Space Doctrine and the Future of the Space Industry

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The article analyses the modern and retrospective international and national regulations in the field of space activities. It is emphasized that the long-term program of space research proves the maturity and competence that we have yet to demonstrate. The development of such a program (rather, doctrine) is beyond the preparation of a formal document. The challenges we have outlined are about the role of the space doctrine in the system of conceptual documents defining the areas of the space sector's sustainable development. In the study, the dialectical materialist method of in the cognition of the objective reality enables to analyze of comprehensively doctrinal provisions in developing the concept "Space doctrine." The empirical research was based on the statistical and analytical materials: World Trade Organization Annual Report 2019, the Roscosmos State Corporation for Space Activities for 2018, Aeronautics and Space Report of the President — Fiscal Year 2019 Activities, the statistical data and reports of the State Space Agency of Ukraine (SSAU) for 1997-2020. The study leads to a number of conclusions. The implementation of the future Space doctrine should be a shift from the initial state of affairs to the new model of space activities and the sustainable development of the space industry. The study reveals three levels of Space doctrine: basic, strategic, and tactical (operational).

Keywords: space doctrine, national space interests, social benefit, sustainable development, innovations, public-private partnership, space technologies

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Introduction

The extension of boundaries after man's entry into outer space has determined the concept of "Space Doctrine." It has raised many questions for scientists. One is the cognition of the nature of law as a special instrument for social engineering of space activities. Moreover, this concept should be not only a regulator and a key mechanism for managing the shift of civilization to a sustainable future. It develops under the all-encompassing integration of space technologies and services into the daily lives of people.

The long-term space action plan is the confirmation of the maturity and competence that we have yet to demonstrate. The development of such a program (rather, doctrine) is beyond the preparation of a formal document. The challenges we have outlined are not much about the provisions or formulations to be considered, but about the role of the space doctrine in the system of conceptual documents that define political decisions (Activity Reports, 2020). Therefore, the technology of space doctrine development requires methods proven in other countries.

We have analyzed practices applied in the adoption and implementation of the space doctrines USA (Air, 2006; Lupton, 1988; Aeronautics, 2019), PRC (White, 2000; White 2011), the Russian Federation (Annual Report, 2019), the United Kingdom (Hughes, 2018), the Republic of India (Gurbachan, 2016). It has shown that the governments of these countries encourage policies that require a nationwide focus on job creation related to space activities. The pursuit of leadership, according to the old standards, is the past. The focus is on reducing budget expenditures and increasing public-private partnerships in space projects. Cooperation between all sectors of the economy and spheres of public life must promote and optimize the combined civil, military and commercial exploitation of space. Such cooperation will best meet the national interests of any country.

When developing new national goals and realizing the national interests, the following three questions should be answered:

1. Degree of human presence: how widely and in what quantity they will be present in space.
2. Commercial potential: an economic level of new, permanent income of the space activities.
3. Ensuring sustainability: the extent to which government is able to create civilian, commercial and military space potential that would comply with established norms, standards and international regulations in space.

Therefore, the design and implementation of the future Space Doctrine should be a shift from the initial state of affairs to the new model of space activities. Moreover, its elaboration requires considering the specific role of the space activities in the social and economic development of society as a factor of various innovative technologies interaction.

The development of the Space Doctrine of Ukraine exemplifies that government representatives, together with specialists from the space industry (but not limited to) and scientists, should use the synergy of efforts to optimize and promote common national space ideas and strategy. The government's key role is to develop core capabilities and technologies to ensure positive outcomes in the future through a sound investment, political and regulatory strategy. Various sectors of the economy must commit to investing in science and technology in order to promote national space activities as a key element of a nationwide development strategy. Using knowledge and resources, the scientists will master the existing technologies and products, and create new ones for their further commercialization.

The structure of the Space Doctrine

We offered the structure of the Space Doctrine based on the experience of the top space countries that have systematically developed and are developing space doctrines throughout the entire period of the space activity. The doctrine has three levels: first, the basic space doctrine is adopted, second, strategic doctrine (on its basis,) and third, tactical (operational) doctrine.

Basic space doctrine

Basic space doctrine (a kind of space Constitution) defines the most fundamental strategic basic provisions; which, based on the long-term sustainable innovative development of the consumer-focused space activities, will indicate the movement vector and their future use (strategic, tactical and operational doctrines are based on the basic doctrine).

All space activities must also be subordinated and correspond to the main national priorities (economy, security, science, education, and improving citizens' quality of life), i.e., they must be the part of the national doctrine and the part of the international community (international cooperation and collaboration). However, as we have repeatedly stated (Soroka, 2019; Soroka, 2020) if space technologies and services do not work or improve the citizens' quality of life (Babcock, 2019), they are not worth spending taxpayers' money.

