

The use of innovative weapon systems in the armed forces in the 21st century - ethical and legal aspects

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Abstract— The article analyzes rapid technological changes and the dynamically evolving geopolitical environment, emphasizing the need to adapt the strategies and operational structures of modern armed forces. The use of modern weapon systems, such as artificial intelligence, drones, robotics, cyber systems and advanced sensors, is becoming a key element of military effectiveness in the 21st century. The authors point out the challenges related to the integration of these technologies, which require a comprehensive approach covering technical, operational and strategic aspects. It is also important to take into account interoperability and the ethical and legal aspects of the use of autonomous weapon systems. Cybersecurity and effective management of financial resources and cooperation with the private sector and international partners are key to success. Ultimately, the ability to quickly adapt and be flexible, investments in human capital and a comprehensive approach to technology integration are necessary to ensure the safety and effectiveness of armed forces operations in a dynamically changing world.

Keywords— new technologies, weapons, armed forces, artificial intelligence, security.

I. INTRODUCTION

Modern armed forces around the world face the challenge of adapting to a dynamically changing security environment. In the 21st century, technology plays an extremely significant role

in transforming the way military operations are conducted. Innovative weapon systems, including advanced technologies such as artificial intelligence, drones, robotics, cybersecurity, as well as advanced sensor systems, are becoming an integral element of modern armies. These advanced technologies not only increase the efficiency and precision of military operations, but also introduce new challenges related to their integration, management, and ethical and legal use.

The development and implementation of innovative weapon systems are of fundamental importance for modern armed forces, which must meet the growing requirements in the field of defense and security. The ability to quickly adapt and use new technologies may determine advantage on the battlefield. At the same time, it is worth noting that dynamic technological progress forces the armed forces to adopt new operational strategies that take into account the capabilities and limitations of these modern weapon systems.

This article aims to analyze the role of innovative weapon systems in the armed forces in the 21st century. Key technologies, their impact on operational capabilities, as well as challenges related to their implementation will be presented. Ethical and legal aspects of the use of modern military technologies, which are an integral part of the discussion on the future of armed conflicts in the 21st century, will also be discussed. This analysis will provide a better understanding of



how advanced technologies are transforming today's armed forces and what implications they may have for the future of global security

II. EUROPEAN UNION ETHICAL AND LEGAL ASPECTS OF THE USE OF MODERN MILITARY TECHNOLOGIES

Modern military technologies open up wide opportunities for the armed forces to optimize their functioning and operations, including the development of unique features and capabilities in the areas of reconnaissance, destruction, command, operation support and logistics support. However, their introduction raises a number of important ethical and legal issues that must be carefully analyzed and taken into account in the strategies and regulations regarding their use (Bierzanek 1982, pp. 31-32).

Autonomous weapon systems - such as combat drones and robots - raise many controversies related to responsibility for decisions made by such systems. An extremely important problem here is the lack of human supervision, which may lead to actions inconsistent with international humanitarian law and increase the risk of civilian casualties. Similar concerns apply to artificial intelligence (AI) in the military context, where life and death decisions are made using algorithms. Transparency and interpretation of these decisions become important to ensure compliance with humanitarian values and human rights (Nastaj-Sałek 2023, pp. 148-151).

Cyberwar, which involves attacks on countries' critical infrastructure, also has serious ethical implications. Such attacks can lead to disruptions in the supply of energy, communications and other services essential to the functioning of society, which directly affects the lives of citizens. Therefore, it is necessary to develop clear rules regarding responsibility for activities in cyberspace (Górka 2023, p. 12).

Advanced reconnaissance and monitoring technologies, such as satellites and electronic reconnaissance systems, raise privacy concerns. The use of these technologies must be balanced with respect for individual privacy and compliance with human rights, which requires appropriate legal regulations (Cyrkun 2023, pp. 175-180).

International humanitarian law (IHL) regulates the use of armed force in an effort to protect civilians and reduce suffering during armed conflict. The introduction of modern military technologies requires adaptation of these standards to ensure that new weapons and strategies comply with IHL principles such as proportionality, distinction and military necessity. Existing treaties, such as the Convention on the Prohibition of Chemical Weapons or the Convention on the Prohibition of Anti-Personnel Mines, may need to be updated in the context of new technologies, such as laser weapons or autonomous weapon systems (Cyrkun 2023, pp. 175-180).

At the national level, individual countries must develop their own policies regarding the use of modern military technologies. Therefore, it is worth noting that national law should take into account both aspects of national security and the protection of civil rights. Consequently, it is necessary to create a legal framework that will allow the ethical and legal use of new

technologies in the armed forces (Anderson 2013, pp. 6-14).

The introduction of new military technologies also raises questions about responsibility for their use. An important factor is to determine who is responsible in the event of violations of international law - the programmer, the operator or the military commander. Clear accountability policies are essential to ensure legal and ethical compliance (Anderson 2013, pp. 6-14).

