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### LEGAL ASPECTS OF THE SPACE INDUSTRY DEVELOPMENT IN UKRAINE AND SPACE TOURISM IN PARTICULAR

**Лариса Марценюк. ПРАВОВІ АСПЕКТИ РОЗВИТКУ КОСМІЧНОЇ ГАЛУЗІ В УКРАЇНІ ТА КОСМІЧНОГО ТУРИЗМУ, ЗОКРЕМА.** Надано хронологію міжнародного космічного права. Проаналізовано основні аспекти основного документу міжнародного космічного права – «Договору про принципи діяльності держав з дослідження та використання космічного простору в мирних цілях». Проаналізовано українське законодавство стосовно розвитку космічної індустрії. Підкреслено, що аерокосмічна діяльність в Україні, окрім міжнародних документів, регулюється низкою національних законопроектів, серед яких основні: Закон України «Про космічну діяльність», Загальнодержавна цільова науково-технічна космічна програма України до 2023 року, Концепція реалізації державної політики у сфері космічної діяльності на період до 2032 року тощо.

Внаслідок хронічного недофінансування підприємств аерокосмічної галузі урядом України, галузь знаходиться в занедбаному стані. Разом з тим, Україна володіє науковими, інженерними та виробничими потужностями для розвитку космічної індустрії, а отже, має всі передумови для виведення цієї галузі з кризи.

Досліджено системні проблеми сучасної авіакосмічної галузі України. Запропоновано дієві заходи виведення космічної галузі з кризи. Серед першочергових заходів відродження космічної індустрії – перетворення підприємств космічної сфери в акціонерні товариства, а також узгодження управлінських функцій між центральними органами виконавчої влади. Також потрібно просувати корпоратизацію державних підприємств, що дозволить залучити вітчизняних та іноземних інвесторів для широкого кола проєктів.

Наголошено, що одним із напрямків комерціалізації космічної діяльності, який останнім часом активно розвивається, є космічний туризм. Надано історичний аспект розвитку космічного туризму як принципово нового продукту на світовому ринку туристичних послуг. Виявлено основні переваги та недоліки космічного туризму.

Запропоновано створення у межах державно-приватного партнерства компанії з орбітального сервісу.

**Ключові слова:** космічна галузь, напрями розвитку космічної галузі, аерокосмічна галузь, космічний туризм, польоти в космос.

**Relevance of the study.** Space exploration, on the one hand, is an opportunity for countries to develop their economies, and on the other hand, it is a significant limitation due to the high cost of space launches.

One of the areas of commercialization of space activities, which has been actively developing recently, is space tourism. Space travel is a flight into space or Earth orbit for entertainment or research purposes, paid for with private funds. Unlike other types of tourism, participation in space tours requires good health from tourists.

Ukraine has scientific, engineering and production facilities for the development of the space industry, but does not even have its own satellite in orbit.

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The extent to which current legislation in Ukraine supports the space industry in Ukraine, and space tourism in particular, will be discussed in this article.

**Recent publications review.** Recently, materials on space tourism have become more common in the scientific literature [1-3]. Thus, the scientist Ignatov in [4] points out that in the coming years there should be a differentiation of space tourism by cost, with promising are suborbital travel, which can be organized at much lower prices than orbital tours and expeditions. So far, space tourists can stay on the ISS, but in the near future it is planned to build space hotels. The greatest interest for space travel, and, accordingly, have great commercial interest – is the Moon and Mars [4, p. 343].

The idea of space tourism was first reflected in the works of Barron Hilton and Craft Eric, published in 1967. They first proposed the idea of commercializing space, but it never succeeded.

Space tourism began to develop actively in the late twentieth century. In 1986, a report «Possible Economic Consequences of Space Tourism Development» was presented at the International Congress of Astronautics. Fifteen years have passed and in 2001 the first tourist visited space.

