

**International Society of Philosophy and Cosmology
Research Institute of Public Law**

Advanced Space Law

Volume 4



Kyiv, 2019

Advanced Space Law, Volume 4, 2019
Academic Journal

ISSN 2663-3663 (Online); ISSN 2663-3655 (Print)

The State Registration Certificate of the print media KB No 23886-13726P, May 11, 2019

<http://asljjournal.org>

E-mail: info@asljjournal.org

Printed according to resolution of Scientific Board of International Society of philosophy and
Cosmology (Minutes of meeting No 32 from December 9, 2019)

Printed according to resolution of Scientific Board of I Research Institute of Public Law (Minutes of
meeting No 12 from December 11, 2019)

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Domestic (National) Public Space Law of the USA. Success and Challenges of our Time

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The author shows the current objective need to approve the principles and specific norms of domestic (national) public space law. The purpose of the article is to prove the expediency of considering the domestic space legislation of the United States, which nowadays consists of ten national laws, to be the comparative basis for the public space law. The author reveals the definition of domestic (national) public space law. The author believes that domestic public space law can successfully resolve the issues of effective and safe use of space by the private sector, the struggle against space debris, the recovery of asteroid or space resources, etc.

Keywords: asteroid, law, space debris, outer space, national public space law, private space companies, satellite

Received: September 11, 2019; accepted: October 07, 2019

Advanced Space Law, Volume 4, 2019: 5-18

<https://doi.org/10.29202/asl/2019/4/1>

Introduction

Today, the development of space law and legislation is gaining momentum and becoming more relevant, because after the entry into space of private space companies, international law, which was approved in the middle of the twentieth century, is not able to resolve the challenges facing the world space community. Most private space companies are registered and operate in the USA. Moreover, only the US has such a great number of domestic space laws. The USA reasonably claim the leadership in the field of national space legislation. They practically propose their law-making developments as objective models for comparative borrowing by other states.

One more challenge that is already accepted in the norms of US law is the permit for US citizens to engage in commercial recovery of an asteroid or space resource, which will grant them the right to own, transport, use and dispose of it, in accordance with international obligations of the United States. Also a significant challenge in this area is the necessity of the analysis of the basics of military space law and improvement of legislation on space debris and its utilization.

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Based on the concept that modern space law consists of four parts: international public space law, international private space law, domestic (national) public law and domestic (national) private law, let us analyze some definitions.

Domestic (national) public space law is a system of compulsory rules of behavior defined in national high level regulations (laws) which specify and detail the rules of international space law aiming at regulation of public relations between subjects of space administration and persons who render space services, in order to ensure the rights and legitimate interests of space services consumers, public interest of the state and mankind on the whole.

The article pays considerable attention to legal challenges, which face the space sphere of the USA. The core of the study is highlighted regulations concerning successes and shortcomings of the national public space legislation of the United States.

Justification of the need for the development of domestic (national) public space law of the USA

Space law is one of the youngest complex formations of legal matter, which was formed quite recently from historical point of view, namely since the first artificial satellite of Earth entered its orbit. It happened on 4 October 1957. At that moment no state put forward any claims as for the flight of an artificial body over their territory at a considerable height. Thus, the first rule of space law, the instantaneous principle that every sovereign state has the right to launch into outer space any space objects without asking for permission from other countries, was established.

At present space law is experiencing its second heyday. It is connected not only with more modern technologies but mainly with the fact that private business entered the outer space. This challenge is also the leading one as for the formation of the newest space law.

It is impossible to disagree with Harold White, that there are four kinds of law: domestic public, domestic private, international public and international private [White, 2010]. The author has repeatedly emphasized this in his early writings [Halunko, 2019].

Thus, space law consists of: 1) international space law; 2) international private law; 3) domestic (national) public law; and 4) domestic (national) private law. Factors of domestic (national) space public law of the USA will be analyzed and disclosed in the article.

The adoption of international space law began in the 60s of the twentieth century. The development of this law started during the cold war between the first space powers of the USSR and the USA and their allies, which were part of corresponding antagonistic state-political camps: "Western" and Soviet". It was realized on the basis of compromise and mutual benefit. The feature of international public space law of that period was the fact that international space treaties were developed under conditions when space activity was carried out exclusively by state owned companies and at state budget. In practice, the states then had monopoly on the production, launching and transporting into outer space of artificial satellites and astronauts (cosmonauts).

With time the situation in most space powers changed as private space states first carefully, but then widely started running space business. Thus it is necessary to understand that international public space legislation remained unchanged. That is why all hope is for approval of domestic space legislation.

Expanding of the boundaries of international space public law is an objectively complex process. Sovereign states are reluctant to accept new international treaties relating to space

activities, as they give priority to national safety and are reluctant to take any commitments that would limit their capabilities. Accordingly, states tend to oppose the adoption of new international legal regimes or other restrictions that would prohibit them anything. Another problem of international public space law is the fact that the mechanism for monitoring the fulfillment of international agreements is imperfect and difficult to implement. At the same time, the democratic states, as a rule, faithfully fulfill the conditions of international agreements, however non-democratic ones do not. [Blount, 2012].

Thus, despite the objectivity and the need to solve the problems of the research and use of outer space through the expansion of international space law, the probability of this is not great. For example, the international agreement “on activities on Moon and other celestial bodies” of 1984 was not even signed by any leading space power.

Only in cases where the interests of all countries coincide — space powers can reach agreement. However, this is done not by direct (tough) legal regulation, but by soft legal mechanisms of space activities, which aim to bring space parties to the international negotiating table and facilitate inter-state dialogue through more effective mechanisms. One of the main components, where it is possible to realize, is the exchange of information, as near-earth space becomes increasingly congested, which increases the risk of accidents. Sovereign States use space as an essential component of commercial and security infrastructure. In order to avoid banal collisions of satellites, states must have information about artificial satellites and space debris of other states. The sharing of information is equally well established in the international space law regime from the beginning, but it has never been clear how much information should be required for common usage [Blount, 2012].

In order to prevent space conflicts and provide the safety of people on Earth and astronauts on space stations, the space powers have taken the path of developing domestic (national) space legislation. This also refers to the leading space state — the United States. On the contrary, the United States from the very beginning of space exploration carried out this on the basis of high-level legislation — national laws, in contrast to the USSR, which by the time of termination of its existence has not adopted any space law. Some modern leading space powers, such as China, also operate without space laws. Nowadays, in the United States the exploration and use of outer space is carried out on the basis of ten internal space laws, which without any doubt is a record among all space powers. For example, Russia has only two.

Philosophy of the vision of this problem by US scientists is the following: to develop domestic space legislation at such a level of quality, balance and pragmatism that it becomes a model for comparative borrowing by other sovereign states.

So, the USA in the conditions of dynamic development of space technologies, their cheapening, the admission to space activity of the private space companies, without possibility in short term to sign the international space contracts, went on the way of dynamic development of domestic (national) space law which, firstly, has to provide development of the national private space law, secondly, has to become a model for comparative borrowing by other sovereign space powers.

Genesis of legal support of the US space industry

The US space industry has a glorious and one of the world’s longest histories. The United States now ranks first in the world in terms of the number of scientific and space business programs. It launched its first satellite on January 31, 1958, thus becoming the world’s second

power to put an artificial object into earth orbit. In 1961, astronaut Alan Shepard became the first American to fly into space. On February 20, 1962, John Glenn's flight made him the first American to make a full orbital flight around the Earth.

The history of the US space industry has been a territory of success and tragedy. On July 20, 1969 astronaut Neil Armstrong stepped on moon. Six "Apollo" missions were conducted to explore Moon between 1969 and 1972. During the 1960s, unmanned spacecrafts photographed and explored Moon. Since the early 1970s, artificial earth satellites have provided connection and navigation, and space interplanetary spaceships have begun to orbit Mars. In 1977, two "Voyager" spacecrafts were launched with a mission to explore the distant planets of the Solar system, which today have already gone beyond its boundaries. Actually it can be claimed that the "Voyager" spacecrafts are the first artificial objects that, thanks to the mind and will of man, went beyond the Solar system.

In 1981, the glorious and tragic era of Space Shuttle reusability for civilian and military missions began. Over 30 years of exploitation, from 1981 to 2011, five Space Shuttle have made 135 flights including, unfortunately, two terrible accidents in which all crew members were killed [Aerospace, 2019]. Every technology has its time. Despite the fact that the United States was a monopoly in the implementation of real launches of reusable spacecraft, President George Bush ordered NASA to terminate the Space Shuttle program, primarily because of its low profitability [Smith, 2003].

By 1982, the US government has put all civilian and commercial payloads into orbit, and US launch vehicle manufacturers have produced vehicles only under contract to NASA or the Department of defense. Most of the satellites, which they put into orbit, were owned by the United States or foreign government agencies [Canis, 2016].

After the end of flights of reusable space boats with the aim to reduce the cost of the programs of putting cargos and people into space, several American companies began to develop launch vehicles with the help of private funding. At that time, the founder of the space company SpaceX, which is headed by Elon Musk, convincingly proved that this would dramatically reduce the cost of putting small satellites into orbit [Smith, 2003].

As it is now known, he succeeded, although not at the first attempt. In today's conditions, this company already owns not only small and medium-class launch vehicles, but successfully launches medium-and heavy-class missiles with reusable stages of the lower module.

In general the USA plays the leading role in the international space arena. We believe that the basis of current success of US space industry is the orientation to the private sector, when NASA turned from the executor of space programs into their customer. And private space companies on the basis of competition started investing heavily in the development of space technologies. Due to this, the US private space sector is strong and prosperous.

Such success is primarily connected with the pragmatic approach of the US government regarding the investment on the principles of public-private partnership of NASA investments in American private companies according to the law. Many private companies in the US rely on government support in the form of grants or contracts, and the law demonstrates the willingness of the US government to provide aid to the private space sector.

Government investments, which are given to private space companies through NASA, have become a crucial step in the evolution of commercial space companies. 67 space companies received a total of \$ 7.2 billion in investments from the government between 2000 and 2018. And about 93 percent of those investments went to companies designed to launch rockets. On this list, SpaceX is a Prime example of how early government investments contributed to the

company's success. For example, SpaceX spent \$ 1 billion in its first decade of activity, and nearly half of that money came from NASA government contracts [Grush, 2019].

So, the US space industry is characterized by a glorious and successful history, was built and is being built on the principles of the rule of law, public-private partnership, when NASA, as a representative of the government became the customer and controller of the fulfillment of space services, and private space companies became on the principles of competition successful and effective performers.

Legal challenges facing the US space sector

The US commercial space sector is developing dynamically. It requires new spaceports, the construction of which requires the improvement of domestic legislation, and not so much public as domestic private space law. In the United States today, spaceports are owned by the Federal government and include: the Kennedy science center, Cape Canaveral air force station (both located in Florida) and Vandenberg air force base (in California). The Federal government used these means for its own launches, and also promoted their use for commercial launches. Now the Federal aviation administration (FAA) has received a license to build 10 spaceports in seven States: California, Florida, Texas, Oklahoma, Alaska, Virginia and New Mexico. Additional launch locations are offered in other States. Spaceports are built for a specific manufacturer. Some space companies plan to launch only heavy vertical launch rockets, while others plan to engage in space tourism using cruise launch vehicles.

Regardless of the type of launch vehicles used by space companies, they have a common infrastructure scheme, including access for the delivery of large launch vehicle components; space for the assembling of launch vehicle parts; constructions for receiving and storing fuel and loading it on board the rockets; secure facilities for the storage of cargo, payloads and scientific experiments; workspace for crews, engineers and launch personnel; meteorological equipment for monitoring weather situations prior to the planned launches [Canis, 2016.].

Therefore, the construction of new spaceports is a significant factor in the development of the sphere of launching cargo and people into space, which requires the improvement of national private space law.

The US space launch insurance system is one of the most developed in the world. However, it sometimes fails. This concerns known cases when the accident occurs not during the launch or withdrawal of satellites into earth orbit, but during the preparation of the launch vehicle for launch. Space launches around the world including in the US are risky, statistics prove that three of the 86 commercial launches, that took place in 2015 failed, which destroyed launch vehicles, cargo and spaceports. Taking into account the potential losses, insurance coverage plays an important role in the development of the commercial space industry. World premiums for space insurance in 2015 amounted to more than \$ 700 million, and insurance losses exceeded \$ 600 million in 2014, with major insurers such as American International Group, Munich Re and Allianz competing in the market [Canis, 2016].

Consequently, domestic private space law needs to be improved to ensure reliable insurance of cargo, launch vehicles and spaceport infrastructure in case of an accident or accidental destruction.

A significant factor of engaging up to commercial space and meeting the needs of consumers with a small budget is the sphere of launching of small satellites, in particular for obtaining images of Earth and for Internet networks. Groups of small satellites are called constellations.

Observers say that the demand for information is the driving force for the development and launch of small satellites. Small satellites can be launched as a secondary payload along with the main cargo that is output by the launch vehicle. Accordingly, the cost of the launch may be only a few million dollars. Presently, the demand for launches exceeds the capabilities of space transport companies. This encourages the emergence of new start-ups that hope to succeed in providing broadband, remote images or communications services, such as Firefly space systems in Texas, Ocket Lab in California and OneWeb in Virginia.

Now, small satellites can be launched from aerial launchers: small launch vehicles attached to the wing of a modified aircraft. In particular, the private space company Virgin Galactic, which plans to organize suborbital space flights, believes that this form of satellite launch will significantly reduce the cost of putting small satellites into orbit [Canis, 2016]. However, it is necessary to remember that small satellites are a source of space debris, both in the process of entering earth orbit and as a result of a short period of work. They will appear many of them, and more and more of them will turn from operating small satellites into space debris.

Therefore, a significant factor of domestic space law (both public and private) is the regulation of engaging new space companies into the construction and launch into earth orbit of small satellites and legal mechanisms of preventing their transformation into space debris.

Spacecrafts, ground stations, and some unique components are protected from transfer to undesirable countries by the US export control system. Such equipment is considered to be dual-use items, since even those designed for commercial or civilian purposes, have the potential to be used for the military sector. In the cold war era, these space products were considered munitions. Although after its end (in the 90-ies) there were some diminutions in respect of exports from the United States of dual-use products. However, in 1998, Congress returned regulatory powers to DOS after some satellite designs were unreasonably transferred to China.

At the same time, it should be mentioned that after the return of export control, there was a conflict between the administration of DOS concerning the export control and the manufacturers of space equipment. The satellite industry has claimed that the lengthy licensing process has resulted in a loss of exports, and the aerospace industries Association (AIA) proves that the US share of the global commercial satellite market has declined from 63% before export controls resumed to 30% after it was introduced. Manufacturers of space equipment believe that export control destroys the competitiveness of the United States in the international space market. They propose to weaken export controls, in particular to remove from export control equipment such as diaphragms on electro-optical satellites, which are used for remote sensing of Earth, integrated plasma thrusters, and casing, which is used for construction and infrastructure of space tourism [Canis, 2016].

Therefore, balancing of the effectiveness of export control of space equipment and preventing the reduction of the export potential of American manufacturers of space products are an urgent challenge that must be solved by the domestic public space law of the United States.

Among American experts, there are certain proposals for the reorganization of US military activities in space. Major proposals include: the creation of the Space force, a new branch of the Armed forces under the Secretary of the air Force; the restoration of the US space command; and the creation of the Department of defense space development. The US Department of defense DOD has sked for \$ 14.1 billion for space in 2020. Of this, approximately \$ 72 million will be used for the initial planning of the new space force. Attention is focused on the growing

threat to US national security in space from adversaries, in particular from Russia and China, and to a lesser extent- from North Korea and Iran. These countries are trying to target space systems at the US using stubs, lasers, kinetic guns, and cyberweapon facilities [McInnis & McCall, 2019].

Consequently, objectively in the life of society there is a new plane of human activity — outer space. That led to the fact that next to the triad of warfare on land, in the air and at sea, a new potential element of the conducting of military operations — near space has appeared. This issue requires not only its regulation on the basis of closed (secret) orders of the Ministry of defense, but it is desirable to adopt a framework national law on this issue, where the fundamental principles of military space law are noted.

Today, there are about 2,000 active satellites in earth's near orbit, and that number is increasing. More than 100 governments as well as commercial entities from more than 50 countries control them. In addition, the increase in space activity over the past 60 years has created 23,000 pieces of uncontrolled debris that can damage or destroy a satellite. In addition, tests of anti-satellite weapons by China in 2007 and more recently by India in 2019, have added additional pieces of debris to an already congested space environment [McInnis & McCall, 2019].

Space observers note: firstly, the great danger from orbital debris as an environmental problem; secondly, they perceive space debris as a danger that potentially affects the interests of US national security. This is justified by the fact that space debris is capable of presenting barriers, disabling or even destroying military and reconnaissance satellites. After their collision, more shrapnel will continue to move and cause greater threats. International compliance with mitigation measures is critical. However, many experts believe that mitigation efforts alone are insufficient. For this reason, in their opinion, it is necessary to carry out more effective measures for the removal of space debris from earth's near-earth orbit [Hildreth & Arnold, 2014].

Thus, there is no doubt that the issue of ensuring the prevention of the formation and disposal of existing cosmic garbage should become the leading direction of the national space law of space states, including the United States.

Successes and shortcomings of the US national public space legislation

Unlike the USSR, which was a totalitarian state, and was able to carry out space exploration without national legislation of a high level during its existence until its collapse, the United States is a legal state. Thus, without special laws in any sphere, including in the space industry, it cannot exist. Accordingly, among the space powers, the United States has the most powerful, developed and traditional legislation.

The space law was codified almost immediately after the US launch of the first artificial Earth satellite. It then included the national Aeronautics and space Act of 1958, on the basis of which the National Aeronautics and space administration (NASA) was created for the needs of research and use of civil space [Space law, 2019].

According to which, US space activities should be conducted in such a way as to contribute to the achievement of the following main objectives: increasing of human knowledge about the atmosphere and outer space; improving of the efficiency of the use of space vehicles; development and operation of space vehicles capable of delivering instruments, equipment and living organisms to outer space; conducting scientific researches to achieve potential

benefits; maintaining the role of the United States as a leader in space science and technology; ensuring of US cooperation with other countries on the peaceful uses of outer space; the most efficient use of scientific and engineering resources, with the close cooperation of all interested institutions, to avoid duplication of effort, facilities and equipment [National Aeronautics, 2004]. It was the world's first national space law.

Thus, the United States was the first to open the era of national (domestic) legislation, thereby approving the first norms of national space law. All other space powers followed this path in the future. In other words, we can consider that the first national (domestic) public space law was practically born in the United States in 1958, by the entry into force of the Law on Aeronautics and space.

The complication of business relations in the space sphere objectively led to the further development of the national space legislation of the United States. In 1984, the Law on commercial space launches was adopted. In which it is proved that private space technology programs have reached a significant level of commercial and economic activity and continue to grow. New and innovative equipment, that can provide entrepreneurs with telecommunications and information services, carry out remote sensing of the Earth, appears. The law noted that private companies should have the right to develop and launch satellites and provide appropriate accompanying services. This, together with the development of commercial launch vehicles, would allow the United States to maintain a competitive position at the international level and enhance the economic well-being of citizens. In general, such capabilities will correspond to the interests of national security and U.S. foreign policy with respect to the peaceful use of outer space [H.R.1011, 1984].

Most appropriately, the mission of this law was revealed by former US President Ronald Wilson Reagan, who said that an important area of activity of the administration is to encourage the private sector to commercial use of outer space. In the past, the state authorities overcomplicated this process. This law should overcome obstacles for interested private companies to invest their capital and efforts in space programs [Stone, 2012].

The analyzed law was amended and supplemented in 1988, which were devoted to the settlement of the issue of compensation of expenses to commercial space companies that used outer space for the benefit of citizens and national security of the United States. The 2004 amendments to this law relate to the legislative regulation of ensuring safe flights with people on board spacecrafts [Space law, 2019].

Consequently, the U.S. commercial space launches Act of 1984 became a leading factor of the successful commercial use of outer space for the benefit of US citizens and national security, at the expense of private business, and served to improve the effectiveness of the international peaceful use of outer space.

The Land Remote Sensing Policy Act of 1992 established a more favourable regime than the 1984 law for right-wing business development in relation to the launch and use of artificial satellites for remote sensing of Earth. This was primarily aimed at further development of the government's Landsat program as the most powerful satellite imagery project. This law, in particular, stipulates that the special central executive authority LPM (Landsat management Program), which represents the interests of NASA and the US Department of defense, is obliged to make agreements with private American companies regarding public financing of this program. In addition, it is in this law that the license conditions and procedures for their implementation regarding private space systems for remote sensing of Earth are established [H.R.6133, 1992].

Thus, the Earth remote sensing Act of 1992 divided the functions of licensing and public financing of Earth remote sensing (LPM) and customers (NASA) and performers in this field, represented by private space companies. This provided a positive, both economic and qualitatively higher technological effect. Civil and military customers of information about Earth, both inside the USA and in the partner countries began to receive more qualitative and with lower cost information about Earth.

When it became necessary for the United States to participate in the launch program for the construction and operation of the International space station, there was an urgent need to settle this issue at the level of the law. Such a law called About commercial space activities was adopted in 1998. Its Purpose is the further commercial development of the space industry, primarily manned Astronautics, the regulation of issues on launching into Earth orbit and returning to Earth of spacecrafts with astronauts on board. The key objectives of this law are to ensure the construction and effective operation of the International space station on the principles of free market and competitiveness, reducing of the cost of this project financing by the government [An Act, 1998].

So, when once again in the space industry of the United States there was a need to implement the complex space program — the construction and effective operation of the International space station, the relevant law was adopted with the purpose of legal support for this.

The national Aeronautics and space administration authorization Act of 2005 became a concrete plan for the short and medium term prospective concerning exploration and use of outer space. According to this law, the NASA administrator is obliged to ensure the implementation of new space programs, the continuation of implementation of existing ones, the creation of new astronaut space flight programs, programs for the development of US Aeronautics by 2020, the launch of robotic missions to study the moon and other celestial bodies to deepen the scientific understanding of astronomy, astrophysics and other branches of science related to space; to carry out researches for the needs of land users, research of scientific processes of Sun-Earth relationship, operation and development of new programs based on research artificial earth satellites; support of University research in space science; research of microgravity problems [An Act, 2005].

While implementing these programs, NASA is required to: advise and coordinate with other federal agencies, including the National Council for science and technology; work closely with the private space sector to encourage work of entrepreneurs who wish to develop new means to launch satellites, crews or cargo into outer space. As much as possible to involve other countries in NASA programs. As a separate issue should be noted the obligation imposed on NASA for the program of permanent presence of people on the moon, as well as the approval of the preliminary program of Mars exploration [An Act, 2005].

Thus, the United States as a legal state fixes all stages of research and use of outer space in the national norms of high-level law. Space programme planning is no exception to this rule. The law that revealed the directions and specific activities for the development of the US space industry was The Aeronautics and space administration act of 2005, according to which ambitious goals were put onto the space industry, in particular the return to the moon and Mars exploration.

Similar in name and one that clarified and expanded some aspects of the legal regulation of the exploration and use of outer space became the national Aeronautics and space administration Act of 2008 in which Congress tasked NASA with carrying out many missions

to explore and use outer space, maintaining a balance between space sciences, air and space flights. In addition, NASA should take a leadership role in international earth observations and research to solve key problems related to climate change and its impact on Earth's biosphere system and environmental protection. According to this law, NASA should pay significant attention to manned and robotic exploration of the solar system and beyond it, to ensure in this area the leading role in the international coordination of space research. [An Act, 2008].

It should be noted that the analyzed law of 2008 a bit duplicates areas and activities of the space programs identified in the same named national act of 2005. But it played a positive role in specification of the funding of space programs for the period of fiscal years 2009 and 2010. In addition, it is fairly specified certain measures, both exploration and use of outer space for the benefit of US citizens and the world community.

The next and already such, that can be said traditional became the national act of high — level Law About administration of Aeronautics and space authorization of 2010, which was adopted for financing space programs from 2011 to 2013 years and for other goals on specification of trends and concrete research programs and use of outer space in national similar on name laws of 2005 and 2008.

According to which the US Congress has set the following main tasks for NASA: to continue and expand research in the space regions closest to Earth, observing the balance between ensuring the solution of scientific, commercial and national security problems of the USA; to motivate and accelerate the development of technologies and production opportunities for wide application to achieve the economic well-being of the USA; to retain the leadership of the USA in space exploration and related activities; to ensure return on investment and enhance the safety of the ISS operation, to get rid of Russia's monopoly on the means of delivery of crews and cargo to the ISS; to develop additional and alternative transport capabilities for the launch of artificial satellites into low earth orbit; to create a national space and export control system that would protect the national security of the United States and at the same time allow the United States and its aerospace industry to conduct joint programs in the field of space science and technology to compete effectively in the world market [An Act, 2010].

Despite the fact that the commercial space competitiveness act of 2015 was another regulatory act of the US Senate, dedicated to the regulation of commercial space, however, due to the improving conditions and open opportunities for American private companies, it should be considered as a new qualitative step in the legal use of outer space by private space companies. Including the granting of ownership rights to American companies that will extract resources from asteroids [An Act, 2015]. This law, among other things, adopts provisions relating to mining operations on celestial bodies, including the moon and asteroids. According to this law, the President is tasked, through Federal agencies, to promote commercial exploration and commercial recovery of space resources by US citizens on space natural bodies [Smith, 2018].

The most recent national law on Aeronautics and space administration was adopted in 2017. This law comprehensively regulates the creation of an enabling environment for the more intensive development of the commercial space industry by encouraging private sector investment and creating a more stable and predictable regulatory environment for this activity [An Act, 2017].

We find Chapter 513 of this law, devoted to commercial research and extraction (use) of natural space resources from outer space, interesting. In this chapter the categorical apparatus

is spelled out, namely: it is determined that an asteroid resource means a space resource found on or within one asteroid. Moreover, it is written that the space resource is an abiotic (inanimate) resource that is located in outer space. According to the fair opinion of scientists and US legislators, space resources are divided into water and minerals [An Act, 2017].

We pay special attention to the categorical definition of the understanding of ownership rights for asteroid and other space resources. In the national Aeronautics and space authorization administration Act of 2017, it is prescribed that a US citizen who is engaged in commercial recovery of an asteroid or space resource according to the analyzed Chapter has the right for any asteroid or space resource, including the right to own, transport, use and selling of an asteroid resource or a space resource obtained in accordance with applicable law, including international obligations of the United States [An Act, 2017].

So, the United States as a legal space power from the very beginning of the exploration and use of outer space has relied on high-level regulations — national laws. The next feature of the development of the national (domestic) public space law of the United States is that the national space laws from the very beginning of space exploration stimulated the attraction of private investment and private companies to space activities. In the latest Aeronautics and space authorization administration Act 2017 in practice, the right of US citizens, who are engaged in the development of asteroids and space resources, to own, to use and dispose the extracted useful resources from them was secured.

Organizational and legal support of the us space sector

Organizational and legal support of the space industry is carried out by both the legislative and Executive authorities of the United States. Federal laws are passed by the US Congress. But the leading role in the organizational support of the exploration and use of outer space is played by NASA, which carries out the overall management, planning, administration and coordination of all activities in these areas.

The NASA office is headed by an administrator who is accountable to the President of the United States for all aspects of the Agency's activities, including the creation and formulation of strategic priorities, ensuring the successful implementation of space policy and the effectiveness of programs. The administrator performs all necessary functions to administer NASA operations in accordance with the law. He has the legal status of senior adviser on space Sciences of the President of the United States. The administrator has in subordination the deputy, associate administrator, chief of staff, etc. [Subject, 2010].

In addition to NASA, the public administration of space activities is provided by federal agencies, which are entrusted with a variety of regulatory functions. The most important federal agencies are: the FAA's Office of Commercial Space Transportation, whose mission is to protect the public, property, national security, and foreign policy interests of the United States during commercial space launches, and to encourage and facilitate commercial space transportation [Office, 2019].

The Department of Commerce (DoC) is responsible for promoting US commercial interests in both domestic and international markets. In particular, it is engaged in supporting space activities to ensure economic growth, development and competitiveness of the United States in the world market [Department, 2019].

The national oceanic and atmospheric administration (NOAA) uses commercial imaging satellites to improve weather forecasting and environmental data collection. The Bureau of

industry and security (DOC) oversees the export and licensing of strategic technologies, including nearly seventy items of space equipment industry components. The Federal communications Commission licenses commercial satellite radio frequencies and determines the placement of satellites in geostationary orbit.

At the same time, it should be mentioned that according to American scientists, the current structure of public administration of the space industry may require changes over time if the commercial space industry grows. Private space firms can take more responsibility for launching of government satellites (including military satellites), offering space flights to tourists, mining asteroids and the moon, and attempting to explore and even populate Mars [Blount, 2012].

Consequently, the legal support of the space industry is carried out by the US Congress, which adopts federal laws to regulate this sphere. The main organizational burden for the planning, administration and coordination of all activities in the exploration and use of outer space is laid on NASA. Which is assisted in this activity by such public administration entities as the Office of commercial space transport, the Department of Commerce, the National oceanic and atmospheric administration, the Bureau of industry and security, the Federal communications Commission, etc.

Conclusion

The article reveals the scientific understanding of the domestic public space law based on the analysis of national laws and practical activities of the US public administration. In the process of research, specific measures were formed that can be solved by the current national space law of the United States in favour of citizens and humanity as a whole. The directions of improvement of the domestic public space legislation of the USA were offered. However, in one article it is impossible to disclose all the issues, so such important topics as the problem of legal resolution of the conflict between the United States and other space powers in the first place with China concerning counteraction to proliferation of space debris, the legal aspects of the destruction by states of their satellites and the building of a foundation for military space law — will be disclosed in subsequent publications.

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International Legislation in the Field of Astronomical Nomenclature

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The names of celestial objects and natural formations on the Earth's surface take into account historical trends and certain generalized systematics. National and regional names are more used in relation to anthropogenic objects. The decision to assign a name to a celestial body is made by the relevant international structures through a preliminary long-term study. International and national legal acts, regulating the sphere of astronomical nomenclature, are analyzed.

Keywords: astronomical nomenclature, space law, astronomical names

Received: September 27, 2019; accepted: November 01, 2019

Advanced Space Law, Volume 4, 2019: 19-25.
<https://doi.org/10.29202/asl/2019/4/2>

Introduction

There are times when, as a sign of sincere gratitude, admiration “in memory of” or from a distant calculation, one person or persons want to give another one something unusual and unique, in addition naming in honour of the lucky one. It is good if the donators have such a thing or object, otherwise, in case of a car, TV, perfume or any material thing made or designed not by you, it is difficult to rename, it is already clear to everyone. You can give a named villa, yacht, hotel, company or firm, fund. And if you want something bigger or large-scale? Village, river, maybe sea or ocean, island, continent? Here everyone understands that it will not be possible. But the star to give, call it whatever you want, paying a lot of money and getting a beautiful multi-colored certificate, someone considers it as a good gift option to another person or even oneself. And is it really so? In practice, as a result of unclear provisions of international law and existing legal gaps in the “Outer Space Treaty”, certain individuals, in fact, appropriate space objects that are the property of the whole community [Svitlychnyy, 2019].

Legal basis for naming objects on Earth's surface and assigning them the names of real persons

Regulation of relations and activities concerning the establishment of names of geographical objects in the country, their regulation, registration and accounting, use and storage are prescribed in the Constitution of Ukraine [Konstytutsiia, 1996], the law on geographical names [Pro heohrafichni nazvy, 2005], and the Code of established practice "Structure and content of the State register of geographical names" [Kodeks, 2009]

According to the Ukrainian legislation, each integral and relatively stable formation on the Earth of natural or anthropogenic origin, which exists or existed in the past and is characterized by a certain location, acts as a geographical object. This applies to both large creators of the landscape (continents, seas and oceans) and continental components (ice sheets, steppes, plains), and smaller formations: fluvial, that is, created as a result of the geological action of temporary or permanent watercourses (rivers and streams, swamps and waterfalls, estuaries and their deltas and valleys, dams, floodplains, canyons and caves, ponds and lakes, rapids and beaches, meanders and oases); mountain (mountains and ranges, hills and plateaus, ridges and outcrops); coastal (atolls and shelves, bays and isthmuses, islands, peninsulas, capes and lagoons, coasts); volcanic (volcanoes themselves and their craters, lava plateaus and domes, geysers and caldera); aeolian, or sediments formed by wind (dunes and deserts).

The law also covers geographical objects created by people: reservoirs, dams, quarries, tunnels, roads and bridges, settlements and streets, railway stations, airports, marinas.

None of these objects can be renamed by paying money. There is a clear and understandable procedure for giving them their own names in honor of famous personalities by local or central authorities.

As the Law specifies, for recognition and establishment of distinction of a certain geographical object from others, it is given the name which is established by research of existing or known in the past historical names, names and renames. Further there is a discussion of names and the most used and acceptable of them is chosen. At the same time, its writing in the state language is carried out according to certain rules. In the next stage, the name is approved by the relevant geographical names authorities and noted in state registers and placed on official maps.

The use of surnames that occur in geographical names show a person's direct relation to this object (participation in the discovery, research, creation or foundation), or great respect for this person, for his feat, biography or a certain action (posthumously and in exceptional cases, taking into account the opinion of the local population).

When naming objects or assigning them names (pseudonyms) of individuals, anniversary and holiday dates, names and dates of historical events, their location, purpose, geographical, historical, toponymic, cultural, architectural and other features, local traditions of the name should be taken into account.

A number of geographical objects have long been named after well-known travelers and researchers. This, for example, is a river in New York state, USA and a strait in the Arctic ocean that washes the shores of Canada, which are named after the Navigator Henry Hudson, who in 1607 made a journey to reach India and China through the North pole. Livingstone falls on the Congo river in Central-West Africa were named in 1877 after the Scottish Explorer of Africa missionary David Livingstone. Mount Fitz-Roy, which is located on the border between Argentina and Chile and one of the Falkland Islands are named in honor of Robert Fitz-Roy,

meteorologist, hydrographer and cartographer, commander of the expedition around the world ship “Beagle”.

