

Challenges and Prospects for Introducing Space Technology into the Services Market

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ABSTRACT

This article is devoted to the research of the space technology services market in the world and in Ukraine, the searching of problems of the market development and directions of their solution. The relevance of the research is, determined by the lack of scientific research in the field of space technology development in conditions of lack of financial resources and post-war economic recovery. The purpose of the study is to identify key areas of space technology development as a means of solving the problems of the Ukrainian market of space services. The study uses general scientific methods of knowledge, in particular, a critical analysis of the scientific and expert literature, systematized information in order to determine the problems of the industry, the methods of comparison and deductive methods to find solutions to the problems. As a result, The classification of basic space technology at the service market is defined; The main trends of the space technology market are defined; The main services in demand at the market are, shown, among which the importance of satellite technology, available to both businesses and the population of Ukraine is, highlighted. The paper argues that Ukraine has significant potential for the implementation of space technology; in particular, it emphasizes that it is formed not only by historical preconditions and established in Soviet, times technical and technological capabilities, but also modern developments of entrepreneurs. The key place in the study is, taken by the definition of modern problems of space technology development and the prospects for their implementation in the services market. The main problems are the weak economic and political situation in the country, insufficient financial basis and lack of incentives for the private sector in the sphere of space technologies. The practical value of the study consists of recommendations for the development of space technology in Ukraine that can be, used in the construction of national strategies for space technology.

HIGHLIGHTS

- ① This article is devoted to the research of the space technology services market in the world and in Ukraine, the searching of problems of the market development and directions of their solution.
- ② As a result, The classification of basic space technology at the service market is defined; The main trends of the space technology market are defined; The main services in demand at the market are, shown.
- ③ The practical value of the study consists of recommendations for the development of space technology in Ukraine that can be, used in the construction of national strategies for space technology.

Keywords: Space technology, Satellite technology, Investments, Market of space technology services

Statement of the problem in a general form and its connection with important scientific or practical tasks. Ukraine is an advanced country in the space industry. It has the necessary technologies for the production and launch of launchers and artificial

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satellites. Our country is the birthplace of world-famous design bureaus, the history of which began at the stage of the development of aviation technologies. Domestic specialists in the space industry are involved in the most complex projects implemented by leading global companies. Despite the difficult times, the space industry is reviving. This was not hindered even by the fact that our State refused one of the largest customers of space products - Russia, thereby losing a significant part of the market. Thanks to the change in the vector of space activity, it was possible to achieve positive results.

In particular, a significant rise is, observed in the industry of space services. Due to the commercialization of space activities, private commercial companies entered the space market. New services have appeared in the field of business, recreation, environmental protection, etc. These include streaming services, high-speed data transmission, space tourism, satellite monitoring and exploration of natural resource deposits. All this suggests that the industry of space services has become the most extensive direction of the modern space economy.

At the same time, having a powerful potential, the development of domestic space technologies in the service market is rather slow. This is due to a number of factors that need to be, resolved immediately.

Unfortunately, owing to the war between Ukraine and Russia, it is quite difficult to develop the space industry at the expense of State funds because of their urgent shortage.

Thus, the main efforts need, to be directed to motivating, stimulating and supporting the development of the private sector of space technologies, which could raise it to the level of competitive countries.

The relevance of the research is also, confirmed by the critical lack of domestic space technologies. These, technologies would allow significant increase the level of national security, which is especially important in wartime conditions.

Analysis of recent research and publications. Space technologies and their role in modern life are, considered in the works of many scientists. In particular in the works of O. Ivanchenko

(Ivanchenko, 2020), M. Polyakov (Polyakov, 2022), M.A. Lazovska (Lazovskaya, 2017), V. Badrak (Badrak, 2021), and others.

Highlighting previously unresolved parts of the overall problem

Despite the sufficient amount of scientific literature in the field of space technologies, the issues of the development of the private space sector in the post-war recovery remain quite debatable. Therefore, the purpose of the study is to determine the key directions of development of space technologies as a means of solving the problems of the Ukrainian market of space services.