Currently, 2 companies are organizing space flights of tourists: the American «Virgin Galactic» and the Russian-American «Space Adventures». With the help of these companies, seven tourists have already visited space: April 28 – May 6, 2001 – Dennis Tito; April 25 – May 5, 2002 – Mark Shuttleworth; October 1-11, 2005 – Gregory Olsen; September 18-29, 2006 – Anushe Ansari; April 7-21, 2007 – Charles Simony; March 26 – April 8, 2009 – Charles Simony; October 12-24, 2008 – Allen Gerrio; September 30 – October 11, 2009 Guy Laliberte. The trip cost tourists from 20 to 35 million dollars.

Space tourism is gaining momentum. Thus, the company «SpaceX» has signed a contract with the American space tour operator «Space Adventures» for tourist flights. From 2021, the company plans to resume tourist flights on Russian spaceships. Two tourists will go to the International Space Station (ISS) on the Russian «Union». Tourists who wish to go into outer space will have to be prepared for a flight to Star City. Release into outer space will take 1.5 hours [5].

In 2022 it is planned to send 4 people into space. This flight will cost at least \$ 100 million. Tourists will fly on the SpaceX Crew Dragon space capsule, which is launched into space by the Falcon 9 rocket carrier. The capsule will travel two to three times farther from Earth than the orbit of the International Space Station. Tourists will be able to choose the duration of the trip.

The Crew Dragon capsule was designed to transport astronauts to the ISS, so the comfort inside the capsule is limited: all passengers have a common space for sleeping and hygiene with an area of 9 m<sup>2</sup>. Before departure, future space tourists will have to undergo a training course in the United States.

Virgin Galactic and Blue Origin also intend to offer space travel up to 100 km above the earth's surface. The American concern Boeing, which is developing a new Starliner passenger capsule to send astronauts to the ISS, also intends to provide travel services [6].

In 2015, the President of the United States signed the Competitiveness of Commercial Space Launches Act, which regulates aspects of the US commercial sector's participation in space activities, including space launch services and remote sensing satellite management.

In 2019, 60% of commercial space companies accumulated capital in the United States. Investors have invested more than three billion dollars in space development. Analysts at the investment Bank of America Merrill Lynch predict that by 2050 the world space economy will reach three trillion US dollars [7].

The US government has managed to create a successful commercial project, combining the interests of the state with the interests of business, which allowed in low orbits. It is not only curiosity but also business interests that inspire people to explore outer space.

For example, cargo delivery. According to the results of 2019, there were more than 2,000 satellites in Earth orbit. Every year their number increases by 15%.

A number of new companies are trying to get their piece of the pie in this market. The most famous – Elon Musk. Commercial launches have already been carried out by companies: SpaceX, Blue Origin, package Lab, OneSpace Technology.

Space tourism is one of the areas of potential decent income. One of the founders of space tourism is considered to be the British billionaire Richard Branson, the founder of Virgin Galactic. Another tourist pioneer – Orion Span, plans to open the first suborbital hotel Aurora

in 2024. The American company Virgin Galactic will make the world's first tourist suborbital flight. The cost of a ticket to space is \$ 250 thousand. And more than 600 people have signed up for the list of potential tourists.

Space tourism is an important area of activity for SpaceX and Blue Origin. In the near future, flights around the moon are planned, and in the long run – tourist landings on Earth and Mars. According to the UBS forecast, in 2030 the volume of the space tourism market will reach 3 billion dollars.

In addition to tourism, businessmen plan to get to asteroids, which consist of metals, including precious ones. Thus, according to American astrophysicist Neil Tyson, the first thriller will be a man who will begin to extract resources outside the Earth.

For example, the most expensive asteroid in the solar system, David, reaches a diameter of 326 km and consists mainly of nickel, cobalt and iron. This asteroid is estimated at \$ 15 quintillion. The cost of all asteroids between Mars and Jupiter, NASA estimates at \$ 700 quintillion.

In 2024, it is planned to land a NASA probe on asteroid 16 Psyche, the cost of resources on which is estimated at \$ 700 trillion. Similar studies are conducted by private companies, such as the British Asteroid Mining Corporation [19].

As for Europe, the development of the space industry is rather slow. Back in 1975, the European Space Agency (ESA) was established to implement joint space programs. Ukraine has signed a cooperation agreement, but no project has been launched yet.

