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SPACE SUPPORT TO OPERATIONS (ACTIONS) OF THE UKRAINIAN DEFENSE FORCES: SYSTEMATIC APPROACH AND PRACTICAL RECOMMENDATIONS

Introduction. *A key element of the modern Armed Forces transformation process is the introduction of space capabilities in all phases of planning and execution of operations of joint (interspecies) groups of troops (forces). Space forces are created as a type or branch of the Armed Forces, the main task of which is to provide space support for operations (combat actions).*

Problem Statement. *The problem is the mismatch between the current status of space activities in the Ukrainian security and defense sector and the current threats and tasks of ensuring the national defense capability and the need to significantly improve its main, systemic link that is the space component of the Ukrainian defense forces.*

Purpose. *To identify ways for raising the effectiveness of space activities in the Ukrainian security and defense sector by analyzing the essence of the space capabilities of the defense forces, and the experience of NATO and the United States in providing space support for operations of joint forces.*

Materials and Methods. *Systematization and analysis of regulatory documents and publications on the practical implementation of space support for the operations of joint forces.*

Results. *The causes of the mismatch between the current status of space activities in the Ukrainian security and defense sector and the current threats and tasks of ensuring the national defense capability have been identified. The experience of NATO and the United States in organizing and implementing space support for operations of joint forces, as well as the essence of space capabilities, has been analyzed. Ways to improve the space activities in the Ukrainian security and defense sector have been identified.*

Conclusions. *Ensuring space support for operations of joint groups of troops is the basis for improving the efficiency of performing assigned tasks. Its main function is to generate special information, products, and services obtained as a result of space activities, systematic use of space infrastructures of the state, foreign partners, and commercial companies in the interests of national defense.*

Keywords: defense forces, space activities, space support, and operations of joint forces.

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The geopolitical realities of the present day have indicated that armed struggle has not lost its role as an instrument of foreign policy. The necessity to repel Russian aggression and to restore the territorial integrity of Ukraine dictates the radical improvement of the system of ensuring the national security in Ukraine and the reformatting of domestic defense forces in accordance with the requirements of war, primarily through the mobilization and deployment of highly effective combat-ready Armed Forces of Ukraine, ensuring priority of their qualitative characteristics and combat capabilities. The main directions of reforming the system of ensuring the national security of Ukraine, strategic goals, and expected results of the development of security and defense forces have been determined by relevant legislative and regulative documents, including the Laws of Ukraine on the National Security of Ukraine [1] and on Defense of Ukraine [2], the National Security Strategy of Ukraine [3], the Military Security Strategy of Ukraine [4], and the Strategic Defense Bulletin of Ukraine [5].

An important component of the application of modern high-tech weapons, military and special equipment is information support, particularly that implemented with the use of space technology. The role of modern space systems in armed struggle is determined by their unique capabilities: global action, high informativeness, spatial differentiation, all-weather capability, the ability to deliver information and to transmit control commands to each participant in events [6].

A significant factor of Russian aggression is its space component backed by thepowerful rocket and space industry and the space forces of the Russian Federation. Due to various objective and subjective reasons, the Russian space threat has not yet received a sufficiently complete and adequate domestic assessment. It has been just realized, and approaches to the development of domestic space activities within the national security system have been at the initial stage of formation.

For instance, the National Security Strategy of Ukraine, among current and projected threats to the national security and interests of Ukraine, particularly defines that rapid technological changes, primarily in energy and biotechnology, developments in artificial intelligence, etc., have been fundamentally transforming the economy and society as a whole [3]. The role of information technologies in all spheres of public life has been rapidly increasing. Weapon systems based on new physical principles are developed with the use of quantum, informational, space, hypersonic, biotechnological technologies, as well as technologies in the field of artificial intelligence, the creation of new materials, robotics, and autonomous unmanned vehicles.

