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Space Tourism: the Emerging Industry of the World Economy

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ABSTRACT

Relevance of the research topic: currently, space is considered as a new economic resource, the use of which can generate profit for companies that have access to it. The participation of private capital in space exploration contributes to the search for new business niches and the formation of new economic sectors, one of which is space tourism. **The purpose of the article** is to study the current state and development trends of a new branch of the world economy – space tourism. To conduct the study, general scientific methods were used: analysis, synthesis, deduction, comparative analysis, generalization, as well as special scientific methods: structural analysis, statistical method, grouping method, graphical method and SWOT analysis method. A review of scientific publications on the problems of space tourism development allowed the author to propose his own definition of this phenomenon and identify its main features at the present stage of development. The author identified and analysed the main types of space tourism (orbital, suborbital, lunar and stratospheric), identified the main participants in the global space tourism market, conducted a comparative analysis of the technologies used to provide services for sending tourists into space, and conducted a SWOT analysis of the development of the global space tourism industry, he also analyzed the state of space tourism in Russia. The results and conclusions of the article are of interest to researchers studying the development of economic sectors related to space activities, as well as to government agencies whose decisions affect the development of the space industry in Russia.

Keywords: space tourism; orbital tourism; suborbital tourism; lunar tourism; spacecraft aircraft; cost of space flight; space travel market; space technology

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INTRODUCTION

Space tourism as a branch of economy is still at the stage of formation. The time of its emergence can be considered 2001, when American multi-billionaire Dennis Tito made the first commercial flight into space. Until now, such flights remain very expensive and are available only to wealthy citizens. Nevertheless, the emergence of a number of private companies: SpaceX, Virgin Galactic, Boeing and Blue Origin, competing with each other, gives confidence that gradually the price of flights will decrease, and space tourism will become accessible to the majority of the Earth's inhabitants.

The theoretical basis of the research was the works of Russian and foreign scientists in the field of space tourism; the empirical base was the data of marketing reports of foreign companies: Polaris Market Research, Market.Us, Maximize Market Research, Precedence Research, Maximize Market Research, Vantage Market Research, as well as statistical data of Statista platform, which are in the public domain.

APPROACHES TO THE DEFINITION OF THE TERM "SPACE TOURISM"

The scientific literature has not yet developed a single definition of the concept of "space tourism". In this regard, the author considers it necessary to note some approaches to the interpretation of this term. A very simple definition was proposed by Sam Cole: "Space tourism is a term that has come to be used to denote ordinary members of the public who buy tickets to travel to space and back" [1, p. 133]. Here the emphasis is placed on the participant of the flight (he/she is not a professional astronaut), as well as on the source of funding for the trip (the participant buys the tickets himself/herself, which distinguishes him/her from astronauts, who not only do not pay for their flight into space, but are paid for it by national space agencies), but the purpose of the event is not taken into account.

Most often in scientific literature space tourism is considered through the target characteristic — as flights into space for entertainment or recreational purposes, paid from private funds [2–5]. A slightly broader interpretation is given by A.M. Yazici and S. Tiwari: "Space tourism is a commercial service provided by publicly funded organisations or private companies to their customers for their travel to space for various purposes such as recreation, business and research" [6, p. 40].

A.B. Zheleznyakov rightly points out that not every "space flight" is such in essence, in particular, travellers who only briefly "touch" the boundary of space at an altitude of 80 km or slightly more, he proposes to call "mesonauts", and "space tourists" — is applicable only to those who go into orbit around the Earth [7, p. 56].

V. Yu. Adygezalova and A.I. Dronov believe that these are "privately paid flights into space (to orbital systems and extra-terrestrial objects) for extreme-adventure, cognitive, research purposes, as well as visiting cultural and historical places and centres related to cosmonautics" [8, p. 55]. Thus, according to their approach, space tourism can have an "earthly" component. Indeed, Russia, which was the leader of the space race in the Soviet times, has a rich "space" history and ground-based space infrastructure, is now actively developing this direction, however, according to the author, this type of tourism refers not to space tourism, but to cultural, cognitive and excursion tourism.

E.F. Galiullin gives the following definition: "Tourism in space is a new direction in the industry, which provides an opportunity for mankind to expand its boundaries and learn more about the space environment" [9, p. 94]. That is, he does not consider space tourism as a new industry.

