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Trends in the Development of Russian Precision-Guided Weapons

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Abstract

This article presents the results of research that set out to identify and diagnose the trends found in the development of Russia's precision-guided weapons. The research process mainly employed the critical assessment of the literature and comparative analyses. As a result of the research, it was established that Russian thought on the strategic use of precision destruction weapons was historically determined and changed with technological progress, economic opportunities and changes in foreign policy objectives. Today, precision-guided weapons are complex strike systems capable of shaping the battlespace. Its high effectiveness makes it a real threat to objects that determine the opposing side's defense capability and can be considered strategic. The new generation of precision-guided weapons and hypersonic weapons will be crucial in achieving victories in armed struggle in the near future. Precision weapons will also be an effective tool of pressure and blackmail used to achieve the goals of international competition without the need for direct military confrontation.

Keywords

precision guided weapons, strategic thinking, Russia, defense

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1. Introduction

Trends in the evolution of means of warfare reflect the development of civilization and influence the prevailing principles of the art of war. The machine gun and the massive use of artillery made World War I a positional war. By 1939, the tank, radio, close air support, and the creation of armored divisions restored mobility to the battlefield. In the 1920s and 1930s, Soviet military theorists developed the concept of conducting the so-called deep battle, which emphasized combined arms operations at the tactical, operational, and strategic levels. The principal developers of this concept, including Mikhail Tukhachevsky and Vladimir Triandafilov, envisioned that deep indirect fire would be necessary in such operations at all three levels of armed struggle. They believed that indirect fire would create the conditions necessary to break through the enemy's frontal defenses and penetrate deep into the defenses and prevent the enemy from reconstituting the forward edge of the defenses (Radin et al., 2019, p. 89). This concept was an attempt to incorporate new technology into the traditional Russian strategy of conducting armed combat. The essence of waging a deep battle was to prevent second echelons and reserves from reaching the battlefield and to overwhelm the troops with fire throughout the depth of the battlegroup. In reality, however, it was not until fifty years later that the Soviet armed forces were able to implement the operational concepts begun in the 1920s. Under Warsaw Pact plans, by using coordinated, deep conventional and nuclear strikes against NATO, the intention was to launch a Soviet offensive in Europe with the goal of reaching the English Channel quickly (Ruehl, 1991).

Russian interest in precision-guided weapons (PGW)[1] has evolved with changes in the international security environment, theories of future warfare and strategic deterrence. In the early 1990s, the rapid development of modern technologies enabled the West, and above all the United States of America (USA), to make precision strikes, which revolutionized the way military combat was conducted in the 20th century. In a way, it is paradoxical that Russia appreciated the importance of these weapons only in the second decade of the 21st century, because one of the pioneers of thinking about the revolutionary nature of precision strikes was Marshal Nikolai Ogarkov of the Soviet Union, who died in the mid-1980s. At the time, Soviet engineers were working on designs for the first generation of domestic precision-strike weapons, but the collapse of communism and the Soviet Union caused serious delays in their development. Therefore, the Russian Federation had a limited number of cruise missiles with conventional warheads until 2010. Today, however, precision strike capabilities are prioritized both in military theory and in the development plans of the Russian Federation Armed Forces.

The problematic situation thus identified leads to the formulation of the main research problem: *What trends can be identified in the development of Russia's precision-guided weapons?* The main research problem was fragmented and the following specific problems were identified:

1) How should the concept of precision-guided weapons be understood?

2) How did Russian views on the use of precision-guided weapons change?

This article presents the results of the research which set out to identify and diagnose the trends found in the development of Russia's precision-guided weapons. The point of reference in the research was the combat experience and the directions of development taken by the US strike systems as determined by the application of modern technologies. Against this background, it was possible to analyze the evolution of Russian strategic thought from World

[1] The term precision-guided munition (PGM) is commonly used in American literature. In this paper, the author uses the term precision guided weapon (PGW), which should be understood in the same way as PGM.

War II to present. Moreover, identifying the factors that determined that the development of precision-guided weapons in the Russian Federation was given the highest priority. The research conclusions presented in this article are the result of the application of critical literature assessment and comparative analysis, as well as inductive and deductive reasoning.