The name of the Ukrainian Mykola Miklukho-Maklay has a section of the coast of the island of New Guinea, which he explored in the period of 1871-1883. (MacLay’s Shore). A Peninsula in Alaska, an island in Hawaii, a strait, a river and a mountain on Sakhalin are named in honor of Yuri Lisyansky, a geographer, oceanographer and navigator.

In Ukraine, settlements are mainly called in honor of prominent persons (Khmelnitsky, Ivano-Frankivsk, Dokuchaevsk, Chubinskoye, etc.), mountains and rocks (Dovbush Rock in the Carpathians, Levashovska mountain in Kyiv).

Astronomical nomenclature

The names of the brightest objects in the sky appeared much earlier than the earth’s geographical names. People began to travel long distances not at once, so the idea of the structure of the earth’s surface and its details were formed gradually. And the sky from the earliest eras was available for contemplation in every inhabited corner of the Earth. For orientations in space and time, the ancient inhabitants of planet remembered the bright configuration of the stars, gave them names in accordance with the similarity with earthly objects (Spica-from the Latin “ear of wheat”) and the deities worshipped (Mars — the ancient Roman God of war). Objects with fast movements — Sun, Moon and bright planets, attracted attention in the first place, so each nation had its own names for them. With the appearance and development of science, the centers of which in a certain way migrated around the planet with the rise and fall of states and civilizations, many names were lost, some were transformed, others remained stable. Each culture had its own specific rules to give names. So, for example, there are the names of some constellations, bearing the names of the heroes of Greek myths: Cepheus, Andromeda, Cassiopeia, etc. The ancient Arabs had a descriptive principle of the location of the star in the constellation. For example, star Rigel is translated from Arabic as “leg”, in the constellation of Orion, it is just where the hunter’s leg should be.

Each star received many variants of designations. There is about a thousand historical and traditional star names, which were used as a kind of astronomical slang (Furud, Muscida, Parma), national names (e.g., the North star in Estonian is Phaniel, in hakushu — Hoschar, in Yugoslav — Nekretnina, in the language of the Northern peoples — Bug Sangan, in Ukrainian- Kil).

The brightest star of the constellation Kiel, visible in the southern hemisphere — well known Canopus is also called Ptolemeon, Pandrosus, Suheil, Alsachl, Gubernaculum, Vasn, Proclos, Terrestris, etc.

Some of the names have undergone a certain transformation over time, for example, the primary names of stars in the constellation Cygnus in Arabic meant (as indicated in the catalog of 1030) “Bright on the tail”, “Chest”, “Elbow of the right wing”. But over time, the names were reduced to one word and the stars were called: Deneb, Sadr, Giyanah. Other stars have several common names associated with the peculiarities of transliteration. For example, the Dawn of the Orion constellation Alnilam is called Lenihan and Alnilam.

In Ukraine has long been used both a set of astronomical names, translated from the Greek language [Yzbornyk, 1983], and astronyms — folk names of planets and constellations, for example, the Well — the constellation of Dolphin; Volyar — the constellation Volopas; Harrow — the constellation Cassiopeia; and others [Naienko, 2016; Klymyshyn, 2006].

With the development of astronomy and international cooperation, it became increasingly difficult to identify the objects of research of different authors, because different national and proper names of stars were used, and constellations in general had different layout and their number was not constant. To somehow generalize information about the stars, the Italian astronomer Alexandro Piccolomini published the first Atlas of the starry sky and proposed to designate the stars in the constellations by the letters of the Greek and Latin alphabets in descending order of their brilliance [De le stelle, 1540]. His successor, the German astronomer Johann Bayer continued this innovation and expanded in his Uranometer [Bayer, 1603]. Astronomer Greenwich Observatory (England) John Flamsteed in 1712 proposed another approach for unambiguous designation of stars — to number the stars with Arabic numerals in each constellation in ascending order of one of the coordinates of the star from west to east [Flamsteed, 1712].

In the future, new star catalogs appeared and the stars in them had their own numbering. For example, for Sirius — a Canis Majoris, and Big Dog, BD -16°1591, ADS 5423.

International astronomical regulatory bodies

In 1919, the International Astronomical Union (IAU) was founded at the Founding Assembly of the International research Union (IAU) [Andersen et al., 2019]. Today it is an Association of 13551 specialist astronomers from 107 countries. This organization has become recognized as the highest international authority in dealing with astronomy issues requiring cooperation and standardization. In particular, it is the IAU that decides on the official names of celestial objects and details on the surface of Solar system bodies.

So in 1922, at the meeting of the first General Assembly of the IAU, a Committee on astronomical nomenclature was established and it was decided to prioritize the division of the celestial sphere of the northern southern hemispheres into constellations. By that time there was no unambiguous definition of their boundaries, moreover, even the number of constellations in different countries at different times was different — from 47 in Ptolemy to 237 in Mongolia. A special commission divided the sky according to certain rules into 88 sections. The official names for each constellation, their boundaries, spelling and abbreviations were fixed, and the stars visible from Earth in each of the constellations were listed. The work was completed in 1928, and in 1930 the standards of constellations were officially published and have not been changed since then.

In 1935, the Committee presented the first systematic list of monthly nomenclature [Blegg & Müller in 1935,]. Later, with the launch of artificial satellites, this list was expanded and refined [Arthur et al., 1963; Arthur et al., 1966].

The Martian nomenclature was refined in 1958, when a special Committee of the IAU recommended for adoption the names of 128 Martian formations, which differed in color and brightness, and which were observed with ground-based telescopes. The beginning of the work was performed at the end of the 19th century by the Italian astronomer Giovanni Virginio Schiaparelli.

Since the advent of space missions made it possible to study in detail the surfaces of the planets of the Solar system and their satellites, a permanent Commission of planetary nomenclature to ensure the normalization of the names of parts to certain standards began to operate at the IAU since 1957.

At the AMIS meeting in Sydney in 1973, the nomenclature group was reorganized and the work expanded. Working groups for Moon, Mercury, Venus, Mars and bodies that move outside the Solar System, began to operate to conduct preliminary work on the selection of themes and proposed names for formations on each planet and satellite [De Vaucouleurs et al., 1975; Tarter, 2005]. In 1984, in order to be able to name surface features on small bodies (asteroids and comets), another working group was established [Masursky et al., 1986]. Since 2012, all of them have been operating in the structure of the IAU Department F — Planetary systems and astrobiology.

The names of the stars

In the late 1990s and early 2000s, a wave of outrage by astronomers swept the world due to the fact that some dubious firms and companies began to arrange the so-called “sale of stars”. For a fee, the buyer received from the representatives of these entrepreneurs certificates with ordered own names of stars. Sometimes in such “sold” lists even bright stars with the centuries-old set name were taken. And the observatories began to flock to the “owners” of stars with the requirement to show them their star. To clarify the situation in this matter on the official website of the IAU even a special page explaining such charlatanism was created. And in 2015, under the division C — “Education, enlightenment, history and heritage” a working group “Names of stars” (Division C WG Star Names, WGSN) was established. It consists of astronomers who have experience with stellar astronomy, recognized experts in the history of astronomy who study astronomy in the culture of the peoples of the world. The group has set itself the goal of cataloguing and standardizing proper star names for the international astronomical community. The names will be based on a great historical and world cultural heritage through the study of archival data and literature on astronomy.

The working group was empowered to establish guidelines on the proposals and adoption of names for stars, to harmonize and summarize historical star names, to collect and maintain, publish and distribute official catalogues of names of stars and exoplanets.

Up to early 2019, the WG has officially approved its own 336 star names, a catalog of which can be found on the official WGSN [Observer’s Handbook, 2018]

There you can also ask a question and get an exhaustive answer about the origin of a particular name of the star and the rationale for such a choice out of many names. The group’s work continues, new research and approved titles are printed annually in WGSN Bulletins.

While carefully studying the newly created catalog you can see that a small part of the stars still bears the names of specific people. But these are special stars that have certain unique features. And they are officially named in honor of the discoverers and researchers of these non-standard objects. Among the stars with names of real persons, the most famous is Barnard’s star, or Barnard’s flying star from the constellation Ophiuchus. It was discovered in 1916 by American astronomer Edward Emerson Barnard. Invisible to the naked eye, the red dwarf has the largest proper motion of any known star on Earth. For 180 years, this star has changed its location among other stars by the magnitude of the apparent diameter of Moon, such a path other stars overcome on the earth’s sky for almost a thousand years.

Earlier in 1897 it was discovered by the Dutch observer Jacobus Cornelius Kapteyn and also named in his honor the star Kapteyn in the constellation of the Painter. Its peculiarity is that it not only has a sufficiently large own motion, but also rotates around the center of the Galaxy in the direction opposite to the movement of the vast majority of objects, thus moving

away from the Solar system at a speed of 245 km / s. The uniqueness of the Scholz star, or rather a small binary star system, which has a total mass of only 0.15 masses of the Sun, is that it has an unusually small own motion. This feature was noticed in 2013 by German astronomer Ralf-Dieter Scholz and calculated that 70 thousand years ago this system was very close to the Sun (0.8 light years). The star of Leighton, the stars of Teagarden, van Maanen, Innes, van Bishrouck, Przybylski, Krzeminski, Popper also have their exceptional features. Yet the vast majority of stars bear names of ancient Greek, Arabic and medieval origin.

Conclusions

Scientists interpret the problem of astronomical nomenclature in different ways, emphasizing that nomenclature lists are not a systematized whole, but only a catalog of registered concepts. Nomenclature names in each terminosystem have their own characteristics, they are often incommensurable, and therefore can not be reduced to one group.

Among the astronomical terms a lot of proper names, which are the names of stars, constellations, planets are recorded and formed by lexico-semantic way based on:

- 1) the names of animals, birds, insects, amphibians;
- 2) the names of objects and their parts;
- 3) the names of professions or occupations.

On the basis of metaphorization astronomical nomen-phrases were created, among which we can point out:

- 1) names of constellations;
- 2) names of aquatic facilities, identified on different planets.

Thus, astronomical nomenclature is a full-fledged part of astronomical terminology, since the scientific astronomical nomen has the same characteristics that the term has: exact correlation with a certain scientific concept, the presence of a definition, system (each nomenclature name occupies a certain place in the hierarchy of astronomical noumenons), unambiguity, the absence of homonyms as undesirable elements in terminology.

Thus, natural formations on Earth and in the sky are subject to national and international legislation both in their use and in the naming rules. Humanity has recognized this for a long time, and anyone has no right to violate this order.

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Features of the Activities of Public Entities in Space Debris Mitigation

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The article investigates the features of the activities of public entities in space debris mitigation. In order to simulate the consequences and develop adequate measures to mitigate space debris, it is necessary to create and analyze databases on space debris, and develop the systems of preventing collisions with the space debris. The commercialization of space affects the development of a system of entities dealing with mitigation of space debris, which can be divided into two groups: public and private entities. However, in our study, we pay attention to the first group of entities acting in the field of space debris mitigation, namely public entities, which can also be divided into two subgroups: international organizations and national space agencies. The further solution of the global space debris problem requires the harmonization of existing and the creation of new rules for the proper functioning of both public and private space debris mitigation actors. After all, only the joint activities of which, when carried out in a coordinated, logical and systematic way, will be able to lead to the desired results — reducing the existing and preventing the creation of new space debris in the future.

Keywords: space debris, public entities, international organizations, space agencies, mitigation, prevention, space activities, space

Received: October 23, 2019; accepted: November 26, 2019

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Advanced Space Law, Volume 4, 2019: 26-33.
<https://doi.org/10.29202/asl/2019/4/3>

Introduction

The conduct of space research and the actual development of the space age, with or without intent, leads to an increase in space debris. By its origin, space debris is divided into natural (remnants of space bodies) or artificial (orbital debris created as a result of the destruction of satellites, spacecraft, remnants of the activities of astronauts). However, both natural and artificial, space debris is located around Earth and is equally a global threat, both for further space exploration and for the life of our planet.

All countries should make every effort to jointly solve the problem of space debris. Now, some entities of international law and public entities in individual states are conducting research activities to solve the problem of space debris. However, the system of public entities of counteraction of space debris is not holistic, which does not allow for proper coordination and cooperation in this area.

That is, in order to simulate the consequences of space debris, analyze the database on space debris, create systems to counteract collisions with space debris, further solve the global problem of space debris, it is necessary to create all conditions for the proper functioning of public entities of counteraction to space debris, whose joint activities should be coordinated, logical and systematic.

Space debris is the unintended result of more than six decades of space travel, and is largely the result of disruptions, explosions or collisions of some 8,950 satellites that have been sent into orbit since 1957. Today, the European space Agency estimates that more than 900,000 objects of debris, more than 1 cm, are in orbit, which could have any impact on a functioning satellite and cause damage or a potential threat to the end of its mission [Space Debris European Space Agency, 2019]. In doing so, space debris around Earth's orbit travels at 17,500 mph, which is enough for a small piece to damage a satellite or spacecraft. The increasing amount of space debris increases the potential danger to all spacecraft, but especially to the International space station, satellites, spacecraft with people on Board [Space, 2017].

The destruction of individual satellites or the loss of specific orbits due to uncontrolled growth of debris, will have a devastating impact on the world economy in space. Today, global satellite operators spend 14 million euros annually on maneuvers to avoid debris, but over 99% are false alerts. However, in recent years, the commercialization of space has increased, which also means the mass launch of both small satellites and large satellites, carried out with new players in the private sector. This will generate several hundred thousand space debris collision warnings [Space, 2019b].

The commercialization of space also affects the development of a system of entities of counteraction to space debris, which can be divided into two groups: public and private entities. But in our study, we will pay attention to the first group of entities of counteraction to space debris, namely public ones, which can also be divided into two subgroups: international organizations and space agencies of individual states.

Organizational and legal support for the activities of international organizations to combat space debris

With regard to international organizations, the United Nations, which is by its nature global, is the largest in terms of distribution. The Committee on the Peaceful Uses of Outer Space (COPUOS) was established by the UN General Assembly in 1959. COPUOS functions to manage the exploration and use of space for the benefit of all mankind: for the sake of peace, security and development. The Committee was mandated to review international cooperation in the peaceful uses of outer space, to examine the space activities that The United Nations could carry out, to promote space research programmes, and to study the legal problems arising from space exploration. COPUOS contributed to the creation of the five treaties and the five principles of space activities. International cooperation in space exploration and the use of space technology to achieve global development goals are discussed at COPUOS annually. Due to the rapid progress of space technology, the space program is constantly changing, so the Committee provides a unique platform at the global level to monitor and discuss these events [Committee, 2019].

COPUOS has two subsidiary bodies, a Scientific and technical subcommittee and a Legal subcommittee, which focus on the prevention and minimization of space debris.

Each year, states and organizations exchange information about their research in the Scientific and technical subcommittee of COPUOS. One important outcome of these discussions was the set of space debris mitigation Guidelines that were approved by the General Assembly in 2007 [Space, 2019c].

The guidelines reflect existing practices that have been developed by a number of national and international organizations. From a technical point of view, the guidelines apply to mission planning and operation of new spacecraft and orbital stages and, if possible, to existing ones.

There is a total of seven guidelines: a) to limit debris released during nominal [spacecraft / orbital stages] operations, b) to minimize the potential for break-ups during operational phases, c) to limit the probability of accidental collision in orbit, d) to avoid intentional destruction and other harmful activities, e) to minimize the potential for postmission break-ups resulting from stored energy, and f) / g) to limit the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit (LEO) region / geosynchronous Earth orbit (GEO) region after the end of their mission [Space, 2019a].

In addition to scientific research, international legal aspects of space debris mitigation measures are discussed by the Legal Subcommittee [Space, 2019c]. To help counteraction to space debris, COPUOS compiled a compendium of standards that developed legal mechanisms related to space debris mitigation measures. The purpose of the compendium is to inform states about the existing instruments and measures that have been implemented by states and international organizations in the field of counteraction to space debris [Compendium, 2019].

That is, the UN as an international global organization deals with counteraction to space debris by supporting the functioning of COPUOS, which very effectively carries out counteraction to space debris by means of coordination of international cooperation, space exploration, the creation of space research programs that focus on the destruction of space debris, as well as the formation of basic principles as for the planning of space missions to prevent the creation of space debris.

The next entity that can be attributed to the international organizations countering space debris is the European Space Agency (ESA).

Under its space safety activities, ESA aims to develop technologies to automate collision warnings, provide highly accurate orbit data and mitigate or remove debris risks, opening a valuable, new job-creating business for European industry, which will acquire a competitive advantage on the global market [Space, 2019b].

The European Space Agency has under its authority the Space Debris Office, which coordinates research activities in all major areas of space debris prevention. These include measurements, modelling, protection and mitigation of consequences from space debris. The Space Debris Office is the main coordinator of such activities with space agencies in Italy, the United Kingdom, France and Germany. Together with the European Space Agency, these national agencies form the European Network of Competences on Space Debris (SD NoC) [ESA, 2019].

The space debris administration coordinates activities on: radar and optical measurements; modeling of space debris and meteoroid environment, risk assessment models; analysis of space debris mitigation measures and their effectiveness for long-term environmental stability; assessment of the risk of collision in orbit; analysis of problems with the space debris database [ESA, 2019].

The space debris administration has developed and maintains several engineering tools for space debris analysis. These tools, which are available for use, are stand-alone and self-installed software products, including MASTER-2005 (prediction of debris and meteor showers (particles) in user-defined target orbits), PROOF-2005 (planning, modeling and observation of radar and optical debris) and DRAMA (verification of compliance of space tasks with debris mitigation guidelines) [ESA, 2019].

That is, the European Space Agency is the coordinator of research activities concerning counteraction to space debris.

International Organization for Standardization (ISO). It is an independent non-governmental international organization that, through its members, brings together experts to share knowledge and develop international standards that support innovation and offer solutions to global challenges.

ISO creates documents that provide requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose. [ISO, 2019].

ISO has now ratified 15 international standards relating to space debris mitigation requirements. For example, *ISO 24113 (Document type: international standard) defines the primary space debris mitigation requirements applicable to all elements of unmanned systems launched into, or passing through, near-Earth space, including launch vehicle orbital stages, operating spacecraft and any objects released as part of normal operations. The requirements contained in ISO 24113 are intended to reduce the growth of space debris by ensuring that spacecraft and launch vehicle orbital stages are designed, operated and disposed of in a manner that prevents them from generating debris throughout their orbit lifetime. The requirements are also intended to reduce the casualty risk on ground associated with atmospheric re-entry of space objects. ISO 24113 is the top-level standard in a family of ISO standards addressing space debris mitigation* [International, 2019].

In addition to international organizations, the inter-Agency Space Debris Coordination Committee (IADC) should be mentioned, it is an international governmental forum for worldwide coordination of activities related to man-made and natural debris in space. The main objectives of the IADC are to share information on space debris activities among member

space agencies, facilitate opportunities for cooperation in space debris research, review current activities that are under way, and identify options for debris mitigation [What's IADC, 2019]. At the 17th IADC meeting in Darmstadt, Germany, the working group undertook the task of developing the first set of international consensus recommendations on space debris mitigation. The IADC space debris mitigation guidelines describe existing practices that have been identified and evaluated to limit the generation of space debris in the environment. The manuals cover the overall environmental impact of space missions, with a focus on limiting debris released during routine operations, minimizing damage from orbit breaks, clearing debris after a mission, and preventing an in-orbit collision. The IADC guidelines on space debris mitigation are not obligatory to fulfil, and therefore apply to mission planning, design and operation of spacecraft and orbital degrees to be put into earth orbit. Organizations are encouraged to use these guidelines to determine the standard they will apply when setting requirements for planned space missions [Inter-Agency, 2019].

Thus, the international mechanism for counteracting to space debris is implemented through the activities of international organizations that are part of the system of public entities of counteraction to space debris. They form the main objectives of solving problems with space debris, adopt international acts in the field of space activities, coordinate national space agencies and implement joint scientific projects aimed at reducing and destroying space debris.

Features of the organization of counteraction to space debris at the national level

The second group of the system of public entities to counter space debris, as already mentioned above, includes the space agencies of individual countries.

Of course, the United States, where the National Aeronautics and Space Administration (hereinafter — NASA) operates, has reached the greatest development in the space sphere so far. NASA is an Agency belonging to the Federal government of the United States and reporting directly to the President of the United States. It carries out the civil space program of the country, as well as scientific research of air and space and scientific and technological research in the field of aviation, Aeronautics and Astronautics [National, 2019].

NASA takes the threat of collisions with space debris seriously and has a long-standing set of guidelines on how to deal with each potential collision threat. These guidelines, part of a larger body of decision-making aids known as flight rules, specify when the expected proximity of a piece of debris increases the probability of a collision enough that evasive action or other precautions to ensure the safety of the crew are needed [Space, 2017].

NASA and the US Department of defense cooperate and share responsibility for the study of satellite debris (including orbital debris). Using special ground-based sensors and surveys of returned satellite surfaces, NASA statistically determines the extent of the population of orbital debris objects [Space, 2017].

According to the experience of other countries, in particular European countries, it is worth noting the existence of interaction between individual EU member states on counteraction to space debris.

Thus, the Italian Space Agency (ASI), the British national space centre (BNSC4), the French Space Agency (CNES), the German Aerospace Agency (DLR) and the European Space Agency (ESA) have developed and formally adopted the European Code of Conduct for Space Debris Mitigation.

The primary objectives of the European Code of Conduct for Space Debris Mitigation are:

- *prevention of on-orbit break-ups and collisions,*
- *removal and subsequent disposal of spacecraft and orbital stages that have reached the end of mission operations from the useful densely populated orbit regions,*
- *limitation of objects released during normal operations* [European, 2004].

To achieve these objectives, the Code defines the main measures to be followed in the design and operation of space systems to prevent or minimize the formation of space debris. These measures are grouped into: — management activities; — project activities; — operational measures; — protection measures. It does not cover security measures at the launch stage [European, 2019].

The German anti-space debris policy, which is implemented by the Space administration of the German aerospace center, is that each contractor involved in a particular space mission applies product safety requirements, including reducing the size of space debris throughout all phases of the project. The legal framework for countering space debris is the Space Activities Act of 22 August 1998 and the Telecommunications Act of 22 June 2004. For space projects in Germany, space debris mitigation requirements are mandatory [Germany, 2019].

In the UK, the outer space Act 1986 is the legal framework for regulating activities in outer space (including the launch and operation of space objects) carried out by persons associated with the United Kingdom. The act grants licensing and other powers to the Secretary of State, who acts through the UK Space Agency. The act provides for the fulfilment of the UK's obligations under international conventions relating to the use of outer space. Under the law, the Secretary of State does not grant a licence unless he is satisfied that the activity being licensed does not endanger public health or the safety of people or property, would be in conformity with international obligations, and would not harm the national security of the United Kingdom. In addition, the legislation requires the licensee to conduct its operations in such a way as to prevent pollution of outer space or adverse changes in Earth's environment [United, 2019].

Discussions are going on in Italy with the aim of developing national legislation related to outer space, including provisions on measures to reduce space debris. Until the adoption of the national space law, the implementation of activities related to the reduction of space debris is still limited to the provisions of the treaties signed by the Italian Space Agency, which has the institutional task of defining, coordinating and managing national space programmes [Italy, 2019].

That is, the activities of space agencies, which are part of the second subgroup of public entities to counteract space debris, differ in their structure and powers. Although, the legal framework of each country, adopted on the basis of international conventions governing space activities, has some peculiarities. In some countries, such as Italy, legislation on space activities is just being formed, herewith most countries cooperate to form a common policy to reduce space debris around Earth.

Conclusion

The modern system of public entities of counteraction to space debris consists of international organizations (the UN Committee on the peaceful uses of outer space, European Space Agency, the International organization for standardization; the Intergovernmental Coordinating Committee on space debris; International telecommunication Union) and the

space agencies of individual states (currently the most active in the field of counteracting space debris is the USA, Italy, the UK, Germany, France).

Public entities of counteraction to space debris should coordinate international measures to counteract space debris, because it is a global problem for humanity. At the same time, their activities should have strong political support, which will allow to economically support and develop new programs to counteract space debris. In addition, it is necessary to create new programs, involve educational and scientific institutions, invest in international scientific projects to create a more effective counteraction to space debris.

The peculiarity of the activities of public entities to counteract space debris is the formation of a regulatory framework, standards that are aimed at reducing space debris, however, at present these standards are advisory in nature, respectively, do not require mandatory actions on the part of space entities. It is now necessary to harmonize the national legislation of individual states with existing international principles for the reduction of space debris, taking into account the commercialization of space activities and the creation of rules for private sector players.

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Moon Exploration: Legal Aspects

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Legal aspects of the theory and practice of Moon exploration are investigated through the problem statement in philosophical and legal discourse with the reflection of history, current condition and prospects, including the issue of its total colonization. Materials and results of initial research were published in 2018-2019. Main concepts and definitions are given. Main legal aspects of Moon exploration are highlighted and briefly reviewed: 1) human rights; 2) licensing; 3) intellectual property protection; 4) natural resource extraction and usage; 5) environmental protection; 6) new technologies, technical activities regulation and safety; 7) natural and cultural heritage preservation. Main conclusions and recommendations are formulated.

Keywords: Moon exploration and colonization, space activities, space law, licensing, intellectual property, environment, human rights, natural and cultural heritage, natural resources, technology

Received: September 27, 2019; accepted: November 01, 2019

Advanced Space Law, Volume 4, 2019: 34-49.
<https://doi.org/10.29202/asl/2019/4/4>

Introduction

In the problem statement in philosophic-legal discourse, we will briefly consider the main legal aspects of the theory and practice of Moon exploration with the reflection of history, current condition and prospects, including to the point of its total colonization. Materials and

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results of initiative researches were published in 2018-2019¹. Main concepts and definitions were given. The following main legal aspects of Moon exploration were allocated: human rights; licensing; intellectual property protection; natural resource extraction and usage; environmental protection; new technologies, technical activity regulation and safety; natural and cultural heritage preservation.

That is why in 2019 the subject of Moon exploration became essential due to:

1) anniversary dates — achievements in the history of Moon exploration. 60 years since first flights of automatic stations to the Moon. “Moon-1” flew at the distance of ~ 6000 km away from it, “Moon-2” reached the surface, “Moon-3” took and transmitted first pictures of the far side of Moon (1959, USSR). 50 years since first human Moon landing and first human step on it (Neil Armstrong, 1969, Apollo-11, USA); 2) new projects and results of flights to the Moon (China, Israel, India, etc.), USA plans to provide mankind attendance of the Moon by 2024, project of moon program development in Russia [Krichevsky, 2019b; Mirovaya pilotiruemaya kosmonavtika, 2005; NASA; ROSKOSMOS].

Experience, problems and perspectives of evolution in theory and practice of Moon exploration and familiarization lead us to comprehension of necessity of urgent liquidation of existing lag in space activity regulation on national and international levels and crucial importance of forward-looking development of space law and new society institutions.

All this correspond to the efforts of world society under United Nations auspices, aimed at stable development of space activity which found their reflection in two new and important UN Conventions on space law and policy which were organized by space Committee — UNOOSA (2018, Moscow, Russia and 2019, Istanbul, Turkey) [United Nations Office for Outer Space Affairs]. This is necessary but not sufficient.

In international space law and space policy there are complex contradictions between the states and other participants concerning choice of model, vector, space exploration rates and technologies, extraterrestrial resources usage taking into account interests, potential of process participants, experience, internal and external constraints and other factors (see: [Volynskaya, 2018; Yeshchuk & Vasina, 2019]).

For efficient response to complex global challenges in rapidly changing environment, usage of space activity potential and new technologies for exploration of space and its resources in order to promote well-balanced stable development world society will have to move from the paradigm of parted and conflicting mankind to a new paradigm of unified mankind including the formation of the World space union [Krichevsky, 2019a].

It is necessary to create a new conception and model of space law for Moon exploration that will reflect the realities and perspectives of space exploration by world society in the upcoming new third period of Space era including the earlier proposed superglobal project of

¹ Authors have considerable experience of scientific researches, development and realization of projects in the sphere of space activity, a number of publications. Sergei Krichevsky is a professional military pilot and test-cosmonaut who was a member of USSR and Russia cosmonaut squad in 1989-1998, in 1992 he took part as an expert of Supreme Council of Russia in the development of law project “About space activity”, since 1998 he has studied history of aerospace engineering and activity. [Mirovaya pilotiruemaya kosmonavtika, 2005: 603; Zakon, 1993; Vlasov & Krichevsky, 1999; Krichevsky, 2012, 2018, 2019a, 2019b; Krichevsky & Udartsev, 2019]. Alexandr Bagrov is an astronomer and developer of tools for space explorations, in 1994-2014 he carried out researches on preparation of space experiment “Oziris”, since 2014 he has taken an active part in preparation of Russian lunar missions [Patent, 2012; Sysoev et al., 2017; Bagrov & Leonov, 2015; Bagrov, 2019a, 2019b].

complete Moon exploration by mankind according to the well-balanced (“deductive”) scenario of creation of cosmic humanity in the long run [Krichevsky, 2018, 2019a, 2019b].

It is essential as Moon exploration is forefront and ground for all space activity with the aim of mankind survival and development on Earth and beyond Earth with the usage of extraterrestrial resource and principally new technologies which are to be created for this purpose taking into account the fact that new ideas, examples and samples already exist.

New second world moon race which started and is developing in the 21st century, aimed at Moon exploration, put forward difficult law questions to mankind. At present this exploration has not begun yet, but perspectives of extraterrestrial resources usage and attractive closeness of Moon to Earth already cause rivalry for them between space states. For almost over 40 years since the race between the USA and the USSR as for the primacy in man landing on Moon (since 1970s) there has not been observed serious activity in moon explorations. Today many people express bewilderment in this regard. But this pause is quite explicable. Even first Moon explorations with the help of spacecrafts let us get the answers to the most vital scientific questions, and further researches could only specify a bit the obtained answers as for nature of Moon as celestial body. But these “specifications” would have to be paid a high price of space missions.

The situation has started to change recently. We are already interested not only in scientific knowledge about Moon but more in applied information that will enable us to move to exploration of its resources. New research tasks are dictated by applied problems of the upcoming Moon exploration. These tasks are connected with different views on the character of human activity in Moon conditions — from usual for terrestrial methods usage of human labor in resource extraction to implementation of machines, robots for all kinds of work.

When the USSR first delivered its pennants to the Moon (14 September 1959, automatic station “Moon-2”) it only set its priority in reaching the first extraterrestrial space body. When astronauts Neil Armstrong and Buzz Aldrin stepped on the Moon surface and installed the US flag (21 July 1969, lunar module of the ship “Apollo-11”), they only built upon the primacy of the USA in landing of mankind on Moon from the planet Earth [Mirovaya pilotiruemaya kosmonavtika, 2005; NASA; ROSKOSMOS]. Neither in the first nor in the second case were these actions viewed as requisition for establishment of sovereignty over Moon. By this time international space Treaty was valid [Treaty, 1967] and it forbade establishment of sovereignty. But there did not arise the question as to which Moon resources can be used in practical life, and high cost of lunar missions put into doubt their feasibility in the nearest future for commercial usage.

Now when hopes for commercialization of Moon resources appeared, there appeared the necessity for development of technologies for their mining. Suchlike working-outs will cost much more than flag demonstration at extraterrestrial territory. Those who invest enormous financial resources into these working-outs are to be sure of their efficiency. A new phase of space race can provide its winner with vital superiority in getting the most obtainable Moon resources and even lead to suppressing of probable rivals. On the one hand, such actions will be viewed as a worthy result of serious investment into researches, but on the other hand, as violating rights of people who are not able to invest big money in suchlike working-outs.

The unfolding race for investigation and Moon resource development nourishes not only on hopes for future dividends but also on absence of international laws which would be able to regulate sharing of “space pie”. When there are no laws the “rule of the most powerful”, which is the most advanced contestant of the race, decides everything. No matter whatever the

leaders of space states would say, they all, apparently, hope that they will outrun their rival on their own and then face them with the fact of their superiority.

Sooner or later the rules of space resources usage must be created. Otherwise the results of costly usage will be litigated and the disputes arisen can lead to serious international conflicts. Everybody understands it and work at space legislation has been conducted for many decades [Halunko, 2019]. But at present slow space law, policy and diplomacy give benefit to those who hope in case of their superiority support it by relevant laws.

The developers of space law can be understood. Laws either reflect principles of long-standing relationships between people and states or are formed on the analogy of them for foreseen situations. In space long-standing rules of behavior (launching registry, astronauts rescue, responsibility for damage from spacecrafts, etc.) are fixed in the Treaty of space activity and a series of supplementary conventions. New space legislation must regulate the activity specific nature of which is unknown to legislators. Who or what will explore space resource and Moon resources in particular. Machines, robots, “avatars”? Cosmonauts? Whom will the mined resources belong to? To machine owners, operators of distantly controlled devices or cosmonauts? Or to some commercial structures which created machines or hire cosmonauts? And who and in what way must be responsible for negative aspects and consequences of space activity?

Actually future space legislation should be based on real predictions of character and scope of work in space. No space agency can formulate them yet. Even announced plans can change several times a year! Vaguely formulated aims (“gain a foothold on Moon”, “main target is Mars”, etc.) cannot be accepted as predictions. Moreover, some intentions should be viewed as utopian. “Traditional” economically ineffective and ecologically “dirty” rocket techniques which initiated space exploration cannot be basis for its large-scale exploration. Heavy and powerful rockets will be surely in demand at the process of creation of initial infrastructure of space settlements on Moon but only until alternative means of cargo transportation to Moon appear which in addition will provide great cargo traffic. And only principally new transport and other technologies and mechanisms will be able to make space exploration real, safe, environmentally friendly, economically possible and efficient.