In the Military Security Strategy of Ukraine, when determining the main aspects of military security at the global level, it has been noted that there is competition among states in the field of space, quantum, informational, cyber, hypersonic, biological, nano-, and other technologies, the design and development of weapon systems based on them using new physical principles, robotics, and advanced materials, militarization of near-Earth space [4]. At the same time, the concept of comprehensive defense of Ukraine in [4] involves actions and resistance to the aggressor on land, sea, and in the airspace of Ukraine, as well as countering threats in cyberspace and information space. That is, space is not mentioned. At the same time, equipping defense forces with high-tech weaponry and state-of-the-art military and special equipment, including through the use of space technologies, is planned in the long-term perspective.

Although pursuant to the Law of Ukraine on Space Activities [7], space activities in the defense and national security sector are carried out by the Ministry of Defense of Ukraine and the intelligence agencies of Ukraine, which, together with relevant ministries and other central executive bodies, are responsible for the implementation of the Government Target R&D Space Program of Ukraine in terms of the creation and use of military and dual-use space technology, the Strategic Defense Bulletin of Ukraine [5] mentions the involvement of the National Space Facilities Cont-

rol and Test Center of the State Space Agency of Ukraine in using the results of space activities for the sake of national defense. The matrix of the main capabilities of the defense forces contains only one capability that is monitoring, assessing the space situation, and notifying the defense forces components about the flights of foreign reconnaissance and remote sensing dual-use spacecraft for preparing and conducting defense operations, the carrier of which is the Armed Forces of Ukraine [5].

The imperfection of the regulatory framework for space activities in the security and defense sector of Ukraine, including the fact that space is not mentioned among the spheres of activity, the imperfection and/or absence of relevant management bodies and specialized organizational structures for its organization and implementation, the departmental dispersion of forces and means, insufficient level and/or lack of interaction and interdepartmental coordination complicate, and in some cases, make impossible the effective (result-oriented) implementation of the tasks of the defense and security forces through the use of space technology and the counteraction to the application (use) of space technology by the Russian aggressor.

The problem is the mismatch between the current state of space activities in the security and defense sector of Ukraine and the modern threats and tasks of ensuring the defense capability of the state, necessitating significant improvement in its main, system-forming link that is the space activities of the defense forces of Ukraine.

The causes of the problem are associated with fundamental changes in the military and political situation, the tasks of national defense and the restoration of Ukraine's territorial integrity, as well as with the prolonged, poorly organized, and inefficient organization of space activities in the security and defense sector of Ukraine. The main causes are follows:

- The need to counter Russian aggression, a component of which is a powerful rocket and space industry and the space forces of the Russian Federation.
- Increasing information needs of the Armed Forces of Ukraine and other components of the defense forces as a result of the threat to national interests and the inability to satisfy them with existing forces and means.
- The degradation of space activities in Ukraine as a whole and in the security and defense sector in particular under the guise of its demilitarization;
- Imperfection of the regulatory framework for space activities in the security and defense sector of Ukraine, particularly the absence of government space policy, military space strategy, and corresponding space doctrine.
- Lack of legislatively defined unified management system for space activities in the security and defense sector of Ukraine, in particular, the lack of a systemic component of its organization and implementation, inadequate level of organization of interaction and coordination of space activities in the security and defense sector among government authorities responsible for inter-industry and interdepartmental connections.
- Inconsistency and duplication of tasks, measures, and works carried out under the government order for the development (creation, production) of space technology, its application (use).
- Predominance of departmental interests over national ones, subjectivity in forming relevant programs and making decisions (mainly focusing on what we have and can do, rather than what is needed).
- Absence of organizational structure and network of authorized centers responsible for creating and maintaining databases of space products and space services at the national and departmental levels.
- Low level of professional space knowledge and low awareness of the role of space capabilities in conducting ground, air, and maritime operations (actions, combat actions, applications), insufficient general awareness and knowledge of space support for military operations (combat actions) by the armed forces.

- The Armed Forces of Ukraine lack a system of adequate level for the integration, application, and participation in providing space information support to troops (forces), space support for operations (combat actions) of the NATO Armed Forces.
- Lack of specialists in the field of space, narrow focus of their professional training, lack of space experience of staffs at all levels.
- Absence of a unified military space science and education school, loss of leading role of scholarly research in the development and implementation of modern space technology into samples of weaponry and military equipment, development of forms and methods of their application (use) for the sake of ensuring necessary (defined) capabilities of the Armed Forces of Ukraine and other components of the defense forces.

