

Review Paper

# Basic Framework for Introducing Space Activities for Security and Defense

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## ABSTRACT

Article is devoted to defining the basic principles of implementation of space activities in Ukraine, the problems of their implementation in the interests of security and defence and ways to solve them. The purpose of the article is to develop ways of solving problems with the implementation of space activities in the interests of security and defence of Ukraine on the basis of principles defined by law. The analysis of the experience of the leading countries that use space technologies in the military sphere and, the current, status of space activities in Ukraine identified the problems of space activities in the interests of security and defence, and developed ways of solving them. The study found that the Ukrainian space industry is unable to ensure the security and defence capabilities of Ukraine. This is due to: the lack of a satellite constellation of its own, the lack of co-operation between the State Space Agency (SSA) and the armed forces of Ukraine, a systematic approach to law reform, unstable and insufficient funding, the lack of independent access to space, unprofitable State space enterprises. In order to solve these problems, the authors propose to create Ukraine's own Satellite constellation, include the State Space Agency in the security and defence sector, draft and adopt a Space Code, attract foreign companies to continue the commercialization of space activities, reorganize the existing enterprises, create an indigenous rocket complex. The practical significance of the study lies in the possibility of using the obtained results for increasing the country's defence capability in the military and, post-war period.

## HIGHLIGHTS

- ① This article is devoted to defining the basic principles of implementation of space activities in Ukraine.
- ② The study found that the Ukrainian space industry is unable to ensure the security and defence capabilities of Ukraine.
- ③ The practical significance of the study lies in the possibility of using the obtained results for increasing the country's defence capability in the military and, post-war period.

**Keywords:** Space activity, security and defence, satellite constellation, state space agency, commercialization

In today's conditions and within the framework of the European integration processes, the need for a thorough study of the basic principles of the implementation of space activities in the interests of the country's security and defense has become ripe.

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A result of the information technology revolution at the end of the 20<sup>th</sup> century was the creation of new military technologies. On their basis, not just new weapons are being developed, but entire combat systems that combine means of defeat, radio-electronic warfare, control, communication, intelligence, surveillance and navigation.

According to military experts, the basis of victory in modern war is the mass use of high-precision weapons, the successful use of which is ensured by its integration with information and space support systems that solve the tasks of intelligence, communication and navigation.

Recently, there has been a steady increase in the importance of space systems and means in solving the tasks of information support of military operations. In addition, work on the creation of weapons that operate in space and through space has intensified.

Ukraine has great opportunities for the successful development of space activities. The unique potential of space technology, the invaluable long-term experience of operating space complexes and participation in international co-operation on research and practical use of space production in combination with space infrastructure and highly qualified personnel can become a reliable foundation for ensuring its security and defence.

However, for this it is necessary to solve a number of problems that restrain the implementation of space activities in accordance with the principles defined by the legislation.

## MATERIALS AND METHODS

The methodological approach of the research was formed taking into account the conducted empirical work of the authors. In this process, both general scientific, social scientific methods, and purely scientific knowledge methods were used.

Accordingly, the historical method made it possible to determine the prerequisites for the establishment of the institute of space activity in the interests of the country's security and defense. The comparative legal method was used to compare the defining approaches to the establishment and development of space activities in the interests of the country's security and defense in atypical situations that arise today. The system-structural method contributed

to the awareness and identification of the main elements, risks and positive elements of the institute of space activity in the interests of the country's security and defense during military operations. In addition, thanks to the forecasting method, a development model for the further improvement of space activities in the interests of the country's security and defense has been formulated.

The work also used the methods of analysis and synthesis during the research on the adaptation of space activities in the interests of the country's security and defense in modern conditions. The use of the content analysis method was justified during the study of the necessary documents from the subject under study.

## Literature Review

The conduct of space activities in Ukraine is a widely researched topic, which is, considered in the works of many scientists. These include Prysiashnyuk (2016), Bukhun (2015), Yu.S. Shemshuchenko, Semenyak (2019) and others.