It turns out that it is impossible to create universal space legislation at present. But it is possible and necessary to formulate and accept new rules of space activity which will spread around space, Moon and further in Solar system mutual understanding and practice of dignified and fair relationships of cooperation between people and countries which have been built over centuries of mankind evolution on Earth.

The situation is interesting, difficult and contradictory. Moon is ideal object for exploration “from scratch”: almost untouched surface and environment without biosphere, territorial, political and economic boundaries. But people have not agreed yet on how to explore Moon, although the process of exploration is getting started already. For successful and effective exploration it is necessary to have new rules, common strategy, significant funds and new technologies, uniting and distribution of world society efforts, cooperation of space and other states in balance with essential problem solving on Earth (by [Krichevsky, 2019b]).

1. Basic concepts and definitions

Moon exploration — goal-oriented process of human activity on exploration of Moon embracing study, research and usage of Moon, all attributes of it, of its surface, subsoil,

resources with the aim of survival and development of man and society on Earth and out of Earth, on Moon, including to the point of total exploration and total colonization of Moon.

Legal aspects of Moon exploration — aspects of space law covering the whole complex of relationships connected with Moon exploration.

Human rights at Moon exploration — main human rights covering all relationships connected with Moon exploration.

Technologies and equipment for Moon exploration — technologies and equipment developed, created and used for Moon exploration at full life cycle.

Licensing of space activity for Moon exploration — system of rules defining permits and limits of activity in Moon exploration.

Intellectual property protection — legal protection of intellectual activity results in space which come in the form of inventions, useful models, industrial samples, etc.

Environmental protection of Moon and circumlunar space — complex of knowledge, “rules of the game”, measures and technologies aimed at preserving this environment.

Natural and cultural heritage preservation at Moon exploration — complex of knowledge, “rules of the game”, measures and technologies aimed at preserving the natural and cultural heritage of mankind on Moon including delivery of security objects (or their copies) from Earth and their preservation on Moon.

2. Short history, condition, problems and perspectives of space law for Moon exploration

In the world there are in function international agreements and treaties which regulate the activity in space. Every sovereign state surely has its own internal legislation, but it should be coordinated at the level of international affairs with international laws, the coordinator of which is UNO.

The formation of space legislation is being carried out under United Nations auspices. Ten years after the launching into space of the first satellite “Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including Moon and Other Celestial Bodies” was signed and ratified by all space states [Treaty, 1967], and most countries of the world joined later. Its urgent development and adoption were caused by amazing success of world (first of all soviet) cosmonautics and fears of states concerning the fact that soon space will be divided between space states. Worst of all, in space can appear some weapon against which no state would have means of protection.

Treaty concerning space of 1967 was the first document which contents was precursive to space legal provisions. It simply declared the freedom of any researches in space and strictly forbade militarization of space. Actually only these main principles of space activity were fixed in the treaty, but neither methods of control of their fulfillment nor system of sanctions for their violation were determined. Though the Treaty claimed that “*Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means*” (Article II), this declaration was contradictory to Article VIII of the same Treaty. It says that “*A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer*

space or on a celestial body...” It can be understood thus: legislation of the owner state is considered valid on the constructed on Moon station with all its buildings, which will exist for millions or billions of years meaning that its sovereignty spreads forever on the whole construction area.

Race for superiority between the USSR and the USA stimulated preparation on the initiative of UNO in 1979 of “Agreement Governing the Activities of States on Moon and Other Celestial Bodies” [Agreement, 1979], in which principles of scientific and economic activity on Moon were discussed in detail. For instance, Article 8.1 of the Agreement declares that “*States Parties may pursue their activities in the exploration and use of moon anywhere on or below its surface...*”

This statement is loophole for those who want “according to the right of superiority” to conquer the prime territories of Moon. There are places on Moon which are of particular interest for placing first long-term stations on them. They include some mountain peaks in circumpolar Moon areas which are practically never shaded and where it is very profitable to put power plants of solar batteries. Of utmost interest are the places of location of “lava tubes” — natural holes under Moon surface where there can be located habitable stations, bases, settlements with guarantee of their protection against space radiation. Unlimited right of the states to locate their stations wherever they want gives preferences to superior space states and automatically infringes rights of those who will reach Moon later.

One more loophole represents Article 9.1 of the Agreement which runs that “*States Parties may establish manned and unmanned stations on the moon. A State Party establishing a station shall use only that area which is required for the needs of the station and shall immediately inform the Secretary-General of the United Nations of the location and purposes of that station...*” While developing “compact” territories the size of developed area will be defined by the developing organization itself, and Agreement makes its claims undisputable. Thus declarative nature as for usage of extraterrestrial territories can also cause conflict situations. Indeed, you can announce about your intention to carry out some works on a certain piece of land and then postpone their realization for years under different circumstances. Or other state will start works on this land without waiting for claimant’s fulfillment of his intentions and will inform UNO of beginning of works. Concerning the statements of Agreement we can see ambiguity of rights of these states as for this disputable piece of land.

But one thing is research of Moon and completely other one is its exploration, use, colonization. State, space agency or commercial organization during the process of space resources development will be interested in the property right for results of its work, income from invested money into development. Instead of this Article 11.3 declares that “*Neither the surface nor the subsurface of the moon, nor any part of natural resources in place, shall become property of any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person*”. It is obvious that compiled 40 years ago Agreement, which was aimed at assist in Moon exploration by space facilities, today is an obstacle for Moon exploration and its resources development.

It is surely a pity that qualified lawyers and legislators who worked out “Agreement Governing the Activities of States on Moon and Other Celestial Bodies” (1979) allowed so much ambiguity in the text of international document. Imperfection of Agreement led to the situation that neither state, member of UN Security Council, nor any of leading space states signed or ratified it. Although legally Agreement came into force, its validity is no way obligatory for states which did not ratify it.

Long pause in Moon exploration, which reflected absence of interest of space states in its development, did not promote development of space laws concerning space resources usage. So nowadays, 60 years after the beginning of Moon exploration by spacecrafts, legislation concerning Moon lags behind practice. Actually Moon got into the state of defenseless victim of any colonial intentions of predators willing for profit. Well-known statement of Roman law “All that is not prohibited is allowed” with absence of any bans frees hands for everybody who is in rush to take part in race for moon resources. Later, when (and if!) space law will be developed, other statement of Roman law will come into force: “One who owns let owns!” Thus, everything obtained before coming of law into force, no matter by what means and in what way it was obtained, will be admitted as its owner’s property. Thus slogan that *“exploration and usage of outer space including Moon and other celestial bodies is carried out in favor and according to interests of all countries, not depending on level of their economic or scientific development, and are property of all human beings”* will turn out as a blank declaration in reality.

Absence of clear legislation as for Moon and its resources is actually the factor which encourages large states to capture all space resources which they can reach. Taking advantage of absence of international laws some countries try to spread their national laws all over the space. In 2015 US President signed the bill HR 2262, according to which US residents are allowed to own all resources obtained by them in space. This law guarantees that obtained resources cannot be confiscated from their owners [H.R.2262, 2015]. Mass media announced that Luxemburg government adopted legislation norms as for mining on asteroids which allows any earthman mine and own space resources without any restrictions [Loi du 20 juillet, 2017].

There is an impression that imperfection of “Agreement Governing the Activities of States on Moon and Other Celestial Bodies” (1979) was caused by superficial ideas of lawyers preparing it of space settlements and specificity of space resources development. This is clearly seen in the article 11.5 of Agreement according to which *“States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible”*. Today this “when” has come and we will try to formulate those conceptual statements which must be reflected in space legislation.

3. Main legal aspects of Moon exploration

3.1. Human rights

Aspect of human rights is viewed by us as first and prioritized as it refers to all people on Earth, especially to those who developed, develops and will develop Moon personally and directly beyond Earth, in outer space, in lunar space and on Moon itself. Existing main human rights are written for Earth, they do not reflect peculiarities of relationships connected with space exploration, including Moon exploration. In such a setting space activity, space law and human rights were studied by one of the article authors in 1993-2012 (see: [Krichevsky, 2012: 222-230]). Problem of human rights in space is not solved yet, is actual and its complexity is growing.

Let us formulate new human rights in connection with Moon exploration in the form of a number of certain positions as supplements and clarifications to the existing main human rights:

1. Right to participate in Moon exploration.
2. Right for obtaining and usage of results of Moon exploration, including right for material and intellectual property created, obtained as a result of space activity.
3. Right for moving from Earth to Moon, staying on Moon, permanent life on Moon.
4. Right for provision of safety and life activity during Moon exploration, staying on Moon and also for provision of social rights and guarantees on Moon and Earth.
5. Right for obtaining terrestrial citizenship (citizenship of states of Earth) for people born on Moon or any other extraterrestrial object.
6. Right for returning from Moon to Earth, moving from Moon to other celestial bodies, objects in outer space and backwards and also right for voluntary non-returning from Moon, from space to Earth.

There are complicated medical and bioethical matters connected with health condition, influence of adverse factors of space flights, environment beyond Earth, on Moon, with consideration of individual genetic and other peculiarities, including long-term consequences for a certain person and his descendants, human reproduction on Moon, after returning on Earth etc.

Great difficulty bear matters of new technologies implementation, interaction between mankind and robots, creation of biological and cybernetic copies, biocybernetic systems, avatars and others, distant and combined control online, with usage of virtual reality and artificial intellect, usage of systems of artificial gravity, radiation defense, lunar dust and other dangerous factors of activity and environment.

New human rights connected with Moon exploration must be formulated and declared on behalf of UNO, and must be deliberately realized.

3.2. Licensing

Resolution of UN General Assembly № 68/74 from 11 December 2013 “Recommendations on national legislation relevant to the peaceful exploration and use of outer space” calls for the states to consider in their laws about national space activity the following: “...3. *Space activities should require authorization by a competent national authority...*” and “4. *The conditions for authorization should be consistent international obligations of States, in particular under the United Nations treaties on outer space, and with other relevant instruments...*” [Resolution, 2013]. These recommendations actually transfer control over economic activity under the jurisdiction of states. Legislation of various states as for space can differ from each other, and this easing can lead to ambiguous formulation of rules of space activity fulfillment. But the thing that worries most of all is that Resolution gives the states the right to set boundaries of extraterrestrial territories which they claim on.

We propose to use the principles of setting of territorial boundaries of appliance of national laws, according to which national sovereignty spreads only up to the height of 100 km over the state territory above which the outer space starts. National legislation cannot be spread onto it according to the valid Agreement of 1967.

It will be reasonable if all outer space is completely transferred under the jurisdiction of International space legislation. In such a case, supranational Committee, operating on behalf of UNO by its mandate, will act as a competent agency giving the right for space activity. Committee can give licenses for space activity to state, interstate and private individuals or organizations on introduction of the state which positions itself as guarantor of future licensee.

One of the kinds of licensing must be issuance of permits for developed territories on celestial bodies, including on Moon². Such licenses must be given for a limited time, in addition, the licensee can be early withdrawn if licensee carries out his works with violation of license conditions. The license conditions must include period of its validity, discussing reasonable time before starting of works and maximum term of license validity after suspension (stopping) of works. Suchlike principle of licensing will help to avoid blank declarations about intentions which are not supported by real plans of realization of works on outer space territory, and avoid holding of one-time events in space aiming at “staking” its presence on licensed territory.

Obligatory constituent of license conditions must be limited territory on which it is permitted to fulfill space activity. Size of this territory must correspond to the set task of space activity. For instance, a plot of land 20 miles in diameter can be allocated for construction of permanent base or settlement. The peculiarity of construction on Moon is that the settlement will be in the form of a single multistoried building the height of which will differ only a bit from its horizontal sizes. In a settlement with size of 10x10 km with height of 1000 stories the square of inhabited accommodation will be 100 billion m², which is enough for living of 100 million population and everyone will have 1000 m² of buildings of for various purposes. That is why the licensed for construction territory of the proposed size will be enough for hundreds of years of active usage. 45000 plots of land of such size on Moon can be allocated and 4500 billion people can comfortably live on them [Bagrov, 2019b].

The question of territorial **property** of “any state, international intergovernmental or nongovernmental organization, national organization or nongovernmental institution or any individual” on Moon is withdrawn if the territory is **given** to licensee not as property, but for temporary usage.

Connected with it the question of “national appropriation by proclamation of sovereignty” during licensing of near-Earth territories on behalf of UNO is gaining different sense. Implementation of scientific and business activities on licensed territory cannot be done behind legal scope. It is clear that jurisdiction on this territory must be given licensee guarantor, to the state under which flag space activity will be fulfilled on the licensed territory. In this case national legislation will take into account interests and traditions of those people who will fulfill licensed activity. Sovereignty of state-guarantor of licensee in connection with implementation of its internal legislation on the given territory is natural basis for state responsibility for realization of license conditions.

The role of states in the development of space resources remains decisive in the regulation of space activities even after the involvement of private corporations. In the future, it will probably only increase (by [Krichevsky & Udartsev, 2019]). Therefore, future space legislation should be based on its support by state structures.

Question of natural resources of licensed territory, including its subsoil, must be clarified better than it was in Article 11.3 of Moon Agreement. There are no places on Moon where mining of mineral resources or conditions of construction of inhabited buildings could have exclusive advantages in comparison with other territories. That is why thesis that territory development “... does not create property right on Moon surface or subsurface or their areas”

²Alexander Bagrov proposed novation: “licensing of territories” (by [Bagrov, 2019b]), which can be implemented for regulation of process of Moon exploration. The analogy is regulation of usage of positions of geostationary orbit in near-Earth space at the distance of ~36 000 km from Earth, when International telecommunication union (ITU), which fulfills distribution of global radio spectrum and satellite orbits, actually gives permits — international licenses on usage of local areas of outer space for telecommunication, liaison apparatus (communication satellites and others). See: [ITU].

(Article 11.3 of Agreement [Agreement, 1979]) is contradictory to Article 1 of Treaty of 1967, according to which “*The exploration and use of outer space, including Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind*” [Treaty, 1967]. How can mankind heritage be really used if people have no right to appropriate it which means to use? It is sensible to draw an analogy with world ocean resources, which are obtained by ship owners or by states which have the right for adjoining their coastal boundary shelf. Obtained seafood and mineral resources are considered as absolute property of getters and can be used both for inner use and for sale. It is necessary to admit property right of licensee for all obtained on the licensed territory resources.

Obligatory conditions for obtaining license for extraterrestrial territories

As a matter of principle, some (justified!) restrictions for mining and usage of space resources can be introduced. For instance, condition of *total processing, utilization* of associated waste must become absolute restriction on mining of mineral resources.

On Moon natural conditions and mechanisms of degradation of human waste are principally different in comparison with those on Earth. Thrown away broken mechanism will lie on Moon for millions of years in the same state. During the time of intense activity on licensed territory there can appear too much waste and it is completely unacceptable to create garbage dumps and waste piles from mineral resources mining. License for space activity must point out absolute inadmissibility of waste piling. On Earth we have already faced ecological consequences of waste piling with which natural recreational mechanisms do not cope. And on Moon, where there are no such mechanisms at all, problem of waste utilization must be solved with the first steps of its development. Problem of human waste utilization is partly solved on inhabited space stations; this experience must be used on Moon, too. Different kinds of mineral waste can be used for lunar construction works. This implies simple and clear rule: you can mine as many resources as you can utilize waste from mining.

We would like to point out one more element of space activity which is not viewed yet in space legislation. Exceptional stability of lunar constructions from local solid basalt lets create on Moon extremely reliable storage of cultural values of mankind [Pavlov & Bagrov, 2018]. That is why space legislation must form the system of preferences for licensees which will give part of their buildings for museum needs.

It turns out that work on space legislation must cover all sides of multifaceted human activity on Moon. Some legislation norms can be postponed to better times, but kernel of space laws — regulatory provisions as for principles of space resources mining and usage — is a matter of some urgency.

We propose to give corresponding status to United Nations Office for Outer Space Affairs (UNOOSA), which will exclusively regulate all kinds of space activity. Stressing on the unique position of Moon as the most perspective object of colonization, we find it necessary to foresee within the framework of Committee work of special unit, which management will include licensing of territories for construction of lunar stations and settlements and duty of control of work conformity on licensed territories to license conditions, and withdrawal of license in case of violation of license conditions. Territory licensing is proposed to carry out according to conceptions of states representing guarantors of licensees and accept jurisdiction of states-guarantors on licensed territories.

3.3. Intellectual property protection

Finally, there is one more space open to pirates. This is the sphere of intellectual property. Space is the area of implementation of the highest technologies saturated by the results of intellectual activity. Surprisingly, but in outer space no invention is defended by patent right. Patent legislation still exists only in the realm of national jurisdiction of states which does not extend to space. Most perspective working-outs, most profitable inventions can be exploited completely legally in space without any commitment to inventors and patent owners [Bagrov, 2019a]. It is necessary to form such international legislation system in which intellectual rights of space technologies developers will be guarded in the whole outer space and during the whole period while they are in demand.

It is important to provide protection of inventions used in space starting from period of priority publication to the whole period of their usage without any limit for protection deadline. Nowadays patent right is based on 20-year term of invention protection, whereas peculiarities of space technology lead to the fact that first (!) invention usage can take place only decades later after filing a patent application.

3.4. Mining and usage of natural resources

Space exploration, and Moon exploration in particular, only at initial period will rely on earth resources. Actually, planet Earth consists of the same mineral composites as other bodies of Solar system. The most attractive resource of Moon is stability of conditions on it and possibility of creation on Moon inhabited objects, invulnerable to natural disasters. This is the resource lack of which on Earth causes serious worries about stable development of our civilization and even about its existence at global climate changes and other global catastrophes. Any constructions on Moon from monolithic lunar basalt will stay without repairmen millions of years which will really reduce cost of capital construction by hundreds and thousands times in comparison with construction on Earth. That is why possibility of creation on Moon safety conditions for relocation of people in response to natural threats is a powerful stimulus for Moon exploration. Undoubtedly, development of territorial Moon resources to the full extent will correspond to main principle Article 1 of Treaty of 1967 which states that “*The exploration and use of outer space... shall be the province of all mankind*” [Treaty, 1967].

Metal oxides are integral part of lunar basalts (up to half of weight), that is why on Moon at any place you can mine oxygen, iron, titanium, rare earth metals and other metals. Hardly the needs of earth industries will be covered by these resources but they will provide the conditions for independent development of lunar settlements.

3.5. Environmental protection

As a result of peculiarities of space activity and used technologies environmental protection concerning Moon exploration covers: Earth, near-Earth space, near-Moon space and Moon [Krichevsky, 2012, 2019b; Vlasov & Krichevsky, 1999].

We have noted earlier categorical inadmissibility of waste storage on Moon. Ways for reaching non-waste colonization of Moon are even now clearly seen. Those solar ovens on the basis of which building 3-D printers will work [Sysoev et al., 2017], can effectively utilize any kind of waste. For instance, waste from recycling of mineral raw materials can be used as material for monolithic construction, and any organic waste, which cannot be used repeatedly, can be volatilized in these ovens, which at volatilization temperature will have speed higher than speed of runaway not only from Moon, but even from Solar system. Thus provision of 100% waste utilization on Moon must not have any technical complications

and right of complete environmental protection in space settlements must be fixed in space legislation.

As elevator transport systems will be one of the key elements of space development technologies, their usage will have a great significance for environmental protection on Earth. The fact is that payload, taken out of Earth, will be transported by elevator system at space speed [Bagrov et al., 2012]. It is possible to find such moment of location of Earth, Moon and Sun when accelerated to speed of Earth orbital movement capsule, undocked from elevator system, will fall onto Sun under the influence of solar gravity. This will make it possible to realize the program of dropping of stored on Earth containers with radioactive and other toxic waste onto Sun. They all will burn out in solar atmosphere without any consequences for it and there will be no threat of environmental pollution by dangerous waste on Earth. Space legislation must surely discuss the necessity of dangerous waste treatment of Earth at the process of Moon exploration (according to Alexander Bagrov, 2019).

For protection of unique objects of natural heritage as untouched wild nature (see p. 3.7), space nature reserves must be created on specially allocated Moon territories — on the analogy with Earth. One of the authors of the article proposed project “Space nature reserves” on Moon: zoning of Moon surface and near-Moon space with allocation in environment the territories of space wild nature protection with limit mode or full ban of technical activity and nature usage aiming at preservation of objects of natural and cultural heritage including monuments to nature and technology on Moon (first publications were in 2003-2012 [Krichevsky, 2012: 202-215, 378-381], also see: [Krichevsky, 2019b: 23]).

Aspect of environmental protection is connected with new technologies, technical regulation and technical activity safety and also with preservation of natural and cultural heritage (see further in p. 3.6 and p. 3.7).

3.6. New technologies, technical regulation and technical activity safety

It is necessary and obligatory to adapt existing on Earth national and international systems of technical regulation and technical safety, to develop them for safe and effective development of Moon at full life cycle of technical activity.

The priority is minimization of consumption of natural resources, risks and negative effects and consequences for a person, society and environment.

It is possible only at transition to the best available technologies and principally new eco-friendly, clean and green technologies. [Krichevsky, 2012; 2018, 2019b; Soroka & Syntichenko, 2018].

One of the authors of the article investigates the evolution of Moon exploration technologies including looking into specific examples of environmentally friendly technologies and projects developed in the world in 20th-21st centuries. Environmentally friendly technologies and projects are those which correspond to ecological norms or outpace them, do not have negative influence on the environment, life and health of people or which have less negative influence in comparison with others. Classification of environmentally friendly, clean technologies and projects of Moon exploration, taking into account their special purpose, covers the whole spectrum of space activity and includes the following main parts: 1) exploration of Moon and other objects; 2) transport; 3) creation of infrastructure on Moon; 4) energy (including for Earth and Moon); 5) life support and human security; 6) mining, processing and usage of natural resources; 7) environmental protection and restoration; 8) preservation of natural and cultural heritage (according to: [Krichevsky, 2019b]).

Legal regulation must be directed at stimulation of transition to environmentally friendly, clean technologies, their wide usage and also at implementation of strict limits as for usage in space, on Moon of technologies which create excessive risks for people and infrastructure and environment pollution.

3.7. Preservation of natural and cultural heritage

Preservation of natural and cultural heritage on Moon is necessary and possible on the basis of legal acts of world society under the auspices of UNO, appropriate international conventions and organizations, activity of UNESCO and United Nations Environment Programme. Their supplement and adaptation with account of conditions and peculiarities of space activity, connected with Moon exploration and research, are necessary [Krichevsky, 2012, 2019b; UNESCO; United Nations].

It is proposed to initiate and in collaboration with UNESCO create and supplement World lists of natural and cultural heritage on Moon, and for this there are already unique and valuable real objects. They are unique natural objects and landscapes of Moon (craters, mountains, etc.); objects of technical culture of mankind (machinery and activity traces: lunar ship modules Apollo, USA; spacecrafts “Lunohod-1”, “Lunohod-2”, USSR, etc.) They need protection among other things due to the starting process of Moon exploration.

High firmness and invulnerability of lunar constructions from effects of disasters let us view them as an exceptional opportunity for storage of physical objects of world culture. Display cases and galleries for visitors can be separated in museum areas on Moon. Exhibits can be located in gas environment which excludes the possibility of survival of all kinds of harmful organisms in it, whereas visitors will stay in conditions of regular atmosphere. Character of lunar construction from monolithic basalt allows even during the process of construction of museum complexes to prototype in smallest details the architectural performance of any terrestrial masterpieces, for example, to create exact copies of halls of Winter Palace in St. Petersburg or St. Peter’s Cathedral in Rome. Copying of many historic buildings, located on Earth in earthquake and flood zones will allow preserving on Moon architecture samples for our descendants. [Pavlov & Bagrov, 2018].

It is necessary to discuss separately questions of preservation of elements of history of the colonization of space: launched on the Moon vehicles, the first lunar stations and settlements, elements of life and authentic items which were used by cosmonauts at the creation of habitable zones on the Moon, activity traces and others. The need to preserve evidence of human expansion into space, history of Moon exploration and development should be discussed in space legislation.

Almost unlimited opportunities of capital construction on Moon can ensure the construction of museum complexes on Moon, capable of accommodating originals or copies of all treasures of world culture — manuscripts, books, paintings, sculptures, architectural masterpieces, reconstructions of archaeological findings, samples of machines, etc. The unlimited growth of the area and volume of museum premises will create in future opportunities to completely refuse from the concept of museum reserves and to provide round-the-clock access for visitors to museum expositions. Humanity is really interested in the fact that accumulated treasures must not be lost because of natural disasters, wars or barbaric destruction on Earth.

At the same time, it can be emphasized that possibilities of lunar construction will allow creating premises of larger volume in which it will be possible to place landscape zones and

create reserves in them for preservation of samples of inhabited territories of Earth (their models and real objects). Moreover, in special landscape zones on Moon in future it will be possible to create and maintain conditions for preservation of rare and endangered species of terrestrial organisms, and even for inhabiting them with disappeared on Earth but recovered by scientific methods animals and plants, with the creation of artificial gravity and other environmental conditions similar to conditions on Earth.

Problems of conservation of objects of natural and cultural heritage of mankind on Moon must be duly reflected in outer space right.

Conclusions

1. A brief analysis of the history, conditions, problems and prospects of main legal aspects of theory and practice of Moon exploration, including to the point of its total colonization, is made.
2. Lack of adequate laws, stimulating and regulating complex activity for Moon exploration, its resources, is a brake for sustainable development of space activity, mankind expansion into space.
3. In connection with the features, problems and prospects of the started in XXI century new world lunar race, aimed at the development of Moon, it is necessary to organize advanced integrated management of Moon exploration process under the auspices of UN, for which to initiate, work out, create:
 - 3.1. New “rules of the game”, including: additions to basic human rights, taking into account the peculiarities of Moon exploration and new status of people, including permanent life on Moon, having children, relationships with states on Earth, social rights and guarantees for them on Moon and Earth; new “Agreement the Activities for Moon exploration and colonization”, etc.;
 - 3.2. new institutions, structures of Moon exploration, including World space agency and Department of Moon;
 - 3.3. legislation about licensing, including permission issues as for the use of technologies, territories and resources;
 - 3.4. legislation on property during Moon exploration including during mining and usage of natural resources;
 - 3.5. legislation on new technologies, technical regulation and safety of technical activities for Moon exploration;
 - 3.6. legislation on the protection of Moon’s environment and near-Moon space.
4. It is proposed to initiate and in cooperation with UNESCO create and supplement lists of world natural and cultural heritage on Moon which need protection in connection with process of Moon exploration.
5. It is advisable to organize a systematic research of legal aspects of Moon exploration, including in the format of new International institute (center) of problems of Moon exploration and colonization, which is proposed to be created.

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Space Law of Ukraine: Present and Future

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The newest doctrine of space law of Ukraine is formulated in the article. The authors reveal that it consists of public and private international space law applicable in Ukraine and domestic space laws, which are classified into public and private. It is emphasized that making amendments and additions to the relevant national Law “On Space Activities”, which has allowed private entities to be engaged in these activities, offers great opportunities to the Ukrainian space industry. However, the transformation into a powerful spacefaring nation still requires Ukraine to overcome bureaucratic and corruption factors in a legal and organizational manner.

Keywords: space law, space activities, public laws, private laws, national doctrine, private entities, international space law

Received: October 10, 2019; accepted: November 07, 2019

Advanced Space Law, Volume 4, 2019: 50-58

<https://doi.org/10.29202/asl/2019/4/5>

Introduction

The improvement of the newest doctrine of the space law system of Ukraine is relevant, because Ukraine is a spacefaring nation, though its space industry development has been constrained because of space law inconsistencies. Due to the unresolved issues of the private sector involvement in space activities, the space industry has faced a number of challenges.

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Primarily, this is the lack of investment. The legal literature has not focused on this problem enough. Dr. Sci. Nataliia Malysheva made a contribution to its study. However, she analysed the challenges in this sector in a bygone era.

We argue that space law of Ukraine should involve a system of international public and private laws and relevant public and private domestic laws. Therefore, the successful development of the space industry requires a legal and organizational neutralization of the destructive influence of the State Space Agency of Ukraine in this sector.

For the first time, the article comprehensively analyses the system of Ukrainian space law sources after the introduction of amendments and additions to the laws, legal regulations regarding the involvement of private entities in space activities. The article is structured as follows: first, the origins of space law of Ukraine, as one of the first spacefaring nation in the world, are revealed, and the rules of public and private international space law applied in Ukraine are under special consideration. Much of the article analyses the domestic rules of space law of Ukraine. The article ends with an analysis, coverage of the issues of the current state of affairs in the domestic space legislation of Ukraine.

Origins of space law of Ukraine

The space industry of Ukraine originated in the days when Ukraine was part of the Soviet Union. It was most active in the 1950s, when special design bureau 586 (Design Bureau “Yuzhnoye”) was established in Dnipro and an industrial manufacturer of space machinery, Southern Machine-Building Plant 586, began to operate simultaneously [Dovhal’, 2011]. The first flight of 8K63 (R-12) rocket on high-boiling propellant constituents, designed and constructed by them, was successful [Gorbulin, 2011]. This enabled the mass production of relatively inexpensive strategic military missiles and satellite launch vehicles. For example, on the basis of this rocket a small-lift launch vehicle Space was constructed. It could lift spacecraft weighing up to 450 kilograms into low Earth orbit up to 200 kilometers [Design, 2019].

At that time international space law developed intensively. Ukraine, as a republic of the USSR, fully adhered to the fundamental international space treaties, which were signed and ratified.

At that moment, the category “space law” occurred in the international legal lexicon. Its occurrence was associated with the beginning of space exploration after the launch of the first artificial satellite on October 4, 1957 by the Soviet Union. And since 1958, the UN General Assembly has adopted a number of resolutions on the use of outer space. Complex initial principles of space activity were formulated in the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, adopted by Resolution 1962 (XVIII). Furthermore, in 1967, the General Assembly of the United Nations adopted and opened for signature the Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. It provided for and developed the principles previously formulated in the Declaration [Malysheva, 2011].

It should be emphasized that both the USSR as a whole and the Soviet Ukraine failed to adopt any space law. All domestic legal regulations of the space industry was carried out according to secret by-laws and administrative regulations.

After independence, the legal regulation of the space industry, in particular on the production and launch of launch vehicles and satellites, began to be carried out by the domestic legislation of Ukraine parallel to international space law. It provided legal support for the launch into outer

space of more than 150 launch vehicles and 377 spacecraft. Technologically, the missileery has significantly increased its capacity in Ukraine. New progressive launch vehicles Dnipro, Zenith-3SL and Cyclone-3 were mass-produced. Successful comprehensive tests of a new generation launch vehicles with Ukrainian constituents Cyclone-4 continue. Several artificial satellites have been produced and successfully launched into orbit by Ukrainian manufacturers [Ishchenko, 2018]. However, due to unsatisfactory government funding and a legislative ban on engaging private capital and business in space programs, Ukraine's space industry has declined.

Therefore, Ukrainian spacecraft manufacturers began to implement the basic rules of international space law upon their ratification by the Soviet Union, while domestic space law was practically absent. All legal regulation on the design, production, operation and launch of space technology was carried out on the basis of secret by-laws and administrative regulations.

Regulations of public international space law applicable in Ukraine

In the scientific literature, the regulations of space law are classified into international and domestic, which in turn are divided into public and private [Halunko & Didenko, 2019]. Public international regulations of space law are universally recognized. Since their ratification by the Soviet Union, Ukraine has fully complied with them. Since independence (1991), Ukraine has been adhering to international space treaties signed and ratified by the USSR. For the reason that, according to the current legislation, Ukraine is the legal successor in title to the rights and obligations under international treaties of the USSR, which do not contradict the Constitution and interests of Ukraine [Pro pravonastupnytstvo, 1991], since each and every Soviet Union space treaties are such that meet these criteria.

Ukraine fully complies with these international space treaties. Namely: the Treaty on the Principles Governing States Activities in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (1967), the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (1968), the Convention on International Liability for Damage Caused by Space Objects (1972), the Convention on Registration of Objects Launched into Outer Space (1976).

During the period of independence, Ukraine has signed many international space treaties, multilateral and bilateral. The multilateral ones are: the Operating Agreement of the Intersputnik International Organization of Space Communications (2002), the Space Millennium: Vienna Declaration on Space and Human Development (1999).

Bilateral treaties are: the Agreement between the Government of Ukraine and the Government of the Federative Republic of Brazil on Technological safeguards Related to the Participation of Ukraine in Launches from the Alcântara Launch Centre (2002), the Note from the French Foreign Ministry to the Embassy of Ukraine in France on Ukraine's accession to the Missile Technology Control Regime (1998). Bilateral treaties, concluded with Russia, are although formally related to the international regulations of space law of Ukraine, but denounced or frozen as a result of sanctions because of the Russia's aggressive actions, which led to annexation of the Ukrainian region of the Autonomous Republic of Crimea and armed aggression in certain regions of Donetsk and Lugansk [Pro rishennya, 2015].

Distinctly, European Space Law should be mentioned. In this respect, Ukraine is a State that has signed, ratified and implemented the Agreement with the European Union, according to which Parties shall improve mutually beneficial dialogue in space. In addition, Chapter

8 of this Agreement is entitled “Space” and provides for promoting mutually beneficial cooperation on civil space research and space applications, in particular in the following areas: global navigation satellite systems; earth surveillance and global monitoring; space science and exploration; applied space technologies, including launcher and propulsion technology [Uhoda, 2014]. Moreover, Ukraine, as a country seeking to become a full member of the EU, voluntarily complies with high standards of public administration that are beneficial to Ukrainian citizens and achievable in terms of material resources and organizational capacity for the Government of Ukraine [Bandura, 2019].