2. The essence of precision-guided weapons

Precision has always been recognized as an important feature in the development of weapon systems. The renowned military theorist, strategist, and historian, General J.F.C. Fuller considered accuracy to be one of the five recognizable attributes of a weapon, along with range, firepower, and portability. Of all these attributes, he considered range to be the attribute that is crucial in the conducting of armed combat (Fuller, 1945, p. 7). It is worth noting that modern PGW combine the qualities of accuracy, range, firepower, and fire-carrying capabilities, and this combination makes them a powerful multiplier of combat power in today's era.

The philosophy of military operations that took place during World War II was based on conducting large-scale, imprecise bombing campaigns. As technology advanced, air operations conducted in the late 20th century targeted selective targets that were individual tanks, artillery pieces, or even infantry. After all, there is no logical reason why missiles or bombs should be wasted without achieving operational effects (Meilinger, 1995, pp. 41-47). Viewed from another perspective, the philosophy of warfighting in World War II reflected the opinion that precision was only possible by achieving the operational objective, and not the object of impact. Subsequent air campaigns took advantage of the opportunities afforded by technological advances and focused on both a precisely defined object of impact and the exercise of precise control over the weapons themselves. The quest for precision through accurate identification of the object of impact remains an essential aspect of military power projection. Historical experience suggests that the best results have been achieved by combining strike platforms with intelligent means of delivery and operator experience. However, it is important to remember that precision is a relative concept, relating to the time at which the weapon is used.

The term precision is directly related to accuracy. Accuracy refers to the closeness of a measured value to a standard or known value, while precision refers to the closeness to each other of two or more measurements made. Precision is independent of accuracy. One can be very precise but inaccurate. It is also possible to be precise but imprecise. For example, if the average measurements of a certain quantity are close to a known value but do not coincide, then we have precision without precision. In other words, accuracy describes the difference between the measurement and the actual value, while precision describes the difference that is observed by repeatedly measuring a specific quantity with the same instrument. A good analogy for understanding accuracy and precision is to imagine a basketball player shooting a ball into a hoop. If the player shoots accurately, it means that he attempts to direct the ball into or near the hoop. If a player throws the ball accurately, he aims for the same place, which may be the hoop itself or somewhere nearby. A good player, will be both accurate and precise when shooting the ball in the same way every time in the hoop (Accuracy).

In military literature, the term "precision-guided weapon" refers to a guided weapon that is capable of destroying a target, generally with a single projectile. This definition covers a fairly wide range of means of destruction including both miniaturized and multi-ton guided aerial bombs weighing only a few grams, manually launched small unmanned aerial vehicles, and intercontinental ballistic missiles (Miasnikov, p. 4). What is important in the definition is the wording regarding the weapon's targeting capability, or more specifically, the weapon's targeting capability. Most relevant aspect is the ability to guide in the last phase of flight of the means of destruction (rocket or bomb).

There are several reasons why it is legitimate to use the term "guidance" instead of "precision strike," despite the fact that the latter has gained widespread acceptance. First, precision striking is always associated with accuracy. However, this raises the question of the value of this accuracy, which de facto varies and depends on the type of weapon. Secondly, targeting is associated with the attribute of making aiming corrections in all phases of the flight of the means of destruction. This attribute is crucial and, based on it, weapons and ammunition can be classified as guided or unguided (Watts, 2007, p. 7). Ammunition alone is not sufficient to meet the requirements of the concept of using precision-guided weapons. For guidance, it is necessary to have accurate information about the object of impact.

The term "precision strike," as noted earlier, is related to the attributes of weapon systems that are necessary to successfully paralyze an enemy on the battlefield. Precision-strike weapons include land-, air-, and sea-launched missiles, torpedoes, and guided bombs carried by aircraft. Precision interaction is enabled by systems that locate targets, make strikes, generate desired effects and evaluate them, and maintain the ability to strike again if necessary (Joint, 1996, p. 21). Precision strike weapons are designed to destroy point targets and minimize collateral damage (DOD, 2020, p. 170). At this point, it is important to emphasize again that precision-guided weapons, once activated, can be actively corrected during flight and target guidance, thereby make correcting errors that may have occurred during the initial assignment to destroy targets. Target guidance should be understood as actively conducting corrections during the final phase of flight, virtually up to the point of impact (Watts, 2007, p. 26).