Currently, technologically advanced countries have been focusing their efforts on the further development of the theory of network-centric warfare, specifically the concept of multi-domain warfare, which implies simultaneous conduct of military operations in different physical domains: on land, in water (underwater), in the air, in space, and in cyberspace. The use of space is considered an extension of the operational zone vertically. For example, a key element of the transformation process of the U.S. Armed Forces is the integration of space forces and assets into all phases of planning and conducting joint operations. The goal is to create a unified information space that combines the comprehensive use of ground, airborne, and space sensors and networks, integrating space with ground forces in conducting joint operations. The outcomes are continuous flow of information and decision-making advantage.

In the United States, United Kingdom, France, Germany, Israel, and Russia, space forces (military branches) have been established as a type or branch of their armed forces, with the primary task of providing space support to the operations (combat actions) of joint military formations (forces). The space support is based on method statements, techniques, and procedures for planning, preparing, and conducting space operations. Space operations encompass the entire spectrum of activities, ranging from launch, control, and maintenance of spacecraft to creating conditions where adversaries cannot utilize their space potential. Space operations also include providing assistance in the application of space systems and assets and utilizing space capabilities in performing other tasks. All activities related to space utilization are aimed at ensuring the guaranteed achievement and preservation of advantages in the area of joint operations.

For instance, the requirements for the preparation and conduct of NATO space operations are defined by the AJP-3.3 standard [8]. Space support to operations includes all activities that provide capabilities through space in order to support NATO operations. Space products are the result of processed and analyzed data, mostly based on the exploitation of space based sensors. Satellite imagery is an example of a space product. Space services are mostly represented by a continuous stream of data, provided directly from space to an end user terminal. Satellite communications and PNT (positioning, navigating, and timing) are examples of space services.

The foundational basis for the formation of NATO doctrinal documents regarding the preparation and conduct of space operations is based on thoroughly developed and field-tested doctrinal documents from the United States, notably the Unified Joint Publications of the U.S. Joint Chiefs of Staff JP 3-0 *Joint Operations* and JP 3-14 *Space Operations*, as well as the U.S. Army Field Manual FM 3-14 *Space Operations of Land Forces* [11].

According to the requirements of JP 3-0, space operations support joint operations throughout the operational environment (OE) by providing information in the form of reconnaissance data, missile attack warning, environmental monitoring, satellite communication, and PNT support. Space operations also combine offensive and defensive actions to achieve and sustain space superiority.

JP 3-14 defines space operations as operations that affect space resources or directly utilize them

to enhance the capabilities of the United States and multinational partners. Joint space forces are defined as space and ground systems, equipment, assets, and personnel or their combination necessary for conducting space operations.

The U.S. Army Field Manual FM 3-14 defines that unified land operations and Army space operations are indivisible. A typical Army Brigade Combat Team has over 2,500 positioning, navigation, and timing PNT-enabled devices and over 250 satellite communications (SATCOM)-enabled devices used to conduct precision fires, movement, maneuver, communications, protection, command and control, and other mission requirements. The space forces and space assets support all warfighting functions and enable the Army to communicate, navigate, target hostiles, protect the forces, and operate in a contested OE more efficiently. Army space operations, duties, and responsibilities are centered on the eight codified joint space capabilities: space situational awareness (SSA), PNT, space control, SATCOM, satellite operations, missile warning, environmental monitoring, and space-based intelligence, surveillance, and reconnaissance. There are two other codified joint space capabilities-nuclear detonation detection and spacelift, but the Army has no involvement with those.

The structural diagram of space operations support for joint military operations of the U.S. Armed Forces is presented in Fig. 1. Let us analyze these space capabilities.

SSA is the basis of space operations [10]. Space situational awareness is the requisite foundational, current, and predictive knowledge and characterization of space objects and the OE upon which space operations depend. The primary requirements for SSA data are credibility, completeness, and operational timeliness of update. SSA involves characterizing, as completely as necessary, the space capabilities operating within the terrestrial environment and the space domain. SSA combines the output of a wide variety of products and sources, including intelligence and cyberspace sources, to provide insight into adversary use of space capabilities and their potential to threaten friendly space capabilities. SSA contributes to a commander's ability to understand adversary intent. A detailed analysis of SSA goes beyond the scope of this research; the fundamentals of SSA are discussed in [12].