Accordingly, the State of Ukraine, in compliance with the provisions of the Agreement under analysis or voluntarily, adheres to the following basic European space legislation: Decisions of the Council of the EU: on the conclusion of the Agreement between the European Space Agency and the European Union on the security and exchange of classified information (2008); on the International Code of Conduct for Outer Space Activities (2012); on the Framework for Space Surveillance and Tracking Support (2014); Resolution of the EU Council on the launch of the initial period of Global Monitoring for Environmental And Security [A European, 2001].

European Space Law on Earth Remote Sensing, including: EU Council Regulations on electronic Recording and reporting on fishing activities and on means of remote sensing (2006); on the measures to be undertaken by the Commission in 2008-2013 making use of the remote sensing applications developed within the framework of the common agricultural policy (2008) [Regulation, 2008].

European Space Law in space policy, in particular, is Resolutions of the Council of the European Union: on further development of the Community’s satellite communications policy, especially with regard to the provision of, and access to, the space segment capacity (1994), on developing a coherent European space strategy (1999), the European Space Strategy (2000), on developing a common European space policy (2003); taking forward the European space policy (2008) [Reillon, 2008].

The European Space Law in navigation is most numerous, for example, the Resolutions of the EU Council: the European contribution to the development of the global satellite navigation system (1994), the agreement between the European Community, the European Space Agency and the European Organisation for the Safety of Air Navigation on developing Global Navigation Satellite Systems (1998), on the involvement of Europe in a new generation of satellite navigation services — Galileo-Definition phase (1999); EU Commission Decisions to set up an expert group on security of European GNSS systems (2009), to conclude an administrative agreement between the European Commission and the European GNSS Supervisory Agency on safety and exchange of classified information (2009), to set up the group of experts on the mission evolution of the European navigation satellite systems, “Mission Evolution Advisory Group” (2010) [Commission, 2010].

Standards of European Space Law in the field of telecommunications and satellite services are numerous, in particular: Decision of EEC on standardisation activities in the field of information and communication technologies (1986); Directives of the EEC Commission on competition in the markets for telecommunications services (1990), and on the adoption of standards for satellite broadcasting of television signals (1990); EU and European Parliament Directives on interconnection in telecommunications with regard to ensuring universal service and interoperability through application of the principles of Open Network security (1997); relating to telecommunications terminal equipment and satellite earth station equipment,

including the mutual recognition of their conformity (1997); EU Commission Regulations laying down detailed provisions regarding satellite-based Vessel Monitoring Systems (2003), regarding competition in telecommunications terminal equipment markets (2007), on the selection of operators of pan-European systems providing mobile satellite communications services (2009) [Baza danykh, 2019].

Therefore, public international regulations of space law include the fundamental space international treaties that Ukraine has fully adhered to since the ratification by the USSR, Ukraine's multilateral and bilateral international space treaties with countries, except Russia, because treaties with a country-aggressor are frozen or denounced due to sanctions, and numerous European space laws.

Regulations of private international space law

For a long time, private international space laws have been a theoretical abstraction for Ukrainian private international law. For example, the current domestic space legislation did not allow private entities to engage in the space industry. Accordingly, no legal relationship could arise between the national space industry of Ukraine and private space enterprises.

The state of affairs changed after the relevant space law "On Space Activity" had been amended and added. According to it, private space organizations and institutions can become entities in space activities. Consequently, it is already intended to conclude the first contract between the national spacecraft manufacturer the State Enterprise Production Association Yuzhny Machine-Building Plant named after A. Makarov and a private aerospace firm Firefly Aerospace regarding the manufacture of rocket parts for about \$ 15 million [Taran, 2019].

Therefore, the amendments to the national relevant space law of Ukraine "On space activities" regarding engagement of private entities to such activities gave birth to the private international space law.

Domestic regulations of space law of Ukraine

Ukraine's space law is based on a number of laws. First of all, the relevant Law on Space Activity [Pro kosmichnu, 1996] providing for the general legal principles of space activities in Ukraine should be mentioned.

The law under analysis applies to all activities related to the exploration and use of outer space. Moreover, state regulation and administration in the field of space activities in Ukraine is carried out by establishment of the basic principles, guidelines and regulations of space activities by legislation, licensing of such activity, etc. [Pro kosmichnu, 1996].

The main drawback of the law under analysis was engagement of exclusively State agencies and enterprises in creation, launch and operation of space equipment. As a result, private investment in the Ukrainian space industry was absent that led to its decline. Only on October 2, 2019, this was corrected; in accordance with the Law of Ukraine "On Amendments to Certain Laws of Ukraine Regulating Space Activity" [Pro vnesennya, 2019], institutions and organizations of any form of ownership may engage in research, development, production, operation, maintenance of launch and return of spacecraft.

This gives significant opportunities for citizens of Ukraine, foreigners, national and foreign legal entities to use the space potential available in Ukraine.

Therefore, the new national space law gives the Ukrainian space industry a new chance for development through private investment.

In addition to the Law of Ukraine “On space activities”, the space industry is regulated by other laws of Ukraine, in particular “On State secrets” (1994), “On State control over international transfers of military and dual-use goods” (2003), “On International Treaties of Ukraine” (2004), “On State property management” (2006), “On licensing of economic activities” (2015), “On administrative services” (2012), and others.

Among the by-laws in the field of space there is the “Regulation on the State Space Agency of Ukraine”, which was approved by the Resolution of the Government of Ukraine. According to it this Agency is the central body of executive power, directed and coordinated by the Government of Ukraine, which ensures the formation and implementation of State policy in the field of space activities [Polozhennya, 2015].

Therefore, domestic regulations of Ukraine’s space law are based on the relevant Law on space activities, several other laws, and a dozen by-laws.

Current state of affairs in domestic space legislation of Ukraine

For the purpose of State support for the space industry, a special Law of Ukraine “On State support for space activities” was adopted in 2000 [Pro derzhavnu, 2000]. It regulates entities carrying out space activities in accordance with relevant law. According to Ukrainian legislators, this approach should ensure the development of scientific, technical, technological and industrial potential, increase export potential, competitiveness of the space industry and become a guarantee of attracting investment in the space industry improvement.

However, this did not happen, because only State agencies and organizations could engage in space activities for a long time. Now this has been adjusted. On January 29, 2020, the amendments to the relevant Law of Ukraine “On Space Activity” are coming into force. From that date, private entities will be able to engage in space activities by filing a declaration of their will to engage in commercial space activities. Such declaration shall be submitted to the Space Agency of Ukraine not less than 5 working days before commencement of such activity. At the same time, administrative responsibility is imposed for conducting commercial activities without submitting this declaration or providing false or incomplete information [Pro vnesennya, 2019].

For the main types of space activities, permits shall be introduced that the Space Agency of Ukraine will grant within 90 calendar days from the date of the receipt of an application for the term of space activity object operation.

The types of space activities that can be carried out under permits only include: testing of launch vehicles, including their units and components and spacecraft; launching launch vehicles and/or spacecraft; controlling spacecraft in Earth orbit or in outer space; returning spacecraft and/or their rotating components from Earth orbit or outer space to Earth. In addition, the amendments to the Law of Ukraine “On Insurance” include the compulsory types as follows: civil liability insurance of subjects of space activity and liability insurance regarding the risks associated with the preparation for launching spacecraft at the spaceport, launching and operating it in outer space. All other types of space activity risk insurance should be voluntary [Pro vnesennya, 2019].

Therefore, the legislator has made an attempt to revive the Ukrainian space industry. Generally, positive changes to the legislation governing space activities have been adopted. Nevertheless, some challenges exist in implementing these changes.

Conclusions

The specificities of law-making in Ukraine is in the requirement of prior development and adoption of subordinate legal regulations, which specify details of the rules of laws, before the laws take effect. As a general rule, by-laws should not contradict the law. However, in Ukraine, as a rule, central executive authorities both develop by-laws and implement them in the future. Regarding the amendments to the relevant Law of Ukraine “On Space Activity,” the State Space Agency of Ukraine will develop details and clarification of subordinate by-laws. However, this State agency with controlling functions in the space industry requires “more trust” [Honcharuk, 2019]. Therefore, this could lead to the emasculation of new progressive provisions of the relevant space law. Accordingly, Ukrainian civil society and space actors should help this national space regulator to become a more open and effective public administration entity.

However, the level of democracy in Ukraine is high, the media is strong, and civil society is experienced in counteracting corruption. Therefore, that Ukraine’s space industry will start to develop dynamically due to the private sector.

The article reveals the latest doctrine of space law in Ukraine, consisting of international and domestic regulations of space law, which are both public and private in nature. However, within one article, it is not possible to reveal fully all the nuances of the development of space law of Ukraine under current conditions. Further thorough analysis of European laws applied by Ukraine and related to the regulation of space activities is still required.

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Administrative Legal Support of Outer Space Activities of the Federative Republic of Brazil

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The Federative Republic of Brazil is a progressive country that meets international standards of space law, has the necessary natural conditions for space exploration (lies near the equator and around the ocean) and seeks to develop international mechanisms for cooperation in the peaceful uses of outer space. In this regard, the experience of the Federal Republic of Brazil in legal support of outer space activities is a hotly debated issue among the states that develop the space industry.

Keywords: space activities, law, legal regulation, Brazil, programme, space policy

Received: October 21, 2019; accepted: November 27, 2019

Advanced Space Law, Volume 4, 2019: 59-67.
<https://doi.org/10.29202/asl/2019/4/6>

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Introduction

Since the late 1950s, space has become another dramatic arena for countries to prove their technological superiority, military firepower and, by extension their political-economical system. Argentina and Brazil started the first space activities in 1961 and 1967, respectively, with the launch of Alfa-Centauro and Sonda I rockets. Since then, individual South American countries have been developing space capacity to provide basic space-based services and small autonomy in this area. As the countries in the South American region develop their activities, the most significant steps have been initiated by such countries as Brazil, Argentina, Peru and Bolivia. Brazil currently has a well-established institute of space research, has sent one astronaut to the ISS, and continues efforts to develop its own launch capability [Sarli et al., 2018].

The disasters that are occurring in outer space (space debris, collision and fall of cosmic bodies, etc.) require joint efforts of modern States. The development of international cooperation in space activities is an extremely important area for the legal regulation of the space industry. Independent space law institutions can improve their own space infrastructure and create new, individual or general space projects by studying the peculiarities of legal support of outer space activities of an individual state.

Replying to a question “why the experience of the Federal Republic of Brazil is sufficiently important for the space industry”, it should be noted that Brazil is the largest Latin American country located near the equator and the ocean. In this light, it is worth stressing that such geographical location makes it possible to carry out space research with minimal risk to humanity. The Federative Republic of Brazil is conducting operations for economic stabilization and is supporting infrastructure industries, including the space one.

The peculiarities of space law in Brazil are the constant attempts to meet the requirements of international norms and high standards of progressive foreign countries.

Thus, the Federative Republic of Brazil is a progressive country that meets international standards of space law, has the necessary natural conditions for space exploration (lies near the equator and around the ocean) and seeks to develop international mechanisms for cooperation in the peaceful uses of outer space. In this regard, the experience of the Federal Republic of Brazil in legal support of outer space activities is a hotly discussed issue among the states that develop the space industry.

The main objective of the article is to analyze the experience of the Federal Republic of Brazil in legal support of outer space activities.

International instruments governing Brazil’s space activities

Since space law is an international public law, it can be inferred that international legislation is a major part of the regulatory framework for Brazil’s space activities. According to Brazilian scientist Rodrigo Gómez, as far as the first actors in the exploration and use of outer space were the USSR and the United States, space law originated as a branch of international public law. In a few decades, space law has become a more complex industry, sometimes affecting other branches of law, such as private international law, environmental law, criminal law, and so on. Clearly, like any other field of law, the study of the sources of international space law is of paramount importance [Gomes, 2019].

A treaty that forms the basis of international space law is the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Tratado sobre os Princípios que Regem as Atividades dos Estados na

Exploração e Utilização do Espaço Sideral, Incluindo a Lua e Outros Corpos Celestes) or the Outer Space Treaty (Tratado do Espaço Sideral). The space treaty has been ratified by Brazil and most modern countries. Moreover, no country has ever opposed this treaty, what shows its importance to modern humanity [Resolution, 2019].

The Outer Space Treaty (Tratado do Espaço Sideral) represents the basic principles of the conduct of space activities and use of space, namely: the exploration and use of outer space should be carried on for the benefit of all peoples; outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means; States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction; States Parties to the Treaty shall regard astronauts as envoys of mankind in outer space; States Parties to the Treaty shall bear international responsibility for national activities in outer space; States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination [Resolution, 2019].

Consequently, after the adoption of the Outer Space Treaty, it became necessary to codify the rules of space law as a branch of international public law.

The codification of international space law has formed a number of uniform standards for implementation of space activities contained in the following, ratified by Brazil, international instruments: Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space; The Convention on International Liability for Damage Caused by Space Objects; The Convention on Registration of Objects Launched into Outer Space; Agreement governing the Activities of States on the Moon and Other Celestial Bodies; Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space; Principles Relating to Remote Sensing of the Earth from Outer Space; Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting; Principles relevant to the Use of Nuclear Power Sources in Outer Space; The Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries [Direito, 2012].

National space laws and regulations governing the conduct of space activities

In addition to the international norms, the principles of space activities in Brazil are determined by national law, which includes:

- the 1988 Federal Constitution;
- Law No.13.243 of January 11, 2016, “On the civil and legal basis for the regulation of science, technology and innovation” ;
- Law No.10.973 of December 2, 2004, “Incentive to innovation and scientific and technological research in production”;
- Spatial Fund, Law No.9.994 of July 24, 2000. Telecommunications Technology Development Fund;
- Law No. 9.610 of February 19, 1998, “On copyright and related rights”;
- the Industrial Property Law No. 9,279 of May 14, 1996;
- the Inter-ministerial Commission for the Export Control of Sensitive Goods, created by Law No. 9.112 of 10 October 1995;

- “Law Establishing the Brazilian Space Agency” Law No.8.854 of February 10, 1994;
- the National Fund for Scientific and Technological Development, confirmed by Law No. 8.172 of January 18, 1991 [Legislação, 2019].

At the same time, subsidiary laws and decrees of the President of the Republic, interdepartmental decrees, inter-ministerial decrees (Ministries of Science, Technology and Innovation, Ministry of Defense), regulations of the Brazilian Space Agency and normative instructions play a significant role.

In other terms, the legal framework for space activities of the Federative Republic of Brazil consists, first and foremost, of international laws that define most of the standards for outer space resources exploitation and also national legislation, which in turn formulates space management policy and establishes various scientific and technology development programmes.

Furthermore, national legislation in the space sector is adopted by a number of government authorities with different legal status.

Public space administration bodies

The general competence in matters of legal regulation of space activities in Brazil have such authorities as the Cabinet of Ministers, which determines future development policy in the country; the President of the Republic, who establishes the legal status of government authorities; the Ministry of Defense, which controls the conduct of space activities in Brazil.

The Ministry of Science, Technology, Innovation and Communication is the civilian cabinet organization established to coordinate science, technology, and innovation activities in the country [Institucional, 2019].

In order to expand its field activities, the Ministry of Science, Technology, Innovation and Communication continues to establish the research units and agencies, whose mission is to guarantee and promote the advancement of science, technology, innovation and communication [Institucional, 2019].

Legal regulation of private actors in outer space is defined by the Brazilian Space Program (Program Espacial Brasileiro — PEB), formed as a national development project which is made up of three systems:

1. Target — the National Policy for the Development of Space Activities (Política Nacional de Desenvolvimento das Atividades Espaciais — PNDAE).
2. Institutional — the National System for the Development of Space Activities (Sistema Nacional de Desenvolvimento das Atividades Espaciais — SINDAE).
3. Instrumental — the National Program of Space Activities (Programa Nacional de Atividades Espaciais — PNAE).

Brazil is seeking to ensure its independence in the space sector through the National Policy for the Development of Space Activities approved by Presidential Decree No. 1.332, of December 8, 1994. The policy itself establishes the objectives and the guidelines that shall guide the actions of the Brazilian Government aimed at development of Space Activities of national interest [Política, 2019; Legislação, 2019].

The general objective of the National Policy for the Development of Space Activities (PNDAE) is to advance the capacity of the country, according to appropriate criteria, to utilize

space techniques and resources in the solution of national problems and in benefit to Brazilian society [Política, 2019].

Generally speaking, the National Program of Space Activities follows the guidelines of the National Policy for the Development of Space Activities, i.e:

1. Provision of assistance to scientific and technological missions;
2. Involvement of highly trained technicians and specialists in all areas of space technology;
3. Formation of research institutions;
4. Promotion of the industrial sector, including the development of automated production;
5. Attraction of investment in the space industry.

Given the multidisciplinary and inter-institutional nature of the Brazilian Program of Space Activities, space activities in Brazil are developed within the framework of the National System for the Development of Space — SINDAE, which was set up by Decree №. 1.953, of 10 July, 1996 [Sistema, 2016; Legislação, 2019].

In Brazil, the concept of a “space development system” is enshrined in legislation, namely the National System for the Development of Space (O Sistema Nacional de Desenvolvimento das Atividades Espaciais — SINDAE) is defined as a group of member organizations responsible for organizing and carrying out space activities aimed at space development of national interest [O que , 2013].

More to the point, the central coordination agency of the National System for the Development of Space is the Brazilian Space Agency (AEB), which reports to the Ministry of Science, Technology and Innovation (MCTI), and is responsible for formulating and coordinating the implementation of the Brazilian space policy [AEB, 2019].

It is worth highlighting, the Brazilian Space Agency is in charge of updating the National Policy for the Development of Space Activities and controlling the National Program of Space Activities. The Superior Council of the AEB is composed of ministries and other governmental agencies involved in space activities, as well as representatives of the Scientific Community and the Industrial Sector [Sistema, 2016].

The following executive bodies constitute the SINDAE: the National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais — INPE); the Department of Aerospace Science and Technology (Departamento de Ciência e Tecnologia Aeroespacial — DCTA); representatives of the industrial sector; universities and research institutes [AEB, 2019].

The main tasks of the National Space Research Institute are fostering scientific research and technological applications, qualifying personnel in the fields of space and atmospheric sciences, space engineering and space technology, as well as climate monitoring and weather forecasting [Sistema, 2016].

In fact, the Brazilian Department of Aerospace Science and Technology is the national military research center subordinated to the Brazilian Air Force, which carries out research and development of launch vehicle systems and related technologies, through its Institute of Aeronautics and Space. The Department of Aerospace Science and Technology (DCTA), under the Ministry of Defence, is gathering a large contingent of highly qualified military and civil servants, including engineers, researchers and technicians [Sistema, 2016].

With a view to increasing the number of students involved in space activities and projects, Brazil provides the learners with six aerospace engineering courses designed by leaders in the field [Sistema, 2016].

It should be noted that the mechanism of planning the Brazilian Space Program is implemented through the National Program of Space Activities (PNAE), which contains a set of strategic guidelines, directives and major space missions. The current National Program of Space Activities is in the fourth edition and covers the period 2012-2021 [Programa, 2018].

The National Program of Space Activities is based on three main strategic directions:

1. Society;
2. Autonomy;
3. Industry.

In this regard, in order to meet the needs of society, emphasis is placed on the development of space applications and techniques that address various national problems. The attendant needs cover the areas of telecommunications, the use of natural resources, environmental change observations, sea and border surveillance, weather and climate forecasting, disaster response and promotion of social inclusion [Programa, 2018].

The second problem concerning autonomy lies in the construction and creation of technical, scientific and technological projects in space. Practice has shown that developing solutions to specific domestic problems implies the need to build and develop technological capacity for the production of space-based satellite navigation systems and missile vehicles capable of placing these satellites in orbit [Programa, 2018].

The industry issue requires the reform of the Brazilian production sector with a view to fostering participation and competitiveness in the market for space goods and services. To this end, manpower training, fostering innovation and productivity, as well as technological learning are essential to the progress of industry [Programa, 2018].

More importantly, the National Program of Space Activities defines policy instruments, which are based on: (1) the development of social skills, namely the recruitment of highly qualified personnel in space science, the improvement of social, environmental and information policies with the purpose of meeting all the basic needs of society; (2) the development of space science and technology to create a well-functioning competitive market and independently resolve domestic issues; (3) stimulating partnership projects: entrepreneurial, national, international (between different states and international organizations) to attract investment and develop space activities.

Space educational activities

Space has demonstrated a remarkable power to inspire widespread interest in science and technology. Therefore, education activities in the space sector is an integral part of space research in every country. In particular, Communication, Navigation, Surveillance, and Air Traffic Management has conducted several training, scientific and technology development programmes. In the light of these experiences, the E2T platform: Education, Space and Technology was conceived as a collection of different programs acting on different stages in the TRL scale. The purpose of the E2T platform is to stimulate interest in space, find talented people and to disclose the existence of national space program to children and the young. The platform aims to promote space workshops, distribute training material, create partnerships and to attract personnel to the space sector [E2T, 2018].

In 2003, the Brazilian Space Agency created the AEB School Programme, which came to be perceived as a viable way of making space science more attractive to young people. The programme is aimed at disseminating knowledge on space activities and at building awareness

within society as to the importance and the benefits of space activity, in order to encourage the development of space-related research activities and to educate future generations. To assist teachers in developing methodologies for inclusion of these themes in the classroom, the programme offers courses, lectures and workshops. The AEB School Programme was established, along with the cycle of conferences named “Space Thursdays”, thematic exhibitions of the Space Program and, in the future, technical courses in partnership with universities. All these activities put Brazilians in direct contact with the everyday life of space science and technologies, in addition to increasing the knowledge of Brazil’s achievements in space. [Espaço, 2018].

The following are the tools for the implementation of the AEB School Programme: (1) space travel — the Astronomy Olympiad conducted in partnership with the National Institute for Space Research and the Department of Aerospace Science and Technology; (2) Young SBPC — the annual event for high school students; (3) one-week courses for teachers that include space topics [Espaço, 2018].

The Space Technological Vocational Center (Centro Vocacional Tecnológico Espacial — CVT-Espacial) is an initiative of the Brazilian Space Agency (AEB) with the support of the Ministry of Science, Technology, Innovation and Communications (MCTIC). Space CVT brings together different methodologies and tools that are harmoniously integrated with each other, thus contributing to the acquisition of knowledge and skills in the space industry. The Space Technological Vocational Center carries out learning activities that are focused on the dissemination of knowledge on space activities and at building awareness within society. Moreover, the center provides training for technical staff, promotes the social adaptation and qualification of teachers, students and other professionals in the field of space activities [Centro, 2018].

In aggregate, educational and technological programs of the space industry in Brazil are focused on all segments of the population — from schoolchildren and students to adults (teachers, engineers, technicians, astronauts, etc.). The goal is to encourage participation in space activities and to develop competence in new technologies.

The process of space development leads to the emergence of new relations of different kinds, which need to be regulated and regimented. Since space activities can cause damage entailing liability and need for reimbursement for damages, the enforcement of liability in international space law acquires special significance [Muraviov et al., 2019].

The success of Europe in space, following the success of the U.S. and the former U.S.S.R., motivated South America nations to institute long-term space technology efforts for both space access and utilization. World Bank data shows that Brazil has the strongest internal market in South America.

Today, space access is available to virtually any nation willing to purchase a launch, and competitively offered by more than eight nations who are able to provide a launch vehicle for payload delivery. Launch suppliers today include U.S., Russia, Ukraine, China, Japan, India, ESA-member countries (France and Italy), and several additional nations are following closely behind with their own government-sponsored launch vehicles. One of the biggest challenges for South America is undoubtedly to develop a launching site. Launch providers include governments and corporations located on three of the seven continents of the world (North America, Europe, and Asia), and are the product of aggressive R&D from national space agencies. Both new and derivative models of launchers have evolved according to individual nation’s space policies and strategies. Their respective launch sites are located close

to the Equator on land, coastal areas, and even on the ocean itself. One of the objectives of Brazil is to promote a better integration between space agencies South America. The region has experienced an important amount of democratic stability and social progress, which is a consequence, among other factors, of the benefits resulting from the political coordination among the countries [Sarli et al., 2018].

Conclusions

In reaching the conclusion, it is necessary to briefly canvas the following systems of the Brazilian Space Program: target, institutional and instrumental.

The target system establishes the objectives and the guidelines that shall guide the actions of the Brazilian Government aimed at development of Space Activities of national interest, and furthermore, implements the consequent actions.

The institutional system consists of the following executive bodies: the Brazilian Space Agency (AEB) — acting as a central organization; the National Institute for Space Research — INPE; the Department of Aerospace Science and Technology; the Brazilian aerospace industry; the National Space Research Institute; educational institutions. The sectoral executive entities of SINDAE are in charge of coordinating the formulation of proposals for the revision of the PNDAE and of elaborating and revising the PNAE, as well as of implementing, causing to implement and follow the actions of the Programme. In all, they provide support to space activities, namely the development, testing and operation of satellites and launch vehicles, including the research activities set forth by the Program.

The instrumental component is identified by the programs, procedures, forms and methods used by space sector stakeholders in the implementation of space policy. The basic instruments used in pursuing space activities are: management techniques; procedures for the formation and implementation of educational and technological programs on space-related topics; procedures aimed at recruiting highly qualified personnel and at advancing science and technology; the conduct of scientific events, preparation and implementation of technology projects and strategies that foster sustainable development; promotion of domestic, national and international partnerships; attraction of investment in the space sector; development of competitive market and industrial policy in the country.

The Federative Republic of Brazil is provided with all conditions necessary for the development of the space industry: favourable geographical location, natural conditions, coherent national space policy and legal support system. Nevertheless, the current process of economic stabilization in the country and lack of investment in the space industry caused the backwardness of national space activities at the international level.

As a final note, this paper concludes that administrative legal support of outer space activities of the Federative Republic of Brazil is highly developed, the national space policy is stable, hence investments into the space sector along with international cooperation will have a positive effect on space exploration.

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Public Regulation of Space Activities in Ukraine

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The article contains the results of the study of theoretical and methodological aspects of state regulation and administration of space activities in Ukraine. The concepts of “public regulation” and “public administration” are analyzed and their structural components are highlighted. The methods and measures of organizational activity of the state are defined with taking into account the tasks and features of its space activity. The definitions of state regulation and administration of space activities are given, and the main tools of organizational activity of the state in the space industry and ways of improvement are outlined.

Keywords: public regulation, public administration, space activity, state programs, law, organizational activity

Received: September 07, 2019; accepted: October 01, 2019

Advanced Space Law, Volume 4, 2019: 68-79.

<https://doi.org/10.29202/asl/2019/4/7>

Introduction

In the conditions of global globalization processes, which cover all spheres of public relations without exception (primarily economic, financial, information, migration, humanitarian), the system of public administration and regulation should not only be ready for the transformations that are taking place, but also to become their initiators and moderators. Therefore, the reforming of this system, i.e. a cardinal change of substantial properties, the introduction of new forms and methods of functioning, is a necessary condition for the implementation of the tasks. In spite of the fact that processes of improvement of organizational structure and forms and methods of activity of public administration bodies have permanent (constant and continuous) character, at present more than ever quantitative and substantive-and-qualitative changes in the system of public administration and public regulation in the economic sphere are necessary. These changes have been caused by the new trends in the development of the state in the conditions of world integration processes and the importance of directing its efforts to the formation of socially oriented economic relations [Nahrebelny, 2013].

After the disintegration of the USSR, there was a real opportunity to carry out space activities on a new basis. Ukraine as an independent subject of international law was interested in developing joint space projects and programs with other States and interstate associations. However, appropriate cooperation was not possible without a proper legal basis. And there was no such base in Ukraine traditionally: neither our own space legislation (in the days of the USSR both space activity and space legislation were structured at the All-Union level, and the Union republics were given the role of “screws of integral mechanism” managed from a single center), nor international bilateral and multilateral agreements on space cooperation our state had in the Soviet times. The Soviet space system engineering and all space infrastructure of the former allied state practically were created together by the enterprises of Russia and Ukraine on the very close integration principles. After the subjects of the respective activity were under the jurisdiction of different states, many legal issues arose, including bilateral Ukrainian-Russian relations, in particular, regarding the division of former Soviet intellectual property for space objects.

In addition, commercialization trends, which have quickly captured the space field, have led to the emergence of a large number of non-state subjects in its arena, that have begun to play the role of independent actors in numerous space projects and programs, including international ones.

Consequently, the public administration bodies of the space industry faced the following questions: to ensure state control over the activities of non-state actors of space activities, to avoid spontaneity in the development of the relevant process, to protect state interests in the conditions of the international responsibility of states for the consequences of space activities of entities under their jurisdiction.

In addition to the problems mentioned above, in Ukraine for more than 20 years, the main attention has been paid to the preservation of the space industry and the implementation of the international space projects mainly, aimed at upgrading of the existing launch vehicles chiefly, adapting them to new launch sites. In the spacecraft segment, the main emphasis was placed on the completion of the production of spacecraft of the previous modifications. The introduction of modern technologies for the manufacture of spacecraft was carried out at a very slow pace. Other ministries and departments, enterprises of other branches of economy, and private companies were not involved in the sphere of space activity practically.

The reason for this was the orientation of the industry enterprises to financing at the expense of the state budget or attracting credits under the state guarantees, which did not allow to provide sufficient financing in the conditions of chronic deficit.

Such a state of affairs did not allow space activities to become the engine of innovative development of the economy of the country, it did not contribute to the formation of a synergistic effect from the introduction of high-tech and highly intelligent products, services, goods, etc.

The concept of “public regulation” and “public administration” of space activities and their differentiation

Article 4 of the Law of Ukraine “On Space Activities” defines one of the basic principles of state regulation of space activities, and Article 5 reveals the ways of state regulation and management in the field of space activities [On Space, 1996]. Although the terms “state regulation” and “public administration” are used in the Law, but what the legislator understands by these terms is not given.

The terms “public regulation” and “public administration” are quite commonly used in scientific researches, political literature, in popular science editions, as well as in some normative acts. In spite of this, they remain determined not definitively, what leads to different interpretations, and, therefore, to the uncertainty of their essence.

Therefore, in determining the content and limits of state influence on the space sphere, as well as the possible directions of its development, it is advisable to analyze the ratio of the content of the categories “public regulation” and “public administration”.

The relationship between them is either not determined by scientists, or revealed depending on their positions on general ideas about forms and methods of activity of the state. The relation between the concepts of “public regulation” and “public administration” should be considered as a derivative of the interpretation of the general categories of “regulation” and “management” [Administrative, 2004].

At the level of general management science, the concepts of “regulation” and “management” are almost never used as identical, however, the relationship between them is interpreted differently. It is generally accepted that regulation and management as social phenomena, having a common scope, imply different in character influences on the objects of management in order to achieve certain results, i.e. the realization of the set goals and objectives of managerial influence. At the same time, regulation covers a broader scope of organizational activity than management. Management means purposeful influence on the objects of management specifically, the use of methods that imply the subordination of these objects to management influence by the subject of management. Regulation is not so much related to the impact on the objects of management, but the environment. It provides a high degree of alternative behavior of managed objects [Administrative, 2004].

At the same time, regulation is sometimes regarded as one of the functions of management, which is caused by the theoretical uncertainty of the relation between these concepts. It is more appropriate to evaluate the relationship between the concepts of “regulation” and “management” in the context of not only their relationship but also the general concept of “organization” (or “organizational activity”).

It is now widely accepted that the concept of “organization” is broader than that of “public administration” and “regulation”. The latter are varieties of organizational activity, and therefore they have common features that reveal the essence of these concepts through determining the very nature of organizational influence on certain social objects. Both regulation and management reflect organizational activities aimed at ordering certain public interests and phenomena.

Thus, the legislator successfully classified the categories of “public regulation” and “public administration” to the types of organizational activity in the space industry, fixing them in section II “Organization of Space Activities” of the Law of Ukraine “On Space Activities” [On Space, 1996]. Therefore, “public regulation” is a broader concept than “public administration” because it covers a broader scope of organization activity of a state. Thus, public regulation and public administration are social phenomena that have both common and distinct features that have essentially one scope. The difference between these two concepts lies in the nature of the influence on social relations and the limits of such influence. Common features inherent in regulation and public administration, due to the fact that they are varieties of organizational activity of the state, aimed at the ordering of certain social phenomena, processes or objects. And the main difference between public administration and state regulation lies not in their object, but in the realization of what interests they provide [Tkach, 2012: 117].

That is, public administration is carried out in the areas where the public interest is first and foremost, and the state regulation is in those areas where it is necessary to strike a balance between public and private interests. State regulation provides for the establishment of certain standards, norms, limits, quotas, tariffs, which are generally binding on members of public relations and persons engaged in relevant activities.

It cannot be disagreed that state regulation of the space industry is a program of responsibility that realizes the tasks of the socio-economic and scientific progress of the state, increasing the well-being of citizens through the fulfillment of its mission by space industry enterprises, providing the state with the necessary resources and measures that will enable synthesis, combination of past, present, future, creation of a new reality of a more perfect world, where the spiritual and material component of human existence are balanced [Dzhur, 2015].

Thus, the public regulation of space activity is a type of organizational activity of the state, which consists in a set of means, methods by which state or non-governmental organizations to which the state delegated regulatory powers set principles, norms, rules for space activity and control (supervision) over such activities for the purpose of meeting public and private interests.

Public space management is a type of organizational activity of the state, which consists in a set of means, the methods by which public administration bodies exert power over the entities of space activity for the purpose of securing public interests.

Thus, public regulation and public administration of space activities have certain common features and differences.

The common features are, firstly, the fact that both public regulation and public administration are varieties of organizational activity of the state. Secondly, both public regulation and public administration use a definite set of tools and methods to streamline space activities.

As for the differences, they consist exactly in what facilities and methods are used for adjusting or administration of space activity.