In the late 1970s in the Soviet Union, the terms "precision-guided weapons" and "precision-guided munitions" (Russian: *высокоточное оружие*) were implemented into Russian military terminology by translating its meaning from Western concepts of military success. The correct Russian meaning was broad and referred to systems that allowed precise damage to be inflicted on the enemy from long distances (McDermott, 2017, p. 8). Currently, in the Russian Federation, long-range PGW are ground, air, and sea-based missile complexes designed to selectively and reliably destroy stationary and quasi-stationary land objects, fired from their means of delivery, from a distance of not less than 400 km from the target (Dictionary). When it comes to distance (range of fire), opinions are divided, mainly due to the fact that no qualitative indicators are available. Although the term "long-range" has no specific definition, it is assumed that, in its broadest sense, it encompasses any system that can fire at distances in excess of 1,000 km. Long-range ballistic missiles practically cross both of these thresholds. However, it must be taken into account that they are designed to carry nuclear, not conventional, weapons. Some states use shorter-range ballistic missiles without nuclear warheads. While doing so, one must keep in mind that their accuracy should be up to a few meters to be effective (Borrie et al., 2019, p. 4). It would be more appropriate to consider the definition of long-range as a qualitative characteristic, reflecting the ability of the weapon to strike critical infrastructure located in the entire depth of the adversary's territory (or the bulk of it). In this sense, on European territory, the threshold could be lowered to 500 km due to the relative compactness of the hypothetical theater of operations and the density of critical infrastructure. This may lead to the conclusion that the quantitative definition of long range will vary for different military-strategic situations. One of the possible consequences of such an approach in the future may be the intensification of the trend toward regionalization, that is, clearly defined geographical areas with specific parameters (Arbatov et al., 2019, p. 27).

According to Russian views, PGW are a type of weapon equipped with command-and-control systems that allow the elimination of targets with a single munition with a probability of at least 0.5. The high probability of hitting the target is achieved by conducting periodic correction of the trajectory of the munition (missile, rocket, warhead) after it is fired from the means of delivery until it reaches the target of attack. The correction of the trajectory of the munition to the target is provided by the guidance system (Ènciklopedija). Rather than taking the weapon's range or the missile's airspeed as criteria for qualification, it is the combination of these parameters with maneuverability that distinguishes PGW from ballistic missiles and makes them strategically relevant. Maneuverability can enable a greater precision strike and therefore gives the system the ability to use conventional warheads effectively. At supersonic speeds, it also has an added importance due to the need to evade missile defense systems and also due to the need to miss moving targets (Borrie et al., 2019, p. 5).

Initially in the 1990s, Russia used the term reconnaissance-strike complex (*разведывательно-ударный комплекс*) or reconnaissance-fire complex (*разведывательно-огневой комплекс*). At the beginning of the new millennium, Russian scientists added the word "system" to better reflect the conceptual assumptions of its combat use (McDermott, 2017, p. 8). The terminology used for conventional precision weapons in official documents, statements by political and military leaders, and in military journals varies. For example the Russian military doctrine of 2014 includes the term "precision weapons system" (*систем высокоточного оружия*) and "strategic, non-nuclear precision weapons systems" (*стратегических неядерных систем высокоточного оружия*) (Voyennaya, 2014, p. 5). Other terms used to refer to conventional PGW and conventional long-range precision weapons include: high-precision means of warfare (*высокоточное средсва поражения*), long-range non-nuclear (conventional) precision weapons (*высокоточное неядерное (обычное) оружие для дальнего радиуса действия*), conventional strategic weapons (*конвенциональное стратегическое оружие*), a precision non-nuclear weapon with a large radius of effects (*высокоточное неядерные средства большой радиуса действия*), precision-guided combat complexes (*высокоточнное боевые комплексы*), non-nuclear precision-guided weapon system (*неядерная система высокоточного оружия*), strategic non-nuclear weapons (*стратегическое неядерное оружие*), conventional long-range precision weapons (*обычное высокоточное оружие большой дальности*) and long-range precision weapons (*высокоточное оружие большой дальности*).

According to the Russian perspective, precision strike weapon complexes/systems include the information gathering and battlefield situation assessment subsystems, the command-and-control subsystem, and the missile strike subsystems (Watts, 2007, p. 28). Depending on the military structure that includes a given strike system and the type of munitions possessed, precision strike weapons can be used to accomplish tactical, operational, and strategic tasks. Precision strike systems include air- and sea-launched cruise missiles, certain types of operational-tactical missiles, air and missile defense sets, guided missiles, classic and cassette bombs dropped from aircraft, and selected artillery and missile complexes of anti-ship systems (Ènciklopedija).