The ethical and legal aspects of the use of modern military technologies are complex and require constant monitoring and adaptation of legal regulations. The introduction of new technologies must be consistent with international humanitarian law and military ethics, so that their use serves the purpose of protecting life and peace and does not lead to the escalation of conflicts and suffering of the civilian population.

III. THE IMPACT OF NEW TECHNOLOGIES ON THE DEVELOPMENT OF OPERATIONAL CAPABILITIES OF THE ARMED FORCES

Modern technologies that create a new quality and gradually rebuild all aspects of our lives - political, economic and social - are also transforming the sphere of security, defense and military. Their influence leads to the transformation of markets, production, work and consumption, and also changes the way the armed forces function and operate. Therefore, in the context of designing the main directions of development of the armed forces for the years 2025–2039, such a significantly important aspect cannot be ignored (<https://www.pzdrowie.pl/aktualnosci/biuro-bezpieczenstwa-narodowego/aktualnosci/w-piatek-president-of-the-RP-publishing-the-main-directions-of-development-of-the-armed-forces-for-1-2025-39.66408>, accessed on June 10, 2024, at 10.00).

New technologies open up opportunities for the armed forces to optimize their functioning and operations, enabling the development of a number of new, unique features and capabilities in areas such as reconnaissance, destruction, command, operations support and logistics support. In order to take advantage of development opportunities, the armed forces must shape a culture of openness, but also readiness to introduce changes, develop innovative solutions and implement new technologies. Only such an approach can make the armed forces an organization that learns quickly and adapts efficiently to dynamic changes in its environment (Bugajski, Falkowski, Łubiński, Marcinko, Sałaciński, Żeligowski 2014, pp. 17-24).

Interoperability, considered the key to effectiveness, has been one of the development priorities of most armies in the world for decades. The Defense Concept of the Republic of Poland, which outlines the vision of the Polish Armed Forces for 2032, also assumes that the future effectiveness of these forces will largely depend on the ability of individual units of the armed forces to cooperate as part of a joint operation. Interoperability not only enables cooperation, but also the implementation of the concept of multi-domain operations, which are currently a model solution for conducting both contemporary and future military operations (Concept of

Defense of the Republic of Poland 2017, p. 45).

New technologies such as artificial intelligence, advanced Internet of Things, access to large data sets and the possibility of their secure transmission through wireless broadband telecommunications networks can raise interoperability to a higher level in terms of cooperation procedures, understanding of reality and the integration of many functions, as well as new domains. Digital technologies will support the creation of an intelligent military ecosystem, capable of effective cooperation in a network consisting of devices and systems. It is worth noting that they will enable the creation of a system connecting devices, sensors and effectors in various domains - on land, in the air, at sea, in cyberspace and in space - ensuring the ability to achieve a synergistic effect of resources and activities. Therefore, military planners should be obliged to plan a vision and, based on it, plan a multidimensional battle space strategy that will make maximum use of today's developing digital technologies (Żebrowski 2017, p. 71).

IV. A NEW CONCEPT OF CONNECTED OPERATIONS

The new concept of conducting joint operations, developed mainly by American sources, describes a way of preparing for operations that enables effective operation in the future security environment. The above concept assumes that joint forces must adopt a specific mode of operation that allows for an extremely rapid transformation or integration of various capabilities both within their own structures and in relation to operational partners at all levels and in all domains - sea, land and air - regardless of from geographical boundaries or organizational connections. Such networks, composed of military forces and non-military partners, will form, evolve, disband and re-form in various configurations, in a more flexible way than the current joint forces (Bernabiuk 2010, p.23).

The essence of a joint force has always been to combine the unique capabilities of each branch of the armed forces to demonstrate and maintain dominant military power. The creation of military groupings that use the above-mentioned concept was closely related to the nature of the activities carried out, i.e. joint operations. The new concept of joint operations aims to accelerate the implementation and expand the use of the idea of joined forces, which have the so-called decisive power (Klos 2009, pp. 79-85).

An important element of this concept is the integration of developing capabilities, in particular regarding special forces operations, activities in cyberspace and broadly understood reconnaissance activities, taking into account new combat methods and new partners. The main goal is to achieve higher levels of effectiveness of actions in response to the most likely threats. According to the new concept, eight key elements of combined operations can be distinguished (Klos 2009, pp. 79-85).

The basis of this aspect is the integration of developing capabilities, in particular those involving special forces operations, activities in cyberspace, as well as reconnaissance activities, taking into account new ways of fighting and new

partners. The primary goal of the discussed concept is to achieve higher levels of effectiveness of actions in response to the most likely threats. According to the new concept, eight key elements of combined operations can be distinguished (Tomaszewski 2015, pp. 44, 45).