Space Control is the operations to ensure freedom of action in space for the U.S. and its allies and deny an adversary freedom of action in space. Space Control consists of Defensive Space Control (DSC), Offensive Space Control (OSC), and Navigation Warfare (NAVWAR). Defensive space control is active and passive measures taken to protect friendly space capabilities from attack, interference, or unintentional hazards. Offensive space control is offensive operations conducted for space negation. Negation, in space operations, is measures to deceive, disrupt, degrade, deny, or destroy space systems.

Space-based intelligence, surveillance, and reconnaissance is a joint space capability. A space capability is the ability of a space asset to accomplish a mission or the ability of a terrestrial-based asset to accomplish a mission in or through space. Space-based surveillance and reconnaissance enable commanders to plan operations considering troop locations and understanding adversary actions that may adversely impact the operations. Space assets are used for assessing battle damage, strategic warning, monitoring force buildup, and determining precise adversary locations.

Missile Warning provides joint forces with theater early warning to dissuade, deter, and defeat ballistic missile attacks. Joint Tactical Ground Stations (JTAGS) provide in-theater warning of ballistic missile launches. JTAGS units receive downlink data directly from space-based infrared sensors. This data are combined with information from airborne and ground-based missile detection systems and practically used in real-time to disseminate warning, notification, and signaling to combat units and missile defense system units.

Environmental Monitoring provides data on meteorological, oceanographic, and space environmental factors which might affect military opera-

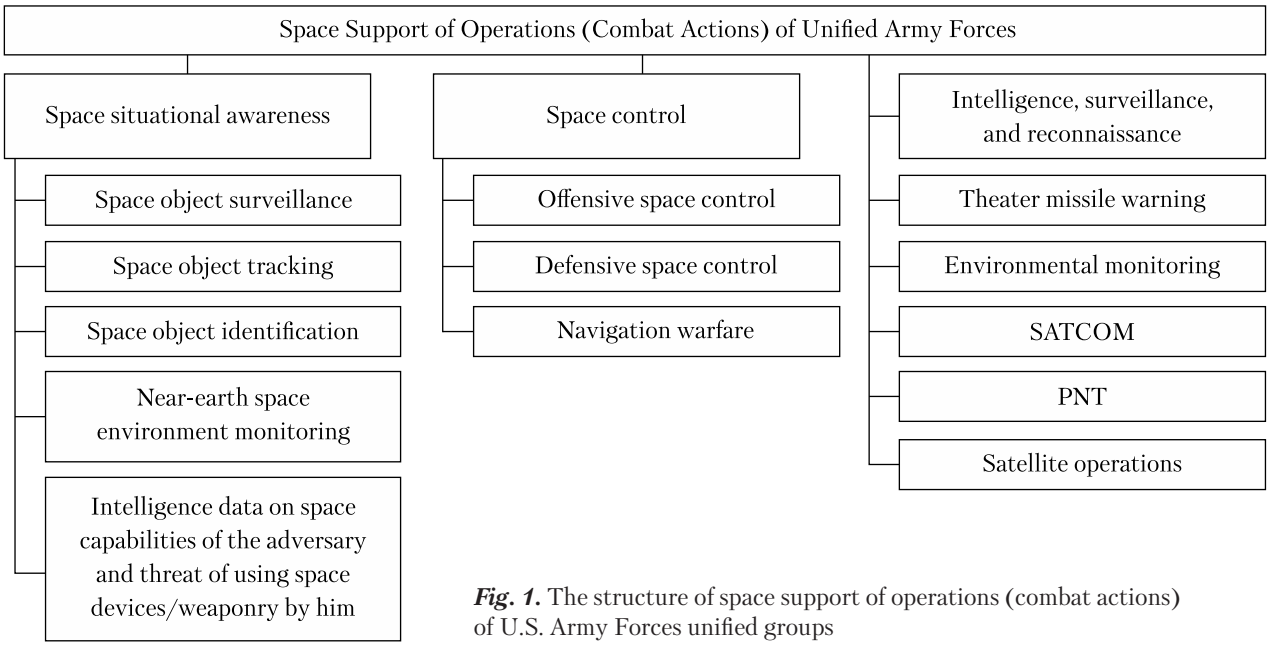

Fig. 1. The structure of space support of operations (combat actions) of U.S. Army Forces unified groups