The advantage of PGW over unguided weapons is their long-range and reduced need for repeated strikes to achieve desired operational effects. PGW allow shaping the battlespace, increasing the protection of their own troops. The main disadvantage of PGW is their high cost, especially for long-range missiles. Nowadays, to ensure high hit accuracy, a combination of radio signals from the Global Positioning System (GPS), laser guidance and inertial navigation systems with gyroscopes are used for guidance (Hoehn, 2020, p. 2).

Precision weapons are so effective that they can pose a threat to all elements of the strategic nuclear triad: fixed and mobile strategic missile launchers, submarines carrying nuclear missiles, and strategic bombers on airfields and in the air, which makes them currently treated on par with nuclear weapons. To plan a strike, it is necessary to analyze all operational conditions in terms of expected effects due to the specific vulnerabilities of the target and the characteristics of the means of destruction used (Miasnikov, 2020, p. 4).

3. The evolution of precision-guided weapons

Prior to 1943, most ammunition used on the battlefield missed its target because initial aiming errors could not be corrected. Unguided ammunition was used, and its lack of accuracy was compensated for by its quantity. The earliest instances of combat success with precision-guided munitions occurred in March 1943. The German Navy introduced the first G7e/T4 Falcon acoustic torpedo on four submarines. Its use probably led to the sinking of four merchant ships, which was considered the first successful use of guided munitions. In May 1943, an American Mark-24 acoustic torpedo fired from a patrol plane sank the German submarine U-640, and by the end of the war, 37 German and Japanese submarines, damaging 18 others (Watts, 2007, p. 3).

Aerial munitions meeting the guidance criterion were first developed in the 1940s when the U.S. Army Air Corps tested the feasibility of using radio to guide bombs dropped from aircraft. At that time, an accuracy of 1,200 feet was achieved, and 16% of the munitions dropped by the crews landed within 1,000 feet of the established target (Correll, 2008). While the system showed promise in terms of accuracy, it was not fully utilized during World War II. This was likely due to technological limitations and the high cost per munition used. By the 1950s, guidance systems used television signals and required a companion aircraft to provide command and control of the bombs being dropped (Hoehn, 2020, p. 2). During the 1960s and early 1970s, progress in the evolution of PGW was rather limited. The weapons were too inaccurate and susceptible to anti-aircraft defenses, so no breakthrough could be made with them in terms of the way armed struggle was conducted. The development of anti-aircraft means, especially short- and medium-range missile sets, forced such changes in the American combat systems that made it possible to defeat it (Watts, 2007, p. 6). The breakthrough appears to have been made in Vietnam with the introduction of laser-guided aerial bomb guidance capabilities. Based on wartime experience, it was determined that the U.S. military used more than 10,500 laser-guided bombs in 1973, with 5,107 weapons achieving a direct hit and another 4,000 coming within 26 feet of the target (Hoehn, 2020, p. 2).

The Soviet Union's investment in increasingly sophisticated weapons in the 1970s, along with the rapid expansion of the Soviet naval fleet, stimulated U.S. countermeasures, which turned out to be increasingly precise weapons. One of these was the acquisition of the F-14 Tomcat supersonic airborne fighter with variable wing geometry, armed with six Phoenix long-range guided air-to-air missiles, as well as advanced early warning radars and guidance systems. In addition, new precision airborne and missile defense weapons have been acquired, notably the Phalanx and Sea Sparrow, and the Harpoon (Hallion, 1995) short-range anti-ship cruise missile, launched from the surface, underwater, and airborne platforms, has been fielded.

Until the Persian Gulf War, aircraft capabilities permitted low-altitude placement of unguided munitions within 30 feet of the target. However, Iraqi air defenses, with their large numbers of man-portable and artillery anti-aircraft sets, did not permit such routine performance. On the other hand, operations above 5,000 meters were very complicated in terms of bombing accuracy, especially against targets requiring direct hits, such as hangars, bunkers, tanks, and artillery assets (Hallion, 1995).

