing limitation of the human role not only in the processes of collecting, processing, and distributing information but also during the implementation of the fire mission, especially the targeting process and system optimization of the contractor and the way of performing the task. The role of the human factor is limited to the approval of the developed data and the transfer of the fire order.

While referring to the concept of indirect fires and MDO (multi-domain operations), it should be noted that the functioning of this subsystem also determines the efficiency of cooperation with other elements of fire support. In addition, the requirements needed to achieve an appropriate level of compatibility and interoperability in the course of cooperation in the Alliance structures indicate the need to develop the ability to cooperate with other allied or coalition automated fire support command, control, and

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communications systems. In the opinion of the allies, the Polish fully automated fire control system, which is very effective, does not ensure comprehensive software compatibility in accordance with the assumptions of Artillery Systems Cooperation Activities (ASCA) (Husheena & Downing, 2020). This is also because the advanced artillery C2 systems significantly expand the functionality of not only fire command (fire control) but also tactical command (combat control), preparing to operate in a strongly integrated environment of all domains of warfare. Based on the conducted analysis, there is also a need to improve the artillery C² system in terms of maximizing the shortening of information and decision-making activities and fire response time, as well as further algorithmization of fire control sub-processes (Paździorek & Całkowski, 2021, p. 165), which is significantly determined by the multiplying capabilities of hostile fires assets.

Another separated subsystem is the **Ammunition resupply system**. In AIFS, it is treated as an element providing artillery ammunition as well as additional services to ensure the smooth work of delivery platforms. Currently, the most important role in this subsystem is played by the ammunition haulers and automated ammunition resupply vehicle formation, which are optimized for the needs, intensifying the tactical effectiveness and maximizing the fire efficiency of artillery assets. In many artillery fire systems, the fire asset is reloaded by an associated ammunition resupply vehicle, which in Polish artillery is not yet a complete standard (Świętochowski & Rewak, 2021, p. 397).

The adopted assumptions indicate that artillery ammunition will normally account for a large proportion of a force's transport system capacity (AArtyP-5, 2015, p. 7-1). For this reason, ways to automate it as much as possible are sought, and ideas to augment or replace human efforts at every stage of the loading and reloading process are discussed (Freedberg, 2020). The automation of loading artillery guns and launchers is also being increased. It is to guarantee not only the speed of ammunition resupply but also increase the rate of fire while relieving the logistic staff and gun launcher crew. A perfect example of such a solution is the ARCHER Ammo Logistic System (BAE Systems, 2022). In addition, new types of guns and automated ammunition resupply vehicles are equipped with new autoloaders, which often replace a human loader, which guarantees higher speed in the reloading and loading process and doubles the rate of fire. Also, a significant part of artillery fire assets, especially multiple launchers, is equipped with devices that facilitate reloading a pod with rockets or missiles.

Solutions in the field of how ammunition is packaged to make resupply faster, more efficient and protected against destruction by the enemy are also being improved. Some of the problems in the ammunition resupply system limit the wider use of guided artillery shells and the modular charge system. This reduces the tonnage of the supplied artillery rounds, but due to their construction, they require special treatment during the resupply process.

A separate issue is the successive complete departure, in the case of Polish artillery, from artillery projectiles and rockets, which are not ammunition of the standard caliber used in the Alliance and limit the interoperability of not only artillery fire assets but also ammunition resupply process.

3. Functional determinants of the artillery indirect fire system

Based on the analyzes of the modern operating environment, several requirements relating to the functioning of AIFS can be identified (Jarecki & Malinowski, 2007, p. 16). From the perspective of formulating assumptions for the modernization of this system, these requirements are very important as functional determinants, also related to emerging new concepts of conducting tactical operations. These requirements include responsiveness, mobility, agility, versatility, lethality, survivability, durability and continuity.

Responsiveness of the AIFS consists in immediately performing the fire mission and ensuring the required effect of artillery fire on the target. These effects are to be in line with the expectations of the supported forces (Land, Air or Navy) so that it is possible to dominate on a dispersed battlefield and react to emerging threats or enemy fire in a timely manner. This is achieved thanks to the efficiency of the sensor-decider-effector relationship and cooperation in a multisensory environment. Meeting the time requirements of AIFS responses forces a significant shortening of automated analyzes and forecasts, visualization of results and selective acquisition of reliable and timely information from various sensors. It also means the availability of the entire system and having delivery platforms very efficiently and, to a large extent, automatically carrying out activities related to opening and conducting artillery fire.

Mobility is an immanent feature of each element of modern operational and tactical groups. It must also be a characteristic of all AIFS subsystems that need to avoid detection and targeting by enemy drones or other sensors. Delivery platforms should be able to take fire positions quickly, and after performing a fire mission to shift fire positions in about 30 seconds to avoid counter-battery fire, which is now achievable (BAE Systems, 2022). This means the need for a wider implementation of *shoot-and-scoot tactics*. In the case of the remaining subsystems, their operation is to ensure a quick change of location and the implementation of the most important tasks during or immediately after the maneuver, in all terrain conditions of the battlefield.