Also, the issue of space activities in the interests of the country's security and defense at the state level in the post-war period as part of the country's recovery plan is researched by a small number of scientists, since the main part of research is carried out by international organizations and governments of countries that are devoted to the analysis of the main aspects and features of the development of the space industry, development strategies for the development of the space industry due to modern conditions. In part, such scientists as E. Marpreanu in the analytical document of 2019 "Space research - statistics and facts" paid attention to research on the main principles of space activity in the interests of the country's security and defense; I. Andrushko in his 2006 work "Space Law: Concept and Content"; O. Beglii in his 2002 work "Legal regulation of the world market of space services and technologies"; A. Hurov in his 2019 work "Legal protection of near-Earth outer space from clogging"; S. Negoda in the work of 2000 "Legal regulation of international commercial space projects"; O. Stelmakh in his 2016 work "International legal security regime of research and use of outer space for peaceful purposes". All researchers in their writings only fragmentarily investigated space activity and the space sphere, in general, not to mention the post-war period

and the component part of the country's recovery plan and the prospects for its further development and improvement. No researcher has formulated prospects for the development of a personalized model of the functioning of the domestic space sphere (Podolchak N., Tsygylyk N., Dziurakh Y. 2022). That is why the article is currently quite relevant and timely and requires further scientific proposals for its improvement and ensuring the effective defense capability of the country in various conditions of life.

Despite the extensive study of the topic, the issue of the basic principles of conducting space activities in the interests of security and defence remains unexplained (Al Sharari, F., Yemelyanov, O., Dziurakh, Yu., Sokil, O., & Danylovyh, O. 2022). Taking into account the above, the purpose of the article is to develop directions for solving the problems of space activities in the interests of the security and defence of Ukraine based on the principles defined by the legislation.

## RESULTS

It should be noted that the issue of space activity in the interests of the country's security and defense in today's conditions requires a significant discussion among scientists, researchers, theoreticians and practitioners for its effective improvement and qualitative development of the researched area.

Concepts and, principles of space activities in Ukraine, including in the interests of security and defence, are defined by, The Law of Ukraine "On Space Activities". According to it, space activity should be, understood as scientific space research, the creation and application of space technology, and the use of outer space (On space activities: Law of Ukraine, 1996).

One of the main tasks of space activity is to ensure the long-term interests of the State in the field of national security and defence capability. To fulfill this task, space activities must be, carried out in accordance with the principles defined by legislation, namely:

- ♦ State regulation state support for the commercialization of space activities, attraction of investments of domestic and foreign companies in its development;

- ♦ Reforming state policy regarding research and use of outer space;
- ♦ Use of all possibilities of space activity and scientific and economic potential in the interests of the state, in particular, in the interests of its security and defense;
- ♦ Support and development of international relations, promotion of international cooperation taking into account the interests of the state.

The conduct of space activities in accordance with these principles is the key to solving the urgent tasks of ensuring the sustainable development of the state, its national security and defense capability. This is, evidenced by the experience of the leading technologically developed countries, which have long been using modern space technologies in the military sphere.

In order to provide information to the military-political leadership of countries, armed forces, strategic, operational and tactical groups, the latest space vehicles are used. With their help, data is obtained about the enemy's military potential, namely, about the composition and location of its troops and weapons, enemy troop control systems, air defence systems, the arrival of new types of weapons and military equipment, objects and their co-ordinates in the case of planning aviation and artillery strikes, etc.

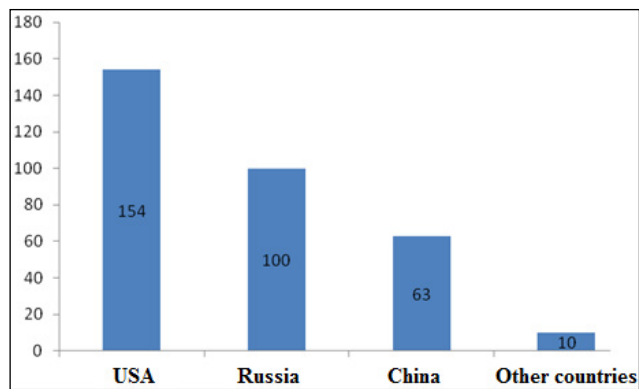
Therefore, weapons and methods of their use are improved, military operations are, planned, the armed forces are, maintained in combat readiness, and plans for their use adjusted in a timely manner. This technology is, not only used for military equipment to perform these tasks. Civilian devices have gained widespread use in ensuring the security and defence of countries. In particular, operational data collection is, carried out using Earth remote sensing satellites from space.

