Problems of Production and Launch of Civilian Launch Vehicles

Valentyn Halunko

Doctor of Law, Professor, President of Company "Science and Space" (Kyiv, Ukraine)
E-mail: scinspace@gmail.com
https://orcid.org/0000-0003-1619-5028

Olga Pravotorova

Doctor of Law, Professor, Kherson State University (Kherson, Ukraine)
E-mail: eschyk-o@ukr.net
https://orcid.org/0000-0002-7458-1595

Ruslan Topolia

Ph.D. in Law, Senior Researcher, Chief forensic expert of Cherkasy region Scientific Research Forensic Center of The Ministry of Internal Affairs of Ukraine (Cherkasy, Ukraine)
E-mail: rusexpert@ukr.net
https://orcid.org/0000-0001-5456-6761

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The article substantiates the urgent need to involve residents of states whose scientific, financial and economic potential is not used in the production and launch of civilian launch vehicles. The basics and primary international legal tools for attracting business structures of various states to the production and launch of civilian launch vehicles have been clarified. An essential criterion for their access to missile technologies has been formed, which is based on unconditional respect and compliance with the norms of international law. According to the criteria of the level of ability to produce launch vehicles into five main classes, the classification of states has been carried out. The concept of transition from bans to stimulating the production of launch vehicles has been formed. The reasons for the successful experience in this area of Romania, the negative experience of the Republic of South Africa and the unsuccessful experience of Brazil have been analyzed.

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Introduction

Planet Earth is overloaded with industrial production. Because of this, the greenhouse effect increases exponentially, which leads to global warming. (Leiserowitz et al., 2020). In addition, we should not forget that periodically our planet is hit by large natural bodies, which leads to the extinction of most living things (Kelland, 2010).

In our opinion, all dangerous and most harmful industrial production should be moved outside the planet Earth to space industrial islands. In turn, a certain part of people will be able to live on space tourist islands temporarily and then permanently in artificial space cities and settlements. The construction of the first and second ones should be carried out by aggressively increasing firstly special and supporting satellites in Earth orbits, and then in orbits around the Sun. As a result, the cradle of humanity, Earth should become a green oasis, without any harmful production (Halunko et al., 2021).

These approaches are supported by the views of Jeffrey Preston Bezos, who in 2019 presented the Blue Origin project to expand the effective simplicity of life for humanity to take advantage of the endless benefits of space resources and move more than one trillion people to artificial space colonies in the future. One of the primary tasks that he sets for himself is to reduce the cost of removing cargo and people outside the Earth's airspace by improving the efficiency of launch vehicles (Brown, 2019).

We fully support the views of Jeffrey Preston Bezos that it is necessary to improve the economic and technical efficiency of launch vehicles. However, we stress that at the same time, there is a need to involve as many sovereign states as possible in the exploration and use of outer space; use the public and private scientific, financial, labor and economic potential of not selected, but most potentially suitable for this states.

However, in today's conditions, only a few states are involved in the use of outer space. Even less amount of states design and can launch cargo space launch vehicles (the United States, China, the EU (France, Italy), Russia, India, Korea, Israel), and only three states – the United States, China, and Russia – have successfully overcome the Manned Space Flight Club. This state of affairs is unacceptable and gradually destroys the sphere of human habitation – the biosphere of the Earth and exposes humanity to rapid destruction in the event of a large natural cosmic body or as a result of a nuclear or other existential catastrophes (Bostrom, 2009).

Accordingly, there is an urgent need to encourage more residents of new states to use outer space, in general, and to design, test, and produce launch vehicles in particular. In this article, we will focus on the problem of involving states that currently do not produce or do not have a full production cycle of launch vehicles in this process.

First, we prove in the article that the essential criteria for the admission of new developing states to missile technologies are respect and compliance with the norms of international law. At the same time, the level of democracy of these states and their compliance with the rule of law within the country are also taken into account, but they play a secondary role. Moreover, when new states are admitted to the Space Club of Launch Vehicle Manufacturers, certain

requirements may be imposed to improve the state of respect for Human Rights and freedom of media activity within the state, but this should not turn into ultimatum pressure.

