Foresight of Ukraine's acquisition of technological superiority and new capabilities to ensure military security

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Abstract. The article examines the current problems of ensuring Ukraine's military security in the context of modern challenges and threats, with a special focus on ways to gain technological superiority and develop new capabilities of the Armed Forces of Ukraine.

The authors emphasise the need to abandon outdated Soviet approaches to defence industry management, introduce innovative technologies and strengthen cooperation with international partners. The study uses a comprehensive approach, including an analysis of the existing legal and organisational framework, a study of international experience, and the development of proposals for reforming Ukraine's defence sector. The main results include the identification of key principles for modernising weapons and military equipment, such as prioritising innovation, stimulating research and development, actively engaging the private sector, and creating mechanisms for effective interaction between customers and manufacturers.

The projected areas of technology development include the creation of robotic systems for aviation, land and sea use, the development of "swarms" of drones with a high level of autonomy, the development of electromagnetic weapons, graphite munitions to affect the enemy's energy infrastructure, and laser systems for remote demining. An important aspect is to adapt to global quality standards, stimulate research projects through a system of grants, and improve certification and adoption processes. The introduction of these technologies will allow Ukraine to create modern military equipment capable of effectively countering threats.

The article will be useful for defence technology researchers, defence industry representatives, military specialists, government officials working on national security issues, as well as international partners interested in cooperation with Ukraine. The findings of the study are aimed at improving the country's defence capability, reforming defence policy and ensuring long-term technological development in the security and defence sector.

Keywords: military security, technology, military-technical policy, armaments and military equipment, innovations, the Armed Forces of Ukraine.

Introduction

The analysis of the evolution of breakthrough technologies and innovations for the different generations of warfare gives evidencies that mastering new technologies unavailable to the adversary has a decisive impact on the course and outcome of war. However, mastering and enquiring of new technologies and developing on their basis an advanced weaponry and military equipment (WME) requires significant time, resources, and a well-developed scientific and technological potential of the state. Currently, in a time of war, Ukraine lacks both sufficient time and resources. The country’s scientific and technological potential is also limited. Therefore, the search for ways to gain a technological advantage over the adversary and develop new capabilities is a crucial scientific challenge.

The Armed Forces of Ukraine (AFU) require modern WME that surpasses the adversary’s capabilities. Some modern WME is provided by partners as part of international technical assistance programs, but it is also necessary to search for internal reserves in order to improve significantly the situation.

To achieve this, it is crucial to revise the principles of meeting the AFU’s needs in modern WME, determine the ways to implement them, and develop mechanisms for acquiring technological superiority over the adversary.

Literature Review

Many studies by Ukrainian and international authors address uptodate issues related to

military-technical policy, the mobilization model of the economic development, and innovative technologies in the military sphere, highlighting key aspects of military security and the modernization of arms.

In particular, works [1–3] explore public policy under conditions of mobilization and challenges in mastering military-technical policy.

Additionally, numerous studies are dedicated to the analyses of global trends in the military sphere and studies of scientific and technological directions in national security [4–10].

However, sufficient attention has not been paid to developing proposals for reforming existing approaches to meeting the AFU's WME needs and determining the relevance and sequence of creating and implementing innovative types of weaponry.

Methodological Framework

In the article applied a comprehensive methodological approach that includes: analysis of the regulatory and legal framework to examine the organizational foundations of formation of the military-technical policy of Ukraine; Study of the international experience to compare the practices of leading nations in implementing innovative technologies to ensure military security, systemic analysis and predictive methods to assess the current state and prospects of the technological capabilities of the Armed Forces of Ukraine, and also for modeling of technological development directions for the defense-industrial complex and their impact on the country's defense capability.