Presentation of the main material

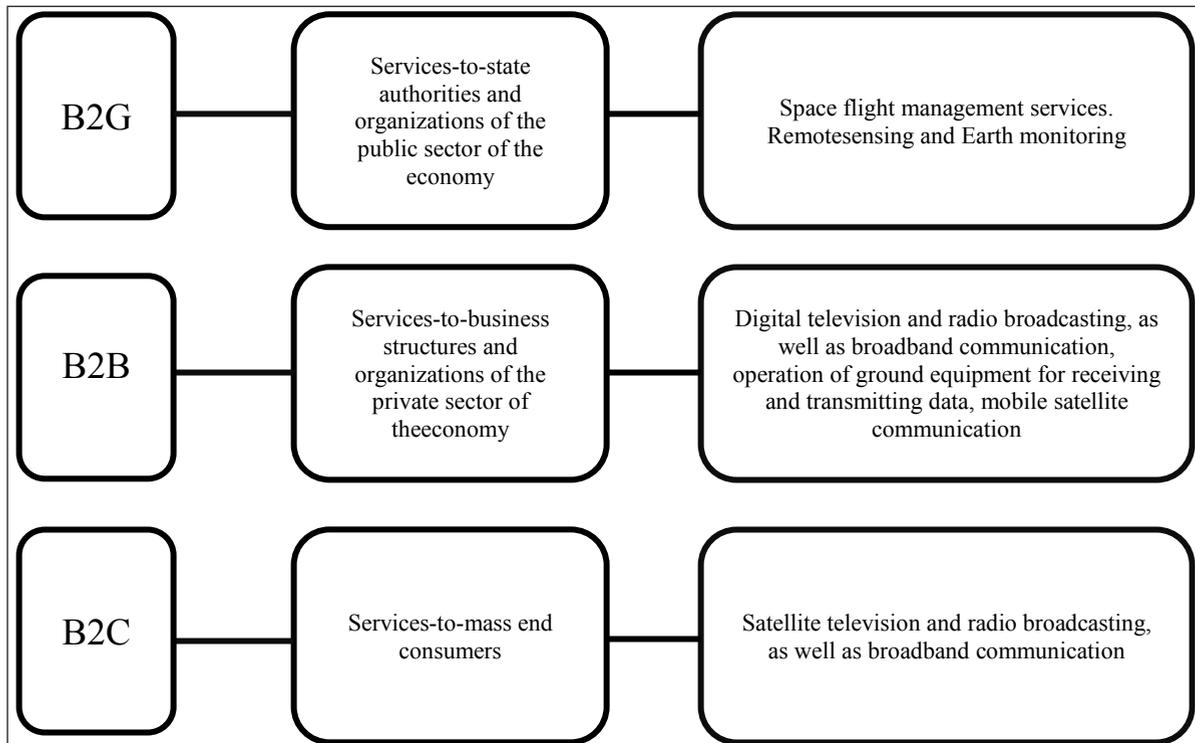
The range of space services is wide enough and cannot be, explored without a clear definition of their types. Services based on space technologies (space services) appeared as a, result of a reorientation towards the use of space rockets and systems, previously aimed at solving defense and scientific tasks.

The results of the functioning of the mentioned systems and means began to be, used to meet the industrial and socio-economic needs of individual regions, cities, organizations and even citizens. The demand for space services has gone far beyond the boundaries of science and defense, and their use has become widespread both among businesses and among the population.

In general, there are three types of services based on space technologies, which are shown in Fig. 1.

Previously, the main consumers of space services were state authorities and organizations of the public sector of the economy. However, the total number of such consumers is small and does not exceed a few dozen. An insignificant number of government orders for space industry products does not allow manufacturing enterprises to develop.

Developed countries understood this problem and directed the development of space technologies towards the development of private space products. The commercial market, unlike the state market, is practically unlimited, it has a significant growth potential. In contrast, B2B and B2C services have the potential of millions of users, and the market itself is, estimated at hundreds of billions of dollars.