Secondly, we have classified the states (residents of these states) according to the criteria of the level of ability to produce launch vehicles into five main classes: 1) states the residents of which carry out a full cycle, design, test, production, the launch of civilian launch vehicles that can put artificial satellites into Earth orbit; 2) that have the ability to provide a full cycle of design, testing, production, the launch of civilian launch vehicles; 3) that take part in the production and launch of civilian launch vehicles; 4) that do not take part, but have ambitions to do so; and 5) states that have the scientific, financial and industrial potential to carry out the design, testing, production, launch of civilian launch vehicles, but have not declared such intentions. Examples are given of the actual status and possible opportunities of residents from the third (Sweden, Poland), fourth (Vietnam, Indonesia, Sudan) and fifth (Philippines) classes to engage in such activities.

We further prove that there is an urgent need for the international community to change the concept: from banning to stimulating the production of launch vehicles by new states. This is justified by a number of factors, including negative ones. After all, "rogue states" that are outside the limits of international law, such as North Korea, are not stopped by international sanctions and bans. They carry out successful production and launch of military rockets (North Korea, 2021), and states whose potential is worthy of being members of the Space Club of launch vehicle manufacturers are not used. Moreover, states that faithfully comply with the Missile Technology Control Regime become defenseless against rogue states that actively develop their military ballistic missiles.

We paid considerable attention to the instructive negative experience of South Africa when they developed military missiles for the delivery of nuclear weapons under the guise of developing civilian launch vehicles. Back in the early 90s of the twentieth century, they built and successfully tested several launch vehicles. However, due to attempts to deceive the international community, under the pressure of US sanctions and economic and political incentives for decades, the program's implementation for the production and launch of launch vehicles is curtailed (Sokolski, 1993).

The reason for the unsuccessful experience of production and launch of launch vehicles in Brazil is briefly revealed. Which, in our opinion, consists in political miscalculations in choosing partners who can potentially share missile technologies. The article ends with a summary of the successful experience of Romania, where private rocket science is actively developing.

Criteria for assigning states to subjects of international law to resident legal entities that can potentially transfer civilian missile technologies

According to Douglas C. North only 25 countries belong to an open society. Only 15% of the world's inhabitants live in such countries. The remaining 85% of the population lives in the so-called by him natural states (North et al., 2009). At the same time, all states of an open society, without exception, are legal, democratic states with a market economy. However, not all states that have prescribed these values in their constitutional norms are such. Accordingly, in our opinion, in essence, all states of an open society should be able to exchange civilian missile technologies. This is confirmed by the fact that almost all states that are included in the Golden twenty-five Open Society countries, called by Douglas C. North, John Joseph Wallis

and Barry R. Weingast (North et al., 2009), are participants in the Missile Technology Control Regime. Other states of this regime include: Argentina, Bulgaria, Brazil, India, South Africa and Ukraine. They have declared building and practically strive for a democratic state governed by the rule of law and an open society. As for two other member states of the regime – Russia (1995) and Turkey (1997), they tried to meet the latter criterion at the time of their admission to the elite club of space powers. However, in the conditions of the present, they have retreated from it. But we do not equate them. These are very different states in terms of compliance with international law.

However, it should be understood that the so-called natural states, according to the classification of Douglas S. North, John Joseph Wallis and Barry R. Weingast (North et al., 2009), are very different. In our opinion, there are some of them that are worthy of joining the club of space powers. For example, although, in some aspects, Turkey has moved away from the principle of the rule of law within its state (Aslund & Snegovaya, 2021), it continues to adhere to all the norms of international law. Accordingly, in our opinion, it is a worthy club of countries participating in the Missile Technology Control Regime. Conversely, Russia has not only abandoned democratic values and the rule of law within the state, but also grossly violates the norms of international law. It took a direct part in the occupation of certain regions of Georgia and Ukraine, and also carried out the annexation of the Autonomous Republic of Crimea of Ukraine (Matsaberidze, 2015). Moreover, Russia threatens the United States and other states with the use of nuclear weapons by launching its ballistic missiles (Dikhtyarenko, 2018). It is clear that states of this type should not be accepted into the club of space powers, and Russia should be excluded from it. Although in practice, due to US, EU and Ukraine sanctions, it can no longer enjoy the benefits of the Missile Technology Control Regime (Aslund & Snegovaya, 2021).