Results

The key principles for meeting the needs of the Armed Forces of Ukraine in modern weapons and military equipment (WME) are proposed to consider the following:

1. Denial of continuation of usage of Soviet-era weaponry and a rapid transition to WME from leading global nations.
2. Abandonment of traditional management tools of the formation and implementation of state military-technical and defense-industrial policies.
3. Declare as inefficient existing organizational structure of Ukrainian defense industry and the whole system of the state management of this structure, including the territorial location of defense enterprises.
4. Do not use pre-war methodologies in the reform of the national defense industry.
5. Eliminate all sort of barriers for private capital to participate in shaping the new structure of Ukraine's defense industry and accelerating the adaptation of national legislation to international law, particularly to European Union regulations.

The following are identified as the main ways to implement these principles:

1. Gradual re-equipment of the Armed Forces of Ukraine with WME from leading nations of the world and domestically produced innovative WME.
2. Creation of favourable conditions, giving comprehensive support, and assistance for domestic manufacturers and scientific-production companies that are currently implementing innovative projects for developing WME prototypes.
3. Tasking the Ministry for Strategic Industries of Ukraine and newly established companies organise without delay communications with foreign partners which produce priority WME models to meet the needs of the Armed Forces of Ukraine.
4. Rapid modernization of existing production capacities and enhancement of enterprise protection against strikes from high-precision enemy weapon.
5. Constant specification of the list (catalogue) of the Prioritised problems and challenges faced by Ukraine's defense forces, whose resolution is expected through technological innovations

(developed by the Innovation Activities Directorate of the Armed Forces of Ukraine), along with adjustments to the required quantity and range of WME, considering their practical application in warfare.

Gaining a technological advantage over the enemy will require the creation (improvement) of:

e*ffective communication mechanisms between WME manufacturers*, the Ministry of Defense of Ukraine, the Armed Forces of Ukraine, and other involved institutions. To establish these mechanisms, the following steps are necessary:

i*mprovement of the regulatory framework* of regulation of the production, certification, licensing, procurement, operation, and authorization for the use of WME.

c*reation of a proactive interaction system* between the customer (Armed Forces of Ukraine) and developers (manufacturers) for the rapid exchange of WME requirements with the establishment of coordination councils, online platforms (portals), technology parks (tech hubs), etc.

i*mplementation of the practice of organisation of regular conferences (roundtables, etc.)* with participation of customers and developers (manufacturers) on the issues of creation and production of WME, with the participation of representatives of the Armed Forces of Ukraine.

*Introduction of a system of a scientific support (fe*edback) during WME development (production).

o*f stimulating mechanisms for R&D (Research & Development)*, (competitions and tenders) for development of WME in priority areas, expand the sector's scientific and technological potential, and create breakthrough technologies. To support these processes at the national level, it is necessary to stimulate R&D initiatives through measures such as:

excluding R&D investments from the corporate tax base, preferential tax rates and «tax holidays», and accelerated depreciation of fixed assets.

simplifying and speeding up of the processes of developing requirements, technical specifications, testing, certification, and adoption of WME (including revising and updating national standards DSTU).

Establishment of a grant-based (incentive) system of the implementation of priorities and requirements for WME models and to encourage developers (manufacturers) in fulfilling orders for WME production.

Implementation of transparent tenders for WME development projects;

Expansion of the codification system for military-purpose WME;

Creation of systemic integration mechanisms of technological solutions from different manufacturers (technological systems integrator of the state level in the WME sector).

Ways to Achieve These Goals:

implementation of global quality and certification standards in the development of technical requirements and WME adoption, facilitation of collaboration between domestic WME developers and manufacturers within Ukraine, as well as with international partners.

creation of a unified coordination center for integrating technological solutions from multiple manufacturers.

introduction of an effective centralized system of management of access to modern WME technologies.

implementation of an adaptive contract system to achieve rapid modifications of technological solutions.

establishment of patent boxes, mechanisms of protection of the intellectual property, and royalty payments etc.

mechanisms for rapid scaling of serial WME production.