First of all, joint operations require the use of a command strategy called "command by objectives." This command model is particularly effective in conditions of increasing uncertainty because it allows commanders to choose the most appropriate methods of carrying out tasks. The human factor plays a key role here, emphasizing the importance of trust, determination and creativity. The essential element of this type of command is the principle of decentralization, which authorizes lower commanders to implement the plans of their superiors using the most effective means. Modern digital technologies additionally increase the effectiveness of target command. (Polak, Krakowski 2015, p. 40).

Mobile ICT devices allow commanders and their staffs to cooperate closely, despite the physical distance. The creation and development of IT networks connecting various forms of communication expands the circle of entities involved and supporting a given operation, enabling real-time analysis for all participants. Command by objectives will be based on the exchange of initiatives, feedback and adaptation to changing conditions, while maintaining the emphasis on the effectiveness and efficiency of actions (Ibidem).

Secondly, operations must ensure the ability to take and maintain the initiative in various spheres of human activity. A key element of maintaining military advantage is controlling the pace of operations - especially in conflicts taking place simultaneously in multiple dimensions. Campaign planning allows you to make decisions faster and manage your activities, getting ahead of your opponent. When implementing command by objectives, future leaders and commanders must be prepared to properly understand the operating environment, visualize operational solutions, and select appropriate courses of action to achieve operational success.

The Polish staff development system also takes into account the need to modify the education process. Examples of this include, among others: activities undertaken at the National Defense University, where Postgraduate Studies in Defense Policy were introduced. Recognition of the importance of the ability to properly interpret situations and factors influencing the conduct of activities in a diverse and unpredictable environment has led to the internationalization of these studies and their integration with other forms of education (Lidwa 2013, p. 9).

Thirdly, future combined operations will be based on the so-called global efficiency, which means they can be implemented in a uniform way anywhere in the world. Currently, most joint operations begin with the creation of operational bases and are then conducted by forces separated from military units that are transferred and deployed to the area of operation. However, it is worth noting that dynamic changes in the global environment require an appropriate military response. The joint force must have capabilities such as conducting cyberspace attacks and strikes anywhere in the world. Although traditional groupings

based on the mass use of force and resources will continue to be an option, their preference will gradually decrease. Alternative forms of deployment of forces and intensified use of logistic resources will enable an increase in the range and effectiveness of operations (Polak, Joniak 2014, p. 7).

V. CONCLUSIONS

As humanity, we are facing rapid technological changes as well as a dynamically evolving geopolitical environment, modern armed forces must constantly adapt their strategies and operational structures. The use of innovative weapon systems in the 21st century is becoming not only a necessity, but also a key element determining the effectiveness and military advantage on the modern battlefield. Finally, it is worth noting that technologies such as artificial intelligence, drones, robotics, cybernetic systems and advanced sensors are changing the face of armed conflicts, offering new opportunities, but also posing numerous challenges for military decision-makers.

The integration of modern technologies in the armed forces requires a comprehensive approach covering both technical, operational and strategic aspects. The implementation of innovative weapon systems cannot be limited only to the purchase of new equipment, but must also include the development of appropriate doctrines, tactics and procedures that will enable the full use of the potential of modern technologies. A key aspect here is interoperability, which allows different systems and units to work together harmoniously in joint operations. Thanks to this, the armed forces can achieve synergy, which translates into an increase in their operational capabilities as well as the effectiveness of their actions.

However, we cannot forget about the ethical and legal aspects of the use of modern military technologies. The introduction of autonomous weapon systems that can make combat decisions without direct human participation raises serious moral dilemmas and questions about responsibility for the actions of these systems. International humanitarian law, which governs the conduct of hostilities, must be continually updated to keep pace with technological progress and ensure the protection of human rights in the context of new war realities.

Cybersecurity is also an important element, which in the era of digitalization is becoming a key aspect of defense. Modern weapon systems are highly dependent on computer networks and information technologies, which makes them vulnerable to cyberattacks. Ensuring an appropriate level of security and developing cyber defense capabilities is becoming a priority for modern armed forces, which must be prepared to fight in cyberspace.

At the same time, the development of innovative military technologies requires significant financial outlays and investments in research and development. At the same time, in the face of limited budget resources, the key challenge is to effectively manage funds and prioritize projects that will bring the greatest operational benefits. Cooperation with the private

sector and international partnerships in research and development can provide significant support in this process, enabling access to the latest technologies and solutions.

To sum up, the use of modern weapon systems in the armed forces of the 21st century opens new perspectives, but at the same time poses numerous challenges. The key success factor is the ability to quickly adapt and be flexible in responding to dynamically changing conditions and threats. The introduction of advanced technologies requires not only investment in equipment, but also in human capital - its education, training and development of skills necessary for the effective use of new systems. The full potential of innovative weapons systems can only be achieved through a comprehensive approach integrating all operational, technological, ethical and legal aspects. Only then will modern armed forces be able to ensure the safety and effectiveness of their operations in a rapidly changing world.

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