Accordingly, a significant factor in the admission of legal entities of developing states to receive missile technologies is their formal membership in the Missile Technology Control Regime club. This, despite all controversial issues, should remain an international legal axiom for allowing residents of new states to access technologies for the production and launch of launch vehicles.

Although specialists in the field of rocket science also have a critical attitude to the effectiveness and fairness of the norms of the Missile Technology Control Regime. So, Alexander Levenko believes that currently, there are restrictions for a number of countries caused by their signing of the Missile Technology Control Regime. The only country that has benefited from this is the United States, with its superpower economy. In his opinion, the Missile Technology Control Regime is a tool that supports unfair competition of the United States in relation to other countries, which contradicts international standards (Levenko, 2021).

Within the signatories of the Missile Technology Control Regime, the right of Veto is also used. Suppose a country wants to develop relations on the topic of missile technology with other countries that have signed or have not signed the Missile Technology Control Regime. In that case, it notifies other signatories who have the right to use the Veto. However, the Missile Technology Control Regime does not prevent countries that have not signed this document from ignoring it. Except when the US government decides that the actions of such a country threaten the national security of the United States. Then war is possible, and most often – sanctions from the United States. These sanctions, according to Alexander Levenko, are ill-conceived and sometimes lead to the fact that the objects of sanctions are combined and achieve success in missile technologies despite the sanctions (for example, the creation of a

launch vehicle of the same design in the DPRK and the Islamic Republic of Iran at the same time) (Levenko, 2021). As a result, the "club of space powers" is constantly replenished. The last to join it were the Republic of Korea, the Islamic Republic of Iran and the DPRK – these countries launched their satellites into space with their own launch vehicles. Thus, Alexander Levenko concludes that the Missile Technology Control Regime, as a document, is outdated. Unity of opinion of the signatories members is impossible in the context of a real confrontation between the United States – EU, the United States – Russia, and the United States – China. It is more reasonable to reach a consensus and turn this agreement into a mechanism for promoting the development of civilian technologies – as long as now it is a mechanism for banning military technologies (Levenko, 2021).

We cannot fully agree with Alexander Levenko's criticism of the Missile Technology Control Regime. We believe that there is no alternative to it. However, we support his view that the concept of curbing the development of civilian missile technologies laid down in the analyzed regime should be replaced by a mechanism for promoting the development of civilian missile technologies.

Consequently, in its essence, formal belonging to the Missile Technology Control Regime, namely to legal democratic states or to states of an open society, should not be the exclusive basis for the admission (non-admission) of states and their private and public legal entities to missile technologies.

At the same time, it is necessary to take into account the leading role of the United States and its allies in practically ensuring the implementation of the Missile Technology Control Regime. They are liberal democracies with market economies and tend to promote trade and friendly external relations. To achieve their goals, they use various methods of negotiation and diplomacy that are necessary for effective control and guarantees of the non-proliferation of missile technologies. However, if this fails, the United States can fight the proliferation of ballistic missiles harshly, in particular by applying various types of sectoral and financial sanctions (Sokolski, 1993).

Therefore, the essential criterion for the admission of new states to missile technologies should be respected for compliance with the norms of international law. These can be: 1) states of established democracy; 2) states that have declared their democratic aspirations as a state governed by the rule of law and are practically building such a state; 3) moderately totalitarian states that have long and fully adhered to the norms of international law.

Classification of states (residents of these states) according to the criteria of the level of ability to produce launch vehicles

Based on the principles of the urgent need to involve the resources of residents of many sovereign states in the design, production, testing and provision of civilian launch vehicles, there is a need to determine the real current state of this problem. We have shown above that the essential criterion for the admission of new states to rocket technology must be respected for compliance with international and space law.

Based on this criterion, states and their residents engaged in the design, production and launch of launch vehicles are divided into five main classes:

1. States residents who carry out a full cycle of design, testing, production, and launch of civilian launch vehicles can launch artificial satellites into Earth orbit. These countries include the United States, China, the EU (France, Italy), India, Korea, Israel, and Japan. For example,

during 2020, the United States carried out 44 launches of launch vehicles, and China 39, which were completely designed and manufactured by scientists and manufacturers of these countries, almost independently of each other. At the same time, private SpaceX played a significant role in ensuring launches in the United States, and China is proud of the successful launch of a new heavy-class launch vehicle, the Long March 5B, which can lift up to 25 tons of cargo into orbit (Deville, 2021).