tions; data for forecasts, alerts, and warnings of the space environment which may negatively impact space assets, space operations, and terrestrial users; current information on subsurface, surface, and air conditions, such as trafficability and land use, beach conditions, vegetation, cloud cover, and moonlight percentage. This space-based capability supports IPB by providing the information needed to identify and analyze potential courses of action.

SATCOM provides the necessary connectivity for worldwide communications and mobile forces operating over large, dispersed areas. Each regional satellite communications support center (RSSC) is a multi-service, multi-agency organization providing theater communication planners with a single point of contact for satellite access planning of military narrowband, wideband, protected band, and commercial SATCOM support. Duties of the Consolidated SATCOM System Expert include providing continuous support to deconflict, assess, analyze, and integrate SATCOM information, status, configurations, synchronization, sustainment issues, deployment issues, and anomalies for all Services and joint operations.

PNT. The space-based Global Positioning System (GPS) is a satellite-based radio navigation system to provide essential, precise, and reliable timing information which enables forces to more effectively execute unified land operations. Precise synchronization enables the synchronization of tactical digital networks, global networks, and communication capabilities.

Satellite Operations maneuver, configure, operate, and sustain on-orbit assets and are characterized as spacecraft and payload operations.

The responsibility for developing and implementing the national military space policy rests personally with the President of the United States. The key figure for the development and implementation of the U.S. military space program within the U.S. Department of Defense is the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence. Within the Department of Defense central apparatus, there have been established the two additional bodies for the formation and implementation of U.S. space policy: the Office of the Chief Space Force's Architect and the Space Council [12].

The planning, preparation, coordination, and execution of all space operations of the U.S. Armed Forces are carried out by the United States Space Force's Space Operations Command. The space forces and assets are directly managed by the Joint Space Operations Center (JSpOC) that was reorganized on July 18, 2018, to enhance coordination between the United States and its allies, as well as between commercial and civilian space organizations [13]. The center consists of the six main divisions:

- Combat Operations Division (COD) is responsible for executing the space tasking order and performing command and control of space forces;
- Strategy and Plans Division (SPD) develops the Joint Space Operations Plan, Space Operations Directive, Master Space Plan, Operational Assessments, Combined Space Tasking Orders, as well as other special instructions and standards. It also integrates air and cyber plans;
- Intelligence, Surveillance, and Reconnaissance Division (ISRD) provides space intelligence to the JSpOC elements;
- 55th Combat Training Squadron (55 CTS) ensures training, standardization, evaluation, provision with armament and tactics, system integration, training and experiments, space weather, and special technical operations support functions for the JspOC;
- 65th Cyber Squadron (65 CYS) provides communication support to the JSpOC;
- Commercial Integration Cell (CIC) integrates commercial space organizations such as owners and operators of commercial satellites into the JSpOC, providing greater linkage between military and commercial space.

Special military units and subunits are designated for the direct execution of space support tasks. For example, in the U.S. Army, pursuant to FM 3-14 [11], corps (division) space element within the operations section ae responsible for planning space operations and coordinating the execution of space tasks, while space support element (SSE) are responsible for such tasks within other involved tactical and operational command elements. Out of the space element and SSE, one or several officers and non-commissioned officers are trained as Space Operations Officers (SOOs).

Space operations officers shall be able to integrate space capabilities with ground, air-borne, and maritime systems; to provide expert analysis of space to support plans and operations of joint forces; to plan and conduct space control operations, including OSC, DSC, and NAVWAR; to use space procedures and infrastructure for tasking, placement, processing, and utilization of space information, products, services, telemetry, tracking, and control of space systems; and to use modeling, simulation, analysis, and other tools for the development and utilization of space capabilities.