Unlike the United States, the Soviet Union began to invest in traditional types of conventional forces, i.e., tanks, infantry fighting vehicles, and tactical aircraft from the late 1960s onward. By the late 1970s, the authorities concluded that the threat of aggression from the North Atlantic Alliance had been greatly reduced (Trulock, 1988, p. 97). Looking ahead, however, it did not appear that this favorable situation was going to last forever. The advent of U.S. precision strike capabilities began to shift the European balance in NATO's favor, prompting the abandonment of the investment the Soviets had made in traditional conventional forces during the previous decade. By the early 1980s, Soviet military authorities and military theorists were increasingly concerned that emerging military technologies, specifically a new family of highly accurate, precision-guided non-nuclear munitions systems, would lead to a revolution in military affairs by the end of the twentieth century that would change the picture of warfare (Trulock, 1988, p. 97).

In the early 1980s, Russian military theorists wrote extensively about the likely implications of using reconnaissance and strike systems for future warfare. Systems with long-range precision strike capabilities enhanced the ability to inflict losses deep within enemy groupings, more than 10 times farther than was possible during World War II on the Eastern Front. Moreover, the probability of eliminating a target with a single shot of a precision weapon ranged from 0.6 to 0.9, for both stationary and mobile targets (Trulock, 1988, p. 107). As Marshal Nikolai Ogarkov wrote in May 1984, the development of non-nuclear means of striking, which included everything from precision munitions to fuel-air bombs, made it possible to significantly increase, the destructive potential of conventional weapons by at least an order of magnitude, thus bringing them closer in effectiveness to weapons of mass destruction (Watts, 2011).

U.S. tests conducted in 1982 confirmed that precision-guided missiles could be used to attack Soviet forces approaching from deep within a battle grouping, i.e., virtually from outside the front lines. In the case of the Warsaw Pact's attempt to overrun Western Europe, both the program codenamed Assault Breaker and the development of stealth aircraft such as the F-117 were intended to use U.S. technological capabilities to offset the three-to-one quantitative advantage the Warsaw Pact had in Central Europe at the time, which could eliminate the need for nuclear weapons (Watts, 2013).

The tests confirmed that nuclear munitions could be replaced by conventional precision-guided munitions in many cases and thus achieve the required level of destruction without incurring their own losses and raising the risk of nuclear escalation (Trulock, 1988, p. 110). This idea was not new. In fact, American defense specialists thought of it in the aftermath of the Vietnam War. In 1975, the final report of the research program on the development of long-range means of destruction concluded that precision conventional munitions could substitute for nuclear weapons in a variety of operational situations (Paolucci, 1975, p. 45), which was conceptually implemented in both the United States and the Russian Federation at the beginning of the new millennium.

In 1986, Russian concerns about the balance of power in Central Europe intensified when NATO decided to implement the concept of cutting-off second echelons and reserves (FOFA).[2] The essence of this concept was to increase the deep strike capability of conventional forces in the theater of operations, which was intended to eliminate the need for the Alliance to use nuclear weapons to deter Warsaw Pact aggression (Shaw, 1986, p. 1). Verification of the feasibility of U.S. air operations using PGW occurred in 1991 during the Gulf War. For the first time in the history of operational warfare, reconnaissance, radio warfare, communications, and command were integrated with precision strike systems, making it

[2] The FOFA concept was developed by Gen. Bernard W. Roders in 1984. It was designed as a complement to the NATO concept of the advanced forward deployment and air-to-ground battle strategy (Canan, 1984).

possible, virtually in real-time, to conduct the air campaign of Operation Desert Storm. Modern technologies made it possible not only for strike aircraft to remain invisible but also to integrate space with combat systems, as emphasized by prominent Russian experts in their assessments (Blank, 1991, p. 10). As the head of the Operational and Strategic Center of the General Staff, Sergei Bogdanov, recognized, the use of the reconnaissance capabilities provided by space for the needs of intellectualized precision strike complexes made it possible to achieve incredible operational effectivity (Blank, 1991, p. 10). In the opinion of Russian General Ivan N. Vorobyev, the effectiveness of PGW changes the picture of the armed struggle and deeply imprints on the strategy of its use in the future (Lambeth, 1992, p. 68). Andreev F. Krepinevich, compared Operation Desert Storm to the use of tanks, for the first time in history on a large scale, by the British at the Battle of Cambrai, France, in November 1917. He posited that the use of PGW leads to a whole new picture of the theater of operations and gives rise to another revolution in the conducting of armed struggle (Krepinevich, 2002, p. 3 & 9).