2. States that have the ability to provide a full cycle of design, testing, production, and launch of civilian launch vehicles, but for various reasons do not carry out this, for example, the United Kingdom, South Africa, and Ukraine. For example, the Southern Machine-Building Plant named after Makarov (Ukraine) used to produce civil space launch vehicles of the Cyclone and Zenit family in cooperation with Russian partners (Hurska, 2020). One after Russia's annexation of the Autonomous Republic of Crimea of Ukraine, the fighting of Russian-terrorist troops in certain areas of the Donetsk and Luhansk regions of Ukraine, cooperation between Ukraine and Russia on the joint construction of launch vehicles was suspended (Russian, 2016). Currently, the Makarov Southern machine-building plant (Dnipro, Ukraine) produces the first stages of Antares launch vehicles and the fourth stage for the European Vega launch vehicle (Hurska, 2020). However, in the current conditions, Ukrainian manufacturers do not carry out a full cycle of production and launch of launch vehicles. Now the Ukrainian government and private businesses are trying to revive the industry and restore the traditional role of Ukraine in the world's space rocket economy. In particular, the private Ukrainian company Science&Space LLC has developed and received a patent for the GreenSpace rocket and space complex with a reusable launch vehicle with "cold engines" (Levenko, 2021).

3. States residents of which take part in the production and launch of civilian launch vehicles, for example, Germany, Canada, Poland, Romania, Bulgaria, Spain, Portugal, and other member countries of the European Space Agency, Australia, New Zealand, Brazil, Argentina, and Kazakhstan.

For example, the Swedish Space Program (NRFP), as a national strategy for the development of Space Research approved by the Swedish parliament in May 2018, states that investment in space is closely linked to the future of the Swedish nation on Earth. In particular, the analyzed strategy provides for further modernization of the Esrange Cosmodrome as a base and test site for launching reusable rockets and balloons. The Esrange launch pad, due to its unique geographical location and the availability of competent personnel, is quite suitable for launching small satellites. At the same time, the Swedish spaceport can compete with space launch pads in Norway and the United Kingdom, which also see opportunities for themselves and try to reach the finish line first in this race. Since 1970, Sweden has participated in the European launch vehicle launch program, in which Swedish companies play a key role in engine development. Sweden participated in the creation of the European Ariane-5 launch vehicle. This participation helps to support the production of space technology by Volvo Aeros (Gutman, 2019).

Poland has its own space agency, which is an active member of the European Space Agency; in particular, it participates in the production of joint European, French and Italian launch vehicles Ariane-5 and Vega. After the collapse of the socialist bloc, Poland stopped producing short-range liquid-fueled ballistic missiles. However, experience and technology are not completely lost. Thus, the Warsaw Aviation Institute develops solid-fuel launch vehicles, hybrid rocket engines and liquid-propellant rocket engines for delivering small satellites to an

altitude of 100 km and 100 kg to an altitude of 600 km. Hybrid and liquid engines use highly concentrated hydrogen peroxide of 98% (in the test laboratory, when developing catalysts and a two-component micro-engine, hydrogen peroxide of 99.9% concentration is used). Polish scientists have also created experimental liquid engines based on highly concentrated hydrogen peroxide 98% and gas. They developed an original catalyst for the decomposition of hydrogen peroxide. For these purposes, the production of highly concentrated hydrogen peroxide 98% has been mastered in the laboratory conditions of the Warsaw Flight Institute. These are currently being transferred to a private company, a Polish Space Company, for production adjustment (Levenko, 2020).

4. States residents of which do not take part in the production and launch of civilian launch vehicles but have ambitions to do it. For example, the Advisory Council for the development of outer space in Indonesia has modest goals to launch its own satellite on its own launch vehicle into a low-Earth orbit (200-300 km) by 2025. In today's conditions, they are testing a small-sized prototype of a launch vehicle. Experts have doubts about the implementation of such a project due to insufficient funding from the Indonesian government. At the same time, the Indonesian Space Agency and the designers of the Indonesian launch vehicle are guided by the experience of NASA and the success of the private American company SpaceX, Japan, China and India (Indonesia, 2020). At the same time, it should be noted that there is no official information that Indonesia is also implementing a project of a solid-fuel three-stage dual-use Launch Vehicle. This project is not being implemented successfully because there was a serious accident when launching one of the rocket stages (Levenko, 2020).