On the basis of the analysis, the author considers it possible to give her own definition: **Space tourism is the newest branch of the global economy related to the commercial activity of sending individuals into space for leisure and recreational purposes, as well as for gaining new knowledge, experiences and impressions.**

The author believes that space tourism should be considered as a *separate emerging industry*, rather

than as a type of extreme tourism, which belongs to the conventional tourism industry. Such an approach is conditioned by the fact that space tourism *unites enterprises* having *identical technologies* (allowing to deliver tourists to space and to support life support systems during the trip) and *specialisation*: they provide *similar economic benefits* (trips to space of different duration), use *similar resources* (in this case — space itself, as well as ground space infrastructure for launching and tracking flights) and satisfy *similar needs* of their customers (those wishing to get experience of space tourism). Thus, space tourism has features that allow it to be identified as a new branch of the economy.

PECULIARITIES OF THE SPACE TOURISM INDUSTRY

Space tourism as a branch of economy has a number of*features*, which, in the author's opinion, at the present stage include:

1. Heavy dependence on new technologies: rocket science, spacecraft design and launch systems.

2. Long period of project development and, as a consequence, payback of initial expenditures (investments). For example, Virgin Galactic planned to conduct the first tests of its rocket plane back in 2008, but it managed to do it only in 2013, and the first flight with tourists on board took place in 2021 [7, p. 53].

3. High level of risk: economic (it is difficult to find investors), technological (possible failures in testing new spacecraft), social (related to the health of tourists, because of which they need to pass a medical examination and preliminary training).

4. High cost of the final service (space travel), as the industry does not yet have economies of scale, and flights are of a one-off nature.

5. Elasticity of demand. Studies conducted in the USA and other countries show that many respondents would like to travel to space if the price was lower [3, 4, 10].

6. Financial and technological barriers to entry of new participants into the industry (lack of money for starting a business and developing own technologies).

TYPES OF SPACE TOURISM

The space tourism market is currently growing rapidly and is projected to exceed US$ 17 billion by 2032. (*Fig. 1*).

However, space tourism is not homogeneous. Two types are most often distinguished in scientific literature: *orbital* and *suborbital*. *Orbital tourism* is connected with flights to the International Space Station (ISS) and staying there for some time, usually from 7 to 14 days. The ISS orbit altitude is 330–430 kilometres above the Earth's surface, and the low-Earth space orbit altitude is 160–2000 kilometres. Accordingly, all flights above 160 km can be considered orbital flights.

Suborbital space tourism assumes that the flight takes place at an altitude of more than 80 kilometres above the Earth's surface, but without entering orbit.[1]In other words, suborbital flights take place beyond the boundary of the mesosphere. And here it is important to note another "space" boundary — between the Earth's atmosphere and space — which passes at an altitude of 100 km above sea level and is called the Karman Line — after physicist Theodore von Karman, who first raised the question about the boundary of the beginning of space, proposing to consider as such the height to which aeroplanes can rise due to the action of aerodynamic forces, and above it — only aircraft equipped with rocket engines [7, p. 53]. Currently, most of the flights within the framework of suborbital space tourism take place at an altitude of more than 80 and less than 120 km with take-off and landing in the same place.[2] That is why companies operating in this industry develop their own vehicles combining the properties of both aircraft and rocket.

The advantages and disadvantages that each of the mentioned types of tourism possesses are presented in *Table 1*.

[1] URL: https://www.maximizemarketresearch.com/market-report/space-tourism-market/203605/ (accessed on 14.02.2024).

[2] Ibidem.