The main strategic vectors of the space activities, which must be clearly defined in the basic Space Doctrine, are the following:

1. A clear understanding of the place and role of the space activities (whether it is of high-priority or not) in the economic system of the state, and whether it is in the national interest.
2. Setting goals (for example, setting a long-term economic goal — ensuring sustainable revenue growth from space activities, patents commercialization, etc.).
3. Identifying tools for their achievement (for example, stimulating the new markets creation through lending, tax benefits, public-private partnership (Malysheva & Hurova, 2018), and giving the preference to the cooperative model for the project's implementation.
4. Creation of innovation development actors (for example, the information on the list of technologies that have been developed under its leadership and projects that have become available to other developers and manufacturers is annually published on the NASA website (NASA, 2020). In fact, it is a well-structured catalogue of technologies that promotes innovative development of private space companies).
5. Creation of the monitoring procedure, analysis of the goals achievement and results (which will be used for the revision of strategic, tactical and operational doctrines).

Therefore, the basic Space Doctrine must meet three main vectors. It must be utilitarian, socially-oriented, and respond to modern worldview changes. These vectors are defined through the specifying of the strategic, tactical, or operational strategies development.

Strategic space doctrine

Strategic space doctrine is developed and agreed upon in reliance on the basic doctrine. It is an integrated set of decisions on the choice of activities, ways of goal achievement, key competencies, and systems of work organization (Lupton, 1988). Strategic doctrine specifies the provisions of the basic doctrine in the short term (10-15 years), defines the optimal ways of space activities development and offers a roadmap to achieve the target goals. In order to determine the promising areas of space activities correctly, it is necessary to hold regular opinion polls among the population (Associated, 2019), and develop a space legal ideology on their basis, to carry out explanatory work among the people on the importance of the space industry development (Funk & Strauss, 2018).

It is necessary to combine the efforts of many specialists to adequately assess the effectiveness and the need for public funds to implement the strategic project. This is an inter-industry problem and it requires resources and a systematic approach and direct coordination by the country's top leadership.

As already mentioned, strategic doctrine must correspond to the three vectors established in the basic doctrine, namely: utilitarian, social and ideological.

The utilitarian vector is specified by establishing clear mechanisms, rules, standards, requirements for the implementation of space activities. Currently, there are pressing issues concerning the adoption of regulatory documents: space objects certification; rules for the registration of the spacecraft; the issue of permits for certain types of space activities; a combination of filing a declaration on the implementation of economic activities with compulsory licensing of the space activities; regulations on the procedure for exercising control and supervision over the space activities safety; provision on the procedure for filing a negotiations notice, notification of the concluded agreements (contracts); provision or instruction on the procedure for registering agreements (contracts); regulations on the procedure for notification of agreements (contracts) concluded between private and foreign entities regarding space activities; adoption of updated procedures and rules for compulsory insurance in the field of the space activities. Nevertheless, experience has proven that excessive regulation of any activity can lead to its stagnation; therefore, the transition from excessive government regulation to self-regulation based on clear and understandable rules will give a boost to the commercial space activities development.

The social vector of the basic Space Doctrine will be implemented through the discovery of the creative potential of the young, attracting them to space projects (currently, we observe an outflow of young specialists in the space industry), through the popularization of successfully implemented space projects (creating space YouTube channels, holding space summer camps). In European countries, and certainly in the USA, the People's Republic of China and the Russian Federation, the achievements of the space industry are the points of national pride; the majority of the population knows about these achievements (Funk & Strauss, 2018), unlike most of the Ukrainians.

The worldview vector is specified by understanding the cosmization of our life in general and through the process of cosmization of law through its transformation. The process will be realized through new development approaches to the holistic concept of the universe and the concept of the organic unity of the whole world and its close connection with space through the creation of new legal standards based on sustainability (Martinez, 2019), safe, innovative and inclusive development of humanity.

As Tatiana Ursul aptly noted, the expansion of the cosmization of legal science and practice is one of their development strategic promising trends during the formation of the space civilization, and the emergence of new and development of existing countries leaders in space and the space expansion of the humanity. In the longer term, terrestrial jurisprudence, alongside the space expansion of humanity, with the development of new forms of organization of the space systems of power and law, will presumably progressively evolve into broader space jurisprudence and legal science — into legal science as space civilization sciences (Ursul, 2018: 289).

The need to change worldviews towards sustainable development should also be noted. In our papers, we have repeatedly stated that modern politicians lack the political willpower to explain the need to give up growing consumption for future generations' sake to their citizens. Humanity will recover from the habit of living beyond means only due to serious

crisis, under conditions of limited consumption (Ursul, 2018).