Officially, space exploration in Vietnam is at an early stage. Universities and amateur clubs are engaged in space exploration. Japanese grants make a significant contribution to the development of space technologies in Vietnam. As for the launch vehicles, it was not possible to get information about their development in Vietnam from open sources. Only demonstration water rockets are being developed and launched (Indonesia, 2020; Vietnam, 2021). However, there is non-official information that private space companies in Vietnam are working with their government to recreate outdated launch vehicles produced in the Soviet Union (Levenko, 2020).

5. The states (residents of these states) that have the scientific, financial and industrial potential to carry out the design, testing, production, and launch of civilian launch vehicles, however, did not declare. For example, the Philippines does not have the ability to independently develop launch vehicles that would deliver useful civilian cargo into outer space. They have not signed most international space treaties and currently do not have a space agency that implements a holistic space development strategy. Although even in the 70s of the 20th century in this state, there was a state program for the development of missiles, which was not implemented. In today's conditions, space research is carried out by national universities through the implementation of separate programs that are not directly related to space. The functions of the space agency are distributed among various government agencies and divisions. Filipino scientists emphasize the need to create a national strategy for the short-, medium- and long-term development of space research, the creation of a National Space Agency. They raise the issue of providing funding for space education and business-related to Space Research and development in the space industry. Their goal is to create a national powerful and thriving space industry (Rogel, 2020).

National Space Activities in Sudan began in the 1970s, leading to the establishment of the National Remote Sensing Center (NRSC) in 1977 by the Government of Sudan under

the jurisdiction of the National Research Council, the Ministry of higher education and research. In 1996, the NRSC was reformed into the remote sensing Authority (RSA) with the competence to conduct research and development in the field of remote sensing of the Earth, the application of GPS technologies. RSA implements human development programs such as education, training, and awareness-raising programs in collaboration with academic institutions and professional associations. In addition to remote sensing and astronomy, Sudan is also developing programs and building the capacity of satellite technologies. In June 2013, the Government of Sudan had established the Institute for Space Research and Aerospace (ISRA) within the National Research Centre of the Ministry of Science and communications as part of the national plan for developing and applying space technologies in several national social and economic plans. The academic community plays an important role in the development of space and astronomy in Sudan. Universities in Sudan, such as the University of the future and the University of Khartoum, offer space science and astronomy programs. The government of Sudan since 2016 has launched an ambitious portfolio of aerospace, aviation and telecommunications development projects, which included successful launches of Sudanese ones. Sudan's private space sector focuses on telecommunication and Internet services, which uses the US and Chinese launch vehicles to launch its satellites into low-Earth orbit (Space in South Africa, 2019).

As for the design and production of its own launch vehicles, Sudan's government and private companies are not officially engaged in this. However, more than five years ago, China sold Sudan a WS-1 Tactical Missile System with technology, equipment and ingredients for self-manufacturing solid rocket fuel. Sudan has good specialists in the field of rocket scientists who have studied in Russia and Ukraine. Thus, practically in Sudan, there is a potential for creating a multi-stage solid-fuel launch vehicle by upgrading the Chinese tactical missile system.

Justification for the paradigm shift – from banning to stimulating the production of launch vehicles by developing countries

In our opinion, the international community should leave the policy of stimulating the development of civilian missile technologies in the past. The states of the space club should not preserve their rocket and space developments on commercially favorable terms, which eventually lose their relevance, but move to stimulate the production of peaceful launch vehicles to residents of new states who potentially need to transfer civilian rocket technologies.

After all, the solution to this problem is a matter of human survival. The success of the space colonization project directly depends on the success of its implementation. Artificial deterrence of the development of peaceful launch vehicles becomes an obstacle on this path. Civilian launch vehicles remain the only source of human and cargo entry into outer space. In addition, curbing the development of peaceful missile carriers practically does not protect humanity from the development of military ballistic missiles by rogue countries. For example, China, which is under increased international sanctions, has built and deployed approximately 700 short-range ballistic missiles capable of hitting most of South Korea, 300 medium-range ballistic missiles that threaten Japan, and has also developed several intercontinental ballistic missiles (McGrath & Wertz, 2015).