According to the Russian point of view, a high-precision weapon that is not subject to any quantitative, qualitative, or territorial restrictions, but is well camouflaged, makes it eligible for "anti-terrorist" treatment. It is also a weapon that can target strategic facilities. Furthermore, due to its minimal flight time and high targeting accuracy, it provides a surprise attack and significantly reduces the possibility of retaliation (Antonov, 2012, p. 65). Russian experts estimate that the another major trend in the development of high-precision, non-nuclear strike missile systems will be the use of space-deployed basing control systems (Arbatov & Dvorkin, 2012, p. 357). An orbital or semi-orbital high-precision missile strike system is likely to emerge in the foreseeable future, with implications for the future arms race. Over the next decade, nuclear deterrence is likely to remain an element of international security guarantees, but its importance can be expected to diminish. It is estimated that non-nuclear precision-guided systems are likely to play an increasingly important role in mutual deterrence and strategic stability. It is in the interest of the international community that this process takes place in a coordinated manner and is regulated by mutual agreements (Arbatov & Dvorkin, 2012, p. 357).

Today, the technological revolution is accelerating with the use of optoelectronics and satellite navigation systems. Work is also underway to make the weapon independent of weather conditions, and ammunition with optional warheads is being procured, enabling a variety of missions, from penetrating hard point targets to the ability to destroy superficially distributed single combat objects on the battlefield with a single salvo (Hallion). However, one should be aware that the acquisition of new weapons is not a simple procedure. There are a number of difficulties arising from the enormous complexity of integrating different types of munitions into a single weapon system. It is also necessary, for example, to skillfully use the information obtained from long-range reconnaissance systems. This information can be used to overcome the difficulties of positioning striking objects and tracking them, navigate the means of destruction, precise timing, and have an appropriate means of communication. Above all, it is essential in order to network the entire process of destruction, which would allow to exercise the command process in combat conditions and to destroy objects of strategic and operational importance in real-time (Watts, 2013).

Secondly, although modern precision-guided missile systems have made accuracy independent of the distance to the target and the location from which the munition was fired, they still have not made unit costs independent of the distance to the target. For example, the most expensive missiles today are U.S. Tomahawk missiles, which are several times more expensive than guided aerial bombs. Thus, unit costs are a major reason why the United States currently holds a monopoly on long-range PGW (Watts, 2013). Among the various weapons, the future is likely to include networked precision-guided weapons, which will allow them to communicate with other systems on the battlefield. The exchange of information between the platforms delivering the means of destruction and the means of reconnaissance, including satellite, and command and combat management posts, will be crucial for accurate and precise mission execution (Esposito, 2019). In turn, the development of hypersonic systems of the Russian Federation may raise the risk of causing an unintended nuclear war, as it will deprive ground-based radars of the ability to determine in a timely manner the trajectory of enemy missiles and the area of their impact, which means that in response to this type of attack, a decision on the type of response will have to be validated immediately after the satellites generate a (probably false) nuclear alert (Arbatov, 2019). Given scientific and technological advances, it is reasonable to expect that deploying precision weapons systems in space could pose an even greater risk to international security (Dvorkin, 2019, p. 4).

It is estimated that future Russian high-tech precision-guided missile systems, mounted on a variety of platforms, are likely to have comprehensive destruction characteristics. In the Russian Federation, it is assumed that the conflict will not be confined to a single operational domain. Actors involved in the fight will likely move between domains, attempting to exploit those that will allow them to achieve the greatest advantage or those in which the likelihood of gaining an advantage will increase (Kepe, 2018, p. 16). In fact, the next generation of Russian PGW will likely be carried and operated by both conventional manned platforms and autonomous, unmanned aircraft. These weapons will have both highly lethal and nonlethal missile effectiveness. It will also likely be capable of operating in a physical environment while being controlled in a virtual. It will be able to be used alone or be integrated with other missile systems. It is likely that its range, maneuverability, and precision of strikes will be increased. Considering the arguments presented, it can be concluded that the directions of development of PGW will be set by hypersonic and laser weapons (Esposito, 2019).

4. Conclusion

Russia's interest in developing conventional precision-guided weapons is not new. In the transformation of the armed forces, acquiring new precision-guided capabilities is a top priority, as evidenced by the successful testing in 2018 of hypersonic weapon systems. They are also evidence of the evolution of Russian thought on conflict resolution in a strategic context. Understanding this trend requires taking into account historical circumstances, advances in Soviet and Russian military theory, addressing doctrinal assumptions and, above all, understanding the Russian Federation's foreign policy objectives.