State regulation is characterized by the creation of conditions for the activities of entities and objects of administration in a direction that is desirable for the state and in which the development of the administration system as a whole will occur. Moreover, state regulation provides several options for the future activity of the administrated objects, creating the opportunity to act more effectively. It includes laws, formal and informal regulations, and ancillary rules established by the state, as well as non-governmental or self-regulatory organizations to which the state has delegated regulatory powers in the field of space activities.

For example, the implementation of the state regulatory policy by the State Space Agency of Ukraine is carried out in accordance with the provisions of the Law of Ukraine “On the Principles of State Regulatory Policy in the Field of Economic Activity” [On the Principles, 2003] and other regulations on state regulatory policy to ensure the systematic and coherent adoption of regulatory acts in the field of economic activity, publicity, and transparency of the implementation of the state regulatory policy.

One of the main principles of the state regulatory policy is transparency and public opinion taken into account, which is based on openness to individuals and legal entities, their associations, actions of regulatory bodies at all stages of regulatory activity; the obligation to consider regulatory bodies initiatives, comments, and proposals submitted in accordance with the procedure established by law; bringing the adopted regulatory acts to the attention of individuals and legal entities, their associations; informing the public about the implementation of regulatory activities [Information, 2018].

Public administration, as it has been shown earlier, should be considered as a certain type of activity of the authorities of the state, which has a power and provides, first of all, organizing and managing influence on the objects of administration through the use of certain powers. The Law of Ukraine “On Space Activities” establishes the competence of the central executive body to ensure the formulation of state policy in the field of space activity, using such methods of administration as *control* (for example, it controls compliance with the requirements of the international treaties of Ukraine on the restriction and prohibition of nuclear weapons testing, nuclear testing weapons at foreign testing sites and peaceful nuclear missions (paragraph 9, part 2, article 6)) and *surveillance* (e.g. state surveillance of compliance with security requirements of space activities, as well as the training and certification of those who control the observance of space rules and the availability of the required level of security for space activities, as well as those investigating incidents and emergencies (Art. 20)) [On Space, 1996].

Thus, public regulation and public administration are used as specific forms of state influence on social and economic processes, which consists in the introduction of a set of measures aimed at achieving social and economic effect in the field of space activities.

Main ways of public regulation and administration of space activity in Ukraine

In accordance with the Law of Ukraine “On Space Activities” state regulation and administration in the field of space activity in Ukraine are carried out through: legislative establishment of basic principles, norms and rules of space activity; development of conceptual bases of state policy in the field of exploration and use of outer space for peaceful purposes and in the interests of state security; the formation of the National Targeted Scientific and Technical Space Program of Ukraine; planning and financing of space activities at the expense of the state budget of Ukraine, as well as facilitating the involvement of other funding sources not prohibited by the current legislation of Ukraine; targeted training at the expense of the state budget of Ukraine; foreign economic activity by subjects of space activities [On Space, 1996].

Let us briefly analyze all these instruments of organizational activity of the state in the space industry.

1. Legislative establishment of the basic principles, norms, and rules of space activities

The rules of space activity in Ukraine include standards of operational suitability of space objects, standards and normative documents governing the procedure of:

- a) licensing of space activities;
- b) certification and registration of space activities;
- c) the organization, execution, and provision of space launches and flights;
- d) supervising and controlling the safety of space launch and flight operations, and the operation of space technology;
- e) environmental protection in the process of space activities;
- f) conducting search, rescue, and rescue operations in the space industry;
- g) conducting an official investigation of incidents and emergencies;
- h) construction, operation, maintenance, and repairs of structures and equipment of ground infrastructure facilities;
- i) training of space objects personnel;
- j) the implementation of measures to protect space activities from unlawful interference with these activities [On Space, 1996].

The rules of space activity also include other normative acts, which are established by the relevant state bodies of Ukraine in accordance with their competence and, which are mandatory for all actors in space activities. These rules, as it has been noted already, regulate the activities in the space industry and its security, as well as compliance with the requirements for the protection of the intellectual property rights, state, military and trade secrets.

In addition to establishing norms and rules for the implementation of space activities, the state establishes direct prohibitions in the implementation of these activities. This concerns, first of all, the demilitarization of outer space. It is prohibited to place nuclear weapons and all other weapons of mass destruction in the orbit or in space in any way or to test such weapons and to use the Moon and other celestial bodies for military purposes. Secondly, it is prohibited to use of space technology as a means of influencing the environment and creating an immediate threat to human life and health.

And if such space activity within the framework of a separate project has led to human casualties, significant material losses or caused significant damage to the environment, it may be limited or prohibited in accordance with the current legislation of Ukraine.

2. Development of the conceptual framework of state policy in the field of exploration and use of outer space for peaceful purposes and in the interests of state security

The state policy should be understood as a set of value goals, state-administrative measures, decisions, and actions, the order of implementation of state-political decisions (goals set by the state power), and the system of state administration of the country's development [State Policy, 2014].

In order to increase the efficiency of space activities, to solve urgent problems of national security and defense, and to realize the geopolitical interests of the state, to promote the socio-economic, scientific, educational and ecological-cultural development of society, to increase the prestige of Ukraine as a space state on the world stage, to turn the space industry of Ukraine into a multiplier of high-tech development of the domestic economy, the Conception of implementation of the state policy in the field of space activities for the period up to 2032 was approved by the Order of the Cabinet of Ministers of Ukraine of March 30, № 238-R. [Conception, 2011] (hereinafter the Conception).

The result of its implementation, that is, the quantitative measurement of its goals, is decisive for public policy. According to this Conception, the state has declared its results, methods, and ways of achieving these results. The main way to solve the existing problems of the space industry of Ukraine is seen through the improvement of the mechanism of providing state support and ensuring the investment attractiveness of space activities.

Analyzing the components of the organization of space activities in Ukraine, it can be noted that the state has taken the lion's share in ensuring the development of the industry through two interrelated processes — state support and investment attractiveness of space activities, which are noted in the regulatory acts.

In the conditions of cardinal narrowing of the sector of state property the state should carry out the corresponding policy adequate to these processes in the economic sphere, realizing its economic-organizational, social, and other functions in it. Such policy should be dominated by regulation, including disposition, control, coordination, forecasting, as well as the application of predominantly economic methods based on a rational and effective tax system that stimulates production and entrepreneurship, but it should not be pressed by imperative or dictatorship in its various forms. The budgetary, financial and credit, and public procurement systems also need to be improved [Nahrebelny, 2013].

In addition to the above-mentioned Conception, other legal acts have been adopted to support the space industry over the past decade. March 16, 2000 — the Law of Ukraine “On State Support of Space Activities” [On State, 2000]. This Law defined the principles of the state support for space activities in Ukraine and recognized the space industry as a priority component of the high tech sector of the economy to ensure the national interests of the state. In order to improve the efficiency of space activities of Ukraine, the Order of the State Space Agency of Ukraine dated by May 21, 2015 №. 100 “The Strategy of Space Activities of Ukraine for the Period up to 2022” was approved [The Strategy, 2015].

All of these regulations are intended to solve the problems facing the space industry. But resolving space issues only by adopting regulations without proper government funding leaves all these efforts at the level of declaring.

3. Formation of the National Targeted Scientific and Technical Space Program of Ukraine

Space activities in Ukraine are carried out on the basis of the National Space Program of Ukraine, which is developed for a period of five years and approved by the Verkhovna Rada of Ukraine upon submission by the Cabinet of Ministers of Ukraine. The State Space Agency of Ukraine, together with the central executive authorities and the National Academy of Sciences of Ukraine, is responsible for the development of the National Space Program of Ukraine, based on the purpose and basic principles of space activity of Ukraine. To date, five Space Programs have been adopted and implemented in Ukraine. Work is underway on the *new sixth National Space Program for 2018-2022*, in accordance with the project, a structural restructuring of the industry is being prepared in order to increase the efficiency of its work as a whole, as well as the central office of the State Space Agency of Ukraine and individual enterprises. In this regard, relevant proposals are being made to the Government, amendments to the Laws of Ukraine that regulate space activities in the country are being prepared. But for today, the sixth program has not been adopted yet. Draft Law № 9457 [Draft Law, 2018] submitted at the end of 2018 by the Cabinet of Ministers of Ukraine was withdrawn on August, 29, 2019.

4. Planning and financing of space activities at the expense of the State Budget of Ukraine, as well as facilitating the attraction of other sources of financing not prohibited by the current legislation of Ukraine

Space activities are financed from the state budget, investments, and other sources. The amount of funding is determined by the national targeted space science and technology programs and other programs aimed at the development of space activities, based on the state budget.

Analysis of the budget programs and nationwide targeted space science programs has shown that none of them has been funded in full. The leadership of the State Space Agency of Ukraine has repeatedly stated that if the state does not change the approach to the space industry — “on a residual principle”, there is no need to talk about Ukraine’s place in the Space at all. [The State, 2018].

Even those funds, that were allocated, were not used effectively, the Accounting Chamber noted about more than once in its reports. For example, the audit of the effectiveness of Ukraine’s obligations in the field of international scientific and technical cooperation and the framework program of the European Union for research and innovation “Horizon 2020”, found violations of budget legislation, including misuse of funds and violations in planning [Report, 2018].

Thus, this area of state regulation and administration of space activities needs the most attention from public administration, because the gaps in planning and financing of these activities will negate all other attempts to bring the space industry to a high level.

Therefore, the national space program budget support system needs to be revised to support the specific projects and developments in the world-class technology. It is necessary to strengthen the commercialization of space services at the state level and to provide foreign policy support for the projects involving domestic aerospace companies. Without addressing these challenges, Ukraine risks to lose its space state positions fairly quickly [Anysenko & Babina, 2018: 146].

5. Targeted training for space industry at the expense of the State Budget of Ukraine

The development of a market economy in Ukraine, the restructuring and conversion of the space rocket industry require the introduction of a scientifically based system of working with the space industry specialists as for their training, retraining, and advanced training. Indicators of the educational potential of personnel should correspond to those of industrialized countries; quality training of workers and industry professionals — to the requirements that are applied to workers by employers of the developed countries, that is, they must be competitive in the world market. The volume and structure of training should meet the needs of the industry, and funding should be provided at the expense of both budgetary and extra-budgetary revenues.

To ensure effective training, retraining, and advanced training of space industry professionals, it is necessary to develop an industry-wide complex plan for training and retraining of personnel within the provisions of the Law of Ukraine “On the National Space Program of Ukraine”.

There is a need, in cooperation with international organizations and financial institutions as well as individual countries, to develop and implement the bilateral and multilateral plans for cooperation in the field of professional development of specialists, providing separate programs for specialists of the State Space Agency of Ukraine, mid-level specialists and managers of enterprises of the industry; organization of a system of short and medium-term seminars and training courses; attraction of highly qualified foreign and domestic specialists at the expense of the international funds.

6. Licensing of space activities

One of the main levers that the state has when presenting permits for space activities is the licensing of such activities. Ensuring the implementation of this administrative function has caused the need to create separate independent management bodies in various countries of the world, even in those that do not have a full cycle of space activities and the developed space industry, but which have their own spacecraft in the Earth orbit.

But in order to allow first, and then in the future to keep under its constant supervision and control the activities which it bears the international responsibility for, the effective system of state administration of the space industry was created in our state according to the Law of Ukraine “On Space Activities” of November 15, 1996. It was headed first by the National and since 2011 by the State Space Agency of Ukraine. According to Article 10 of this Law, implementing the norms of the international obligations of Ukraine, it was established the obligation of any space entities that carry out or intend to carry out these activities in Ukraine, or under the jurisdiction of Ukraine outside its territory, to obtain a license from the Agency for the right to exercise it.

The list of licensed space activities was enshrined in Article 9 of the Law of Ukraine “On Licensing of Certain Types of Economic Activity” [On Licensing, 2000] of June, 1, 2000. At

the same time, Article 4 of the same Law established certain restrictions in the implementation of the certain licensed types of space activities, namely, those related to the development, testing, production, and operation of launch vehicles, including their space launches for any purpose: only state-owned enterprises were allowed to carry out such activities. The government approved and successfully implemented the procedure for licensing space activities, and at the departmental level — the relevant License Terms [On Approval, 2000]. The United Nations entities responsible for the peaceful exploration and use of outer space, the United Nations Office for Outer Space Affairs and the Legal Subcommittee of the United Nations Committee on the Use of Outer Space, were informed about the introduction of the above-mentioned procedure for licensing space activities [Malysheva, 2016].

The State Space Agency of Ukraine, which is the central executive authority that ensures the formation and implements state policy in the field of space activity, has lost the authority to license such types of space activities as the development, testing, production, operation of rockets, spacecraft and their components, terrestrial complex management of spacecraft and its constituent parts in connection with the entry into force on June 28, 2015, the Law of Ukraine of March 2, 2015, “On Licensing of Commercial Activities” [On Licensing, 2015]. In Article 7 of the relevant Law, any space activity was not found among the 30 licensed activities [On Licensing, 2015].

In addition, from February 27, 2019, the Draft Law “On Amendments to Some Laws of Ukraine on Demonopolization and Development of Space Activities” was registered under the number 10096, in the explanatory note of which it is proposed “...the mechanism for licensing space activities should be replaced by a mechanism for issuing free permits for testing and launching launch vehicles, launching or ensuring the launch of a spacecraft, the return of a spacecraft or its components, for example, from the earth orbit or outer space to the Earth, the management of a spacecraft [On Amendments, 2019]. We agree that the state monopoly on space activities in today’s conditions should be abolished, but licensing is a necessary tool of state control.

The license is issued by the competent state authorities for the implementation of a certain type of activity or certain operations, and which are administrative acts of state regulation of business activity in the country. The Commercial Code of Ukraine establishes that licensing is a means of state regulation in the field of business, aimed at ensuring a unified state policy in this area and protecting the economic and social interests of the state, society, and individual consumers [Commercial Code, 2003].

Thus, we believe that it is necessary to demonopolize the space industry and allow commercial structures to participate in space activities, but the state should retain the right to control such activities using an effective licensing mechanism. To resolve the existing gaps in the current legislation, it is necessary to amend the Law of Ukraine “On Licensing of Commercial Activities” and establish requirements for licensing the development, testing, production, operation of rockets, spacecraft and their components, ground-based spacecraft control system and its components.

7. Control over implementation of foreign economic activity by subjects of space activity

Ukraine’s international obligations on ensuring the missile technology control regime are reflected in the Law of Ukraine “On State Control over International Transfers of Military and Dual-Use Goods” [On State, 2003] and Resolution of the Cabinet of Ministers of Ukraine dated January 28, 2004 № 86 “On Approval of the Procedure for State Control over International Transfers of Dual-Use Goods” [On Approval, 2004], that raised the legal regulation of relations

in the sphere of export control to the legislative level and established additional mechanisms of state regulation in this sphere, which correspond to the global practice.

At the same time, with regard to the “insurance” of space activities, its transfer to the rails of sustainable development, our state is not able yet to solve the contradictions of domestic producers by economic and legal methods: how to produce competitive products, adhering to the relevant international obligations in the field of sustainable development. First of all, it concerns: projects to create promising rockets — carriers with the safe components of rocket fuel, and the adoption at the national level of Rules for the Prevention of Contamination of Outer Space. The prospects of reconciling the latter due to the significant rise in cost of space technology and the inability to recoup additional costs for manufacturers of this equipment by the state are quite problematic.

The conclusions about the increasing role of the state in the space industry have been repeatedly drawn in the scientific publications [Krichevsky & Udartsev, 2019]. Therefore, the development of the global space market, which is tightly associated with the latest technology and often has global implications, as well as the consolidation of private enterprises in the market demand: to develop fundamentally new approaches to issues about the control of those entities at the national and international levels, and their legal status; attention to issues of the financial security of responsibility of States for space activities, the prevention of harm and its compensation (that is, the need for the introduction of the “top” of mandatory insurance); additional mechanisms to limit the spread of missile technology. These circumstances also cannot but cause increased attention of states to the establishment of additional instruments of state regulation of activities in the exploration and use of outer space at the present stage of development of commercial space.

Conclusion

Thus, the analysis of the tendencies of development of national legislation on space activity regulation gives grounds to state that the increased requirements for the mechanisms of state regulation of this activity in modern conditions lag behind the needs of time. At the same time, the norms and principles of “classical” international space law are fully implemented in the domestic law for carrying out of the international obligations. Namely, Articles 3-25 of the Law of Ukraine “On Space Activities” [On Space Activities, 1996], which among other things introduces such mechanisms of state regulation of space activities as the permissive nature (licensing) of this activity, its program-planned bases of organization and implementation, the need for registration and certification of space technology, the introduction of compulsory insurance of space activities, the expansion of the framework of international cooperation and so on. But modern scientific researches and practice show that the main objectives of state regulation and administration of space activities should be: strengthening of legal protection of investors in Ukraine; introduction of tax and other incentives for the formation of proposals for long-term investment resources; demonopolization of the state for space activities; return of state control functions for space activities of all subjects through the mechanism of licensing of such activities; more clear regulation of the property rights to the investment objects and creation of transparent integration of such objects.

Within the framework of one article it is difficult to consider all the problematic issues facing the space sphere, so they will be studied in our subsequent studies.

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Commercialization of Space Activities: Correlation of Private and Public Interest in the Pursuit of Outer Space Exploration

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The article reveals the issues of space exploration by private entities who have intensified their efforts in space activities. The US and Luxembourg legal regulations, which both govern the private sector involvement in State space activities and allow citizens to freely engage in the development of planets and asteroids, to own and dispose of resources, including water and minerals, are under analysis. Therefore, due to the occurrence of legal collisions, the International Law Association and the Space Law Committee, established on its basis, should influence regulating space issues. These institutions are known for their open policies and extensive external relations. Their key mission is to study, clarify and develop international public and private law and prepare comparative law research. The author concludes that being an important human resource, space objects and natural resources should belong to all humanity, not to individual States or private enterprises. The adoption of the US and Luxembourg legislation on legalizing, extracting, using and appropriating space resources by private enterprises seems to be in full compliance with international obligations, however, in fact they violate the principles governing the activities of States in the exploration and use of outer space, including the moon and other celestial bodies, which are not subject to national appropriation, neither by proclaiming sovereignty, nor by uses or occupation, nor by any other means.

Keywords: ownership, space objects, natural resources, international space law, regulations, organization

Received: August 28, 2019; accepted: October 07, 2019

Advanced Space Law, Volume 4, 2019: 80-91.

<https://doi.org/10.29202/asl/2019/4/8>

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Problem statement

Speaking about the development of rocket and space engineering, astronautics and other space activities in Ukraine, the world usually connects this with the name of a famous rocket pioneer Mykola Kybalchych, who was born in Korop, Chernihiv region. Back in the nineteenth century, he developed a unique aircraft project that could carry out space-flight missions. In 1916, Yurii Kondratiuk made calculations for the manned flight to the Moon. Americans used these calculations when they sent their astronauts to the satellite. Serhii Koroliov, who was born in the city of Zhytomyr, was an outstanding pioneer of practical cosmonautics. In 1957, the first artificial Earth satellite was launched under his guidance. Valentyn Hlushko was a general designer of rockets. He constructed the world's first electrothermal rocket engine and the first liquid-fuel rocket engines. A valuable contribution to the development of astronautics was made by Ukrainian enterprises, i.e. the Dnipropetrovsk Southern Machine-Building Plant and the Design Bureau "Southern". In 1957, a military missile carrier "Kosmos" was created and successfully used for space flights. The Meteor spacecraft and military communications satellite "Strela" were also in the extensive use.

Nowadays, Ukraine takes an active part in the exploration of the infinite expanses of the Universe, developing and launching spacecraft. Due to the rapid technological progress, astronomers make new discoveries in the universe. One of the largest craters of the planet Mercury is named after Taras Shevchenko. What is more, among the craters on Venus there is one named after the astronomer and geophysicist Zinaida Aksenteva. Another crater on Mars is named after the Kharkiv planetologist Mykola Barabashov, and two others — in honor of the cities of Yevpatoriya and Fastiv. Finally, one of the satellites of Jupiter perpetuated the name of the ancient Kyiv chronicler Nestor. On the Moon, twelve craters bear the names of Ukrainian scientists, including Yurii Kondratiuk, Serhii Koroliov and Volodymyr Vernadsky. A stony asteroid from the inner regions of the asteroid belt-1709 Ukraine was named in honor of Ukraine. There are also asteroids Odesa, Poltava, Dykanka, Kherson, Kakhovka, Sumiana (in honor of the city of Sumy), and dozens of other small planets in the interstellar space bear Crimean names. Among these are Kobzar (in honor of Taras Shevchenko), Kamenyar (in honor of Ivan Franko), Lesya (in honor of Lesya Ukrainka), as well as Skovoroda, Hohol, Narbut, Korolenko, Paradjanov, Dovzhenko, Bykov, Babel and many others. Moreover, there are asteroids Knushevia (in honor of the Taras Shevchenko National University of Kyiv) and Kyivtech (in honor of the Kyiv Polytechnic Institute) [Halaktyka, 2018].

However, the space objects registered in the international catalog are not Ukraine's property. What is in general consistent with international law, in particular, "Treaty on principles governing the activities of states in the exploration and use of outer space, including the moon and other celestial bodies" (Outer Space Treaty) [Treaty, 1967]. However, in practice, as a result of unclear provisions of international law and existing legal gaps in the "Outer Space Treaty", certain individuals, in fact, appropriate space objects that are the property of the whole community [Svitlychnyy, 2019].

The aim of the article is to reveal the peculiarities of the ownership of space objects, as well as to analyze regulations and scientific opinions on the use of space natural resources, to determine and outline the immediate prospects for further development of international space law and structure of the United Nations.

Main research areas

Dennis M. Hope is an American man who believes that he is now planet overlord of the moon, but the most interesting thing is that many people truly consider him as such. No one denies his business subdividing extraterrestrial land and selling it off in chunks. Contrary to popular belief, ownership by individuals of extraterrestrial properties is not forbidden. The 1967 UN Outer Space Treaty stipulates that no government can own extraterrestrial property, but it neglected to mention individuals or corporations.

In 1980, Dennis M. Hope sent the United Nations a declaration of ownership detailing his intent to subdivide and sell all planets in our Solar System and their moons. The US government had several years to contest such a claim, which they never did. This allowed Mr. Hope to take the next step and copyright his work with the US Copyright registry office. So, with his claim and Copyright Registration Certificate from the US Government in hand, Mr. Hope became what is probably the largest landowner on the planet today. Since then the Lunar Embassy has sold more than 611 million acres of land on the moon as well as properties on Mars, Venus, Mercury and IO.

Today, The Lunar Embassy has official representations in 35 countries around the world: Canada, UK, Ireland, France, Japan, Australia, Finland and others. Moreover, authorized sales offices of extraterrestrial real estate were established in Germany, the Baltic States, Ukraine, Israel. The Lunar Embassy is the only company in the world to possess a legal basis and copyright for the sale of land on the Moon, and other extraterrestrial property within the confines of our Solar System. About 5 million people from 193 countries have already purchased acres of land on the Moon. Among the owners of land plots are famous politicians, NASA astronauts, world sport stars, actors and music stars [Lunar, 2019].

The United States Government updated U.S. commercial space legislation in 2015 with the passage of the Commercial Space Launch Competitiveness Act. The update to US law explicitly allows US citizens to engage in the commercial exploration and exploitation of space resources including water and minerals. The right does not extend to biological life, so anything that is alive may not be exploited commercially [US Commercial, 2015].

Tanja Masson-Zwaan — president of the International Institute of Space Law considers the new U.S. space resources law to be helpful to commercial interests, since it explicitly codifies rights for the private sector that were only implicit in the 1967 Outer Space Treaty. It adds a level of certainty to the prospects of off-Earth resource harvesting in the eyes of investors, and provides a solid foundation for building additional supportive regulatory frameworks in the United States and elsewhere for commercial lunar and other space resource focused activities of the private sector [Masson-Zwaan & Richards, 2015].

In this regard, International Institute of Space Law stated its official position, adopted by consensus by the Board of Directors on 20 December 2015. It was mentioned that in view of the absence of a clear prohibition of the taking of resources in the Outer Space Treaty one can conclude that the use of space resources is permitted. Viewed from this perspective, the new United States Act is a possible interpretation of the Outer Space Treaty. Whether and to what extent this interpretation is shared by other States remains to be seen [Position, 2015].

What is more, other normative acts also contributed to the update of U.S. commercial space legislation. In particular, Agreement Governing the Activities of States on the Moon and Other Celestial Bodies adopted by the General Assembly in 1979 in resolution 34/68. The Agreement provides that the Moon and its natural resources are the common heritage of mankind and that an international regime should be established to govern the exploitation of such resources

when such exploitation is about to become feasible [Agreement, 1979].

The morality crisis leads to the fact that US citizens will fulfil their own material interests at the expense of space objects that are the property of all mankind. To this should be added the fact that in the United States, the question of legal regulation of social relations raises many questions. As Justice Oliver Wendell Holmes wrote in the Harvard Law Review, the law is a “standard which we hold the parties to know beforehand, but not a matter dependent upon the whim of the particular jury”. Unfortunately, according to Philip Howard, there is no such standard in US justice [Howard, 2002].

By US law, property is divided into:

1. Real property (realty, real estate): the land and everything connected with it;
2. Personal property (personalty, shattel): all other types of property, that is, actually movable property.

The right to real estate consists, legally speaking, of the title to land and everything located on and above the ground surface, including airspace (with aviation restrictions) as well as underground, including groundwater and fossil fuels, unless otherwise provided by statutory or common law [Tiahai, 2011].

The property rights system’s diversity is achieved through the inclusion of extortion. The bottom line is to ensure the possibility of a person becoming the absolute owner of real estate. The legal category, to which reference is made in this article, endows the actors with a real right [Tiahai, 2011].

In the People’s Republic of China, the regulation of property rights is carried out in accordance with the Real Right Law of the People’s Republic of China, which has been adopted at the 5th session of the Tenth National People’s Congress on March 16, 2007 and went into effect on October 1, 2007. Acquisition and realization of real rights must comply with the legislation, norms of public morality, and not harm the public interests and legitimate interests of other persons (Article 7). According to Art. 24 of the People’s Republic of China regime of movable property may be distributed by watercraft, aircraft and motor vehicles [Zakon, 2007].

In accordance with the Article 130 of the Civil Code of the Russian Federation, which is called “Immovable and movable things”, the following are categorized as immovable things (immovable property, immovables): land parcels, natural resource parcels, separate water objects and everything that is firmly connected with land, i.e., objects, objects whose movement is impossible without disproportionate harm to their use, including forests, perennial plantings, buildings and structures. Immovable things also include the following, if subject to state registration: airships and ocean-going vessels, inland waterway vessels, outer space objects. Other property may be categorized as immovable things by statute. Things that are not categorized as immovables, including money, commercial paper, and securities, are movable property. The registration of rights to movable things is not required except for cases indicated by a statute [Hrazhdanskyi kodeks, 1994].

According to Art. 181 CC to real estate include land, as well as facilities located on the land, the movement of which is impossible without their depreciation and changing their purpose. Immovable things also include the following, if subject to state registration: airships and ocean-going vessels, inland waterway vessels, outer space objects. According to movable things there are things that can be freely moved in space [Tsyvilnyi kodeks 2003].

More to the point, the widening of the regime on immovables to space objects is possible only under direct requirements of the law. That is, all matters related to the space object are within the competence of the state.

During the 1085th plenary meeting that took place on December 20, 1961 in the General Assembly Hall in New York, United States of America, the General Assembly of the United Nations, after an introduction reaffirming general principles, enacted International Space Law's basis. It was proclaimed that all States have the right to explore outer space [Resolutions, 1961].

It is worth stressing that the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, RES 1962 (XVIII), General Assembly 18th session, December 13, 1963, is the second important text concerning Space Law. It is a resolution that was adopted by the General Assembly in 1963. The first important decision concerning Space Law dates back to December 20, 1961. It is the General Assembly Resolution 1721 (XVI) on the International Co-operation in the Peaceful Uses of Outer Space. The latter Declaration reaffirms and expands the scope of the earlier one. The principles contained in it represent the consensus and maximum agreement attainable by the Committee on Peaceful Uses of Outer-Space established by the Assembly to deal with technical co-operation of states and the legal regulation of outer space.

The General Assembly then enounces points that should guide States in the exploration and use of outer space:

1. "The exploration and use of outer space shall be carried on for the benefit and in the interests of all mankind".
2. "Outer space and celestial bodies are free for exploration and use by all States on a basis of equality and in accordance with international law".
3. "Outer space and celestial bodies are not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means".
4. "The activities of States in the exploration and use of outer space shall be carried on in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding".
5. "States bear international responsibility for national activities in outer space, whether carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried on in conformity with the principles set forth in the present Declaration. The activities of non-governmental entities in outer space shall require authorization and continuing supervision by the State concerned. When activities are carried on in outer space by an international organization, responsibility for compliance with the principles set forth in this Declaration shall be borne by the international organization and by the States participating in it" [Declaration, 1963].

The seventeen articles of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (adopted on December 19, 1966, entered into force on October 10, 1967) closely follow the 1963 Declaration stating that exploration and use of outer space is for the benefit of all mankind and must be accomplished in accordance with international law and in the interest of peace and international cooperation. Often referred to as the "space constitution," this treaty forms the basis of today's international space law, including provisions regarding use of outer space and a ban on the placement of weapons of mass destruction there [Treaty, 1967].

On November 16, 2016, Japan's Space Activities Act was promulgated, establishing a system for licensing the launching of rockets and the operation of satellites by private-sector companies. Almost 20 Western and other countries have already enacted this sort of legislation. Japan is a relative latecomer in this respect. The contents of these laws vary from country to country depending on such factors as whether they have their own launching site or sites and how mature their space activities are. What is more, Aoki Setsuko, Professor of law at Keio University Law School, claims that the Space Activities Act aims to expand Japan's space business. It also provides for government compensation to augment liability insurance coverage against accidents. The aim is to promote broad private-sector participation in space business. Alongside technological development and financing, the design of the legal and regulatory system is a key determinant of success or failure in space business. The new Space Activities Act is sure to give a major boost to this business in Japan, which has both technological strength and great potential. Within the next few years we can expect to see start-ups launching small rockets carrying miniaturized satellites into orbit [Setsuko, 2017].

Article 8 of the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies uses the term "space object" and defines the term "space vehicle", which includes its equipment, facilities, stations and installations [Agreement, 1979].

Meanwhile, Serhii Vaskov and Servii Malkov point out that a spacecraft, in a legal sense, is a space object or its component part intended to function in outer space. International legal regime of the spacecraft is related to the one of the space object. A distinctive feature of most spacecraft is the ability to function independently in space. While producing a spacecraft design such characteristics as stable high vacuum, weightlessness, intense radiation, the presence of meteorite particles are taken into account. The spacecraft is equipped with scientific instruments, thermoregulation systems, energy conservation, motion control, radio communication with Earth and other spacecraft, life support systems, etc. [Vaskov & Malkov, 2003: 15].

Despite the name "Space Objects" (Article 17 of the Law of the Russian Federation of August 20, 1993 on Space Activities), the law does not explain the notion of "space object", but only specifies issues of ownership, registration, jurisdiction and control over a particular object. The Article lays down jurisdiction principles regarding space objects. Under those principles, the Russian Federation shall retain jurisdiction and control over space objects registered therein during the time spent by such objects on the ground and at any stage of their flight in outer space or on celestial bodies, and also upon their return to the Earth [Zakon RF, 1993]. However, the Law of Ukraine on November 15, 1996 "On Space Activity" states that objects of space activity (space technology) are material objects of artificial origin that are designed, manufactured and operated in outer space (space segment, space infrastructure) as well as on the Earth's surface (terrestrial segment, terrestrial infrastructure) for the purpose of exploration and use of outer space [Pro kosmichnu, 1996].

It is worthy to mention that by virtue of the existing provisions of international law and the Outer Space Treaty, any person can appropriate space objects, extract minerals, etc. This is exactly what gives rise to various actions of governmental and non-governmental organizations of different states in this direction.

The United States Government updated US commercial space legislation in 2015 with the passage of the Commercial Space Launch Competitiveness Act. The update to US law explicitly allows US citizens to "engage in the commercial exploration and exploitation of space resources including water and minerals".

In this connection, Dr. Gbenga Oduntan, a Senior Lecturer in International Commercial Law at University of Kent, expressed the view that the 1967 Space Treaty, in principle, prohibits exploitation of potentially finite resources for other than scientific research purposes, the territorial appropriation of real property over celestial bodies by private persons and space experience business. In essence, all of the above is contrary to the idea of the use of outer space for the benefit of humankind. Space could play a key role in assisting developing countries in improving their capabilities. G. Oduntan believes that with respect to space resources, all states should follow the old legal principle of the Romans: *Quod omnes tangit, ab omnibus tractari et approbari debet* (“What touches all should be considered and approved by all”). The following thought is shared by other scientists [Lefebvre, 2016].

“Metalinfo” reports that after the adoption of the US Commercial Space Launch Competitiveness Act, which laid the legal foundations for the private exploration of space and the exploitation of its natural resources, Luxembourg became the first European country and second in the world after the United States to adopt legislation regulating the ownership of resources acquired in space by commercial companies, providing legal certainty for commercial projects in the space sector. This regulation establishes procedures for approving space mining projects, the commercial use of resources and control over project implementation [Luxembourg, 2017].

The law of 20 July 2017 on the exploration and use of space resources (the Space Law), as adopted by the Luxembourg Parliament on 13 July 2017 and effective from 1 August 2017, creates a licensing and supervisory regime in Luxembourg addressing the ownership of resources acquired in space. Similar to the US Commercial Space Launch and Competitiveness Act, the Space Law provides that commercial companies operating within its regulatory framework may legally appropriate resources acquired in space from celestial bodies known as Near Earth Objects (NEOs). Notably, the Space Law does not apply to satellite communications, orbital positions or the use of frequency bands. Unlike the law in the US, the document does not require the companies to depend on Luxembourg, but only to be present on the territory of the country. Already five foreign space companies, including those from the US and Japan, have established formal agreements to start work on the territory of Luxembourg. According to the government, about 60 more enterprises have announced their intention to open representative offices. In a push to diversify Luxembourg’s investment funds and banking dominated economy and establish Luxembourg as the European centre of the asteroid mining business, the government has committed 200 million euros to help fund companies set up space exploration related companies [Liuksemburh, 2017].