In other words, the international community should develop and approve the international

public and private space legislation that will be favorable for the development of rocket carriers of resident states whose financial and economic potential is not currently being used.

After all, the research, use and legal protection of outer space, its colonization should be carried out by individuals and legal entities of most countries of the world. It is not only the natural right of sovereign states to undertake activities related to the exploration and use of outer space. This is a scientific and financial burden that they must put on the benefit of all mankind. This should be done on the basis of both public and private International Space Law. Otherwise, the situation may go beyond the humanistic and legal dimensions. This process can become uncontrolled, lead to further development of terrorist organizations and states that contribute to terrorism of their missile technologies, and developing democratic states become defenseless against them (Halunko & Didenko, 2019).

Experience of the Republic of South Africa in developing the national missile program

The experience of the Republic of South Africa is interesting and instructive. At which we can observe the transformation of the national missile program of an actively developing state.

For example, South Africa initiated its first space program in the 1980s of the twentieth century. Its goal was to develop its own satellites and launch vehicles. The space infrastructure of the facility for satellite integration and testing and the Launch Complex for launching launch vehicles were created in Arniston, on the southern coast of the cape, about 180 km west of Cape Town. A powerful industry has been developed to support this program (Space, 2020).

Until 1993, this country was successfully developing a program of its ballistic missile carriers. In total, four space rockets were built: three of them were launched on suborbital trajectories in the late 1980s. However, as a result of the direct efforts of the United States, South Africa abandoned the rocket program. This was justified by the fact that the South African space program was a cover for combat topics, namely the danger of nuclear proliferation and the likely danger of violating the Missile Technology Control Regime (Sokolski, 1993).

In 1993, the South African government suspended its missile program not because of international sanctions, but because of the economic and political advantages provided by the United States. However, in 1999, the United States sanctioned South Africa for importing ballistic missile technology from Israel. After all, according to American law, the United States president is obliged to prohibit the export of ballistic missiles or related technologies by any foreign entity that exports or imports missile technologies, contrary to international guidelines contained in the Missile Technology Control Regime. Since the US president delegated this authority to the secretary of state to make this decision, and the evidence for South Africa's missile operations with Israel was convincing (Israeli officials admitted that they exported ballistic missiles), the deputy secretary of state duly reported the sanctions (Sokolski, 1993).

As already revealed above, South Africa's missile program was suspended. The reason for this was the national policy of apartheid, which was condemned by the international community, the possible manufacture of dozens of nuclear charges that were produced secretly outside the borders of UN International control. Thus, it is likely that South Africa at that time violated the treaties on the non-proliferation of nuclear weapons and the regime of non-proliferation of missile technologies. Accordingly, the concerns of the United States and other states of sustainable democracy were justified. At the same time, the South African government

of that time made the right conclusions, in our opinion. It abandoned further development of the rocket program and focused public funds on the space satellite program.

Despite these problems, South Africa occupies a significant place in the world. Currently, South Africa includes many subjects that play a significant role in scientific research, exploration and use of space. They have found their approval in scientific institutions and the business industry. They have practical achievements in the implementation of satellite programs, satellite engineering and auxiliary space technologies. An audit of the South African industry showed that the annual turnover of the private space business and the public space sector is about 20 million dollars. About 180-200 people are involved directly in the South African space industry. The existing infrastructure and skilled workforce, both within these facilities and in the broad industry that supports them, allow South Africa to position itself as a Regional Center for Space Science and Technology (Space, 2020).

South Africa is an active participant in International Space Activities. Space activities in South Africa are regulated by the Space Affairs Act of 1993. The South African Space Affairs Council (SACSA), established under this law, is responsible for representing South Africa in international forums dealing with space affairs, as well as for authorizing, licensing and overseeing space activities in South Africa. The South African National Space Agency (SANSA) was established in 2010 to coordinate and implement the National Space Program. SANSA reports to the Department of Science and technology. SANSA is the leading agency for establishing and implementing agency-level space cooperation agreements with other countries' space agencies. Civil society is also playing an increasingly important role in the development of the space industry in South Africa. More and more scientific and research institutions and private sector agents are being involved in space activities. The University of Cape Town has Space and Astronomical Society that promotes space awareness among students and local youth. South Africa's national space policy issues general guidelines for conducting space activities that should be implemented in support of national priorities, especially in relation to poverty reduction, economic opportunities, technological opportunities and improving the quality of life (Space, 2020).