As this article demonstrates, Russia has long regarded precision-guided weapons as an essential component of modern warfare. Marshal Nikolai Ogarkov is considered the father of this school of thought, but later Russian military theorists such as General Vladimir Slipchenko and others have also made significant contributions to its development. The economic collapse of the 1990s, combined with warming relations with the West, made indigenous development of precision-guided weapons both financially difficult and less politically necessary. However, this situation changed dramatically after Vladimir Putin came to power, the annexation of Crimea, and the Russian Federation's involvement in Syria.

As a result of the research, it was determined that there are terminological differences in understanding precision-guided weapon systems between the Russian Federation and the U.S. and NATO. Moreover, the Russian Federation uses a variety of nomenclatures to describe precision-guided weapons. According to the Russian perspective, precision-guided weapons should be considered in terms of complex systems and should not be limited to means of destruction. Precision-guided weapons make it possible to shape the battlespace, which proves their high effectiveness. Therefore, they can pose a real threat to all of the elements of the adversary's defense system, and first and foremost the strategic nuclear triad. In the Russian Federation, precision-guided weapons are treated on par with nuclear weapons. It is believed that the rapid technological progress made in the last decade will make it possible to exploit space and make hypersonic weapons decisive for achieving victory in future armed struggle. It is estimated that hypersonic weapons, due to their attributes, will be used as a tool to apply pressure and aggression, and to achieve foreign policy objectives without the need for direct armed confrontation. The large-scale acquisition of hypersonic capabilities and the high effectiveness of the PGW will undoubtedly influence doctrinal changes and the strategy of its use in the future.

The author believes that the opinions and conclusions presented in this article may serve as a starting point for considering the utility of the PGW in the strategic context; and, in particular, their role in achieving the objectives of the rivalry that the Russian Federation is currently conducting on the international arena.

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References

1. Accuracy vs. Precision. https://www.diffen.com/difference/Accuracy_vs_Precision
2. Antonov, A.I., (2012). *Контроль над вооружениями: история, состояние, перспективы* [Arms Control: History, Status, Prospects]. ПИР–Центр. http://mil.ru/files/morf/A_Antonov___monografia.pdf
3. Arbatov, A. (2019). *Роль ядерного сдерживания в стратегической стабильности. Гарантия или угроза* [Nuclear Deterrence: A Guarantee or Threat to Strategic Stability?]. Carnegie. https://carnegie.ru/2019/01/28/ru-pub-78209
4. Arbatov, A. & Dvorkin, V. (Ed.) (2012). *Противоракетная Оборона: Противостояние Или Сотрудничество?* [Missile Defense: Confrontation or Cooperation?]. Carnegie Endowment for International Peace. https://carnegieendowment.org/files/PRO_Book_rus20121.pdf
5. Arbatov, A., Oznobishchev, S., & Bubnova, N. (Ed.). (2019). *Russia: Arms Control. Disarmament and International Security*. Primakov national research institute of world economy and international relations Russian academy of sciences.
6. Blank, S. (1991). *Soviet Military Views Operation Desert Storm: A Preliminary Assessment*. Strategic Studies Institute. https://www.researchgate.net/publication/279439030_The_Soviet_Military_Views_Operation_Desert_Storm_A_Preliminary_Assessment
7. Borrie, J., Dowler, A., & Podvig, P. (2019). *Hypersonic Weapons. A Challenge and Opportunity for Strategic Arms Control*. United Nations Office for Disarmament Affairs.