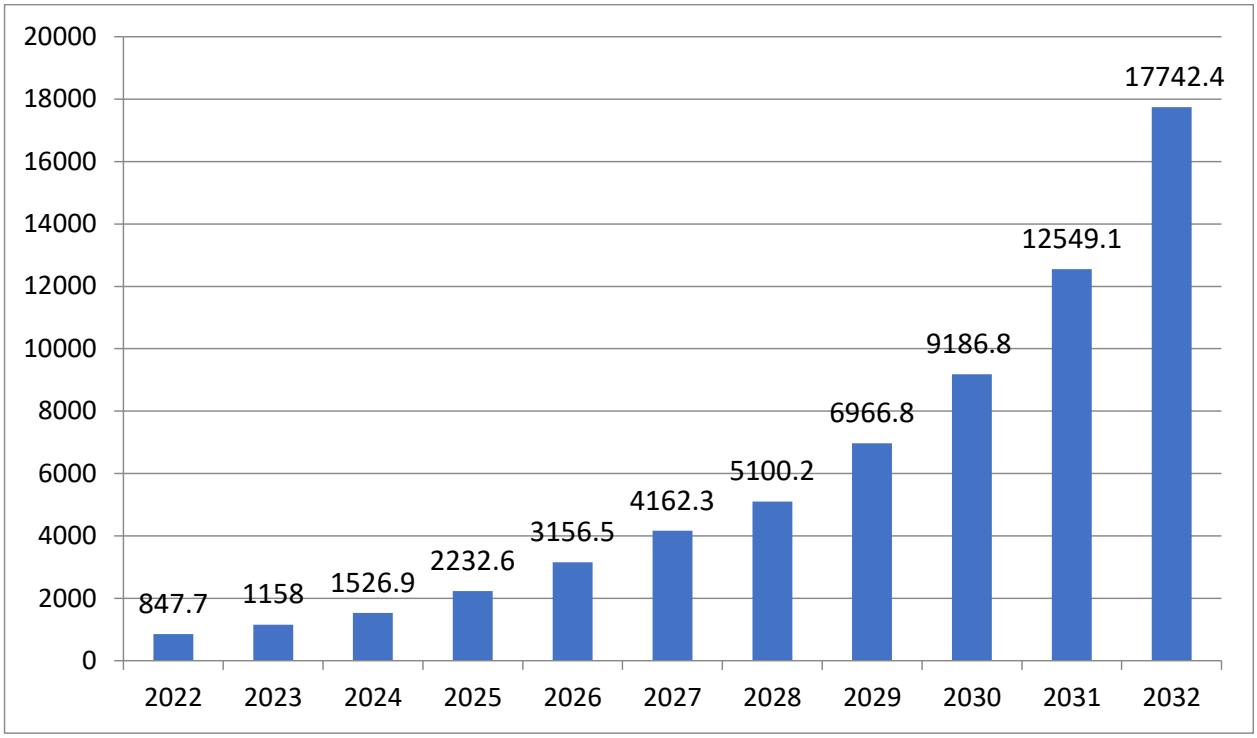

Fig.1. **Volume of the global space tourism market, million dollars**

Source: URL: https://market.us/report/space-tourism-market/

In 2022, the suborbital segment of space tourism accounted for the largest market share of $ 446.7 million (52.7% of the market). At the same time, it is expected to grow to $ 8.7 billion by 2030, a compound annual growth rate of 37.8%.[3]

The volume of the orbital space tourism market will also grow by 2030 (*Fig. 2*).

The increasing number of private space companies promotes competition between them and expands the possibilities for ordinary citizens to choose a travel organiser. Some companies are planning to organise flights in the stratosphere (18–50 km above the Earth's surface), to the edge of the mesosphere, which is much more comfortable and less dangerous for tourists. Such journeys are still being planned, but tickets for them can be purchased already now (*Table 2*).

Space Perspective's "Neptune" and World View Enterprises' "Explorer" spacecraft are being developed in the form of capsule-shaped spheres or balloons that, although they do not rise to a high altitude above the Earth's surface, allow you to see it and experience the darkness of space, and most importantly, they are designed to make space tourism as comfortable as possible. In particular, they are supposed to have a catering system, as well as bars with drinks, restrooms, cocktail tables, panoramic windows, mobile communications and other amenities to provide a luxurious travelling experience.

Lunar tourism is now beginning to develop. For example, in 2007, Space Adventures Ltd. offered its customers the opportunity to visit the lunar orbit for $ 100 million. In 2017, SpaceX also announced such a trip for $ 70 million. [6]. A number of companies are developing new spacecraft for this kind of tourism (*Table 3*).

DEVELOPMENT OF SPACE TOURISM BY MACRO-REGIONS OF THE WORLD

North America was the leader in space tourism in 2022, accounting for more than 39.8% of the market. This is attributed to the activi-

[3] URL: https://market.us/report/space-tourism-market/ (accessed on 14.02.2024).