Active duty and reserve SSEs are formed by Space Battalions of the Army Space Brigade. According to the definition, SSEs are teams that include experts in image and reconnaissance data analysis, specialists in forecasting the impact of space weather conditions on satellite communications. The main task of the SSE is to coordinate the content and timing of actions for the use of space forces and assets throughout the duration of military operations to achieve maximum results.

The analysis of the structure of space support for military operations (Fig. 1) has confirmed the absence of some support elements in the security and defense sector of Ukraine and the limited effectiveness and subordination to various agencies. This necessitates a series of measures to define the tasks of space support for the prospective structure of the Ukrainian defense forces, to develop the organizational structure, and to functionally fill the system of space support for operations (combat actions) of joint forces.

As an example, let us consider the space capability of space reconnaissance, surveillance, and reconnaissance, in particular obtaining a space image, which is implemented by a space operation that involves the following steps:

- Availability of reliable data from the domestic catalog of space objects for selecting recon-

naissance spacecraft for a specific task (source: Space Situational Awareness);
- Weather forecast data (source: environmental monitoring);
- Selection of spacecraft, determination of precise spacecraft coordinates, and ensuring of operation in the unified time system (source: Space Situational Awareness, PNT);
- Planning and imaging (source: satellite operations);
- Assessment of atmospheric conditions and their impact on communication quality (source: Space Situational Awareness, environmental monitoring of the near-Earth space), transmission of imaging data from reconnaissance spacecraft to relay satellite (source: SATCOM). (This stage may be omitted);
- Reception of data by the ground-based complex, preliminary processing of the space image (source: satellite operations);
- Precise georeferencing of the image (source: PNT) and thematic processing of the image (source: space-based reconnaissance);
- Provision of space imaging materials to the customer.

It is important to note the presence of space control components of in a space operation, at least including defensive space control and navigation warfare. Additionally, the outcome of a space operation depends on the availability and professional utilization of software and hardware complexes for modeling space situations, operating spacecraft onboard equipment, and processing acquired data.

To conduct the discussed space operation in the security and defense sector of Ukraine, several questions need to be addressed:

1. Whom does the customer place order with?
2. Who plans the space operation?
3. Who coordinates activities and is responsible for the outcome?
4. How do the structures involved in conducting the space operation interact, and how are they united by a common purpose?

Further, let us consider an example of using space capabilities for planning and conducting direct support of troops (forces), specifically in the application of precision-guided munitions. Figure 2 shows a schematic and the result of a strike on the Antonivsky Bridge near Kherson by projectiles launched from the High Mobility Artillery Rocket System (HIMARS).

For the effective application of precision-guided munitions, let us focus solely on the components of space support, namely:
- Target coordinates determination;
- Carrier coordinates determination;
- Ensuring precise delivery of the munition.

Target coordinates are determined based on the results of satellite imagery, an operation discussed in the previous example. One of the important characteristics of a satellite imagery system is the accuracy of geopositioning objects in the image. For instance, the accuracy of the coordinate referencing for satellite images (like ICEYE) is around ± 18 m (RMSD $\sigma = 6$ m, achieved with geometric correction and satellite adjustment based on known objects) [14]. However, such accuracy may not ensure the result shown in Fig. 2. To enhance the accuracy of coordinate referencing, additional measures such as orbit reproduction using telemetry data for a flight day, utilizing supplementary information like data from space geodesy, and so forth are taken. Achieving precise coordinate referencing for satellite imagery requires substantial additional data, complex mathematical calculations, and significantly reduces operational efficiency in solving tasks.

The accuracy of determining the coordinates of the launch platform using the Global Navigation Satellite System, according to [11], is 5 m. It can be improved by using precision-guided munitions from preliminarily prepared positions.