In Europe, the principle of «geographical distribution» applies – the total budget is distributed among the participants, and they have no objective interest in attracting third-party companies. In Europe, there is also a growing interest in light rockets, which can quickly and inexpensively launch small satellites into low orbit.

**The article's objective** is to highlight the history and prospects of space tourism as a fundamentally new product in the global market of tourist services.

**Discussion.** One of the important elements of the reform of the National Police of Ukraine is the creation of The satellite systems of the leading countries in orbit provide telecommunications, climate observation, military espionage, surveillance of the oceans, rivers, forests, mining, and scanning of the Earth's surface for scientific purposes. This allows you to create optimal logistics in various fields. Today, the average launch cost is \$ 60-80 million, and the average cost of a satellite is \$ 2-3 million. Unfortunately, Ukraine does not yet have any satellite of its own.

Cooperation between states and international intergovernmental organizations in the field of space exploration has led to a separate branch of international law – international space law: a set of rules and principles governing relations between these subjects of international law in space, as well as establishing the legal regime of outer space and celestial bodies. Legal relations between the states – the subjects of space activities have become the basis for the formation of space law and have become an important component of the international legal system.

The chronology of international space law is as follows. On December 13, 1963, the UN General Assembly unanimously adopted the Declaration of Legal Principles for the Exploration and Use of Outer Space [8], and then on December 19, 1966, the draft «Treaty on the Principles for the Peaceful Exploration and Use of Outer Space», including the Moon and other celestial bodies. The Treaty on Space entered into force on October 10, 1967, its members are more than 120 countries, Ukraine – since October 31, 1967 [8; 9].

The significance of the Treaty on Space is that, for the first time in the history of astronautics, the basic principles of international space law were enshrined at the level of a multilateral international agreement: the study and use of space for the benefit of all mankind; equal right of all states to explore and use outer space; ban on national appropriation of space; compliance of space activities with international law; use of the Moon and other celestial bodies exclusively for peaceful purposes; international responsibility of states for all national space activities; international liability of states for damage caused by space objects, etc. [9].

Ukraine could become a country that sells space services because it has the ability to build rockets and spacecraft on its own. But this requires the support of the authorities. For comparison: the budget of Roscosmos (excluding military programs) for 2020 amounted to almost \$ 2.5 billion, the budget of NASA – \$ 25 billion, and 5-year spending on the space industry of Ukraine – only \$ 877 million.

The Law of Ukraine «On Space Activities» [10] identifies the following principles of space activities: government regulation; state support for the commercialization of space activities and attracting investment in the space industry of Ukraine. Space activities in Ukraine are

carried out on the basis of the National Targeted Scientific and Technical Space Program of Ukraine, which is developed for five years and approved by the Verkhovna Rada of Ukraine on the proposal of the Cabinet of Ministers of Ukraine. The Law of Ukraine «On State Support of Space Activities» states that funds for financing space activities for state needs are allocated in the State Budget of Ukraine in separate lines [11].

In order to form the state space policy and create its own state structure of enterprise management, in 1992 the National Space Agency of Ukraine (since 2010 – the State Space Agency of Ukraine) was established with the status of a central executive body, which ensures the formation and implementation of state policy in space [12].

The draft National Targeted Scientific and Technical Space Program of Ukraine until 2023 provides for three options for achieving the goals. The first option involves minimal financial and political support from the state, attracting small amounts of extrabudgetary resources. The second option is to conduct space activities on a commercial basis with a purely regulatory function of the state. The third option: attracting foreign investment together with financial support from the state. At the same time, the state retains full control of the space sphere [13].

The Concept for the implementation of state policy in the field of space activities for the period up to 2032 states that the main reason for the recession in the industry is the long-term lack of effective state support [14]. The concept identifies the following areas of development: ensuring the development of space technology; increase of scientific and technical potential; improvement of rocket and space technology; implementation of effective industrial policy and modernization of production; ensuring the commercialization of space activities; deepening international cooperation. The government's lack of awareness of the importance of developing high-tech enterprises leads to ineffective state regulation of the space industry. The mechanism of cooperation between the state and commercial space does not have a development strategy that affects global competitiveness [15].