The use of the above-mentioned space technologies is an integral part of conducting military operations. During the Persian Gulf War in 1991, International coalition forces deployed more than eight dozen spacecraft: reconnaissance satellites, missile warning satellites, navigation satellites, and meteorological satellites. Most of these devices were, created in the USA.

Active implementation of space technologies took place during the military operations in Yugoslavia in 1999. Satellites for navigation, communication, intelligence and meteorology were, used to support the NATO military operation. According to experts, about one hundred and twenty (120) units of such equipment were, used. In 2003, during the US war in Iraq, about six dozen spacecraft were, used for various purposes. Thirty, (30) units of space technology were used for remote sensing of the Earth (Prsyazhnyuk, 2016).

Considering the above, it can be, said that the use of space technologies significantly increases the quality of military operations. In 2021, there were two thousand six hundred and sixty six (2,666) artificial satellites in orbit around the Earth for various tasks, of which one hundred and fifty four (154) belong to the American military, about one hundred (100) to the Russian, and, sixtythree (63) to the Chinese army.

In other countries, such as France, Israel, Germany, Italy, India, Great Britain, Turkey, Mexico, Spain and Japan, their number is less than ten (Figure 1). All other States, including Ukraine, do not have a single military satellite.



Source: Systematized by the author based on (Yugova, 2021).

Fig. 1: Number of military satellites by country

The data provided are not final. Due to the secrecy and the existence of dual-use flying spacecraft used by the military and businesses, it is impossible to name the exact number of military satellites. Every year it increases. New satellites are, launched into Earth orbit, collecting even more information and performing even more functions.

The largest number of military satellites are, developed in the USA. Every year they improve.

In particular, the impetus for this was the war in Ukraine. In the event of the spread of military aggression of the Russian Federation beyond its borders or the deterioration of relations with China, the advantage in space can become the main trump card of the USA, which should be, manifested in the ability to provide the main functions of satellites - navigation, communication and surveillance.

In order to achieve this goal, it is, planned to minimize the vulnerability of these satellites to attacks or to increase the reliability of the system itself, which will be able to function even after the loss of several satellites (The Universe.Space.Tech, 2022). Co-operation with commercial operators is, seen as an important aspect of ensuring the country's security and defense capabilities. In particular, the creation of hybrid systems for the use of data obtained with the help of satellites is, not excluded.

China is not far behind the United States in terms of using space technology to ensure the country's security and defence capabilities. Foreign experts believe that the PRC is exploring space only for military purposes, justifying this opinion by the fact that it has a significant number of military satellites. In addition, China also has a powerful anti-missile capability, so it can attack satellites in geostationary orbit. American scientists, based on theoretical research, suggest that the space robotic arm, which is one of the latest developments, in addition to performing the tasks of comprehensive capture and operation of space objects, cleaning of space debris and maintenance in orbit, can, also be, used as a space anti-satellite weapon (Heginbortham, 2015).

However, to date, the PRC has not used its military space capabilities to invade or intimidate any country. In addition, this country actively cooperates with other countries in space exploration. Thus, it can be, concluded that the development of China's space activities is the state's strategy for ensuring self-defence.

This cannot, be said, about Russia, which uses space technologies in the war with Ukraine. Russian military satellites are, used for espionage, for communication between, various units and to, jam enemy signals. However, experts are sure that most of the military satellites (especially, communication and surveillance) are faulty. For their creation,

outdated or foreign-made technologies were used, which, due to Western sanctions, are difficult to find (Radio Svoboda, 2022).

Ukraine does not have its own satellite base. However, its advantage is aid from allied countries, which is being provided on an unprecedented scale. In particular, satellite technologies play an important role in defence, starting with GPS and ending with the modern Internet Starlink from Elon Musk. It is important that, mainly, commercial technologies are used.

For example, the Ukrainian start-up Lunar Research Service takes an active part in providing components for nanosatellites and parts for weapons printed on a 3D printer. Modern space technologies prevent the blocking of satellite signals by Russia, the facts of which have been confirmed by the American company Hawkeye 360. GPS-interference began to be recorded two months before the Russian invasion. In particular, a violation of the operation of drones in the eastern part of Ukraine was detected.