The M30 and M31 series munitions of the M142 HIMARS reactive fire support system are equipped with an inertial guidance system with GPS correction [15], ensuring a circular probable error of at most 7 m. This circular probable error can be reduced by space capabilities such as time synchronization of all components of the opera-

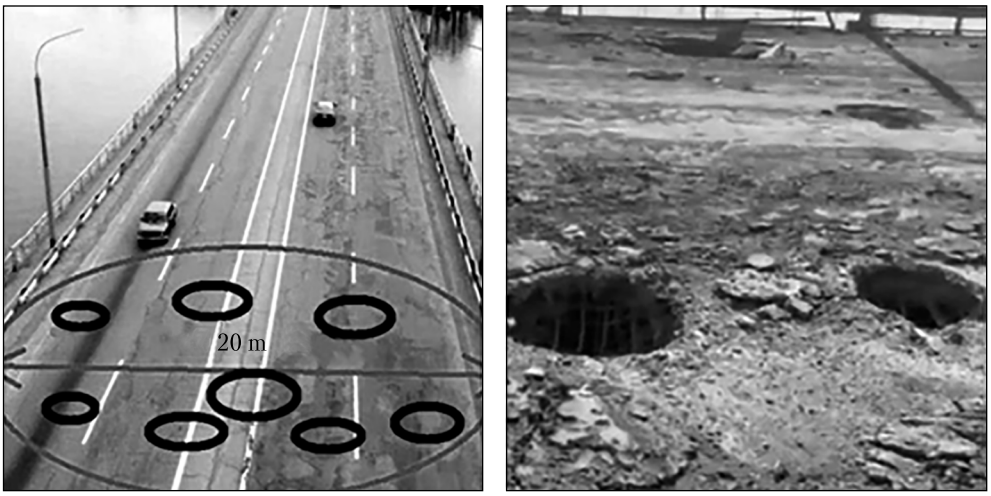

Fig. 2. Schematic and result of a HIMARS strike on the Antonivsky Bridge (Kherson)

tion and consideration of atmospheric conditions affecting GPS signal quality.

Thus, obtaining and using space support data in planning and conducting operations by joint forces is a complex task that requires appropriate organizational structure, engineering infrastructure, and highly skilled staff.

To improve space activity in the security and defense sector of Ukraine, the following steps are necessary:

1. To define the authorities, objects, and means of management, their powers, tasks, and functions, as well as the tasks and functions of all subjects of space activity in the security and defense sector of Ukraine.

2. To develop regulatory legal acts establishing the goals, tasks, powers, and responsibilities of subjects of space activity in the security and defense sector of Ukraine regarding the organization and conduct of space research, creation, and use of space objects, and the use of space.

3. To justify the place, role, and content of space activity while forming the conceptual principles of operational training standards, the development (refinement) of guidelines, directives, combat regulations, and other documents of the operational standards system for the Armed Forces of Ukraine and other components of defense forces in accordance with NATO procedures and standards.

4. To justify the place, role, and content of space forces as a branch of the armed forces. To define the functions of space support for military operations and to justify the structure of the operations support system for joint forces operations.

5. To modify the funding scheme for space activity. Currently, the State Space Agency is the main fund manager and responsible contractor of the budget-funded program of the State Targeted Comprehensive R&D Space Program of Ukraine. Under this approach, other government structures have little influence on justifying the requirements and characteristics of space information, services, and products. In our opinion, funds for space activity in the interests of the country's security and defense sector should be allocated to security and defense force structures for ordering the necessary products of specified quality and supervising over the results.

6. To start training specialists for conducting space operations and organizing and conducting scholarly research. In [16], the status of training specialists with higher education in the field of space activity in the defense sector of Ukraine has been analyzed, and proposals for improving the training have been provided. Currently, the

tactical-level staff specializing in space activity for the Ministry of Defense of Ukraine and the National Center for Management and Testing of Space Assets is trained at Serhii Korolev Military Institute in Zhytomyr. The list of training specializations proposed in [16] should be supplemented with specializations in space control, PNT support, satellite communication, and environmental monitoring. It is advisable to conduct the training of officers in space operations at the tactical level in a specialized higher military educational institution, considering the prospect of creating a separate branch of forces.

Thus, the purpose of space activity in the security and defense sector is to ensure the effective fulfillment of the national defense tasks, to form and maintain the main capabilities (operational, combat, special) of the Armed Forces of Ukraine and other components of defense forces by creating a system of operations support for joint forces operations.