Note: Developed by the author

Fig. 1: Types of services based on space technologies

In recent years, there has been a steady growth of the world space market, which is currently, estimated at 400 billion dollars. Every year it grows by an average of 5%. Market investors note that by investing 1 dollar in the products of the space industry, you can get a profit of 7 dollars (Ivanchenko, 2020).

If the average annual growth rate of 2.2% is, maintained, by 2026 the turnover of the space services market will amount to 144.5 billion dollars.

User services remain the most promising area of the space services market. Unlike them, space flight management services will remain in their previously established positions for a long time. This is due to, the fact that it is more profitable for the big players in the space market to, independently develop, launch and maintain spacecraft.

If the average annual growth rate of 5.48% is, maintained, the market for financial satellite services will grow in 2026.

In 2020, it was valued at 22.46 Billion dollars, and in 2026, its capitalization is, expected at the level of 27.15 Billion dollars. The rapid growth of this market segment is due to the rapid implementation

of 5G. The suborbital flight market is also showing impressive growth rates. In 2020, it was, estimated at 423.7 Million dollars. At the same time, the average growth of investments in this field of activity grows annually and is 16.5% on average.

The only thing that holds back the development of this market is the weak interest of the public, because these services are very expensive and available to individuals.

Among other market segments in which growth is, observed, it is necessary to note media, entertainment, retail trade, defence industry. It is these, segments that, ensure the stability of demand for space services (Polyakov, 2022).

Let us consider the most common services of space technologies on the world and domestic markets, which form a constant demand and could shape the directions of the development of the space industry in Ukraine.

Space technologies on the world market of services are, represented by a wide range of services aimed at a large number of users. Satellite services have the greatest share among space technologies. These services mean providing access to satellite data

exchange technologies. The clients of companies that provide such services are DTH operators specializing in streaming and telecommunication companies. Satellite services are very popular and profitable. The client pays exclusively for the rental of satellite production facilities. There is no need to invest in their creation or launch. The main types of satellite services are, listed in Table 1.

Table 1: The main types of satellite services (Lazovskaya, 2017; Polyakov, 2022).

Types of satellite services	Importance
Consumer services	Broadband communication, satellite broadcasting and television
Fixed satellite services	Providing access to the use of ground equipment for the purpose of receiving and transmitting data
Mobile satellite communication services	Providing network coverage to cellular operators
Remote sensing of the Earth	Meteorological observations, exploration of new deposits of natural resources, forecasting of emergency situations and natural disasters
Space flight management services	Launch and maintenance of space vehicles
Satellite monitoring services	Observing the Earth's surface, collecting data on the state of the Earth's surface for further analysis and forecasting of climate change, the level of harmful emissions into the atmosphere, etc. The latest achievement in this direction is the use of GIS maps
Space tourism and transportation services	Private space flights for recreational or scientific purposes. With the current level of technological development, flying to the boundary of the atmosphere and terrestrial orbit becomes possible not only for people who have been preparing for it for many years, but also for those who do not have special knowledge and many years of training

Note: Developed by the author.

Ukraine has significant potential in the development of the space technology services market. It has invaluable long-term experience in the operation of space complexes, developed space infrastructure and highly qualified personnel. Of course, the war made its corrections and slowed down the

development of space technology and the space industry as a whole. However, after its end, the space industry will continue its development. The following factors will contribute to this:

- ♦ Application for joining the European Union and obtaining the legal status of a candidate for EU membership. This is, expected to increase the number of orders from foreign companies that have money but do not have the resources to develop spacecraft.
- ♦ Co-operation of Ukraine with ESA. Our state participates in the space program of ESA and NASA for the study and development of the Artemis moon. Further co-operation with this organization will open new opportunities for Ukraine to co-operate with Western colleagues. In turn, this will ensure the exchange of experience and improvement of the qualifications of Ukrainian specialists. In addition, co-operation with ESA will contribute to the investment of Ukrainian space startups (Polyakov, 2022).