Table 1

Comparative analysis of orbital and suborbital space tourism

Type	Advantages	Disadvantages
Orbital tourism	- The opportunity to fly in space as a professional astronaut; - the opportunity to see the Earth from different angles; - availability on the market for the delivery of tourists to orbit of proven vehicles that have proven their reliability in the process of operation (Russian Soyuz spacecraft)	- High cost for travellers; – Mandatory lengthy training (approximately 6 months); – Significant health risks for travellers; - risk of ineligibility for flight due to health reasons
Suborbital space tourism	- The opportunity to see space and experience weightlessness; - shorter and less complicated flights with fewer health risks for tourists; - relatively low cost and therefore more accessible; - do not require lengthy and elaborate training; - reusability of space vehicles	- The probability of seeing only certain angles of the Earth, as determined by the flight path; – The flight is often carried out on newly developed vehicles, which significantly increases the technical risks of their use

Source: compiled by the author.

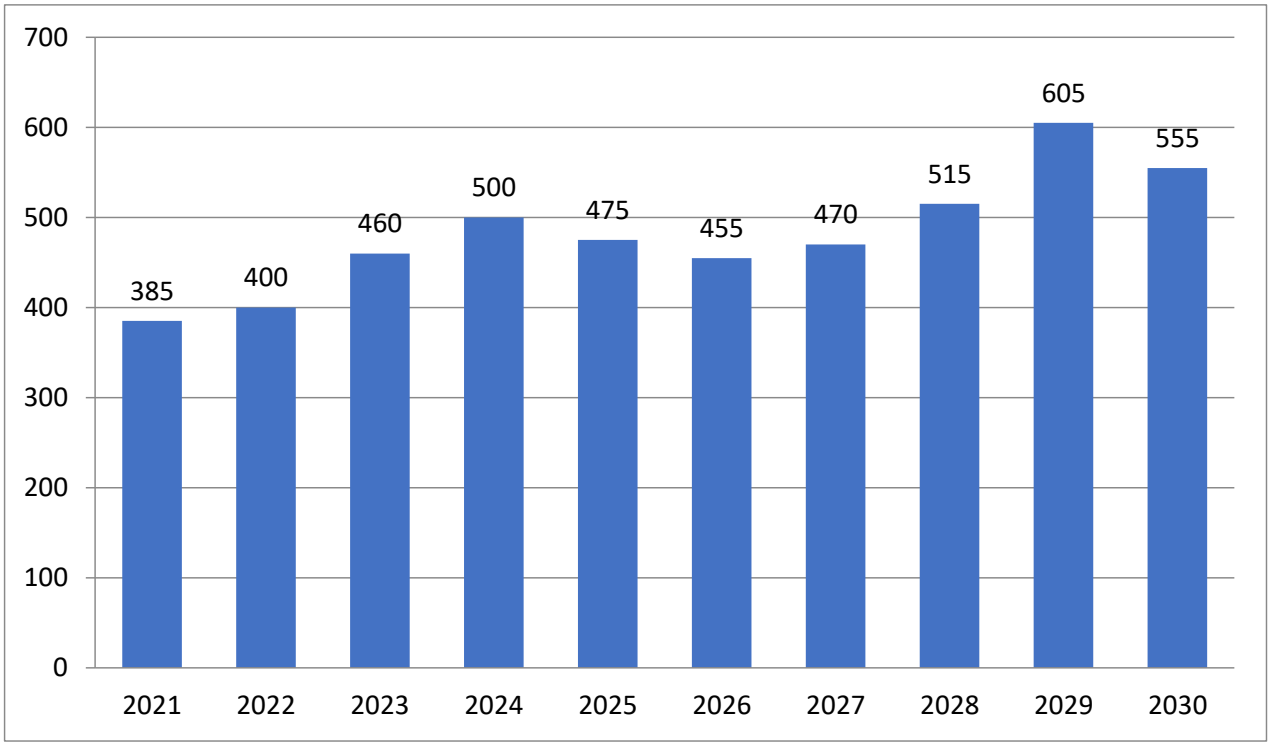

Fig. 2. **Volume of the global orbital space tourism market (million dollars)**

Source: URL: https://www.statista.com/statistics/1239530/orbital-space-tourism-and-travel-revenue-forecast-worldwide/

Table 2

Comparative characteristics of the main participants in the space tourism market and the declared price of their travel in 2023