Thanks to commercial satellites, Hawkeye managed to identify the sources of the interference data. It was also possible to follow the actions of the Russian army in real time. Satellite images discovered a 60 km long column of military equipment moving in the Kyiv region. It is necessary to note the help of the company BlackSky, which is engaged in geospatial intelligence. It provides Ukraine and the USA with high-quality satellite images.

After analyzing the experience of other countries, it can be said that Ukraine has a catastrophic lack of defence and, dual purpose, space technology. It would help solve a complex of military and defence tasks and prevent tragedies that happen almost every day in Ukrainian cities and villages. At the same time, commercial operators of partner states provide significant assistance to the Armed Forces. This means that at this stage, the only option for Ukraine remains the purchase and exchange of satellite information, which is, carried out mainly on a commercial basis. Thus, having a significant potential of space technology, many years of experience in operating space complexes, space infrastructure and highly qualified personnel, Ukraine is, forced to become a consumer of foreign space information. All this once again confirms the need to develop one's own space activities.

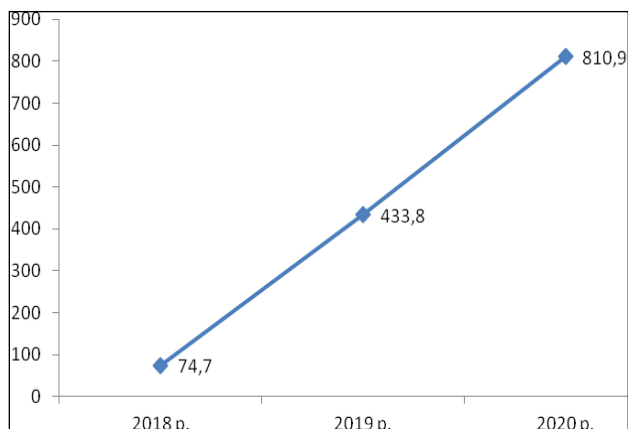
The Ukrainian space industry is not capable of ensuring the security and defence capability of our country. This is due to many problems. Lack of own satellite grouping. Having analyzed the experience of technologically developed countries, we can conclude that without its own military satellites, the state cannot fully oppose the enemy. That is why the creation of a satellite grouping is urgent, which will help to solve a number of economic issues and issues of security and defence capability of the country (Nekrasov, 2020). An important step in this direction was the launch of the first Earth remote sensing satellite, which took place on January 14, 2022. Perhaps, in the future, a full-fledged grouping of such devices will be created.

Lack of interaction between the State Space Agency (SCA) and The Armed Forces of Ukraine, which significantly slows down the process of development, creation, launch and use of military and dual-use space systems in the field of security and defense. In the conditions of martial law, the DKA works around the clock, providing the military with satellite, analytical, navigational data, data on the flights of reconnaissance satellites, etc. The lack of a systematic approach to the reform of legislation, which is necessary to increase the role of the space sphere in the world economy and to, effectively use Ukrainian resources to increase the country's security and defense capabilities.

Lack of stable and sufficient funding. The lack of funds is the main reason for the aging of the technological base of the space industry and the impossibility of introducing innovations that would allow the production of new space technology (Buhun, 2015). Thus, according to the Space Program until 2025, approved by the Government on September 21, 2021, financing in the industry will amount to UAH forty (40) billion (UAH 15.76 billion - budget funds, UAH 25.02 billion - other sources) (On the approval of the Concept of the National Targeted Scientific and Technical Space Program of Ukraine for 2021-2025), 2021). However, given that no government space program has been completed, these funds may not, be allocated to the extent planned.

Unprofitability of state enterprises in the space industry. According to the report of the State Space Agency for 2020, the total losses of the companies subordinate to it amount to UAH 810.9 million

(Economichna Pravda, 2021). In previous years, the enterprises of the space industry also worked at a loss, as evidenced by the data shown in Fig. 2.



Source: Systematized by the author based on (Economichna Pravda, 2021)

Fig. 2: The level of unprofitability of state enterprises in the space industry in 2018-2020, UAH Million

Lack of access to space. Ukraine is, considered a space state. However, according to experts, without independent access to space, it is not such (Nekrasov, 2020). In order for Ukraine to be able to realize the existing space potential for the security and defense of its own territory, the following ways of solving the problems are, proposed, in Table 1.

Solving the above-mentioned problems will make it possible to conduct space activities in Ukraine in accordance with the principles defined by the current legislation and in the interests of national security and defense capability for the long term.