Space support is the basis for raising the effectiveness of fulfilling the tasks assigned to the defense forces. Its main function is to produce (form) specialized space information, space products, and space services obtained as a result of targeted and coordinated space activities, systematic use of all available space infrastructure of the state, space infrastructure of foreign partners, and commercial companies for the sake of national defense.

The main tasks addressed in the formation and development of the operations support system (combat actions) for joint (inter-service) force groups (forces) are:

- Determining the needs for providing specialized space information, space products, and space services necessary for making timely and well-justified decisions, effective troop (force) management, and weapon deployment.
- Studying the possibilities of systematically using all available forces and resources in the country for the sake of providing the Armed Forces of Ukraine and other components of defense forces with specialized space information, space products, and space services.
- Establishing and developing the operations (combat actions) support system for joint forces, as a modern highly informative component of the overall information support for troop (force) deployment, which is aimed at extracting, collecting, processing, and delivering information about our troops, weapons, and the adversary for the most effective application of troops (forces) based on the use of advanced space technologies and tools.
- Conducting applied scholarly research to improve and develop processes and technologies for forming and using specialized space information, space products, and space services for the sake of the Armed Forces of Ukraine and other components of defense forces in accordance with NATO procedures and standards.

The necessary conditions and key factors for the effective organization and implementation of space activities in the security and defense sector of Ukraine, modern information support for troop (force) deployment using specialized space information, space products, and space services in accordance with NATO procedures and standards, are as follows:

1. To significantly improve the management system for space activities in the security and defense sector of Ukraine, to organize and develop joint use of state space infrastructure, interaction, and interdepartmental coordination in solving space activity tasks in the security and defense sector.

2. To form and develop a unified military space science and pedagogical school, ensuring the leading role of scholarly research in the development and implementation of modern space technology for creating weapons and military equipment and in the development of forms and methods of their application (use).

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КОСМІЧНА ПІДТРИМКА ОПЕРАЦІЙ (ДІЙ) СИЛ ОБОРОНИ УКРАЇНИ: СИСТЕМНИЙ ПІДХІД ТА ПРАКТИЧНІ РЕКОМЕНДАЦІЇ

Вступ. Ключовим елементом процесу трансформації сучасних збройних сил є введення космічних сил і засобів в усі фази планування та проведення операцій об'єднаних (міжвидових) угруповань військ (сил). Як вид або рід збройних сил створюються космічні сили, основним завданням яких є здійснення космічної підтримки операцій (бойових дій).

Проблематика. Проблемним є невідповідність нинішнього стану космічної діяльності у секторі безпеки й оборони України сучасним загрозам і завданням забезпечення обороноздатності держави та необхідності суттєвого удосконалення її головної, системотворної, ланки — космічної діяльності сил оборони України.

Мета. Визначення шляхів підвищення ефективності космічної діяльності в секторі безпеки і оборони України шляхом аналізу сутності космічних можливостей сил оборони, досвіду НАТО і США щодо здійснення космічної підтримки операцій об'єднаних угруповань військ.

Матеріали й методи. Систематизація та аналіз нормативних документів і публікацій щодо практичної реалізації космічної підтримки операцій об'єднаних угруповань військ.

Результати. Визначено причини невідповідності нинішнього стану космічної діяльності у секторі безпеки і оборони України сучасним загрозам та завданням забезпечення обороноздатності держави. Проаналізовано досвід НАТО і США щодо організації та здійсненню космічної підтримки операцій об'єднаних угруповань військ, а також сутність космічних можливостей. Визначено шляхи покращення космічної діяльності в секторі безпеки і оборони України.

Висновки. Забезпечення космічної підтримки операцій об'єднаних угруповань військ є основою підвищення ефективності виконання завдань за призначенням, головна функція якої полягає у виробленні спеціальних інформації, продуктів та послуг, отриманих у результаті космічної діяльності, системного використання космічних інфраструктур держави, іноземних партнерів і комерційних компаній в інтересах оборони держави.

Ключові слова: сили оборони, космічна діяльність, космічна підтримка, операції об'єднаних угруповань військ.