The spacecraft and development company	Type of space tourism and number of persons on board	Year of the beginning of the organisation of space travel	Maximum flight altitude above the Earth's surface, km	Duration of the journey	Flight price, in millions of USD
SpaceShipTwo (VirginGalactic)	Suborbital. 6 tourists and 2 crew members	2021	82–110	90–120 min, of which 6 min.in weightlessness	450
NewShepard (BlueOrigin)	Suborbital. 6 tourists (no pilots required for control)	2021	90–106	10–11 min, of which in weightlessness – 3–4 min.	250
Bloon (Zero 2 Infinity)	Stratospheric. 4 tourists and 2 pilots	2025	36	270 min, of which in weightlessness – 0 min.	132.5
Neptune (SpacePerspective)	Stratospheric. 8 tourists and 1 pilot	2025	30	360 min, of which in weightlessness – 0 min.	125
Explorer (World View Enterprises)	Stratospheric. 8 tourists and 2 pilots	2024	30.5	360–480 minutes, of which in weightlessness – 0 min.	50
Crew Dragon(SpaceX)	Orbital. 7 tourists or crew members (no manual control required)	2020	330–430	3–6 hours – towards the ISS and 8 days – on ISS	55

Source: compiled by the author.

ties of SpaceX, Blue Origin, and Virgin Galactic, which are contributing significantly to the industry growth. In addition, the regulatory environment in North America (and especially in the U.S.) is also fuelling the growth of the industry. The U.S. government has shown a willingness to work with private companies by offering financial (grants and government contracts) and technical support. The high average disposable income and the presence of billionaires investing in space tourism are all contributing to the expansion of the industry in the USA (*Fig. 3*).

However, according to forecasts by a number of American consulting companies, significant investments in space tourism programmes by India and China will lead to the Asia-Pacific region becoming the fastest growing region in the world in the near future at a compound annual growth rate of 35.5%[4]. China's space tourism market is expected to reach USD 480 million by 2032, at a compound annual growth rate of 20% from 2023 to 2032. In Japan and Canada, space tourism growth during the same period will be 11.4% and 13.8% respectively, and in Europe it will be around 20%.[5]

[4] URL: https://market.us/report/space-tourism-market/ (accessed on14.02.2024).

[5] URL: https://www.precedenceresearch.com/space-tourism-market (accessed on 14.02.2024).

Table 3

Vehicles being developed for space tourism

Company (year of establishment, country)	Spacecraft	Type of space tourism	Number of seats	Note
SpaceX (2002, USA)	Starship / Starship Human Landing System	Lunar, interplanetary (flights to Mars)	100 travellers (no manual operation required)	Reusable super heavy rocket (starship). Assumes refuelling in Earth orbit. The first flight test took place in 2023. The estimated price of the flight is $ 1 million
Orion Span (2018, USA)	Orion	Orbital and lunar	6 tourists (in Earth orbit) and 4 tourists (in lunar orbit)	It has been in development since 2004. It was tested in lunar orbit without a crew in 2022
China Aerospace Science and Technology Corporation (1999, China)	Mengzhou	Lunar	6 tourists and 3 pilots	The first test flight took place in 2016
S.P. Korolev RSC Energia (1946, Russia)	Orel	Lunar	4 crew members	It has been under development since 2009. The first unmanned flight is planned for 2025. The first crewed flight is planned for 2029

Source: compiled by the author.