To date, more than forty State-owned enterprises work in the space industry. The most active participation in its development is, taken by the Southern Design Bureau and the Southern Machine-Building Plant. Four hundred (400) artificial satellites were, manufactured at "Pivdenmash" alone. (Pivdenmash is a factory of the highest quality equipment in the city of Dnipro (Pivdenmash. 2022).

For this purpose, the plant located in Dnipro has all the necessary production facilities. Thanks to this, it can implement the full cycle of production of space equipment. Today, the company produces the following products. Missile complexes, space vehicles, rocket engines, flight control systems and orientation in space, flight path measuring systems, etc.

Ukraine can boast of its developments - launch vehicles (Dnipro, Tsyklon-3, Zenit 3SL) and satellites (Sich-1, Okean-O, Special attention should be paid to the development and launch of its own remote sensing satellite Sich-2-30. Launched, into orbit in January 2022, which was an important step in the revival of the Ukrainian space industry (zaborona.com).

It should, be noted that Ukrainian factories also produce other space products. Therefore, despite the

hostilities and the difficult situation in the country, the concern "Pivdenmash" continues to work on the production of the first stage of the American Antares missile (mil.in.ua 2021).

The development of missiles and engines is also ongoing in co-operation with Northrop Grumman - an American military-industrial company that works in the field of electronics and information technologies. Ukrainian enterprises co-operate with the European Space Agency and other foreign companies and space startups. In recent years, a large number of private space startups have appeared in Ukraine. To date, there are about three dozen such projects.

Each of them is responsible for a certain sphere of space activity - satellite monitoring, research work, telecommunications. Among private companies in the space industry, Firefly Aerospace should be noted. Firefly is, known for the test flight of the Alpha rocket. The EOS Company made a significant contribution to the development of the domestic space industry. Its main field of activity is the provision of services related to satellite monitoring of the Earth, processing and analysis of the received data (universe magazine.com 2021).

Obtaining contracts from the European Commission and the Ukrainian government is, considered an important achievement of this company.

In 2016, the company SETS was founded in Ukraine. It is engaged in the production of rocket engines. In 2021, it received a NASA patent, which makes it the only company in the world capable of producing highly stable power plants. They significantly extend the service life of satellites and help reduce the amount of space debris (zn.ua, 2021).

Rocket engines are, manufactured by the Ukrainian company Flight Control Propulsion. In addition to engines, it produces high-precision rocket-space subsystems and equipment. The manufacture of these products is one of the most promising areas of development of the domestic space sector.

Considering the above, it can be said that the glorious space past contributed to the development of the modern space industry, but it is not only about it. In Ukraine, there are many private companies ready to launch the creation of products that the market requires. For example, researching real market demands, we can talk about the value

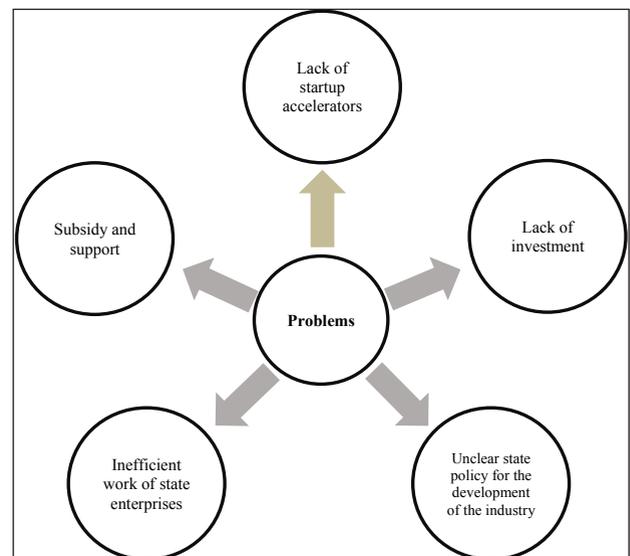
of space images, the resolution of which reaches 1 meter.