8. Canan, J.W., (1984.09.01). NATO On the Upbeat. *Airforce magazine*. https://www.airforcemag.com/article/0984nato/
9. Correll, J.T., (2008). *Daylight Precision Bombing*, Air Force Magazine. https://www.airforcemag.com/article/1008daylight/
10. *Defense Primer: U.S. Precision-Guided Munitions*. (2020). The Congressional Research Service.
11. *Dictionary military terms of the Russian Federation*. http://dictionary.mil.ru/folder/123102/item/129202/
12. *DOD Dictionary of Military and Associated Terms*. https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/dictionary.pdf
13. Dvorkin, V., (2019). *Стратегическая стабильность: сохранить или разрушить* [Preserving Strategic Stability Amid U.S.-Russian Confrontation]. Carnegie. https://carnegie.ru/2018/11/28/ru-pub-77809
14. *Ènciklopedija Minoborony Rossii*. https://desecuritate.uph.edu.pl/images/De_Securitate_NUMER_2_2019.pdf http://энциклопедия.минобороны.рф/encyclopedia/dictionary/details_rvsn.htm?id=12896@morfDictionary
15. Esposito, F., (2019). *Precision-Guided Munitions of the Future and the Related Challenges to NATO*, JAPCC. https://www.japcc.org/precision-guided-munitions-of-the-future/
16. Fuller, J.F.C. (1945). *Armament and History: A Study of the Influence of Armament on History: From the Dawn of Classical Warfare to the Second World War*. New York: Charles Scribner's Sons. DOI: https://doi.org/10.1017/S003467050004050X
17. Hallion, R.P. (1995) *Precision Guided Munitions and the New Era of Warfare*, APSC Paper Number 53. Commonwealth of Australia. https://fas.org/man/dod-101/sys/smart/docs/paper53.htm
18. Hoehn, J.R. (2020). *Precision-Guided Munitions: Background and Issues for Congress*. Congressional Research Service.
19. *Joint Vision 2010*. (1996). Center for Counterproliferation Research National Defense University Washington.
20. Kepe, M. (2018). *Exploring Europe's Capability Requirements for 2035 and Beyond*. European Defence Agency.
21. Krepinevich, Jr, A.F. (2002). *The Military-Technical Revolution: A Preliminary Assessment*. Center for Strategic and Budgetary Assessments.
22. Lambeth, B.S. (1992). *Desert Storm and its meaning. The View from Moscow*. Rand Corporation.
23. McDermott, R.N., & Bukkvoll, T. (2018). Tools of Future Wars — Russia is Entering the Precision-Strike Regime, *Journal of Slavic Military Studies*, NO. 2, pp. 191-213. https://doi.org/10.1080/13518046.2018.1451097
24. Meilinger, P.S. (1995). *10 Propositions Regarding Air Power, Air Force History and Museums Program*. Air Force Historian.
25. Miasnikov, E. *Long-Range Precision-Guided Conventional Weapons: Implications For Strategic Balance, Arms Control And Non-Proliferation*. https://www.armscontrol.ru/pubs/en/em090918.pdf
26. Paolucci, D.A. (1975). *Summary Report of the Long Range Research and Development Planning Program (LRRDPP)*. Skyline Center.

27. Radin, A., Davis, L.E., Geist, E., Han, E., Massicot, D., Povlock, M., Reach, C., Boston, S., Charap, S., Mackenzie, W., Migacheva, K., Johnston, T., & Long, A. (2019). *The Future of the Russian Military Russia's Ground Combat Capabilities and Implications for U.S.-Russia Competition*. Appendixes. Rand Corporation.
28. Ruehl, L. (1991). Offensive defense in the Warsaw Pact, *Survival. Global Politics and Strategy*, Issue 5, pp. 442–450. https://doi.org/10.1080/00396339108442611
29. Shaw, A. (1986). *Technologies for NATO's Follow-on Forces Attack Concept*. Congress of the United State. https://ota.fas.org/reports/8630.pdf
30. Trulock, N. (1988). *Emerging Technologies and Future War: A Soviet View*. In Marshall, A.W. & Wolf, C., Jr. (Ed.), *The Future Security Environment*. US Government Printing Office. http://albertwohlstetter.com/CILTS/FSE/19881000-CILTS-FutureSecurityEnvironment.pdf
31. Watts, B.D. (2013). *Precision Strike: An Evolution. The world once thought guided munitions were the future of warfare. The truth has been more complicated*, The National Interest 02.11.2013. https://nationalinterest.org/commentary/precision-strike-evolution-9347
32. Watts, B.D. (2011). *The Maturing Revolution in Military Affairs*, Center for Security Studies. https://ethz.ch/content/specialinterest/gess/cis/center-for-securities-studies/en/services/digital-library/articles/article.html/162685
33. Watts, B.D. (2007). *Six Decades of Guided Munitions and Battle Networks: Progress and Prospects*, Center for Strategicand Budgetary Assessments.
34. *Voyennaya doktrina Rossijskoj Fiedieracyi* (2014). Moscow.