Geologists believe asteroids are packed with iron ore, nickel and precious metals at much higher concentrations than those found on Earth, making up a market valued in the trillions of dollars. Some of the companies that have signed accords with Luxembourg include US-based companies Deep Space Industries and Planetary Resources, as well as Japanese ispace. With Planetary Resources the link is mostly financial, as the country recently invested more than \$28 million in the firm to help launch its first commercial asteroid prospecting mission by 2020. As part of the deal, Planetary Resources is setting up a European headquarters in the country, which will conduct key research and development activities in support of its commercial asteroid prospecting capabilities, as well as support international business activities. Luxembourg’s administration is also working on a legal frame for exploiting space resources so that private companies can be entitled to the resources they mine from asteroids, but not to own the celestial bodies themselves [Planetary, 2019].

The Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space held its fifty-sixth session at the United Nations Office at Vienna in 2017 (A/AC.105/1122). Some delegations expressed the view that the attempts of some States to conduct their space activities while bypassing their obligations under the Outer Space Treaty were a matter of concern. The delegation expressing that view was also of the view that examples of such practice by States included (a) the legitimization of activities conducted by national non-governmental entities in the exploration of space resources that were in contradiction with the provisions of the Treaty; and (b) the establishment of a register or a flag of convenience for private commercial entities interested in pursuing the exploitation of space resources. In that connection, the Subcommittee should seek clarification of key terms, including “common heritage of mankind”, “common province of mankind”, “national appropriation of outer space” and “exploitation/exploration of space resources” [Annotyrovannaia, 2017].

In fact, there is no entity in international law (not within the U.N. Outer Space Treaty of 1967 or the subsequent Moon Agreement of 1979) that has been established to grant title to any extraterrestrial body, and no sovereign entity can provide for a space resource to be “obtained in accordance with applicable law,” because there is no such law. No legal provision exists that would enable a U.S. citizen, or anybody else, to “own, transport, use, and sell the asteroid resource or space resource”, nor is there an entity that can provide for the protection of any portion of any celestial body. With this law, Congress is not claiming the required sovereignty or jurisdiction to do so either [Rummel, 2015].

This may be a puzzling outcome for an enacted law, but perhaps it isn’t. The real benefit of this law is not the solutions it fails to provide, but that it focuses attention on the need to extend and elaborate the international agreements regarding the “exploration and use of outer space” [Rummel, 2015].

President Donald Trump is unveiling an America first “National Space Strategy” which builds on America’s pioneering, spacefaring tradition, laying the groundwork for the next generation of American exploration in space. The Trump administration’s National Space Strategy prioritizes American interests first and foremost, ensuring a strategy that will make America strong, competitive, and great. The new strategy emphasizes dynamic and cooperative interplay between the national security, commercial, and civil space sectors. The United States will partner with the commercial sector to ensure that American companies remain world leaders in space technology. The National Space Strategy establishes forthrightly that securing the scientific, commercial, and national security benefits of space is a top priority for this Administration. The National Space Strategy protects vital interest in space — to ensure unfettered access to, and freedom to operate in space, in order to advance America’s security, economic prosperity, and scientific knowledge. President Trump has already taken significant steps to reorient American space policy and set it on the right path for the future. On June 30, 2017, the President revived the National Space Council for the first time in 24 years. On

December 11, 2017, President Trump once again set America’s sights toward the stars by signing Space Policy Directive — 1, which instructed the National Aeronautics and Space Administration (NASA) to return American astronauts to the moon for long-term exploration and utilization, followed by human missions to Mars and other destinations [President, 2018].

Following a recommendation from the National Space Council, President Donald Trump and Vice President Mike Pence asked NASA to accelerate lunar exploration plans and put Americans back on the Moon by 2024, leading to a sustained presence on and around the Moon. The president signed at the White House Space Policy Directive 1, a change in national

space policy that provides for a U.S. — led, integrated program with private sector partners for a human return to the Moon, followed by missions to Mars and beyond. “Under President Trump’s leadership, America will lead in space once again on all fronts”, said Vice President Pence.

The UAE is also aiming to build first inhabitable human settlement on Mars by 2117, which means we can expect to see a whole city on another planet in less than 100 years. It will be called the Mars Scientific City, and is part of the long-term Mohammed Bin Rashid Space Centre’s Emirates Mars Mission to establish a human colony on the Red Planet. Spread over 1.9million square feet, the new city will help prepare humans for Mars, featuring a laboratory that will simulate the red planet’s terrain and harsh environment through advanced 3D printing technology.

Moreover, in 2014, the Mars Orbiter Mission (MOM) spacecraft, also known as Mangalyaan, arrived at the Red Planet, just two days after NASA’s Mars Atmosphere and Volatile Evolution probe (MAVEN) reached Mars orbit. Mangalyaan, which means “Mars craft” in Sanskrit, was the first interplanetary probe ever launched by India [Tymofeev, 2018].

It is important to note that in the absence of clear international rules on space objects, more and more states, under the influence of private business, have taken a political course on the commercialization of space. According to Anton Pervushyn, modern astronautics is largely subordinated to the interests of commerce. As it became clear that the closest planets are uninhabitable and cargo delivery to orbit would long continue to be a complicated matter, priority is given to the establishment and maintenance of a satellite group that solves many commercial objectives: mapping, navigation, broadcasting, space weather monitoring and securing resources [Shykarev, 2018].

From our perspective, modern astronautics is primarily subordinated to the interests of large commercial structures. In other words, as Illia Khel notes, space is open for business. This is how humanity colonizes the suburbs of the Moon, Moon, asteroids, Mars, and other objects — through the cornucopia of a distributed, commercial ecosystem that is much more powerful than any individual company or state [Khel, 2018].

Let us consider the most famous commercial structures in space activities. At the top of the list stands the private company SpaceX (USA) founded in 2002 by Elon Musk with the goal of reducing space transportation costs to enable the colonization of Mars. Some other private companies in the US include: Amazon, Virgin Galactic, Orbital ATK, Rocket Lab (RL). It is also necessary to take into account such big companies as: Interstellar Technologies (Japan), OneSpace (China), which are regularly involved in various commercial space activities.

With the view that space is used for various purposes, the activities of different entities must comply with international law. As Volodymyr Koretsky, the founder of Ukrainian school of international private and public law, once said “... there are international economic relations, so there should be rules governing these relations. If there are norms governing this group of relations, then the system of those norms should have been born” [Koretskyi, 1989: 120-121]. Concurring with the cited opinion, it should be emphasized that the leading role in various space activities should be played, first and foremost, by States themselves.

In all, among the large number of international treaties, conventions, and other acts that may affect the development of mineral extraction in space, the most applicable ones are the following: the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (adopted on December 19, 1966, entered into force on October 10, 1967); the Convention on International Liability for

Damage Caused by Space Objects (entered into force on September 1, 1972); the Convention on Registration of Objects Launched into Outer Space (commonly known as the Registration Convention which went into force in 1976.); the Convention on Early Notification of a Nuclear Accident entered into force on October 27, 1986; the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency came into effect on February 26, 1987; the Principles Relevant to the Use of Nuclear Power Sources in Outer Space adopted by the U.N. General Assembly on 14 December 1992.

Practically speaking, current regulations and rules of international law are not able to solve the existing problems of space, including the ban on the right to the commercial use and sale of space assets. Both the United Nations General Assembly and scientists have repeatedly drawn their attention to the shortcomings in international law on the use of outer space. As an example, in the report of the Committee on the Peaceful Uses of Outer Space, the point was made that a legally binding instrument on the use of space resources for commercial purposes should be created in the near future on the basis of international consensus. For a whole range of reasons, this innovative space industry needs legal certainty. Therefore, a universal, comprehensive convention on outer space should be developed with the aim of finding solutions for existing issues, which would allow the international legal regime to be taken to the next level of its development.

Clearly, there is a question about the need to create an effective international legal act that would address the existing outer space problems, including a common understanding of the principles concerning the use of space assets. The development of science and technology indicates that international organizations in the field of space exploration and use of outer space can no longer accumulate both positive and negative information about space. In this regard, there is the question regarding the establishment of a specialized efficient organization.

The question of creating such an organization is not new. Back in 1969, the Committee on the Peaceful Uses of Outer Space took note of the discussion of the Subcommittee under the item on information on the establishment of international intergovernmental organizations [Kamenetskaia, 1980: 115-117].

Addressing a major issue, the English researcher S. Horsford rightly points out that one of the basic principles of the future activity of such an organization is the discharge its functions on the basis of equal consideration of the interests of all states [Horsford, 1995: 201].

Conclusions

Indeed, the Moon and its natural resources are the common heritage of mankind and an international regime should be established to govern the exploitation of such resources when such exploitation is about to become feasible. The adoption by the United States and Luxembourg of legislative acts aimed at the legalization, extraction, use and appropriation of space resources by private companies actually violates the principles that outer space and celestial bodies are not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

Certainly, one of the most promising directions for implementation and resolution of specific problems is confidence-building in space activities through the development of programme documents that must be authentically interpreted by all subjects of international law. In particular, this refers to the definition of “space objects” and other concepts that have been addressed in United Nations General Assembly resolutions.

The existing legal framework of international space law is not keeping pace with the development of scientific and technological progress, and the Committee on the Peaceful Uses of Outer Space with its Legal Subcommittees are not able to solve all the pressing problems of space activities. It is also worth pointing out that among the large number of international agreements, conventions and other acts in the field of space activity, some of them are still not signed by the leading space nations.

As a final note, this paper concludes that the path to the adoption of harmonized legal acts and the establishment of an appropriate organization for space activities is not easy and requires the resolution of a number of organizational, economic, legal and political issues. The solution to urgent problems depends on the will of the world's leading States, who must join forces for international cooperation to preserve peace and security.

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Extension of Space Activities, Emergence of Space State and Cosmization of Legal Science

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The need for cosmization of legal science and application of interdisciplinary, intersectional approaches for the in-depth study of new space phenomena is expected to grow significantly. This will be caused not only by a new stage in the space human expansion, but also the increasing competition in this area, the start of the emergence of space statehood in developed countries, the complication of law enforcement mechanisms, as well as the threat of space wars. For the first time, due to the development of space activities and the emergence of space statehood we can provide projections for some areas regarding thematic development of the main branches of legal science and its general cosmization. It outlines the perspective problems, which the philosophy of law, the general theory of state and law, the history of state and law, international public and private law, comparative law, constitutional, administrative, civil law and other industries legal science confront with through the emergence of space legal science. It is proved that to study the fundamental problems of the development of the space state and law (national and international), it is necessary to combine the efforts of legal science with other social, humanitarian, and military sciences. A systematic multi-faceted scientific study of the emerging space civilization, its statehood and law, and the risks associated with it in the strategic documents of states, will allow achieving positive results in understanding of the prospects of the modern state and law evolution, in creating a new international security system on Earth and in outer space. General conclusions are drawn about the features and characteristics, possible trends of the cosmization of jurisprudence.

Keywords: space activities, space state, cosmization of legal science, interdisciplinary and intersectional studies of the space state, space jurisprudence

Received: November 01, 2019; accepted: December 07, 2019

Advanced Space Law, Volume 4, 2019: 92-106.

<https://doi.org/10.29202/asl/2019/4/9>

Introduction

In view of expanding space activity, deploying the emerging space human civilization and its control system in the form of diverse space statehood [Udartsev, 2019b; Udartsev, 2019c; Krichevsky & Udartsev, 2019], two strategic trends in the development of legal science can be distinguished. Firstly, its cosmization is gradually becoming the objective need for the emergence of a diversified space legal science, theoretical and practical space jurisprudence. Secondly, in order to conduct a comprehensive and in-depth study of the evolution of the state and law on Earth into space ones, it is necessary to combine the efforts of all branches of legal science and its interaction with other social, humanitarian and military sciences.

An intersectional approach in science is always applied to varying degree when we speak about synthesizing knowledge and developing new things. In the history of science, the epochs when interdisciplinary and intersectional studies of social phenomena acquire importance are replaced by the time when they are losing their greatness.

The relevance of the intersectional approach increases during historical changes and in the periods immediately preceding them. Under such conditions, new phenomena appear or pre-existing one substantially change that no longer fit into their concept. Previous knowledge and forecasts are insufficient, inaccurate and even erroneous. So one needs a new complex, deep and multi-faceted rethinking of a changed reality. If we do not solve major methodological, philosophical, and general theoretical problems, applied theory and practice are expected to be in an unstable, uncertain state not only with respect to the existing situation, but also to development trends and the near future.

Having found a comprehensive solution to general cognitive problems, science and practice start studying various aspects and elements of new phenomena and processes of reformatted reality in details. At this stage, applications and narrow specialization are again especially in demand, the study of intra-disciplinary and private issues is being updated. Interdisciplinary and intersectional studies are narrowing somewhat and continue carrying out the synthesis, coordination and testing of accumulated knowledge, private sectorial theories and ideas, periodically making breakthroughs for better understanding of the new ones.

Next two decades may slightly change the attitude towards outer space and prospects regarding to the evolution of humanity and the mind in the universe. Apparently, comprehending of the new phenomena in the life of humanity caused by a new surge of space activity and expansion will be marked by appearing both trends.

“Tsunami” of space activity is approaching

After a half-century relative lull, the scientific, technological and technological revolution makes space activity unfold with renewed vigor and on a new scale. The conditions are being created for a new stage of the practical expansion of humanity into space. The emergence of the space civilization of the Earth is global and affects all spheres of life. As rightly noted in the literature that in the 2000s, “under the influence of the global digital revolution, the “old space” (the traditional state space industry of the few pivotal countries) was replaced by the “new space” known as the world of business and technology startups, which was constituted by more than 80 countries” [Yanik, 2019; Pajson, 2013]. Since 2008, the American Furton Corporation began to calculate the annual Space Competitiveness Index on the base of its own methodology, which included 40 indicators (industrial development, human resources, state institutions). The reports about the world space economic performance of the Space

Foundation, which was created in the early 1980s, are published annually [Yanik, 2019; Futron's, 2014; The Space, 2019].

Currently, space activity in the countries throughout the world is growing like an avalanche; by the end of the second decade of the 21st century, all countries are participating in it in this or that way.

Preparation for the space human expansion is becoming a daily challenge in many countries. I will describe some events occurred for the last ten days of August of 2019 in an abridged and systematized form [Dajdzhest, 2019].

The US President issued a Memorandum on the use of spacecraft containing nuclear reactors. A prototype of a space nuclear tugboat, which is being developed in Russia, was shown at the International Aviation and Space Salon (MAKS) — 2019 (intended for the transportation of goods in deep space, including the possibility to use it for creating bases on other planets in the future). By 2030, it is planned to create a complex for producing satellites with such a nuclear tug at “Vostochny” cosmodrome (spaceport). In Russia, the rules for creating and operating a federal fund for remote sensing of Earth from space have been approved.

The Chinese lunar rover “Yutu-2” resumed its work to further examine the far side of the Moon to analyze the structure of the soil for the presence of minerals, to determine the level of neutron radiation emitted by stars. Indian Lunar Station, Chandrayan-2, has been on the orbit approach to the Moon.¹

The participation of the USA, Canada, Japan, Russia and the European Space Agency in the creation and operation of the lunar orbital station is still debated. NASA began accepting applications from national space companies for participating in the supply program regarding the future near-moon orbital station (for which \$ 7 billion is allocated). In 2021, the United States is planning an unmanned Moon overflight. In 2024, they plan to return people to the Moon. The European Space Agency continues investigating the suitability of caves and lava tubes on the Moon to support astronaut life. Roscosmos and the Russian Academy of Sciences are going to complete a program on the study and exploration of the Moon by the end of autumn 2019. Roscosmos announced a tender for examining the Moon on a manned flight. In the early 2030s, flights of people to the Moon are expected to be done annually. Besides, it might be the start of creating a permanent lunar base. China has assembled the first flight model of a promising manned, partially reusable spacecraft. The vessel is designed for flights to space stations and the Moon.²

The spacecraft, “Soyuz MS-14”, with the robot on board known as Fedor, was able to dock with the ISS only at the second attempt. A robotic astronaut's assistant, which was developed in Germany, returned to Earth from the ISS on another spacecraft, so-called “The SpaceX” CRS-18. The said robot allows automating and facilitating a number of astronauts' functions.

¹On the 6th of September, 2019 the contact with the Indian apparatus was lost two km. before it has achieved the surface of the Moon. Two days later, it was found on the lunar surface, 500 meters from the landing site in an inverted position but it was not destroyed. Attempts have been made to reestablish a contact. In the coming years, India plans to make vigorous efforts to boost space activities and fix a list of countries leading in this field. According to Indian experts, over the next 10 years, 300 to 1,200 different satellites will be launched into space annually, and starting from 2023 the number of small satellites will be at least 700 [Dronina, 2019].

²The promising space ambitions of China are considered the largest ones. In particular, it is stated that China plans to create the Earth-Moon space economic zone by 2050, which is expected to bring a return amounting to about \$ 10 trillion a year. [Kitaj planiruet, 2019].

In 2019, the first Vietnamese satellite designed to radar observation of the Earth is preparing to launch.³ Iran has denied a Western media report regarding unsuccessful torture launch satellite in the Imam Khomeini Space Center.

NASA announced that the assembly of the new James Webb space telescope had been completed. Its cost is \$ 9.7 billion. The telescope will be launched in March 2021. It will search for traces of life in the atmosphere of other stars' planets, study the emergence of the first stars and galaxies of the Universe. The light coming from stars to Earth was noted up to 13.5 billion years ago.

In 2020, the Japanese vehicle, "Hayabusa-2", will deliver soil samples from the Ryugu asteroid to Earth. NASA completed the installation of a drone helicopter on the Mars 2020 Rover, which is scheduled to land on the surface of Mars in the winter of 2021. In 2025, NASA officially approved a mission to the satellite of Jupiter.

The Agency for Space Research and Technology "Uzbekcosmos" has been created in Uzbekistan, will introduce the law "On Space Activities" into parliament by November 2019 and within a year it plans to prepare a program for the development of the country's space industry for the next 10 years.

The US Space Command officially began to work (the sixth type of US armed forces appeared). In Thailand, the military force launched a new military space center to ensure the country's national security in outer space. NASA published a test report regarding the Indian anti-satellite weapon occurred in the spring of 2019 (about 15% of fragments of the destroyed satellite remain in orbit, creating the threat of accidents in near space) [Dajdzhest, 2019].

This is a brief information about events occurred only for 10 days. Tens of thousands of civil and military organizations of all countries are involved in space activities. It has an increasing impact on the life of humanity, opens up new prospects for statehood.

In the fall of 2019, information regarding the development and approval of the Russian three-stage Lunar program appeared. Earlier, in February, the head Scientific Institute of Central Research Institute "Roscosmos" published a document, which states that the first Russian manned expedition should go to the Moon in 2031, then such flights will become annual. Prior to this, during test launches in 2028 and 2029, it is planned to test the takeoff and landing complex and fly around the Moon on a manned ship [Roscosmos, 2019]. Two agreements were concluded and signed: the first one was related to the cooperation between Russia and China in the exploration of the Moon and the second one is connected with the creation of the Joint Data Center for the exploration of the Moon and deep space [Rossiya, 2019].

In July 2019, another experiment of the Sirius international (Russian-American) project ended, simulating a four-month space flight of six crew members (four Russian astronauts and two American astronauts) to the Moon with landing on the Moon and returning to the Earth [Mezhdunarodnyj, 2019].

Some experts doubt to find the solution to this problem within the specified time due to the lack of a fully-fledged lunar module, funding and some uncertain results of the next US presidential election that could affect the lunar program and its timing [Poceluev, 2019; V NASA sochli, 2019]. Despite these doubts regarding NASA's implementation of a new astronaut landing on the moon in 2024, it seems that US astronauts would be still the first to

³Currently, autonomous and cheaper types of telecommunications, including television, covering a significant territory of the country, are impossible without satellites. In May 2019, Bangladesh launched its satellite and transferred the broadcasting of several television channels to it. Myanmar and Cambodia is going to launch of satellites too [Verhoturov, 2019].

reach the surface of the Earth's satellite in the 21st century. It became known that the estimated budget of the "Artemis" lunar program, which aims to return to the Moon, will exceed \$ 6-8 billion per year of approved NASA's budget amounting to about \$ 20 billion. They have envisaged to do several manned flights to the Moon and create the lunar station by 2030 [V NASA otmetili, 2019]. The USA continues to expand a number of countries participating in the Lunar Coalition for the study and exploration of the Moon and Mars. Australia will join the lunar program [Avstraliya, 2019; V NASA otmetili, 2019].

There were allegations that the U.S. plans to deploy weapons in outer space, since it is considered that, the activities of all ground troops currently depend largely on satellites and their security. The US Department of Defense has announced a tender for the establishment of a military orbital station. Presumably, it can be used as a space command post and will open up the possibility of deploying the US military in the Earth's orbit and in the space environment between the Earth and the Moon. This will inevitably provoke a response from the Russian Federation and China, especially since the USSR had already had experience in developing military space stations [Bovdunov & Komarova, 2019]. As the international tension is rising, some experts, somewhat exaggerating the threat, report that today the situation in space is similar to "that one occurred in May 1941 on the western border of the USSR" [Pokrovskij, 2019].

Currently, in the context of terminating some strategic international treaties regarding curbing the development of armaments, various types of space weapons, in particular laser ones, are being developed. The placement of weapons of mass destruction in outer space is prohibited by international law (Article IV of the 1967 Outer Space Treaty). However, some varieties of atomic weapon, such as neutron (in particular, neutron guns), are trying to be pushed beyond the established prohibitions by experts of individual countries. Although these weapons are considered as less effective in the Earth's atmosphere, but in the vacuum of space they can become a weapon of mass destruction.

The emergence of space statehood and fundamental importance of this process

In the context of the fourth industrial revolution in technology (especially information), fundamental breakthroughs in the natural and technical sciences, as well as in view of the rising new powerful wave of space activity, globalization processes in the economy, politics, culture, information, law, the state and law are transforming. Their values, historical goals, scale, structure, areas of activity and functioning technologies are changing. New dimensions and prospects of their potential and macrohistorical purpose are revealed.

The space statehood emerged in the second half of the twentieth century has been completed by the early 21st century [For details, see: Udartsev, 2019a; Udartsev, 2019b; Udartsev, 2019c; Krichevsky & Udartsev, 2019].

In the course of historical evolution, states acquired many new features and properties, evolving to larger, stronger, more stable and legal entities. The forms and modes of functioning of states changed under different historical, geographical and cultural conditions — from relatively simple to very complex structures of power, from dictatorships to the most humane and enlightened ones. It occurred that the vast territory on the continents was under a number of states administration. The colonial empires, whose territory extended beyond the continents, sporadically appeared and disintegrated. However, all this happened as part of the development

of the Earth. Only in the second half of the twentieth century, especially at the early 21st century, due to the development of practical cosmonautics, science and technology, new opportunities opened up. They were aimed at expanding initially scientific and then practical human activities beyond the Earth.

For the first time, the opportunities driven by the development of a vast new space, space objects and resources⁴ lead to a significant change in the state and law. Besides, they contribute to provide flexible, smart and clear governance of the ever-growing number of actors in an unlimited extent and physical features of outer space. This will require rethinking and timely reconfiguration of public administration mechanisms and legal regulation.

On the one hand, this learning challenge is considered the very relevant one, especially for a general theoretical and strategic understanding of the nature and prospects of the development of state and law in the context of the current process of human evolution and the emergence of space civilization. On the other hand, this issue has a more applied futurological aspect. It seeks to identify and stimulate the development of advanced technologies and knowledge, which are the most effective when moving towards promising goals. In addition, it focuses on studying the emergence of new components of the economy, ideology, politics and law, as well as developing a global space civilization as a complex system with its member states, taking into account possible risks at the national and international levels.

It requires understanding the problems connected with public administration. They have to be considered with due regard for the development of artificial intelligence (AI), its widespread adoption, autonomous and human-controlled functioning, cloning, genetic improvement and adaptation to different human space conditions, as well as the prospects of a longer life, and in the conditions of growing, transplanting and replacing human organs. In the future, probably in the next century, governance and legal regulation will be predominant. It will be connected with a large-scale industrial development of space resources and the gradual phased creation of stations and settlements, first on the Moon, the nearby planets of the Solar System, and later beyond.

We will highlight two general points related to the emergence of space statehood.

Firstly, the process of transforming modern nations on Earth to space ones of different levels [Krichevsky & Udartsev, 2019], constitutes an early stage of the evolution regarding the system of space civilization governance.

Nevertheless, secondly, this process has already begun and takes into account its emerging new directions of development that is changes occurred in the space state will be accumulated in mechanisms, goals, and means of governance, regulating, planning and control. As it develops further, significant changes are inevitable.

As rightly pointed out in the modern theory of law, development of law is done in two main ways — spontaneously, that is in the process of self-regulation of public life, as well as in the process of targeted law-making and legal regulation (systematic and rational in the legal process) [Pridvorov & Trofimov, 2012: 135-155]. A harmonious combination of these two principles provides the best result. These two principles — spontaneous and purposeful (self-organization, self-government and organization, management in relation to state administration and the political system), obviously, can contribute to develop the diverse social life of space civilization, space government and legal regulation.

⁴ Therefore, an asteroid flying near the Earth in 2015, according to experts, contained 90 million tons of platinum in its core. It is worth \$ 25-50 trillion. 12 of 16,000 asteroids crossing the Earth's orbit have been identified by astronomers as ideal for transferring them to Earth orbit for developing their resources [Kaku, 2019: 92].

Space statehood will exist and evolve in a more diverse space conditions (compared to the one on Earth) acquiring its own spatio-temporal, natural and social features.

The expansion of the space sector in the legal education and legal science

The upcoming competition among world leaders for space, space economy, energy and other fields, primarily for space resources and the exploration of the Moon [Krichevskij, 2019: 16-25], Mars, nearby asteroids, requires to *improve training of lawyers specializing in space law*. Primarily, we need theorists, experts in international and civil laws, etc. Therefore, we have need of both scientists in the field of space law and the space state, as well as lawyers specializing in space law. Following the discussions between the Russian Academy of Sciences and “Roscosmos” concerning the Russian Lunar Program at the end of 2018, they rightly noted: “To consider it necessary ... to develop a plan for the legal support of the interests of the Russian Federation in potential territorial disputes and entrust the preparation of the necessary number of specialists in space law to specialized universities (Moscow State University, RUDN University, etc.)” [Kucher, 2019]. This task inevitably arises in other countries.

This will require pooling the resources of many countries: scientific, technical, technological, financial, personnel, economic m especially, in case of large space projects. As the Canadian Space Agency astronaut, Robert Brent Tirska (who got with the Asgardia National Space State Award), correctly observed that “space colonization would not take place if all interested parties did not work together. They shall forget about the borders between countries and the fragmentation of scientific disciplines” [Astronaut, 2019].

The first stage of transforming terrestrial states into space one (primarily this will affect leading states) will be connected with setting fundamental philosophical and general theoretical objectives. Along with that, it will raise sectoral, theoretical and applied, as well as practical issues that will be coordinated, expanded and deepened as the historical process develops and accelerates.

Modern legal science lags behind practical cosmonautics. However, if it is activated and expended in the coming years, this lag can pose many challenges. Sergey Krichevsky is right when he states that “humanity has not agreed yet on how to explore the Moon, but the development is already underway” [Krichevskij, 2019]. Space legal science has to creat may things almost from scratch. In this regard, the head of Asgardia, Igor Ashurbeyli, was not exaggerating, when he responded to the journalist’s question, “what modern laws related to space exploration, in his opinion, were outdated and require serious revision?” as follows: “In general, normal laws never existed in the space. There was one, and even that was not signed by all states. However, after the US President Donald Trump announced that America was going to create an aerospace fleet and would do, as it seemed fit, I believe that henceforth there are no laws in space at all. This is a cosmic jungle. Therefore, we will wait for appearing of cowboys, saloons and the gold rush. There is no law!” [Five, 2019].

As Arkadiy Ursul rightly notes that there is a new global revolution in science, so-called a multi-revolutionary explosion in modern science [Ursul, 2019]. Legal science is on the verge of a global and superglobal transformation. So multi-aspect cosmization of legal science shall be considered as one of the strategic manifestations of this general trend. Legal science has to make planetary jurisprudence be aimed at space. Along with the development of space activities, the scientific and practical sphere of law will inevitably expand. Such conditions

as spatial, resource, temporary, energy, climate and others as well as some characteristics of space, other planets and their satellites will be increasingly taken into account in the legal regulation. The legal doctrine, institutions and norms of international and national law will be gradually supplemented and rebuilt. Although many things will have to be created from scratch or rebuilt at a time as humanity conquers and explore outer space, with its further transformation and gradual occupation by natural and artificial intelligent creatures.

The need for interdisciplinary and intersectional study of space statehood. Cosmization of branches of legal science

a) state legal science

Something appearing in the new areas of legal studies can be noted even today, since the need for this will arise in the near future.

Therefore, *the philosophy of law and the state, as well as the general theory of state and law*, will have to study the main evolutionary trends, models, forms, structure and functions of space states. This also applies to conditions, factors, features and options for the transformation of states on Earth into space ones, as well as their relationships, correlation with other social institutions, individual, group and social consciousness, including artificial intelligence. Space exploration will create many fundamental problems for legal science, which we can only assume.

It can be considered that *the theory of a space state emergence and its further evolution will replace the previously dominant ideas about the future of the state* over time. This will be through cessation of its evolution at the planetary level or appearing left-wing radical ideas about wither or abolition of the state in the near future. The state as a historical phenomenon, with the emergence and development of the space human civilization, has to go a long historical path, while adapting to the changing conditions of the existed human (and possibly posthuman) civilization and the degree of its spread in space, as well as to various cosmic levels of functioning and space civilizations development.

The emergence of space civilization and its statehood will apparently lead to further development of international space cooperation, national and international space law. The basic legal doctrines and trends in legal thought will continue to broaden knowledge of the law. It can be assumed that the emergence of space statehood will also affect the doctrine of legal positivism. It might adopt some cosmic features. Representatives of space legal positivism, apparently, will be inclined to consider law as the legislation of the space state or as acts, norms, precedents that are sanctioned by the laws of the space state. The studies of the cosmic nature of different phenomena will provoke all the basic theories of law and the state to reveal their space potential. New cosmic trends will appear in theories of natural and customary law. It might occur that synthetic, integral theories of law will be the most popular, as far as they will be considered as more complete and comprehensive doctrines even at the level of space philosophy of law.

Theory of legal policy, as a measure of the development and enforcement of law at different levels of legal regulation, has to expand the range of its tasks. These might include the emergence of promising avenues and the harmonization of the legislative system development. In addition, these would entail the improvement of legal education, the lawmaking process and institutions as well as legal examination, taking into account the expanding space law and the activities of the space state, not only within the Earth, but also beyond.

The history of state and law and the history of legal and political thought will have to study leading, lagging and accompanying processes in public consciousness, in legal and political science, as well as in practical institutional development with regard to the emerging transformation of statehood. The same is expected to occur with the background and history of this multi-aspect process in political and legal reality of different countries.

With respect to the science of constitutional law, it will face the challenge of developing constitutional foundations and principles of the space states activity, adapting the basic laws of the state to the process and prospects of space exploration, which will be, firstly, conducted not far from the Earth, then even in longer distance. It will be necessary to develop an adequate model, which, later on, might be embedded in a space state activity. The latter will inevitably expand. It is important to clarify the ratio of the subsystems of its organs (branches of power), to determine the status and procedure for forming new bodies of the space state, as well as the optimal combination of powers of bodies, rights, freedoms and duties (including new ones) of a person and citizen, legal entities, taking into account the new spatio-temporal reality, goals and objectives of development, as well as the technical level of civilization. Obviously, we have to carry out further unification of the constitutional legislation of space states.

The theories of administrative law, public administration (today, about 40 countries have already created various state bodies for organizing and managing space activity) *and public service, customs and tax law* will have to clarify, rethink and expand the conceptual apparatus, as well as theoretical constructions related to ensuring order and effective public administration. Besides, it will lead to retraining of civil servants. Moreover, it will require scientific and legislative elaboration of the legal regulation regarding the use of different vehicles and technologies, which are connected with the deployment of the space industry, the transportation of goods, other scales and levels of risks, as well as the elimination of the latter. A new space customs and sanitary-epidemiological service is expected to be of high quality and high-tech.

There are other challenges. They are connected with scientific understanding of the legal regulation as to the expansion of AI application for working in space. It includes places that are inaccessible to humans, the usage of the most sophisticated space technology, various sectors of the space economy, as well as the harmonization of AI components with government, people and the rule of law. We have few ideas about military (currently six countries have created space troops or space units) and law enforcement service in outer space, as well as space service itself and other security services. They are far from those, which we have on the Earth. The legal regulation of AI will affect all branches of legal science.