Agility facilitates the quick adaptation of the possessed potential capabilities to the requirements of each new task, which can now be implemented not only for the benefit of the land domain. Agility is the ability to act faster than the enemy. It is achieved

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through the autonomy of delivery platforms, relational linking of AIFS with other fires systems and sharing sensors, as well as C2 decentralization. In addition, the efficiently implemented and effective targeting process is the key aspect of artillery tactical fire control. Artillery will also be symbiotic with air and missile defense systems (Freedberg, 2018) to effectively participate in the implementation of the A2/AD concept.

Versatility enables participation in the implementation of the full spectrum of tasks, in all terrain, climatic, and weather conditions, in continuous availability and obtaining appropriate fire effects in the required place and time. This requirement is achievable by AIFS by having and linking it to a set of diverse sensors capable of multi-spectral observation, as well as the availability of a wide range of artillery ammunition. It is also related to a set of universal delivery platforms adapted to take full advantage of the possibilities of various projectiles, rockets and missiles on a vastly larger area of operations.

Lethality is a condition for obtaining the expected effects of fires, beneficial for the operations of the supported troops, in accordance with the previously planned scale of this effects of field artillery fire. Its achievement results from the artillery shell's lethality and the use of sensors ensuring the appropriate accuracy of the target's location and precise battle damage assessment. It should be noted that the technologies currently implemented in artillery ammunition are to guarantee more concentrated lethality, which will minimize collateral damage on the battlefield.

Survivability guarantees availability in the course of operations. It is achieved by proactively combating threats, shielding fire support units from those threats, and protecting troops. The ways of meeting this requirement are also indicated in relation to the Polish artillery (Świętochowski & Rewak, 2021, p. 397). They concern the use of active protection systems and minimum STANAG 4569 level 2 armor in delivery platforms. Due to the significant development of these combat systems, another solution is the use of anti-drone systems. They can be complemented by a modern self-defense system equipped with heavy machine guns and smoke grenade launchers. An additional solution is the use of advanced camouflage systems for multispectral signature management and heat transfer reduction. However, during operations, the basic solution is the ability to disperse delivery platforms and other AIFS elements while ensuring an appropriate level of protection and defense.

Durability and continuity consist in ensuring the functioning of AIFS for a longer uninterrupted period resulting from the time of conducting tactical operations. They are achieved through systematic and comprehensive logistic support. However, the most important element in AIFS is the assets for supplying artillery ammunition. That is why it is so important to use automated delivery and reloading of artillery ammunition solutions. In meeting these requirements, it is also important to optimally manage the possessed types of artillery ammunition to maximise indirect artillery fire's effectiveness. An indirect solution is also the wider use of special ammunition or PKG or CCF technology, which, through the ability to conduct precision strikes and to upgrade the level of accuracy, reduce the number of rounds to achieve the same effects and significantly reduce the logistic burden. The uninterrupted functioning of logistic support is also associated with the need for appropriate solutions and technologies in the field of protection and defense, similar to delivery platforms.

3. Conclusion

Preliminary conclusions from the conflict in Ukraine indicate that the range of fire, precision and artillery system reaction time must be treated as key factors for the further upgrade of the Polish artillery. They should be complemented by a technological and tactical increase in the level of protection and defense of the entire AIFS, as well as accelerated rearmament and unification to the standard calibers used in the Alliance.

The general idea of modernization, due to the requirements of the modern battlefield, should be based on three pillars of artillery munitions and appropriate delivery platforms. Firstly, 155 mm projectiles for the close fight against the enemy's frontline forces and selected fire missions in the deep fight. Secondly, guided rockets for the deep fight against enemy reinforcements and supply lines. Thirdly, missiles for very deep strikes against targets in the enemy rear.

The facts gathered in the course of the research indicate that the challenge facing the C2 artillery subsystem will be the increasing systemic exchange of timely and accurate information necessary for fire direction and fire control and the increasing need for cross-domain cooperation and data sharing with various sensors and effectors. On the other hand, the transformations of the nature of the artillery supply chain will focus on the automation and reliability of the supply of artillery ammunition as the most critical supply class. The efficient supply of artillery ammunition should be complemented by an ammunition resupply system enabling full automation of reloading and loading processes.

Of course, in addition to developing the material components of AIFS, evolution requires transformations of the intangible components, which also determine the system's overall capabilities. In this sphere, the training issues are significant, in particular, the coordination of the activities of various indirect fires components and the tactical change in the perception of the role of indirect fire artillery on the tactical level of operations. Another major challenge is increasing the universality of organizational structures and modifying the procedures and doctrines, enabling quick adaptation of the solutions proposed therein to dynamic changes in the operating environment.

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Summing up the presented considerations, one should also be aware that in the short term, it will be necessary to make an inevitable choice of what to upgrade and supplement in the AIFS first in order to increase the Polish indirect artillery capabilities significantly.

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