Thus, the administrative and legal basis underdevelopment of a new Space Doctrine should be the guidelines for ensuring the long-term sustainability of space activities, which will help achieve safe and sustainable development of the space activities in the long run (Soroka, 2020).

Furthermore, the implementation of the space science projects should be realized, taking into account the latest trends in globalization, as the implementation of the ambitious space projects is possible only through international cooperation (Science, 2020a). The deepening of the relations based on science and technology, forming a common strategy for long-term sustainable cooperation in the space industry, may bring to a new development level and increase its global competitiveness in the long run (Science, 2020b).

It is important to note the creation and use of artificial intelligence in space activities. We have proven that artificial intelligence is a basic form of scientific and technological progress that can bring significant social benefits (Soroka & Kurkova, 2019). However, its development in a legal void is unacceptable. Various public and private stakeholders, as well as the politicians at the local, national and international levels, should ensure the compatibility of development and deployment of artificial intelligence with the protection and enforcement of fundamental human rights and freedoms (Benedek & Matthias, 2013). The lack of legal regulation of the creation and use of artificial intelligence, and based on its space technologies, any country, can lead to legal and ethical problems in the field of the observance of human rights and the person and the citizen.

Tactical space doctrine

Tactical and operational space doctrines (short-term, 3-5 years) describe specific space activities (e.g., development and production of launch vehicles; development and production of rocket engines, satellite and television services, satellite Internet services and sales of services; satellite navigation and sale of services, services for Earth observation, sale of images and services, etc.). These doctrines can either regulate one type of space activity or can be combined with other types to achieve detailed space goals. The tactical (operational) doctrine specifies persons responsible for their implementation and sets deadlines and funding sources. This doctrine is effective in implementing a specific space program or scientific project.

Systemic measures aimed at developing and implementation of new strategies provide modification of the current legislation (foremost, the Law of Ukraine "On Space Activity" (On Space, 1996)), organizational decisions, development of interagency activities, adoption of program documents at various levels. Among the most important process documents are the tactical (operational) doctrines.

Thus, it is necessary to develop and adopt program documents, which provide, chiefly, the rationing of the following basic activities:

1. Implementation of the national and international scientific and technical projects in the interests of certain priorities of the space activities. The base document is the space doctrine of Ukraine.
2. Development of the space industry, provision of branch management: assistance in the international markets, reforming of the enterprises, cross-sector coordination, creating conditions for public-private partnership, work loading of the enterprises, furthering of the industry interests in government agencies and the international institutions. The basic document is the space doctrine of the reforming and

development of the space industry of Ukraine, which is being jointly developed by the Ministry for Development of Economy, Trade and Agriculture of Ukraine, the State Space Agency of Ukraine (SSAU), the National Academy of Sciences of Ukraine (NAS of Ukraine) and Ukroboronprom (UOP), and approved by the Cabinet of Ministers of Ukraine.

3. Space activities in the interests of the national defense and security, implementing the target projects on the creation of the equipment and technologies and developing advanced technologies. The basic document is the strategic space doctrine, developed jointly by the Ministry of Defense of Ukraine and the State Space Agency of Ukraine (SSAU), and approved by the National Security and Defense Council of Ukraine. It is the basis of the relevant section of the state defense order.
4. Implementation of the promising projects in the interests of the outer space research and application are the advanced fundamental and applied researches. The basic document is the strategic space doctrine, developed by the National Academy of Sciences of Ukraine (NAN Ukraine) and relevant research organizations and design-engineering department.
5. Development of the ground-based infrastructure is coordinated with the activities of the National Scientific and Technical Space Program of the National Space Facilities Control and Test Center for the support and development of ground centers. The basic document is the strategic space doctrine, approved and funded by the State Space Agency of Ukraine (SSAU).
6. Validation and initiation of annual national projects in the field of space activities (Gorbulin, 2020).

Therefore, when forming the Space Doctrine of Ukraine, it is necessary to take into account both the national space interests and the peculiarities of modern international space activities.

First, nowadays, the paradigm of space activities is shifting from the idea of space leadership to the priorities of sustainable development and consumer orientation. However, until all the countries of the world understand that the sustainable development of terrestrial civilization combined with the sustainable development of space activities can make a difference to humanity (Martinez, 2018), we will face the confrontation in space races between space-faring nations (Patel, 2020). Therefore, in order to create reliable protection of the national space interests, it is necessary not only to create conditions for scientific and technological progress and economic development, but also to provide the activities with competent legal support. As experience has shown, as illustrated by the confrontation between the two states (USSR and USA), the first stage of the technological race in space was won by the USSR. Nevertheless, without giving or developing the legal basis for its space activities, the USSR, and then the Russian Federation, which inherited and continued the Soviet policy in space activities, has strategically lost to the USA. Now we are witnessing how the planned strategic policy of the United States regarding the legal confirmation of its national interests in outer space requires the world community to adapt to their rules (Executive Order, 2020).