International public and private laws might play a significant role in addressing the challenges concerning space statehood and its legal functioning, the peaceful orientation of the space activities of international organizations, space states and private corporations involved in space activities. *The philosophy and general theory of international law* would also change. The current crisis of international law and the international security system can have disastrous consequences. Many things have to be done. They are legal regulation of interstate relations and increase of their role because of UN reform, creation of stronger global governance structures, effective checks and balances, legal regulation and peace at the planetary level. It is obvious that if we fail, the explosive development of space activities can lead not only to increasing the competition, but also to the space wars between states for control of space resources and space itself. The science and practice of international law should contribute to ensuring universal human interests in space activities, the interests of the space civilization of

planet Earth as a whole, as well as preserving a relative balance of forces, rights and obligations of pivotal countries, maintaining the international law and order, international security and peace on Earth and in space. It is necessary to create reliable international legal foundations of international (primarily interstate) mutually beneficial cooperation in the preparation and implementation of super-global projects of humanity with appropriate international control.

b) civil science

The science of civil law will have to develop the possibility of applying the theory and legal structure of property law, its various forms and reasonable restrictions to the multidimensional sphere of space activity, to the space economy, science, technology and culture.

The development of laws relating to space subsoil usage (in international private law and in the law of a particular state), antitrust and corporate law, which will take into account the specificity of various space entities, objects and their keeping conditions, as well as the extracted substances will be of particular importance.

It will be necessary to adapt every possible civil law structure of the rights and obligations of participants of legal relations in different types of agreements to space conditions and various space activities, and if necessary, modify them.

There is the need for developing new concepts and theories of the state and private capital participation in various types of space activity, applying AI and robots in it, public-private partnerships in technical, intellectual, information, transport, banking, insurance and other activities in space (as well as in the study of developing legislation and the practice of its application in countries leading in space activities).

c) criminal science

Previously unknown prohibitions and permissions, new concepts, *corpus delicti* and crimes will appear in the theory of criminal law, crime and punishment, and *penal law*. The knowledge about many other legal concepts, norms and institutions will expand somewhat and gradually adjusted with the experience gained by the states regarding maintaining order while carrying out space activities and regulating relations in space industries, bases and settlements outside the Earth, as well as while accumulating and selecting the best practices on relevant legislation.

Expanded studies in *criminology* will be more closely aligned with genetic and medical developments. In case of *forensics*, such studies will be connected with scientific and technical expertise, taking into account different space conditions.

d) procedural branches of legal science

Theories of procedural law (constitutional, administrative, civil, criminal, etc.) will have to develop optimal stand-off procedural forms. These things will be inevitable, if we take into account space distance, peculiarities of the passage of time and the necessity to address many issues without undue and mandatory displacement of people and movement of equipment in outer space.

e) comparative law

Comparative law can play an important additional role in integrating and coordinating the activities of space states, in unitizing their certain state and legal institutions and regulations, as necessary information becomes available.

It might be necessary to study further state and law of the developed foreign countries, which are on the cusp of being a space state and forming national space law (the USA, China, France, Israel, India, Japan, Great Britain, etc.). The countries of catching-up development will try to reproduce legal development in the same way.

Study of challenges arisen during space evolution of state and law in social, humanitarian and military sciences

The transformation of developed states on Earth into space states also requires the participation of other *social and human sciences such as philosophy, political science, economics, ecology, sociology, history, psychology, philology, etc.* They will help to understand this phenomenon and its consequences. Changes occurred in statehood will make each of these sciences adjust and expand overall perceptions about the state and the political system, their nature, purpose, scope, levels, methods of social management and regulation, about nature and historical place of man in the evolution of the mind, etc.

At the same time, the cosmization of the globe's economy and *economic science* is of paramount importance. Recently, people started to pay more attention to the emergence of the space economy, though, yet, insufficient (unlike the space state, until recent years its emergence had been virtually invisible). As Andrey Yanika rightly noted in his article, "the pace of the space economy evolution and its increasing influence on the most diverse spheres of "life on Earth" are currently ahead of the scientific understanding of the processes. However, we should pay more attention to this object because there are some evidence due to which we can state that the space transformation of the world economy at large has already begun [Yanik, 2019; Chernyh, 2016]. It is obvious that economic science and other social and human sciences should keep in mind the strategic trends of the evolution of humanity, the emergence of a space civilization with its space ones — economics, politics, law, culture and science.

The emergence of space civilization will stimulate the development of gradually expanding branches of legal science and other social and human sciences, but with the addition of one word, "space" (*space political science, space economics, space ecology, etc.*).

Military science (the inevitable emergence of space military science), and *theories of national, global and space security* face new challenges: the emergence of the armies of developed states in space, but now this list is limited: Russia, China, the USA, France, Japan, and Great Britain (it will obviously be longer in the coming years), and the threat of spreading the military conflicts and weapons into space, the emergence of competition and struggle among the developed countries for strategically important areas in space, on the Moon and other planets in the near future.

Conclusion

It should not be assumed that the cosmization of legal science is, predominantly, supplementary to the development of human technical civilization and designed to ensure its security and sustainable progressive development. Everything will be in a smooth and sufficient manner. Discussions, struggle between old and new approaches, ideas, theories will occur at all stages of science development. One can expect graceful conservative arguments about the inadmissibility of running ahead (it shall be done in order not to change anything afterward). They might express ideas about how much we expect to spend on astronauts and the exploration of deep space, why these issues are not urgent and there are a lot of other things

that have to be done on Earth (for example, to build and repair roads, finance the modernization of housing and communal services, etc., etc.).

History does not stand still. Technological development is unevenly but fast. It depends on time, countries, certain areas of science and types of technology. The human space expansion leads to the gap between the developed space states that are actively involved in improving the space economy, science and technology and backward countries.

One can also assume that there will be imbalance and uneven development regarding certain branches of legal science. This can have different consequences. They sometimes can be positive, especially, for supporting the sustainable development of key aspects of space statehood and the space economy (for example, advancing in the cosmization of certain sub-sectors and branches, legal institutions. This is possible both, for objective reasons, associated with the uneven development and cosmosization of certain areas of public life, and, for subjective reasons, depending on specific leaders, scientists, and training of personnel in a particular branch of legal science. Nevertheless, apparently, the uneven cosmization of some branches of legal science would be more optimal and preferable during the development of space civilization.

Summing up, we can draw the following main conclusions:

1. The need for the development of the space economy, culture, science and technology, for the emergence of space statehood and space law will contribute to the cosmization, firstly, of fragments, parts, and then legal science as a whole — both as Public Affairs and as Jurisprudence. At the same time, it is important that legal science develops in this direction systematically; taking into account trends in the development of public relations, science and technology, and synchronously in responds to the increasing needs of space civilization and the space state.

2. The new scales, goals, values, forms and functions of the space state will require the solution of many general, theoretical and applied, scientific, sectorial, cognitive tasks, taking into account its role, limits and forms of participation in the development of the space economy and its legal regulation. The emergence of a space state requires the combined efforts of different researchers in order to conduct a comprehensive study of the space potential of the state and law, the possibilities and consequences of this process in the context of other global and superglobal processes that humanity has entered into.

3. Legal science based on interdisciplinary studies and in the context of intersectoral studies of other social and human sciences should be more actively involved in the study of the emergence of space statehood and an updated international security system to ensure peace and minimize new emerging risks on Earth and in space.

4. The expanding cosmization of legal science and practice is one of the strategic promising areas of its development during space civilization emergence, competition between pivotal countries regarding space and the general space human expansion. In the longer term, along with the space human expansion, with the development of new forms of organization of space systems of power and law, jurisprudence on Earth will apparently evolve more and more and will become as a part of space jurisprudence. Legal science will become a branch of space civilization science.

5. The emergence of space statehood and its corresponding governing bodies, mechanisms, institutions, principles of legal regulation and administration (as well as self-regulation and self-government) will lead to a significant transformation of legal science, law, and especially legislation. This transformation will take place in several areas:

- adaptation of the legal doctrine of the existing scientific knowledge to a new changing reality and improving the existing legislation in accordance with it; clarification of ideas about the nature and functioning of previous phenomena in new conditions;
- completion, expansion, substantial clarification of the position of legal science on various issues aimed at mainstreaming new features, elements of reality and the process of changes in previous phenomena with their further transformation;
- development of new ideas, concepts, theories, cognitive models, designs to explain a qualitatively new thing in political and legal reality and the trends of its evolution;
- perception of possible new knowledge, theories from the natural and technical sciences, a new methodology and their implementation in legal science and its industry; even more active synthesis of ideas, theories of the humanities, social, natural and, partly, technical sciences in various branches of legal science, especially in forensic science; expanding the scope of application of scientific knowledge, developments in the natural and technical sciences, AI in legal research;
- emerging readiness in the public consciousness and in science to the percept, influence and grasp ideas and concepts (including those in the field of space civilization governance and legal regulation) of hypothetical and other space civilizations (including, possibly, more advanced ones, in comparison with civilization on Earth) in a more distant future; the need for interaction and cooperation⁵ in the activities of space civilizations will inevitably lead to the emergence of the next level of inter-civilizational political and legal development.

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⁵ Tatiana Ursul writes, not without reason, about the inevitability of cooperation between space civilizations as factors in the evolution of the universe [Ursul, 2018: 289].

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Legal Regulation of Standardization and Certification of Space Objects

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The article provides a comparative analysis of international law and national legislation of Ukraine on the legal regulation of space activities. Such institutions of state regulation of objects of space activities as registration and certification are investigated. The problems of legal responsibility of subjects of ownership of space objects in case of expansion of space activities in Ukraine to the private sector are revealed. The article focuses on the fact that in Ukraine there are a number of organizational and legal problems in the field of space activities. Organizational problems include the low level of awareness of the population of Ukraine regarding the goals and objectives of space activities; the lack of qualified legal support for space activities in Ukraine; corruption and insufficient attention by the government to the development of the space industry. The problems of legal regulation of space activities, including the protection of property rights to space objects, include: the lack of proper systematization of national legislation; the delay in the adoption of policy documents in the field of space activities; the declarativity of most of the adopted norms in this area. The adoption of the Law of Ukraine, allowing private space activities, is proposed. The study will contribute to the development of a systematic approach in legislation to the protection of property rights to space objects in accordance with the international legal regulation of the activities of States in the field of protection of property rights to space objects and the like.

The adoption of the Law of Ukraine “On Private Space Activities” is proposed. The study will contribute to the development of a systematic approach in national legislation to the protection of property rights to space objects in accordance with the international legal regulation of the activities of states in the field of protection of property rights to space objects and the like.

Keywords: space objects, space technology, registration, certification, standardization, law, space activities, legal responsibility, private companies

Received: September 22, 2019; accepted: October 24, 2019

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Advanced Space Law, Volume 4, 2019: 107-115.
<https://doi.org/10.29202/asl/2019/4/10>

Introduction

Activities in the exploration and use of outer space began to develop a little more than 50 years ago. And even today it is impossible to imagine the life of a modern man without space technologies: telecommunications, satellite navigation, remote sensing of Earth from space, predictions of natural disasters and weather fluctuations, the search for minerals and the like. In just half a century of manned space exploration, representatives of more than 35 countries have visited space. International crews of astronauts have been working in orbit as part of the International space station for the past fifteen years. Space tourism is also beginning to develop [Stelmah, 2016: 3].

Along with the undoubted benefits of space technologies, the exploration and use of outer space is associated with a number of risks, threats and challenges that pose a danger to both Earth's population and outer space, as well as to humans and other biological beings in space. That is why the security of space activities in recent years has become one of the most serious problems of space activities [Stelmah, 2016: 3]. However, there is still a number of problems that we will consider in this article. The relevance of the article is due to the lack of comprehensive studies devoted to legal regulation of standardization and certification of space objects. In particular, issues relating to: the defense and protection of the ownership of space objects; the registration of both civil and military satellites; and the protection of the environment remain under-addressed. Despite the substantial legal framework in this area, which includes a set of conventions, agreements and covenants developed at both the universal and regional levels, all these issues require a comprehensive solution.

Objects of space activity-problems of terminology

According To the law of Ukraine "On space activities", the term "objects of space activities" is synonymous with the term "space technology" (para. 3. 1). Space activity involves the creation and application of space technology, (space objects), which are material objects of artificial origin, which are designed, manufactured and operated. That is, creation is design and manufacture, and application is operation. The use of these concepts in determining the content of various terms is not entirely appropriate [Stelmakh, 2016: 146].

Unlike celestial bodies of natural origin (such as Moon, planets, etc.), space objects in international space law are understood to be man-made, artificial earth satellites, automatic and manned ships and stations, launch vehicles, etc. International space law regulates activities related to space objects from the moment of their launch or construction in outer space (including on celestial bodies). Until then, their creation and launch activities are within the scope of domestic law, unless otherwise specifically agreed between States (for example, in the case of the joint creation or launch of a space object by several States). After returning to Earth, a space object, as a rule, is again subject to national law, but in the case of its landing on foreign territory, the relations that arise between states are regulated by the rules of international space law [Stelmakh, 2016: 147].

The content of the term “objects of space activities (space technology)” covers the peculiar means (objects) by which space activities are carried out (provided) [Stelmakh, 2016: 147].

In the Law, the term “space technology”, as noted above, is synonymous with the term “objects of space activities”, while distinguishing them into those that are designed, manufactured and operated: in outer space (space segment, space infrastructure); on Earth’s surface (ground segment, ground infrastructure) (para. 3 article. 1 of the Law of Ukraine).

In the Law of Ukraine “On space activities” the term “ground infrastructure” is also used, and in the laws of some other countries — the term “space infrastructure” is used [Stelmakh, 2016: 147].

The legislation of Ukraine divides space technology into types for the purpose: for civil, for the needs of dual-purpose defense (Art. 7); for military purposes (Art. 26, 28) [On space, 1996]. Unfortunately, the definition of these terms is not given, so there is confusion in the application of the terms “space technology for defense purposes” and “military purposes”. A logical question arises: are they identical or not. It is impossible to draw a final conclusion from the content of the Law of Ukraine “On space activities”, since the term “space technology for defense purposes” is used only once (art. 7), which allows us to make an assumption about the randomness of such consumption — instead it was necessary to use the term “military space technology” [Stelmakh, 2016: 147].

Thus, space activities are regulated at the international and national levels. The international level is characterized by the norms contained in multilateral and bilateral treaties concluded by States to regulate public relations in the space sphere. At the national level, activities in the space field are regulated by domestic legislation.

State registration and certification of space objects in Ukraine

The interest of the world community in the exploration and use of outer space has deep roots dating back to first civilizations. Therefore, it is not surprising that with the development of science and technology and, accordingly, the possibilities of conquering outer space, questions arise about the procedure for carrying out its research, protection, rational use and ensuring the safety of Earth and humanity from the abuse of outer space. The implementation of relations on the exploration and use of outer space has become the basis for the formation of a number of international acts aimed at their settlement. These include the Treaty on principles of the states’ activities in the exploration and use of outer space, including Moon and celestial bodies, the Agreement on the rescue of astronauts, the return of astronauts and the return of objects launched into outer space, the Convention on international liability for damage caused by space objects and the like. The norms of these international documents are reflected in the national space law of the signatory countries and form the basis and conditions for the use of outer space at the international and national levels.

Together with the freedom of exploration and use of outer space, the prohibition of placing weapons of mass destruction, international documents set forth special rules under which the state bears direct international liability to cover losses to the affected country and on the basis of the licensing regime should ensure the supervision of compliance of private enterprises with the norms prescribed by international law. National space legislation is intended not only to provide legal regulation of space exploration for the needs of science, but also to contribute to the national defense of these countries. Now space technologies are developing extremely quickly and if earlier at least five years were necessary to launch a satellite, now even four months are enough to prepare a mini-satellite.

Such national action is presumed to be taken in accordance with the applicable national laws, policies and administrative procedures. They also establish requirements and procedures for private companies to supply the concerned governmental office (keeper of the national registry) with the required information about their launched space objects. Such requirements and procedures are generally imposed through applicable licensing processes. The nature and scope of the information to be entered as well as the timing of recording in the national registry are left to the discretion of each State, though it would be logical that they coincide, as a bare minimum, with the requirements for international registration under Article IV of the Registration Convention [Jakhu et al., 2018].

Therefore, it is very important that national legislation on space activities should comply with generally accepted international norms, and international norms take into account the peculiarities of each state in the use of the law on space exploration.

Any object of space activity in Ukraine is subject to certification for compliance with the requirements of operational suitability established by the regulatory documents in force in Ukraine, with the issuance of a certificate of conformity. The procedure of certification of space technology in Ukraine is determined by the system of certification of space technology of Ukraine, which operates within the framework of the State certification system (UkrSC ST).

State certification is an element of the administrative and legal mechanism of space activity management, which is often used in other fields. For example, certification of energy efficiency of buildings. According to the Law of Ukraine “On Energy Efficiency of Buildings” [On Energy, 2017] mandatory energy efficiency certification is being introduced since 2019 [Soroka, Larysa and all].

The procedure for testing and certification of an imported object of space activity or an object of space activity exported from Ukraine, as well as registration of relevant certification documents is established by the rules of certification of space technology in Ukraine, which are approved by the Cabinet of Ministers of Ukraine.

In addition to the mandatory certification, objects of space activities must be registered with the government. Thus, article 13 of the law of Ukraine “On space activities” contains provisions on registration of spacecraft and unique objects of space activities. Spacecrafts are subject to mandatory state registration in the State register of spacecrafts of Ukraine according to the rules of registration of spacecrafts in Ukraine, which are approved by the Cabinet of Ministers of Ukraine. If a spacecraft is created jointly with legal entities of other states or international organizations, the issue of its registration is resolved in accordance with the concluded international agreements (contracts). A registration certificate is issued for a spacecraft entered in the State register of spacecraft of Ukraine.

After entering the spacecraft into the State register of spacecrafts of Ukraine, all entries concerning this object made earlier in the registers of spacecraft of other States are not recognized by Ukraine.

The inclusion of a spacecraft in the register of spacecraft of another state, if this object is not excluded from the State register of spacecrafts of Ukraine, is not recognized by Ukraine.

In order to ensure the functioning, preservation and further development of unique objects of space activity, the State register of unique objects of space activity is introduced, as well as state supervision over their condition, use and appropriate measures are taken to support the targeted financing of these objects in accordance with the procedure established by the Cabinet of Ministers of Ukraine.

Article 14 Of the Law of Ukraine “On space activities” contains provisions on the withdrawal of spacecrafts from the State register, therefore the spacecraft is withdrawn from the State register of spacecrafts of Ukraine by the Central Executive body implementing the state policy in the field of space activities in case of: physical destruction (death); transfer in the prescribed manner to another state, international or foreign enterprise, institution or organization.

In case of withdrawal of the spacecraft from the State register of spacecrafts of Ukraine, the registration certificate becomes invalid.

An object of space activity is allowed for operation if it has a certificate of conformity.

The Central Executive authority that implements state policy in the field of space activities may limit or prohibit the operation of space facilities in the event of: delay or absence of certificate of conformity; operation of object of space activity with violation of the current legislation of Ukraine; operation of object of space activity with violation of the requirements of the operational-technical documentation for the object.

International registration of space objects

It is impossible to ensure the exploration and use of outer space without a full understanding of the situation in outer space. From this point of view such elements play an important role:

1) registration as a means of identifying and establishing a legal link between the object and one of the launching states;

2) monitoring (remote sensing) of outer space, which includes the observation and control of the flight of a space object.

Despite the adoption of the Convention on the registration of objects launched into outer space (1974) [Convention, 1974], there remain a number of problems that need to be addressed. The Central registry of space objects the United Nations office for outer space affairs receives information with a large time gap from the moment of launch, which creates certain gaps in the registry, thereby reducing the transparency and completeness of the information it contains.

To address this issue, it would be desirable to establish a time frame within which states and international intergovernmental organizations should provide relevant data. It may also be necessary to provide two stages of reporting and, accordingly, initiate two categories of data (or two divisions of the registry):

1) scheduled launches;

2) launches, that have taken place.

Information about scheduled launches could be given by the providers of launch services, but the registry of launches that have taken place, together with the registration of objects would continue to be implemented as it is today, through diplomatic channels by the state, which according to the agreement between all states that are classified as the states to launch for a specific case, was defined as one that is prepared to assume and perform the duties of the state registration. Another important aspect, which, in our opinion, requires attention, is the strengthening of the means used to identify objects (now we are talking about designations, labeling, etc)

The main purpose of registration, as we noted earlier, is the ability to quickly identify the object. Currently, states are limited to the application of identification marks (designations and markings) mainly on the object as a whole, without taking into account the possibility of destruction of the space object or its disintegration into parts. In the case of collisions in orbit

or the return of an object to Earth, there may be a situation where certain parts of the object are separated and they can cause harm. There is a situation when the state has fulfilled the obligations arising from the Convention on registration of objects launched into outer space (1974), purely formally. In view of this, it would be appropriate to oblige states to apply a designation, marking, stamp with a registration number, etc. to all large elements of a space object that may be detached [Stelmakh, 2016: 140].

Thus, the main purpose of registration is the possibility of rapid identification of the object. It should be emphasized that, as of today, States are limited to the application of identification marks (designations and markings) mainly on the object as a whole, without taking into account the possibility of destruction of the space object or its disintegration into parts. The Central registry of space objects of the United Nations office for outer space affairs receives information with a large time gap from the moment of launch, which creates certain gaps in the registry, thereby reducing the transparency and completeness of the information it contains. Of course, this situation should be changed, because the registration of satellites as a means of their protection is very important.

Ways to overcome the problems of legal regulation of space activities

In addition to organizational problems, Ukraine has problems with legal regulation in the sphere that affect not only the general issues of development of Ukraine as a space power, but also concern the issues of ownership of satellite communication systems. In particular, on September 5, 2018, the Cabinet of Ministers of Ukraine approved the Concept of the national target scientific and technical space program of Ukraine for 2018-2022 [On approval, 2018]. Accordingly, the State space Agency, together with other interested Central Executive authorities, was entrusted with the duty to develop and submit, in accordance with the established procedure, for consideration by the Cabinet of Ministers of Ukraine, a draft national target scientific and technical space program of Ukraine for 2018-2022. However, it is still not approved. Now there is a bill № 9457 of 28.12.2018 “On approval of the national target scientific and technical space program of Ukraine for 2019-2023” [Draft, 2018], but 2019 is already expiring, and this bill has not been approved. It should be noted that from the standpoint of legal theory, program documents serve as the basis for the development of the sphere of public relations and its legal regulation. Procrastination with the approval of this program becomes the basis for the haphazard creation of legal norms in the space industry, the reason for the adoption of regulations “as necessary”. Accordingly, it creates a pile of unrelated norms that complicate the implementation of public relations, make Ukraine uninteresting for international partnership and foreign investment.

Thus, the issue of launching its own objects of space activity, including military ones, is very relevant for Ukraine. It faces the need to address many issues, including, first of all, changing priorities for the development of the space industry in Ukraine, overcoming corruption, forming a corps of lawyers capable of defending the interests of the Ukrainian state in international courts, improving the quality of diplomatic activity. After all, all these shortcomings exclude Ukraine far back in comparison with other states in the study and exploration of space. This situation looks hopeless in the light of the announcement in November 2019 by the North Atlantic Alliance of space as a separate sphere of operations, which does not exclude its further consideration as a platform for military action.

Legal liability of private sector entities as owners of space objects

The Vienna Declaration on space activities and human society development, adopted by the third United Nations conference on the exploration and peaceful uses of outer space (1999), defines environmental protection and the rational use of earth resources as one of the priorities for the development of space activities [Space, 1999]. It is determined that the international community should take all measures to ensure, at the highest possible level, that the implementation of all space activities, especially those that may have adverse environmental effects at the local level and globally, reduces such effects, as well as to take appropriate measures to achieve such an objective. This issue becomes relevant for Ukraine in connection with the adoption by the Verkhovna Rada of Ukraine in the second reading of the draft Law “On amendments to some legislative acts of Ukraine on state regulation of space activities” [On Amendments, 2019], which will enter into force on 29.01.2020. This bill provides for the de-monopolization of space exploration and the involvement of private companies in space activities. Its purpose is to ensure the development, increase investment attractiveness, as well as create a competitive environment for the development of the space industry in Ukraine, along with the public sector of private property enterprises.

With its provisions, the Law of Ukraine “On amendments to some legislative acts of Ukraine on state regulation of space activities” changes a number of existing legal acts, namely: the Laws of Ukraine “On entrepreneurship”, “On space activities”, “On licensing of kinds of economic activities”. However, it does not contain any rules that would determine the procedure for attracting private companies to legal liability as subjects of space activities.

Accordingly, despite quite positive achievements in the development of the space industry, it is necessary to remember the need to comply with international standards of space activities, one of which is the safety of individuals and legal entities, the environment, as well as the protection of the near and far space environment. These standards impose obligations on Ukraine to control the activities of private companies that will engage in space activities on its territory, which in the absence of appropriate legal mechanisms and standards becomes extremely difficult. And in some cases, working with foreign companies is impossible. That is why the clarification of the procedure of legal responsibility of private entities of space activities is the basis for transparent and legal development of the space industry in Ukraine.

In connection with the stated provisions, we consider it necessary to propose instead of amending certain normative acts of Ukraine to develop a draft Law of Ukraine “On private space activities”, which should combine international standards of space activities and the peculiarities of national legislation of Ukraine. In particular, it should fix:

- modern principles of private space activity in Ukraine;
- requirements to subjects of private space activity and to establish subjects of the state and public control over this type of activity;
- the range of areas of space activities to which private companies can be involved;
- the list of space objects on creation and use of which the subjects of private space activity will have the right;
- the procedure for the settlement of intellectual property relations in this area;
- features of legal responsibility of subjects of private space activity.

Conclusion

Thus, having analyzed the issues related to the protection of property rights to space objects, we come to the conclusion that this problem is quite relevant and many of its aspects in Ukraine are still in the so-called transformational state.

It is established that in Ukraine there are a number of organizational and legal problems in the field of space activities. Organizational problems include the low level of awareness of the population of Ukraine regarding the goals and objectives of space activities; the lack of qualified legal support for space activities in Ukraine; corruption and insufficient attention by the government to the development of the space industry. The problems of legal regulation of space activities, including the protection of property rights to space objects, include: the lack of proper systematization of national legislation; the delay in the adoption of policy documents in the field of space activities; the declarativity of most of the adopted norms in this area.

We believe that the directions of solving these problems in the organizational sphere are increasing the attention of the government to the problems of the space industry in Ukraine, the active participation of state bodies. Improving the legal regulation of space activities in Ukraine provides for the approval of program documents for the development of space activities, systematization of existing legislation in this area with the elimination of differences between regulatory acts. Also one of the priorities is the adoption of the Law of Ukraine "About private space activities", which should solidify: modern principles of private space activities in Ukraine; requirements to the subjects of private space activities and to identify the subjects of state and public control over this kind of activity; a circle of directions of space activity in which private companies can be involved; a list of space objects for creation and use of which the subjects of private space activities will have the right; the procedure for the settlement of intellectual property relations in this sphere; features of legal responsibility of subjects of private space activity.

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Features of Legal Support of Space Activities in Ukraine

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In the article, the authors reveal the historical and legal aspects of space activities in Ukraine. The historical and legal acts of the Ukrainian SSR and the Soviet Union, regulating the space industry, are analyzed. Considerable attention was paid to the peculiarities of legal regulation of the activities of the main space design bureaus of the time. It is concluded that the space activities of the USSR — in general and the Ukrainian SSR were provided on the basis of sublegislative normative legal acts (resolutions of the Council of Ministers and orders of the Central bodies of the Communist party). However, the lack of the national space law was offset by systematic and full funding of space activities, resulting in the Soviet Union having a powerful space industry. In the conditions of modern development, Ukraine has all the opportunities to achieve significant development of the space industry, using the positive experience of the USSR and opening access to space activities of private investment.

Keywords: space activities, law, space law, space technologies, private investments, Soviet regime, launch vehicles

Received: September 11, 2019; accepted: October 07, 2019

Advanced Space Law, Volume 4, 2019: 116-124.

<https://doi.org/10.29202/asl/2019/4/11>

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Introduction

Now, when new changes in the space law of Ukraine allowed private individuals to develop, manufacture and launch spacecraft, once a powerful space power has a chance to increase its contribution to the world's space technology through private investment.

The space industry of Ukraine has its glorious history and legal specifics of origin and development in the depths of the Soviet regime. In the article the authors revealed the historical and legal features of the origin and development of the space industry of Ukraine. There is a certain literature on these issues, which, however, in most cases does not disclose the analyzed problems. After all, scientists have focused on the technical and historical factors of the development of the space industry in Ukraine. They hardly analyzed the legal issues.

Scientific novelty: firstly, it is proved that Soviet Ukraine, which was under the totalitarian control of Moscow, did not have a high level of legislation (laws) regulation of the space industry was carried out on the basis of sublegislative normative and administrative legal acts of the ruling party and government; secondly, the space industry had funding in full; thirdly, the space industry of Ukraine, after independence, had certain scientific and technological successes, but due to the legislative ban to attract private investment in this industry led to its decline.

First, in the article we will reveal the phenomenon of how the Soviet regime managed to create high space technologies in the conditions of poverty of citizens, systemic violation of human rights. We will then focus on the specifics of the international legal regulation of the exploration and use of outer space. Significant attention in the article will be paid to the specifics of the legal regulation of the main space design bureaus and sublegislative normative legal regulation of the space industry in the Soviet state. The article ends with the disclosure of the modern legal regulation of the space industry in Ukraine.

Human rights violations and high space technologies as a phenomenon of the Soviet past

In the history of space, an important place belongs to the state, which ceased to exist in 1991 — the USSR. A part of which consisted of Ukrainian lands. Modern Ukraine is the successor of the Ukrainian Soviet Socialist Republic. It, from the point of view of international law, has been recognized since the formation of the UNO. Although the real independence Soviet Ukraine did not have. All important decisions were made in Moscow — the capital of the USSR, and Kyiv — the capital of Soviet Ukraine, implicitly carried them out. After all, after the Holodomor (1932-1933), when the Soviet regime starved more than five million Ukrainians, resistance to the Soviet regime was carried out only by the Ukrainian insurgent army (until 1963) in the Western provinces of Galicia [Natsional'na, 2008]. The population of other regions did not have enough forces for resistance.

However, the Soviet state, although through ruthless exploitation of citizens, has achieved significant success in the development of the space industry and space technologies. Among them there are the first artificial satellite of Earth, the first manned human flight into outer space, the first flyby of Moon, the first artificial objects on the surface of Venus and Mars, etc.

It was a peculiar phenomenon. When in the forties and fifties of the twentieth century, most of the citizens who inhabited the republics of the USSR were starving, and for the military and civilian rocket space industry, the ruling Communist party and the Soviet government, spared

no expense. The first space programs were carried out according to the rule of actual costs. How much money was spent, the same amount came from the state budget. Practically the estimate was absent. As much money was spent on space, as much it was possible to explore, without restrictions of upper limit.

This led to the fact that the material support of designers, engineers and manufacturers of space technology was high, and even higher was the prestige of working in the space industry. Accordingly, the best engineers and workers sought to get there. And they did, because at that time there was almost no corruption in the Soviet Empire. All this led to the fact that in the space industry worked design, engineering and working elite. Against the background of general impoverishment, these persons lived very well. Although this did not save them from repression.

In the exploration and use of outer space, the Soviet Empire for a long time, along with the United States, had more success. However, in general, this had terrible consequences for the Soviet country. The arms race, including competitions in the field of rocket construction, played a cruel joke with that country. They became one of the significant reasons for the termination of the existence of the Soviet Union.

Although it is undeniable that it was in the depths of that system that the rocket space industry of Ukraine was created, international space law was established, and separate elements of national space law were initiated. The system of space legal norms of Ukraine designed to regulate space activities of today was born in the last twentieth century [Malkov, 2001].

Ukraine and international-legal regulation of the exploration and use of outer space

Space rules can be objectively divided into international and national norms of space law. Although during the entry of Ukrainian lands into the Soviet Empire, the second ones only conditionally can be called the norms of space law. After all, they were based on sublegislative normative legal and administrative acts of the Soviet government, secret instructions of the ruling Communist party at the time and regulatory and administrative orders of the Minister of defense and other special ministries of that country.

As for international space law, Ukraine, as an integral part of the Soviet system at that time, fully adhered to the international space treaties signed and ratified by the Soviet Union. In today's conditions, Ukraine continues to comply with them, because it is the successor of the rights and obligations under international treaties of the USSR, which do not contradict the Constitution and national interests. [Pro pravonastupnytstvo, 1991].

Based on these positions, the space treaties that Ukraine adheres to include:

- The Treaty on the principles of the activities of States in the exploration and use of outer space, including Moon and other celestial bodies of 1967, which the USSR ratified by the decree of the Presidium of the Supreme Soviet of the USSR of June 18, 1967. The Treaty entered into force for the USSR including Ukraine on October 10, 1967;
- The agreement on the rescue of cosmonauts, the return of cosmonauts and the return of objects launched into outer space in 1968, the USSR ratified it by the decree of the Presidium of the Supreme Soviet of the USSR from September 17, 1968. The agreement entered into force for the USSR, including for Ukraine on December 03, 1968;

- Convention on international responsibility for damage caused to space objects, 1972;
- Convention on registration of objects launched into outer space, 1976.

So, Ukraine from the moment of ratification of the USSR to the present day fully adheres to the norms of the fundamental international space treaties, as the successor of the rights and obligations under international treaties, since they do not contradict the Constitution and the interests of Ukraine. These international treaties contain the norms of international space law.

Leading designers of rocket technology of the Soviet state and legal regulation of special design bureaus which they headed

The most famous Soviet designer of rocket technology is Sergei Korolev (1907-1966). He was born, raised and educated in Ukraine. However, the development of its first missiles began in Moscow in 1931. From 1938 to 1944 he was repressed by the Soviet regime. Since September 1945, he resumed activities in the field of rocket science. In 1950, he passed on combat duty for the armed forces of the Soviet state rocket R1 (analogue of the German V-2). After that, by order of the government of the Soviet state on April 24, 1950, a special space design Bureau № 1 (Research Institute 88) was created, and Sergei Korolev was appointed as its chief designer. In 1956, under his leadership, a two-stage Intercontinental ballistic missile R7 with a head mass of 7 tons and a flight range of 8000 kilometers was created. However, Sergey Korolev achieved the greatest success not in the military, but in the peaceful segment of space launches. He added the third and fourth stages to the combat rocket, which made it possible to launch the first artificial earth satellite on October 4, 1957 and open the space age of mankind. And on April 12, 1961, he again surprised the world community. He conducted the first manned flight of a spacecraft with cosmonaut Yuri Gagarin on board [Mozharovs'ka, 2019].