For Implementation of these mechanics it is necessary:

to ensure priority funding for WME development and production as one of the key and promising direction of development of Ukraine's defense-industrial complex. exploring and utilizing new methods and spheres to adapt and realize the potential of enterprises in volatile conditions of the external environment within the frame of chosen mission, giving preference to evolutionary approach to innovation policy and an offensive development strategy.

implementing of innovations in the technical re-equipment of enterprises within the sectoron the base of new digital and robotic technologies of production.

facilitating of conditions of establishing of the component production for WME, reducing dependence on foreign suppliers and organizing WME manufacturing based on the most successful solutions;

development of procurement mechanisms for WME. Necessary actions for this are the following:

further development of the electronic procurement system concidering EU requirements and international best practices;

expansion of international cooperation in the field of public procurement;

implementation of systemic measures to reduce corruption risks and enhancing transparency and strengthen control over contracting authorities and increasing accountability of officials, and reinforce internal controls;

implementation of mechanisms to ensure contract fulfillment;

initiate at the state-level a creation of credit lines for developers and manufacturers;

ensure simplification of contracting procedures in the Ministry of Defense and Armed Forces of Ukraine, as well as the procedures of the document collection and WME approval processes.

Beside this, based on the experience of russia's full-scale aggression against Ukraine, the development of innovative military technologies (breakthrough technologies) should be accelerated.

For robotic systems, the priority areas of development should include:

aviation:

development of unmanned aerial systems (UAS) capable of operating at operational-tactical (operational, strategic) levels of expanded range and high-power UAVs capable operate in large, highly autonomous groups with high interconnectivity and varied functionality (groups of UAV - reconnaissance, strike, electronic warfare, etc.);

development of Advanced Autonomous and Robotic UAVs systems capable of autonomously receiving targeting from other UAVs, detecting, identifying, aiming, and striking targets with minimal operator intervention (only required for attack confirmation).

creation of «drone swarms», allowing a single operator to control multiple UAVs simultaneously.

Unmanned ground systems development:

strike UGS (unmaned ground systems) (equipped with machine guns, missiles, anti-tank weapons, artillery, mortars, air defense) with high autonomy (similar to aerial systems);

reconnaissance UGS (remote sensor networks—optical, acoustic, seismic, etc.).

portable UGS for various tasks (strike, reconnaissance);

demining UGS;

support UGS (for casualty evacuation, cargo transport, ammunition supply, electronic warfare, etc.).

Unmanned maritime systems development:

underwater strike and reconnaissance unmanned maritime systems (UMS);

UMS carriers of missile (anti-ship) and mine weaponry (mine-laying UMS).

Key Principles for Robotic Systems Development should be high autonomy, modular design, and the ability to integrate into networks and share data, implementation of hybrid navigation and control systems (satellite / inertial / terrain-based), development of optical self-guidance systems.

Medium-Term (Up to 6 Years) - Development:

electromagnetic weapons for disrupting enemy equipment, command system, reconnaissance, and targeting systems;

graphite (carbon-based) munitions for disabling enemy power infrastructure;

acoustic (infrasound) weapons to impact enemy personnel;

chemical (biological) formulations and technologies for degrading enemy engines, fuel, insulation, etc.

Long-Term (9+ Years):

development od directed-energy weapons (laser, particle beam, etc., including systems for remote demining).

Conclusion

The results of this study highlight the relevance and necessity of a comprehensive approach to technological development and the acquisition of new capabilities to ensure Ukraine's military security. The proposed strategies presuppose a reassessment of the current military technical policy, the implementation of innovative approaches to development of weapons and military equipment, the acceleration of research and development, and active cooperation between the state, private sector, and international partners.

Implementing initiatives proposed will not only equip the Ukrainian Armed Forces with modern combat systems but also will create conditions for a technological breakthrough, which is crucial in addressing contemporary challenges and threats. This will contribute into improving of the country defense capability, the effectiveness of its forces deployment in modern warfare, and ensuring the long-term development of the defense sector.

Recommendations

This article may be of interest to a wide range of professionals, including military and defense technology scientists, representatives of the defense industry, decision-makers and representatives of the Ukrainian Armed Forces responsible for its modernization, the introduction of new equipment, and the development of defense capabilities. The study provides valuable insights into understanding of modern approaches to ensuring the military security of Ukraine and the role of innovative technologies in this process.

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