## DISCUSSION

In order to ensure the effective operation of the space sphere, it is necessary to effectively and actively involve the world community in order to overcome all the negative consequences that

Table 1: Problems of space activity and ways to solve them

Problems	Solutions
Lack of own satellite grouping	The creation of its own satellite group will allow solving a number of issues of security and defense capability of Ukraine. However, this requires funding. In the conditions of the war and the post-war period, the allocation of such funds from the budget is impossible, so it is necessary to attract foreign companies that use the achievements of space development and are interested in their implementation
Lack of interaction between the State Space Agency (SCA) and the Armed Forces of Ukraine	It is proposed to include the State Space Agency in the security and defense sector. This will make it possible to optimize the development, launch and use of space systems and ensure the real needs of the state in the field of security and defense. It should be noted that the relevant draft law was submitted for consideration by the Verkhovna Rada of Ukraine. According to it, amendments should be made to the Law "On National Security of Ukraine" and the Law of Ukraine "On Space Activities" (No. 7485)
Lack of a systematic approach to reforming legislation	Taking into account the importance of the space industry for the security and defense of Ukraine, a comprehensive analysis of all legislation is proposed for its compliance with today's conditions. We are talking about strategies, laws and regulations. Next, the adoption of the Space Code is proposed, which will help launch the reform process in the interests of the state
Lack of stable and sufficient funding	It is possible to increase the funding of space activities through the involvement of foreign companies and further commercialization of space activities. It is also proposed to create preferential taxation of space industry enterprises and investors who attract funds for their development
Unprofitability of state enterprises in the space industry	Solving this problem is impossible without the reorganization of state-owned enterprises that will work alongside private companies. To date, an important step has been taken in this direction, namely, the adoption of Law of Ukraine No. 143-IX dated October 2, 2019 "On Amendments to Certain Laws of Ukraine Regarding State Regulation of Space Activities". It removed the state monopoly on the occupation of space activities
Lack of access to space	In order to gain independent access to space, it is necessary to create your own space missile complex. We are talking about an air launch platform, which allows not to build a ground spaceport

Source: Systematized by the author based on (Shemshuchenko, 2019; On amendments to some laws of Ukraine regarding state regulation of space activities, 2019)

arise today in our current conditions. It is the effective and high-quality implementation of space activities in accordance with the legislative principles that is the key to solving the urgent tasks of ensuring the sustainable development of the state, its national security and the country's defense capability. It is necessary to actively implement the experience of the leading technologically developed countries, which have long been using modern space technologies in the military sphere, into the activities and development of the space sphere. And it is also necessary to establish a unified connection with those global space intelligence systems that will ensure global defense capability and security.

It has been proven that Ukraine is only a consumer of the world's space information, but not their allies in any way. Accordingly, it is necessary to develop one's own potential, which will contribute to the development of the space sphere at a highly qualified level, since the country has quite a large number of highly qualified specialists in the researched field, who, with the help of world support, could bring it to the world arena as a parity ally and together improve and to develop this field

## CONCLUSION

The conduct of space activities in accordance with the principles defined by legislation is a guarantee of solving the urgent tasks of ensuring the sustainable development of the state, its national security and defense. This is, evidenced by the experience of the leading technologically developed states, which have long been using modern space technologies in the military sphere.

Having a significant potential of space technology, many years of experience in the operation of space complexes, space infrastructure and highly qualified personnel, Ukraine is, forced to become a consumer of foreign space technologies. All this once again confirms the need to develop one's own space activities, without which it is impossible to solve the problems of national security and defense capability of the country. However, this cannot, be done without solving the problems faced by the space industry.

These include the lack of an own satellite group, the interaction of the State Space Agency with the Armed Forces of Ukraine, a systematic approach to

legislation reform, sufficient funding, independent access to space, as well as the unprofitability of state-owned enterprises in the space industry. Overcoming these problems is impossible without creating your own satellite grouping. The practical significance of the study is that the obtained results can be, applied to increase the country's defense capability in the war and post-war period.

A practical component of the formation and development of the space sphere will be that all the proposed results of improvement and improvement of its activity will be the result of an effective and strong defense capability of the country on a par with the world community in the defense sector, which will take place during the war period and after the war period in the process of rebuilding Ukraine.

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