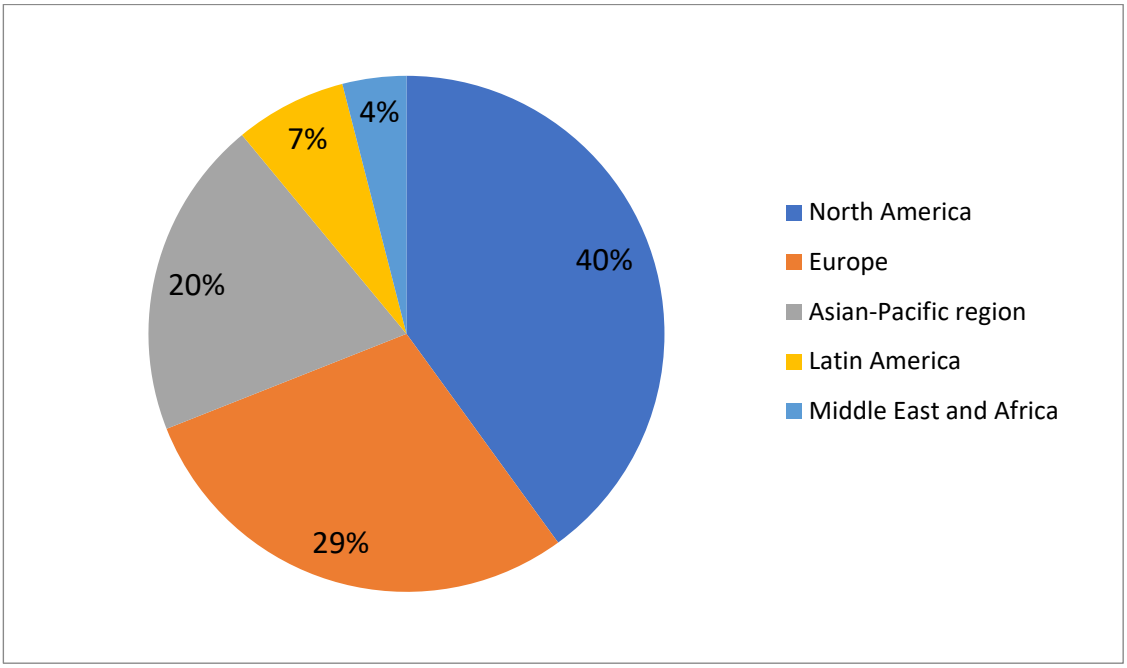

Fig. 3. **Shares of the global space tourism market by macro-regions in 2022**

Source: URL: https://www.precedenceresearch.com/space-tourism-market

Table 4

SWOT-analysis of the development of space tourism industry

S (strengths) – Technological advances in the development of reusable spacecraft and rockets; -development of artificial intelligence technology to assist in planning space travel, analysing satellite data and ensuring basic safety standards [11]; - high demand from individuals; - an influx of private capital aimed at finding more efficient ways to provide services; - government support for the development of the industry in a number of countries around the world; - successful experience of private companies in the field of orbital and suborbital tourism, which serves as a model for attracting new players to the industry.	W (weaknesses) – High cost and price of space travel; - significant safety risks; - lack of a well-developed legal framework protecting the rights of space tourists and companies operating in this field [9, p. 98]; - insufficiently developed infrastructure
O (opportunities) – Strengthening the links of space tourism with other industries to reduce the risks of flight and create a more comfortable travelling environment; – Utilising space tourism for educational purposes; - gradually reducing costs through new technologies and increasing demand for space travel; - expanding the types of space tourism through lunar tourism technologies and deep space travel; - development of artificial gravity technology on board spacecraft for orbital, lunar and interplanetary travel [12], which will significantly reduce the negative effects of space on the health of tourists	T (threats) – Depletion of rare metal reserves (lithium, gallium, indium, germanium, neodymium, platinum, etc.) required for the production of components used in spacecraft construction and other high-tech industries; - the likelihood of global instability, which affects the amount of investment in the industry by governments and private companies, forcing them to reallocate funds to other sectors of the economy, such as defence

Source: compiled by the author.

ANALYSING THE DEVELOPMENT OF THE GLOBAL SPACE TOURISM INDUSTRY

The space tourism industry is emerging due to many factors. As already mentioned, it strongly depends on the level of technology, which determines both the range of flights and their safety. The development of propulsion and new fuel elements determine the possibilities of energy production and refuelling of ships in space. Creation of an autonomous life support system will make it possible to extract water in space and build space hotels for tourists with the possibility of a long stay.

Since the industry is still in its infancy, it makes it difficult to make accurate forecasts of its development. Therefore, in order to assess its current state and potential opportunities, the author conducted a SWOT-analysis, which allows to take into account both internal (strengths and weaknesses) and external (opportunities and threats) formation factors associated with the development of other sectors of the economy and uncontrolled impact of the external environment (*Table 4*).

Thus, space tourism in the near future has a significant development potential. The threat identified by the author due to the depletion of rare metal reserves can be levelled, firstly, by recycling end-of-life parts and production waste in order to extract rare metals from them; secondly, by finding new ways of enrichment and extraction of such metals, including from hard-to-reach and deep deposits; thirdly, through the development of technologies that allow to obtain compounds with the same properties as rare metals.