Valentin Glushko (1908-1989), was born in Odessa, Ukraine. He is the founder of the Soviet liquid rocket engines. His engines RD107 and RD108 stood on the first Soviet Intercontinental missile R7. It was on his engines fly rockets Sergey Korolev. They put into orbit the first artificial satellite and sent the first human into space, etc. He began his professional career in the development of rocket engines in 1929. In 1930, under his leadership, the first Soviet liquid-propellant rocket engine was created. From 1938 to 1944 he was repressed by the Soviet regime. Valentin Glushko created more than 50 types of rocket engines. His rocket engines R253 stood on the carriers "Proton" and "Soyuz". Since 1974, he became the General designer of the research and production Association "Energia" It was for the needs of this reusable space system that the most powerful rocket engine RD170 was created [Akademik, 2019].

Mikhail Yangel (1911-1971), was born in Irkutsk province, Russian Empire, in a family of ethnic Ukrainians. Since April 1954, chief designer of special design Bureau №. 586 in Dnipro, Ukraine [Dovhal', 2011]. He was a doctor of science, academician of the Academy of Sciences of Ukraine. His design office carried out the development of a new choice 8K63, missile on high boiling fuel components with an autonomous control system, known as R-12. In June 1957, the first and successful test of the medium-range missile R-12 (NATO classification SS4) was carried out [Gorbulin, 2011].

On the basis of this rocket, a light-class carrier rocket with the name "Cosmos" was created. It launched spacecraft weighing up to 450 kilograms into an orbit of up to 200 kilometers, from the Kapustin-Yar and Plesetsk cosmodromes. A total of 165 launches were carried out, of

which 143 were successful. Thus, Mikhail Yangel, founded a new direction in Soviet rocket science on new fuel components with an Autonomous control system.

In addition, he founded a research and design school, the result of the activities of which were significant successes of pupils of the space construction master, in particular, the Design Office “Yuzhnoye” has created a carrier rocket Zenit 3SL, which with great accuracy puts into orbit a payload of 13740 kilograms [Biographies, 2019].

Vladimir Chelomey, (1914-1984), was born on June 30, 1914 in Siedlec, Poland. Soon his family moved to Kyiv, where he received secondary and higher engineering education. During World War II, he was Director and chief designer of plant № 51, where he developed aircraft shells (an analogue of the German V-1). In 1955, a special design Bureau-52 was created, the chief designer of which became Vladimir Chelomey. There cruise missiles were created, the wings of which — for the first time in the world — opened in flight. He was also the first to introduce the mortar launch of ballistic missiles from containers. Developed under his leadership, the UR-500 proton launch vehicle can put satellites weighing up to 22 tons into orbit, and stations weighing more than 5 tons on interplanetary routes [Gorbulin, 2014].

Alexander Nadiradze (1914-1987), was born in Georgia. He was the chief designer of mobile intercontinental complexes with solid-fuel ballistic missiles. In the Soviet classification “Pioneer” 15P645K with a missile 15ZH45 (RSD-10), in the Western classification SS20. He died on September 3, 1987, and on December 8 this same year presidents of the US Ronald Reagan and of the USSR Mikhail Gorbachev signed Treaty about eliminating of average and a lesser range missiles, that led to full destruction of all missiles — “Pioneer” created by designer Alexander Nadiradze [Dohovir, 1987; Pro realizatsiyu, 1994]. Although created during his lifetime Topol RS-12M (15P158) missile system was successfully adopted by the strategic missile forces of the armed forces of the Soviet Union after the death of the chief designer on December 1, 1988. Its development began in 1977 in accordance with the Resolution of the Council of Ministers of the Soviet state № 212. This complex is armed with a three-stage solid-propellant intercontinental ballistic missile 15ZH58 in the NATO SS22 classification. The maximum range of the missile is 11,000 km [RS 12M, 2019].

Consequently, the vast majority of the leading designers of rocket technology in the Soviet era were of Ukrainian origin. It was thanks to them (Sergei Korolev, Valentin Glushko, Mikhail Yangel, Vladimir Chelomey) that the majority of launch vehicles were created, both for the military and for peaceful space. The first satellite and the first man were launched into outer space, the orbital stations reached Moon, Venus, Mars, etc. The legal activities of the special design bureaus, which they headed, were regulated by the common sublegislative normative legal acts of the Communist party and the government. A significant part of these designers were illegally repressed by the Soviet regime.

Sublegislative normative legal regulation of the space industry in the Soviet country and the role of design bureaus and enterprises located in Ukraine in this process

As noted above, the Soviet state did not create a single national space law. All legal regulation as for the development, construction, testing and operation of missile technology was carried out on the basis of sublegislative normative legal and regulations and administrative acts.

The beginning of such regulation practically became the top secret resolution of the Council of Ministers of the Soviet state of May 13, 1946 № 1017-419 “About questions of jet weapons”.

The document provided the establishment of a special Committee on jet technology under the Council of Ministers, as well as research institutes, design bureaus and testing grounds on this topic. These included the special Design Bureau of the Research Institute № 88, at which in August of the same year the Department № 3 was formed for the development of long-range ballistic missiles under the leadership of Sergei Korolev, which eventually became the special Design Bureau № 1 (OKB1) [Baturin, 2017].

In Ukraine, on the basis of an administrative act, which was implemented through the order of the Minister of the armed forces of the Soviet state, the machine-Building plant № 586 in the city of Dnipro, was reorganized on May 10, 1952 into the southern machine-building plant № 586. At this plant, mass production of combat strategic missiles was started. There in the city of Dnipro, in April, 1954 the Special design Bureau № 586 — future design “Southern” Bureau was formed. And after 5 years of their joint development — medium-range rocket R-12 on high boiling fuel was adopted by the Armed forces of the Soviet state [The Legend, 2013]. In 1962, the first Ukrainian satellite Kosmos-1 was put into orbit by the carrier rocket 63S1 Kosmos, and in 1980 flight tests of the heavy carrier rocket Cyclone-3 were completed. However, the main segment of the design and production of missile technology in Ukraine in that era were military orders.

Over time, OKB-1 under the leadership of chief designer Sergei Korolev was tasked to develop several types of spacecrafts. On May 22, 1959, Resolution № 264 of the Council of Ministers “on the preparation of man for space flights” was issued. In it the deadlines of conducting of first selection into the team of Soviet cosmonauts were defined, and also performers and order of works on creating experimental ship-satellite, which should become the basis for the development of manned ship for man flights into space [Zheleznyakov and all, 2002]. December 10, 1959 the resolution of the Council of Ministers of the USSR № 618 “On the creation of automatic interplanetary stations for landing on Moon, flights to Venus and Mars” was adopted.

Further, on June 4, 1960, the Council of Ministers issued Resolution № 238 “On the implementation of the plan for the exploration of outer space for 1960 and the 1st half of 1961”. On June 23, 1960, the Council of Ministers issued Resolution № 296 “On the creation of powerful launch vehicles, satellites, spaceships and the exploration of outer space in 1960-1967”. In this resolution, the first attempt was made at the highest level to approve the program for the development of Soviet cosmonautics in the form of a seven-year plan. In 1962, work began on the design of the Soyuz rocket and space complex for a manned flyby of Moon. These works were legalized by the resolutions of the Council of Ministers № 160 of April 16, 1962 and № 435 of December 3, 1963, on September 24, 1962, the Resolution “On further exploration of Moon” was issued. It fixes the decision to land a Soviet cosmonaut on Moon [Malkov, 2001].

In addition to the program for the development of Moon, the Soviet state worked out projects of manned flights to the nearest planets: Mars and Venus. Implementation of these projects in some cases was carried out according to the orders of special ministries. So on July 30, 1969 the Minister of the Ministry of General mechanical engineering signed the order № 232 “About development of a rocket and space complex that provides expedition to Mars” [Malkov, 2001].

In the second half of the 70-ies of the XX century, space activities for the exploration of space and celestial bodies in the Soviet country began to be carried out not as intensively as before. In connection with the desire to restore and enhance the activities on space research,

Solar system planets, their satellites the Commission of the Presidium of the Council of Ministers on military-industrial issues adopted on 1 August 1983 resolution № 274 “On the development of unmanned spacecraft to study planets of the Solar system, Moon and outer space”. According to it, it was entrusted to conduct the research and development work on the creation of a mobile device for the study of the Mars satellite-Phobos [Malkov, 2001].

Consequently, the legal regulation of the space industry in the Soviet state was carried out on the basis of sublegislative norms and administrative acts of the Soviet government and ministries, primarily the Ministry of defense. The special design Bureau № 586 (the future Pivdenne design Bureau) and the southern machine-building plant № 586 were established by normative and administrative acts. They specialized in the design and manufacture of medium-range liquid-propellant military missiles and light-class launch vehicles to launch satellites into low-earth orbits on high-boiling fuel. Subsequently, the designers and missile manufactures mastered military ballistic missiles of heavy class, which after their removal from service were used as launch vehicles to launch satellites.

Legal regulation of the space industry in Ukraine in the first years of independence of Ukraine

Ukraine as a state became independent in 1991. All spheres of public life, including the legal regulation of the production and launch of launch vehicles and satellites at the level of international space law began to be regulated also by domestic legislation. During the first decades of independence, more than 150 launch vehicles and 375 spacecrafts were launched into space. One of the greatest space achievements of Ukraine was the creation of powerful spacecraft and launch vehicles. For example, such satellites for remote sensing of the earth as “Sich”, carrier rockets “Dnipro” and “Zenit-3SL”, as well as “Cyclone-3”. On August 1, 1995, the first Ukrainian artificial research satellite “Sich-1” was launched into low-earth orbit. And the launch was carried out with the help of the Ukrainian carrier rocket “Cyclone-3” [Ishchenko, 2018].

In 1996, the first Law of Ukraine “Aboutn space activities” came into force, which defines that space activities are scientific space research related to the creation and application of space technology, the use of outer space. State regulation and management in the sphere of space activity in Ukraine are carried out by legislative establishment of the basic principles, norms and rules of space activity, introduction of licensing of such activity, etc. [Pro kosmichnu, 1996]. The main drawback of this law was that the creation, launch and operation of space equipment could be handled exclusively by government agencies and enterprises. This led to the fact that the space industry of Ukraine did not receive private investment, as a consequence — to its decline. So the state budget totally lacked funds for the implementation of space programs. Only on October 2, 2019 it was corrected according to the Law of Ukraine №143-IX “About modification of some laws of Ukraine concerning the state regulation of space activity” [Pro vnesennya zmin, 2019]. In which it is specified that scientific researches, development, production, operation, ensuring start-up and return of space vehicles can be carried out by the establishments and the organizations of any form of ownership and organizational-legal form. This opens up significant opportunities for private investors to use the space potential that is available in Ukraine.

Thus, the new national space law provides the space industry of Ukraine with a new chance for development through private investment.

Conclusions

When analyzing the history of space activities, the current situation and forecasting the future of the space state, the world community and all our civilization on Earth and beyond, the prospects of space humanity, we deal with complex conceptual, legal, socioenvironmental, digital and other models of the past, present and future. The adequacy and reliability of promising models of the space activities and the cosmic future of humanity raise doubts in comparison with the complex real global socio-political processes, trends and threats to human life on Earth in the 21st century [Krichevsky & Udartsev, 2019 : 31].

In the article we have revealed the historical and legal aspects of the heyday and decline of the space industry of Ukraine when it became part of the Soviet state and in the first years of independence. The issues of the phenomenon of space technology in the Soviet Ukraine, features of the international legal and national regulation of research and use of outer space at the time were clarified. The authors stressed that the new space law of Ukraine (2019), provides significant opportunities for private investors. In the following articles we will pay more attention to the latest national space legislation of Ukraine.

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Global Administrative Law and Regulation of Extraction of Minerals in Outer Space

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Entrepreneurship is one of the areas of space exploration. The steadily growing number of types of space entrepreneurship, the risk increases that some of them will remain outside the legal framework. The aim of the study is to analyse the state of affairs in legal regulation of extraction of minerals in outer space, evaluate its shortcomings and propose new means of regulating this type of business relations. The authors hypothesize that it is expedient to exercise legal regulation of extraction of minerals on celestial bodies and their import to Earth by the provisions of global administrative law. In addition, it is proposed to create a global administrator of space resource relations. It should be provided with a set of legal means that will ensure regulation of social relations in this field to avoid threats to the world market from the uncontrolled supply of space resources to Earth.

Keywords: mineral deposits; space entrepreneurship; global administrative law

Received: September 01, 2019; accepted: October 07, 2019

Advanced Space Law, Volume 4, 2019: 125-136.

<https://doi.org/10.29202/asl/2019/4/12>

Introduction

The first space object (Elementary Satellite-1) was launched into outer space by the Soviet Union on October 4, 1957. This date can be considered the beginning of active exploration of space by man. The importance and significance of space activities for all humanity required its legal regulation at the international level. In 1959, the UN Committee for the Peaceful Uses of Outer Space was established and it is still in force. Its legal subcommittee has played and continues to play an important role in shaping international space law. The basic international instrument to regulate space relations is the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 12 January 1967 (hereinafter the Outer Space Treaty). Ukraine is one of the first States to ratify it. It happened on May 22, 1967.

Since 1957, space exploration and space activities have been conducted in two different areas. First, it is activities related to space exploration. Second, these are various forms of

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military activities. Accordingly, the vast majority of the legal provisions enshrined in the Outer Space Treaty regulate relations formed during scientific and military activities in outer space: some of these provisions restrict the military use of space to some extent and the other encourage cooperation in research activities. In addition, the Treaty contains provisions governing specific practical issues of space exploration (defines the principles of jurisdiction over space objects, establishes the procedure for compensation for damage caused by space activities, establishes obligations to assist astronauts, etc.)

However, in a little while the third area of space activities began to form, which is space entrepreneurship, entrepreneurship in outer space or the use of space for commercial purposes. The Outer Space Treaty never explicitly mentions the possibility of this space activity, but does not impose any prohibition on it. Therefore, the International Organization of Space Communications “Intersputnik” of November 15, 1971 refers to the commercial use of the space communication system by means of the space complex (Article 5) and the procedure for distribution of profits that may be obtained from such commercial use between the members of the organization (paragraph 9 of Article 15). The subjects of commercial activity are States, but this does not change its essence.

Directions for the use of outer space for commercial purposes

Total entrepreneurship in outer space is constantly growing, though not very fast. Now it is possible to mention the presence of the areas (types) of the use of outer space for commercial purposes: (a) commercial satellite communication; (b) commercial satellite television; (c) commercial use of satellite land remote sensing; (d) commercial use of global satellite navigation; (e) space research (experiments) for commercial purposes; (e) etc. They all are about the use of spacecraft, mainly satellites, to provide high-tech services related to the collection, processing and transmission of information. For a long time, the term “space technology” is used to refer to the latest, high-tech developments of guaranteed quality. Frequently, States or their bodies continue to be the subjects carrying out commercial projects.

Recently, however, there have been significant changes in the use of outer space for commercial purposes. The results of scientific research and technological development enables to “materialize” it. As mentioned above, until recently space entrepreneurship has focused solely on providing sophisticated information services to consumers and individuals of Earth. At present, a commercial activity related to tangible objects in outer space starts. First, it is the services of moving such objects in space, as well as importing and exporting them beyond Earth.

The beginning of this process should be identified with the emergence and development of space tourism. Contrasting others, this type of entrepreneurship is not related to the transfer or processing of information, but involves the paid transfer of an individual in space. The payment is very high that is why there have been only about 10 people to use tourist service for 19 years. Due to the limited interest in the phenomenon, legal regulation of space tourism at the international level has not taken place. At present, issues related are governed by the legal regulations of national law, using the specific provisions of international treaties. However, tourism in outer space is developing, gradually “pulling” other types of terrestrial entrepreneurship. For example, Orion Span plans to launch the first space hotel in late 2021. However, over the next 50 years, the impact of space tourism may not have a significant impact on the world economy.

Another matter is the extraction of material resources (minerals, water, etc.) from the moon and other celestial bodies. At present, minerals are not extracted outside our planet, but scientific developments aimed at ensuring the implementation of such activities are at the final stage. The authors will not study this problem further, however, it should be noted that Planetary Resources, Moon Express, SpaceX, Blue Origin and other, mainly American, companies are concerned with the development of space exploration technologies. The Grand Duchy of Luxembourg has provided the space industry with ideal terms and significant investments at the State level [Luxembourg, 2019].

Extraction of minerals on celestial bodies as a space business

From a legal perspective, the extraction of minerals on celestial bodies and in outer space requires a considerable number of complex issues to be solved. This is due to the absence of special international legal treaty that would regulate space entrepreneurship in general and mining in outer space in particular. With regard to the basic document of space law, the Outer Space Treaty, the rules of its provisions are contradictory leading to more confusing than solving the problems. For example, Article 2 provides for that outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means. However, outer space shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality, and there shall be free access to all areas of celestial bodies (Part 2 of Article 1). Comprehensive analysis of Articles 6 and 7 indicates that the use of outer space can be carried out both by the State itself and by private legal entities registered therein (in the Treaty referred to as “non-governmental entities”), whereby the State bears some responsibility for the activities of such legal entity.

The authors argue that in the context of the study, these provisions should be interpreted as follows: governmental agencies and private entities may carry out the exploitation and extraction of minerals in outer space with the permission and under the supervision of the State, therein they are incorporated. Despite the fact that no sovereignty of the curatorial State extends to the territory of the celestial bodies where the minerals are mined, but only its permission. However, this position contradicts the Preamble and Part 1 of Article 1 of the Treaty, according to which the use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind. In relation to commercial extraction of minerals from the celestial body, the state of affairs reveals that outer space, in particular the interior of the celestial body, is used in the commercial interests of an individual State or its private legal entity due to their economic and scientific dominance over other countries and may cause some harm to humanity.

Primarily, the potential harm to humanity means that transporting to Earth certain, less common (“rare-earth”) and other, more common, elements for commercial purposes can lead to uncontrolled and unpredictable changes in the markets of mineral deposits, significantly affecting the course of economic processes and causing severe crises in different economic sectors. This thesis can be confirmed by the following calculation. According to the World Bank, the total gross product of planet Earth was about USD 85 trillion [GDP, 2019]. At the same time, according to John Lewis, professor of astronomy at the University of Arizona, the estimated value of resources that can be mined on a single asteroid (3554), 2.5 km in diameter,

is about USD 20 trillion (one quarter of the world gross product in 2018): USD 8 trillion — iron and nickel, USD 6 trillion — cobalt, USD 6 trillion — platinum and other platinum group metals [Khvostik, 2018]. That is, the value of one asteroid will far exceed the value of all mineral deposits sold for a year in the world. It is impossible to foresee and predict the effects of the resources inflow from other planets to Earth, since no analogues have happened in the world history. A long way off is the bankruptcy of Spain, caused by the importation of gold from the New World.

However, the resource exploitation in space is a progressive phenomenon, and progress cannot be stopped by prohibitions and restrictions. Therefore, the space mining activities require regulation so that it does not lead to the collapse of the world economy and provides a positive effect not only for the individual producer, but also for all humanity. There are a number of important issues to address, such as:

- who has the right to extract minerals in space;
- which permit document provides grounds for such activities to be carried out; who and in what order issues this document;
- who and how controls the resource exploitation in space;
- what instruments are in place to protect the earth's resource markets from "space dumping";
- in what manner the positive impact of the space mining industry on the entire Earth's population is ensured.

It should be emphasized that the regulation of mining outer space resources is an extremely serious challenge for the international community. This is due to its possible significant global effects, both positive and negative.

At first glance, it seems obvious that the regulation of relations aimed at protecting the interests of all countries of Earth, and humanity as a whole, shall be governed by legal rules enshrined in international instruments. To authorize individual States to resolve them is not appropriate, since there is a high risk that the latter will be governed by national, before all economic and security, interests, and then by interests of other countries and the planet Earth community.

However, is it objectively possible to adopt international treaties that would address space commerce? It is doubtful due to the following. As mentioned above, more than 100 States have ratified the basic international treaty on space activities, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 12 January 1967. In thirty countries, this Treaty has been signed and not ratified.

The Convention on International Liability for Damage to Space Objects was ratified in 1972 by 89 countries only, and a few more were signed and not ratified.

The 1974 Convention on Registration of Objects Launched into Outer Space was ratified by even fewer states, 64 in total.

In 1979, the Agreement Governing the Activities of States on the Moon and Other Celestial was approved, which, by the way, could address a number of issues regarding extraction of outer space minerals. However, in 40 years, only 16 (!!!) States have ratified this Agreement.

Therefore, the authority of international acts regulating legal relations in space activities is not too high. The reluctance of particular States to accept restrictions in a promising and attractive (including commercially) area is evident.

Consequently, there was an attempt to regulate public relations in space mining by national law. In 2015, the United States adopted the Commercial Space Launch Competitiveness Act,

which formally and unequivocally legalized the possibility of extracting minerals in outer space (on celestial bodies) by private companies and securing property rights of mineral deposits extracted.

This initiative has caused global community's controversy. For example, at the meetings of the UN Committee on the Peaceful Uses of Outer Space, the view was expressed that the adoption of such a law is an American way of unilaterally violating international space law [A/AC.105/C.2/2016/TRE/L.1., 2016]. A number of legal scholars have come to similar conclusions. They argue that the Outer Space Treaty provided the basic principles of international space law, and the US violated these principles [Oduntan, 2015; Benett, 1988; de Selding, 2015]. While no unity exist in regards to which principles are violated, the conclusions are based on a private interpretation of certain provisions of the Outer Space Treaty. Their opponents disagree. They mostly argue that the adoption of the Law does not contradict the provisions of the Treaty, but harmoniously develops them and fills the gap that come from unregulated private rights and interests in the process of space exploration [Masson-Zwaan & Richards; Rummel, 2015; Koerth-Baker, 2015]. Moreover, their statements are based on private text interpretations of the main source of space law.

The authors will not participate in the discussion, but note that it is based on legal speculation around the provisions of a legal regulation substantially outdated. Moreover, another factor is important. Obviously, the US Commercial Space Launch Competitiveness Act has ushered in an era of national regulation of commercial mining activities in outer space. In 2017, a similar law was adopted by the Grand Duchy of Luxembourg. The adoption of similar laws by other spacefaring nations is a matter of time.

Therefore, the intermediate conclusions are:

First, the beginning of extraction of minerals in outer space is a matter of the coming decade.

Second, this type of activities should be regulated in detail to prevent uncontrolled effects on planet Earth's economy.

Third, the space mining industry regulation by the rules of international law is almost impossible, due to the lack of spacefaring nations' concern.

Fourth, the space entrepreneurship regulation by national law can lead to a state of affairs that activities in outer space, common to all humankind, will be regulated by each State independently, contrary to the provisions of other States.

The place and role of global administrative law in space mining

Therefore, it is precisely in this critical situation, the concept of global administrative law can be applied. By definition, global administrative law is a combination of legal rules, principles and institutional norms applicable to the administration process, related to more than purely national structures of legal and political authority. Professors Kingsbury and Donaldson emphasize that its specificity is that this law is the framework for administering within what might be thought of as a global administrative space, the existence of which contributes to blurring of national and international, public and private dimensions [Kingsbury & Donaldson, 2011]. Sometimes, global administrative law is placed in an area governed by administrative law outside the state [López, 2018]. This is phenomenon in our case. Victoriya Pugach argues that within the concept of global administrative law, administrative activity can be implemented outside national regulatory framework, while the status of administrative

bodies can be acquired by global and transnational institutions [Pugach, 2019: 76]. This is fully consistent with the challenges that space entrepreneurship poses to humanity.

Legal regulation of mineral extraction in outer space should begin in the absence of any experience, based on projections and assumptions. Certainly, the space resources law regulations, adopted for the first time, will contain a significant number of flaws and shortcomings, and will require constant changes and clarifications. The amendments can be ensured only through a specially authorized entity, the global space resources administration body. Here it would be appropriate to mention the opinion of Georgios Dymitropulus. In his work, he argues that contrary to the traditional (national) understanding of administration, global administration is largely a rule-making activity [Dimitropoulos, 2011]. In this case, granting a global space resources administration body with sufficient rulemaking authorities will ensure dynamism and effective regulation, unachievable if an international treaty is applied.

This body can be formed in different ways: on the basis of an international treaty, on the basis of an intergovernmental agreement of spacefaring nations, as a UN agency, like the World Postal Union, as an open association of entities engaged in the mining industry in space, as an association under the aegis of international organization, etc.

It is particularly attractive to establish this global administrator on the basis of, or having regards to the work of the Hague Space Resources Governance Working Group. This body is international. It was founded on December 1, 2014 by the results of a roundtable at the Hague Institute for Global Justice. The roundtable was attended by experts from many countries around the world, moreover, representatives of the leading companies of the space and aerospace industry took an active part in the work. Many of them are part of this group, which is focused on stimulating the process of international legal settlement of the extraction of resources in outer space [A/AC.105/C.2/2018/CRP.18., 2018].

Nowadays, the Hague International Space Resources Governance Working Group continues work and it has already proposed the Draft Building Blocks for the Development of an International Framework on Space Resources Activities [Draft, 2018]. This act is purely advisory. According to its analysis by Russian researcher Svetlana Popova, it is interrelated with the US and Luxembourg legal provisions mentioned above, moreover, the purpose of the Draft is to legalize the economic feasibility of commercializing space resources activities, supported by a number of States, which involves the realization of the principle of freedom of access to these resources and the property right of extracted or manufactured in situ in space [Popova, 208: 170].

This is confirmed by one of the participants of the Hague Working Group, English businessman Hunter-Scallion. He argues that the shortcomings of the legal framework on space resources activities have already become noticeable, and in this case, they should be addressed not only by lobbying for the adoption of the law on mining in space in the UK, but also in the international arena [GDP, 2019].

However, the implementation of this approach, as well as other options for international legal settlement of the problem seems unpromising. In addition, the Draft Building Blocks for the Development of an International Framework on Space Resources Activities mentions the appropriateness of forming an international body or bodies whose powers, however, are of a purely decorative nature. For example, another international non-functional bureaucratic body is being formed. Nevertheless, the Hague Working Group continues to work and it may reconsider its positions.

Therefore, it would be appropriate to empower a global space-resource administrator with regulatory authority.

With regard to the authorities to issue permits for the exploitation of minerals in outer space, registration of entities, engaged in entrepreneurial activity in this area, and the space objects through which such activity is carried out, they may be transferred to national agencies, provided that the latter will apply the legal rules of global administrator acts in their permitting and registration activities.

This approach will reduce the resistance of spacefaring nations against the creation of a global administrator and against the introduction of global regulation.

In its activities, the global administrator can use a variety of public administration mechanisms. For example, one of the well-known mechanisms traditionally used to protect domestic markets and ensure economic development is the customs policy and customs in which this policy is implemented. Now the Space Customs Law does not exist. This is because the subject matter of legal regulation is objectively absent. As it is known, customs law regulates public relations regarding the movement of goods across the customs border. These goods must be tangible objects. So far, tangible objects from celestial bodies have been brought to Earth quite rarely. The last time a major “import” operation was carried out by the Luna-24 space station in 1976. On the Internet, a photocopy of a customs declaration filed by American astronaut Neil Armstrong upon his return from the moon in 1969 can be easily found. Whether this document is original or one of the widespread fakes, it is unknown, but it is obvious that the return of the American expedition to Earth from another celestial body was one of the few cases where customs law was able to get involved in regulating space relations.

The reasons for this are as follows. In accordance with international agreements and law application, state sovereignty extends to the airspace delineated vertically through the state border. The upper boundaries of the airspace of the State remain unclear. There are various proposals for the “roof” of the country. Most of them are about 90 to 110 km above sea level. Though it seems paradoxical, the vertical limit of state sovereignty is undeniable even in the absence of a relevant international or national international-legal act. This is due to objective physical processes, namely the constant movement of planet Earth in outer space. Accordingly, airspace under the jurisdiction of the State, airspace that is not under the jurisdiction of any of the States and outer space have different legal regimes.

The movement of goods across the customs border, which almost coincides with the State one and its import into the customs territory of the State, is regulated by customs law. However, it should be considered that the State party to the Outer Space Treaty, on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. The rule is not stated quite clearly, but since space has not been engaged in manufacturing and trading activities for now, the law practice identifies the space object with the State territory. Accordingly, it is of no interest to the customs authorities in the event of its return to land.

It is a different matter when an item (tangible object), which is not contained in a space object when it is launched from Earth, is brought to our planet. The territory of the moon and other celestial bodies is not part of the territory of any of the States of the world. Accordingly, a tangible object imported from another celestial body to planet Earth is a commodity that moves across the customs border to the customs territory of the State.

This is how the Customs authorities regarded or had an opportunity to estimate the importation of stone and dust from the moon into their territory. The information on customs

declarations of imports from the celestial body by astronaut contains the idea that each State independently regulates its relations in customs affairs concerning the movement of goods across the customs border, and goods of space origin are no exception here. While customs law issues are not addressed by the US Commercial Space Launch Competitiveness Act, they generally reflect its ideas.

However, is this position justified? It seems that it is not. Properly established customs policy is a reliable mechanism for securing the protection of the earth's resource markets from "space dumping" and for shaping the positive impact of the space mining industry on the entire population of planet Earth. However, an individual State pursuing such activities, the space commercial entities registered therein, as mentioned above, will not be interested in a fair solution to these problems. On the other hand, space resources should be considered first and foremost as being imported to planet Earth and only after that as being released into the territory of a particular State.

Therefore, a global administrator should be in charge of formulating and implementing customs policy for the importation of space resources. This will enable to apply the tools known in customs law.

The super global projects are brand new and additional to the already implemented space activities (e.g. monitoring of the Earth's environment, telecommunication systems, etc.). They are urgent for the unification of the world community, the transition to a new quality of the process of space exploration aimed at the survival and development of mankind in the paradigm of the ultimate strategic perspective towards the Earth's protection, terrestrial civilization and space humanity establishment [Krichevsky, 2018: 101].

Conclusion

The mining in outer space will begin in the near future. These activities are not regulated by the provisions of international law and begins to be governed by the provisions of national law. This situation can lead to various (not just legal) conflicts over the property rights of extracted resources. In addition, the uncontrolled importation of minerals on planet Earth poses a serious threat to its economy. It is possible to counteract these challenges by using an instrument of global administrative law.

The creation of a global administrator in space resources should be central. The legal basis for its implementation is not significant. It shall address several important factors.

First, the global space administrator should be a completely independent entity focused on protecting and safeguarding the interests of planet Earth and its population in accordance with the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, as well as other international space law regulations.

Second, complete transparency and control of its activities should be ensured. This is required because the shift of regulatory influence from national to global bodies has initially complicated the mechanism of ensuring accountability and control of the latter, significantly reducing their responsibility to those who are subject to administrative influence. However, to address these challenges, the activities of global administrators get increasing regulation by administrative and legal standards, which include requirements for transparency, participation, validity of decisions, and the like. This should ensure accountability of the administrator and feedback.

Third, the global administrator shall be empowered with law-making authorities. The normative acts issued by him shall be obligatory for all entities engaged in space resources activities.

Fourth, special means of ensuring the authority of the global administrator should exist. This can be space arbitration, databases accessible to all space businesses, the promotion of space entrepreneurship, and the protection of space entrepreneurs' interests in national and international bodies.

Fifth, a global administrator in space resources shall be given some supervisory powers.

Properly organized customs can become one of the main mechanisms for securing the common interests of planet Earth's inhabitants and for controlling and regulating the impact on the world economy of importing space mineral deposits to our planet. It may include:

- limits for the import of specific minerals to Earth based on the needs and capabilities of local markets;
- quotas for the import of minerals during a certain period. It is difficult to determine the quota period without serious calculations. On the one hand, it should take into account the complexity of extracting and transporting goods from space, and on the other hand, it should ensure the dynamism and timeliness of regulation. The electronic tender for firms admitted as able to carry out exploitation and extraction independently is optimal for implementing quotas;
- customs duties on imports of space minerals and goods produced in outer space. This instrument will ensure that the prices of imported minerals are in line with the prices of minerals of the terrestrial markets. The purpose of customs duties should be not to collect maximum funds from the entrepreneur, but to protect the world economy from sharp shocks and price fluctuations;
- control of the importation of minerals and goods produced in outer space to Earth. The conformity of total goods delivered to the size of supply quotas shall be subject to control. Furthermore, characteristics of the goods, which may be dangerous to the population of the earth, shall be subject to inspection.

The application of these instruments requires a small number of workers, because in any case a rather limited range of business entities will be engaged in space resources activities for a long period.

For proceeds from the collection of duties and quotas for the supply of minerals to the earth, the manner of their use should be determined by an international treaty on establishing a global administrator. Reasonably, they shall be in accordance with Article 1 of the Outer Space Treaty. That is, the funds from extraction of minerals shall be used for the benefit of all countries, irrespective of their degree of economic or scientific development. Independently the global administrator is not capable of ensuring such missions to be performed that is why they should be implemented by recognized international organizations.

Therefore, three important questions remain open.

First, how should planetary (space) customs law relate to national customs law, or whether the minerals of space origin are to be subject to customs controls and customs payments at the national level?

Second, how and in what order should control over the activities of the global space resource administrator be implemented?

Third, how should relations be established between the global administrator and the States, which independently, without the involvement of private entities, will extract minerals in outer space (apparently the role can be assumed by the PRC)?

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Advanced Space Law, Volume 4, 2019

Academic Journal

Advanced Space Law, Том 4, 2019

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