Secondly, the space industry has already become an integral part of the real economic sector, financial, information and social spheres, and its development is largely determined by the needs of the modern information society (Science, 2020b). Therefore, it is necessary

to develop and adopt other strategic documents on the settlement of digitalization, robotics, and the use of artificial intelligence on the basis of the adopted Space Doctrine in the near future. After all, the use of space technology in combination with artificial intelligence and other information technologies is the major component of the Fourth Industrial Revolution (Javaid et al., 2020).

We should remind that the First Industrial Revolution had taken place in the late 18th century, when steam-operated machines were put into mass production. The Second Revolution took place in the late 19th century. It is associated with the use of the electric drive. The Third Revolution began in the 70s of the 20th century. It has received an impetus with the advent of computer technology and information and communication technologies (Hart, 2020). We are now witnessing the beginning of the Fourth Industrial Revolution; the large databases, accumulated during the Third Revolution with artificial intelligence and space technology, will help to proceed from simple computation to autonomous decision-making based on the "find and offer" principle (Big Data, 2018).

Third, in the modern world, sustainable development and security problems can be solved only in the context of space technologies development. When we have been analyzing the sustainable development goals (THE 17, 2020), approved by the UN, we could not help but notice that they were developed using a problem-based approach. There is a problem that needs to be solved (defense strategy). First, the global challenges faced by the world community, are outlined and then solving these challenges is considered as the goal setting. In fact, this general technique is effective for setting the agenda. Let's take into account that the previously adopted Millennium Development Goals have not been fully implemented (Millennium, 2015). We can assume that Sustainable Development Goals will not be fully achieved either. Therefore, we believe that after 2030 new universal goals will require a new approach and methodology. It is more progressive, as it focuses on looking for new ideas and technologies for goal achievement and is more proactive than a problem-based approach. For example, goal setting is the adaptation and use of space technologies and artificial intelligence. This new goal is not an attempt to identify a universal problem and find a solution to solve it, but rather an approach to the new opportunities with the help of technology (Human Decisions, 2018). With the benefit of space technology, in the nearest future, people will have better opportunities to live in a sustainable and secure society, both on the Earth and in space (Report, 2019).

Fourth, nowadays, space activities play the role of a scientific driver not only for the public sector of the economy, but also for private business (Report, 2019; Space2030, 2018). Therefore, the Space Doctrine as the fundamental strategic document should establish effective mechanisms for obtaining investments in the public-private partnership and international cooperation for the existing assets: manufacturing and experimental capacities, intellectual property, etc. The experience has proven that scientific solutions, developed and implemented by Ukrainian space industry specialists can naturally complement both Ukrainian and world business in various economic realms with high-tech solutions. They can promote the innovative development of agro-industrial, transport, information and communication, mining and metallurgical companies.

Conclusion

The conducted analysis of the current and retrospective strategic documents in the space industry and the current challenges facing the world community and Ukraine people enables us to draw the following conclusions.

A clear understanding of the space capabilities value, not only for national defense but also for the general national well-being, will allow for establishing a clear position on the strategic development of the space activities, based on the Space Doctrine designed.

The implementation of the future Space Doctrine should be a shift from the initial state of affairs to the new model of space activities.

The study proposes the three levels of the Space Doctrine of Ukraine.

The first level is a basic space doctrine. The basic doctrine defines the most fundamental strategic provisions. They will indicate the vector of movement and how to use it in the future, based on the long-term sustainable, innovative development of the space activities with its focus on the consumer. The vectors must be the following: utilitarian, socially-oriented, and correspond to modern worldview changes. They are specified through the development of strategic, tactical, or operational strategies.

The second level of the Space Doctrine is strategic. The strategic doctrine is developed and agreed upon based on the basic doctrine. This is an integrated set of decisions on the choice of activities, ways to achieve goals, key competencies, and work management systems. The strategic doctrine specifies the provisions of the basic doctrine in the short-term future (10-15 years). It determines the optimal paths for space activities development and proposes a roadmap for achieving the target goals.

The third level of the Space Doctrine is tactical or operational space doctrine. The tactical space doctrines are short-term, for 3-5 years, describing specific types of space activities. For example, development and production of launch vehicles; development and production of rocket engines; satellite and television services, satellite Internet and sales of services; satellite navigation and sale of services, services for earth observation, sale of images and services, etc. This doctrine can either regulate one type of the space activities, or they can be combined with other types to achieve detailed space goals. The tactical doctrine specifies persons responsible for their implementation, sets the deadlines and funding sources.

In the context of the Space Doctrine of Ukraine, the study proposes to consider both national space interests and the peculiarities of modern international space activities in developing updated strategic documents for the space sector.

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