The economic and political threats caused by global instability in international relations are the most difficult to mitigate, as they include a great number of different risks affecting the development of space tourism. According to the author, the dangers can be avoided by respecting interna-

tional law regarding the free flow of information and participation in international organisations with both economic and political objectives. Since space is a common resource and all countries have equal rights to it, this message should be the starting point for building trusting and mutually beneficial relations in the space sector.

DEVELOPMENT OF SPACE TOURISM IN RUSSIA

In 2001, it was thanks to Russia that the space tourism industry began to take shape. Between 2001 and 2009, the American company Space Adventures Ltd. and the Russian Aviation and Space Agency (the predecessor of Roscosmos) sent seven space tourists to the ISS, using several types of Soyuz spacecraft, and organising preflight training in Star City, where professional cosmonauts are trained.

However, the development of the new Crew Dragon spacecraft by SpaceX has squeezed Russia's position in the orbital space tourism market, and in 2022 an American spacecraft rather than the Russian Soyuz was used to deliver tourists to the ISS. Since flights to the ISS are very expensive and are currently available only to dollar millionaires, which are more numerous in the USA than in our country, it can be stated that Russia has lost the orbital space tourism market due to the refusal of Space Adventures Ltd. to use Soyuz spacecrafts.

As for suborbital space tourism, unfortunately, there are currently no companies in Russia engaged in the development of spacecraft to send tourists on such journeys. Although our government recognises the need to attract private business to the space industry, it is not ready to give it freedom in this area and reserves the right to control all areas of its activities. For example, CosmoCourses, a private space company established in 2014, planned to organise suborbital flights, but faced the fact that all developments had to be ordered from Roscosmos.[6] As a result, it was never able to start the practical implementation of its own project due to legal and bureaucratic difficulties and announced its liquidation in 2021.

What is now called space tourism in Russia, in the author's opinion, should properly be called "air tourism". It is represented by several companies, such as "Vezhitel", "Country of Space Tourism", "Agency of Space Tourism", "RocketTrip", which offer one and a half hour flights on IL-76 (small landing ship)aircraft on a parabolic trajectory at an altitude of 6–9 km above the Earth's surface (i.e., tourists do not leave the lower atmosphere — the troposphere). At the same time, they can feel the state of weightlessness for 25–30 seconds while passing the top of the parabola. The price of such a flight is now 420 thousand roubles per person in a group of 14 people.[7]

Another type of aviation tourism is a trip on a supersonic MiG-29 fighter jet with an ascent to a height of 18 km above the Earth's surface (the boundary between the troposphere and stratosphere) and an opportunity to see the curvature of the horizon. Cost — 80–100 thousand roubles per person for 20–30 min.[8]

In the author's opinion, a change in the situation of space tourism development in Russia would be helped by the entry into this sphere of big business capable of financing costly space projects at the initial stages of development until they get profitable. The US experience shows that it is large private companies headed by dollar billionaires that can make the investments necessary to create new spacecraft for tourists. Currently, Russian private business is concentrated in industries related to energy resource extraction. At the same time, space is not considered as a source of unlimited economic benefits, while the Earth's subsoil is exhaustible. In this case, our country could benefit from studying the US experience in the field of legislative regulation of space activities and support for private space companies.

[6] URL: https://ngs.ru/text/science/2018/11/07/65590081/ (accessed on 25.03.2024).

[7] URL: https://starcity-tours.ru/zerogravity/ (accessed on14.02.2024).

[8] URL: https://poletnaistrebitele.ru/poletvstratosferu (accessed on 14.02.2024).

CONCLUSIONS

1. Space tourism should be considered as a separate branch of the economy rather than a type of traditional tourism industry.

2. This industry has a number of peculiarities due to the development of new technologies, barriers to entry into the industry, the time of project development, the cost of services provided and the level of risk.

3. Increasing competition among private companies worldwide creates preconditions for reducing the cost of space travel for tourists.

4. The conducted SWOT-analysis has shown that space tourism as a branch of the world economy has a significant potential for development.

In conclusion it should be noted that space tourism is capable of completely transforming all spheres of human life. It is obvious that to support the industry it will be necessary to create new space infrastructure objects; to conduct research in biology, physics, astrophysics, chemistry, and other sciences; to develop up-to-date technologies. All this will require the emergence of new professions and modernisation of requirements for the existing ones. Thus, space tourism can have a significant multiplier effect on the entire global economic system.

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