Such a request also exists from the side of the state, which is especially relevant in the conditions of war, and will remain relevant during the period of recovery of Ukraine's economy and improvement of its defense capability. So far, Ukraine is not able to produce such equipment, but there is hope that in the near future Ukrainian enterprises will produce it. Today, to solve the problem, it is necessary to increase the number of launch vehicles and space vehicles (Badrak, 2021).

In order for the space industry to develop faster and more efficiently, it is necessary to create prerequisites for its development. Today, according to experts, the biggest problem in the development of the space technology market is the possibility of commercialization of promising developments in the space industry.

Firstly, this is due to, the fact that in the conditions of economic reconstruction, all funds will be, directed to investments in construction, while the space program will be, perceived as less important.

However, if commercial organizations with their products appear on the space, technology market of Ukraine, it will begin to develop more dynamically than with the funds of the state budget. The main problems of the development of the commercial market of space technologies are, defined in Fig. 2.



Note: Systematized by the author

Fig. 2: Problems of the development of space technologies in the service market

The issue of the development of space technologies could be, boosted by stimulating investment in the space industry from two channels: the private domestic and foreign sectors and as a result of international partnerships. Today, such a program was planned, but it is almost impossible to develop it in 2021 and 2022 due to the lack of financial resources and socio-economic and political stability. State organizations could represent Ukraine's interests in the space technology market and negotiate cooperation with other organizations and countries. In turn, the received projects could be handed over to State or private enterprises.

Innovative development of space technologies can take place through the creation of startup accelerators or technology transfer centers from more developed countries and partner countries in the space industry. In order to launch such projects, the state must create an organization that will accept proposals from business (or even the population) regarding the development of startups within the space development program of Ukraine. For this purpose, a special commission for such projects is being created, which will select the best ideas and a working group that will search for investors.

The problem becomes even more complicated in the conditions of unclear state regulation and directions for stimulating the private sector in the space industry. In particular, the problem of the state's share in the ownership of such projects and established holdings, which powers in such public-private groups will be held by third-party participants such as "Antonov", "Aviation Engines", etc. For example, today the reform provides that when creating a space technology development holding, 100% of the shares will be in the value of the state, which will transfer part of the property to the participants.

Practice shows that a significant part of, State-owned, organizations do not develop, but, on the contrary, degrade the industry. Such enterprises cannot be flexible to market requirements they do not foresee the possibility of co-operation with domestic, foreign business, international partners.

In order to take the situation to a new level, the enterprises should be transferred into private ownership to the initiators of the development of space technologies, who can sell the results of their

activities on the commercial market and at the same time serve the needs of the state.

A successful example of such work is the American experience, according to which all space technologies have a dual purpose, as they have both government and commercial contracts, and the results of their activities, upon request, are sent to the US National Geospatial Information Agency, which works to ensure the national interests of the country.

Subsidies and government orders are the main directions of development of the commercial space sector in developed countries. Even if we say that the American aerospace enterprise Space X is private, in fact, the participation of the state in its development is quite significant, since it creates state orders for the services of this enterprise, thereby stimulating its development. In addition, a number of other manufacturers of space products, such as Boeing or Airbus, enjoy the privileges of state subsidies, which allow enterprises to save resources and direct them to the further development of new technologies (Polyakov, 2022).

CONCLUSION

It can be argued that the main problems of the development of the space industry are related to the lack of public finances, outdated material and technical and scientific bases, but the main problems are actually administrative in nature.

The space industry is one of the most profitable and promising in the market of innovative services, and therefore all over the world, including Ukraine, there are many Businessmen willing to invest in reliable projects of the space industry. Reliable projects are those that have clear, transparent State regulation and have State guarantees of stimulation and support.

In order for this industry to develop dynamically, its administration needs to be brought to a completely new market through commercialization of projects and public-private cooperation. Of course, the development of the industry can also take place through budget financing, but in this case, the achievement of goals will take decades, while the modern market will require radically new solutions.

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