International comic law does not define the role and ways of interaction with commercial companies. The legal aspects of the mechanism of state regulation of the space sphere are not agreed at the international level. This slows down technological progress, leads to unbalanced access to technology, information and knowledge of the population. Such inconsistencies may cause conflicts in the geopolitical arena in the future [16].

The space industry in Ukraine belongs entirely to the state. Ukraine has a State Space Agency and a National Space Program, but their funding is limited or non-existent. For example, the leading space company – the design bureau «South» – in 2018 received from the budget of UAH 50 million, in 2019 – zero. Due to the fact that the KB participates in various space programs abroad, the company is still operating. Currently, three spacecraft are being assembled in the shop. The first of them – at its own expense – the satellite «Sich-2-1» for remote sensing of the Earth. The satellite will be presented to Ukraine, it will be the first device that will control the entire territory of the country. The second satellite is Sich-2M, of the highest class. The third – «Microsat-M», a scientific device that will help predict earthquakes [17].

In October 2019, the Law №1071 on the support of the space industry was adopted, which opened opportunities for joint work of the public industry and private companies or customers. Verkhovna Rada of Ukraine is considering the possibility of creating an industrial park on the basis of Pivdenmash on the model of Silicon Valley.

In June 2020, experts from the Ministry of Economy discussed ways to bring the domestic space industry out of the crisis, in particular, planned bills that provide for the transformation of space enterprises into joint stock companies, as well as coordination of management functions between central executive bodies.

For the further development of the industry should promote the corporatization of state-owned enterprises, This will attract investors for a wide range of projects, including the organization of space tourism.

**Conclusions.** The coronavirus pandemic has highlighted the need to create our «bases» outside the Earth, which will be a kind of insurance to preserve the achievements of terrestrial civilization and the human gene pool. Systemic problems of the modern aerospace industry of Ukraine are: a sharp decline in recent years, the role of Ukraine as an equal partner in international cooperation, mainly the role of supplier of individual elements and components; lack of state order; lack of a transparent mechanism for attracting private investment in the aerospace industry; non-systematic revenues from international contracts.

In order to revive the space industry in Ukraine, it is necessary to: reorganize state-

owned enterprises in the space industry in Ukraine; creation of scientific, technical and industrial parks with the participation of aerospace enterprises, design bureaus and research institutes; introduction of the annual State Space Order system; resumption of aerospace education programs in Ukraine for staffing the industry; creating conditions for the formation of public-private partnership in the aerospace sector; focus on the markets of countries seeking to join the club of aviation and space countries of the world; expansion of the network of foreign representations in the aerospace industry [18].

We live in the era of the birth of suborbital space tourism. The advantages of space tourism development are: maintaining competitiveness in the space technology market; development of new technologies of space engines; profits from the launch of satellites into orbit on our launch vehicles. The disadvantages of space tourism include: significant costs for training and sending people into space; lack of possibility to develop spacecraft without the participation of other countries, etc. In the future, it is possible to create an orbital service company within the framework of a public-private partnership.

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### Abstract

The author has provided the chronology of international space law and analyzed the main aspects of the main document of international space law – «Treaty on the principles of activities of states in the exploration and use of outer space for peaceful purposes». She has analyzed the Ukrainian legislation on the development of the space industry.

Due to the chronic underfunding of aerospace enterprises by the Ukrainian government, the industry is in a state of disrepair. At the same time, Ukraine possesses the scientific, engineering and production facilities for the development of the space industry, and therefore has all the prerequisites for bringing this industry out of the crisis.

The author has identified problems of the aerospace industry in Ukraine. She has proposed effective measures to take the space industry out of the crisis, Among them: transformation of space enterprises into joint-stock companies, coordination of management functions between central executive authorities.

A special attention has been paid to space tourism. The historical aspect of the development of space tourism is provided. The main advantages and disadvantages of space tourism are revealed. The author has proposed to create an orbital service company within the framework of a public-private partnership.

**Key words:** *space industry, directions of development of the space industry, aerospace industry, space tourism, space travel.*