So, the attempts of a developing state under the guise of civilian missile technologies to develop the military end badly. On the example of South Africa, you can see that this leads to the practical closure of them under the pressure of US sanctions and economic and political incentives. When the practically ready and tested system for designing, manufacturing and successfully launching launch vehicles was stopped.

Brazil's thorny path and the success of implementing missile programs by private companies in Romania

The Brazilian space agency has its own Alcantara spaceport. From which Brazilian probe missiles are launched, in particular VSB-30 (2004). Rocket science experts are well aware of the developments of Brazilian scientists regarding hybrid and hydrogen peroxide-based rocket engines. Since 1984, a number of two – or four-stage solid-fuel launch vehicles have been developed. Brazil has repeatedly tried to create common to developed space states heavy launch vehicles, such as Cyclone-4 with Ukraine and implement the Southern Cross rocket program with Russia, but due to various factors, the successful implementation of these projects did not happen (Strelkova, 2017).

So, Brazil's path to space was and remains difficult. This state has a very strong financial,

scientific and economic potential, its own spaceport and, although not entirely successful. Nevertheless, it has gained experience in the development, construction and launch of launch vehicles. This makes it possible to believe in the great space future of Brazil as a powerful platform for the production and launch of everything, including heavy and especially heavy launch vehicles.

The Romanian space agency (ROSA) is the national and international coordinator of Romania's space activities. It is a state institution that is fully funded from its own income. The mission of the Romanian space agency is to coordinate national research programs and space programs to promote Romania's development in the space industry. As a coordinator of national research and space programs, ROSA develops and coordinates the implementation of the National Space Program. As a government representative, the Romanian space agency enters into cooperation agreements with international organizations such as the European Space Agency (ESA) and the Space Research Committee (COSPAR), as well as bilateral cooperation agreements at the government level. At the same time, the agency conducts its own research and development through the ROSA Research Center (Agenția, 2021).

Romania has created good conditions for the development of the private space business. This makes it possible for private space companies to develop. The private company ARCA is developing a series of Haas 2C launch vehicles to launch from a military base in the Black Sea and has plans to launch small satellites into orbit. In addition, there is an influential public organization ARCAspace – the Romanian association of cosmonautics and aeronautics, although the main office of which is located in New Mexico, USA. It was founded in 1999 as a non-governmental organization in Romania by Romanian engineer D. Popescu and other rocket science enthusiasts. Since then, ARCA has launched two stratospheric rockets, four large-scale stratospheric balloons, including a cluster balloon, and received two government contracts with the Romanian government and one contract with the European Space Agency. They are developing a single-stage rocket to enter orbit, which should be economical, not reusable. ARCA has developed and continues to develop a family of Haas missiles in various sizes and configurations, including the ambitions of a Space Launch Vehicle with a capsule capable of delivering a crew of five people to space (Levenko, 2020).

So, despite the lack of direct state funding, Romania has created good conditions for the development of private space rocket science. This is facilitated by a system of favorable geopolitical, legal, organizational-legal and organizational factors. Geopolitical factors include Romania's membership in the European community, particularly the European Space Agency and NATO, and the presence of joint formal and non-formal associations with the United States. In legal terms, Romania is a member state of the EU and is fully within its legal framework. The National Space Agency is a member of the European Space Agency. In the organizational and legal field, private space companies are under the pragmatic supervision of the Romanian national agency, which is interested in the development of private rocket construction. A successful organizational aspect is the presence of professional enthusiasts who started and developed the national rocket science industry in Romania.

Conclusions

All of the above makes it possible to generalize that at the present stage of human development, it is unacceptable that the potential of most states of the world is not used for the benefit of the exploration and use of outer space. The causes of this negative phenomenon

are formed. International legal ways to attract to the construction of civilian launch vehicles scientific, financial and another potential of residents of dozens of states that meet the established requirements for the safety of transmitting missile technologies to them are identified. In the following scientific articles, we will further develop the principles and legal tools for involving in the production of civilian launch vehicles as many developing states that respect the norms of international law as possible.

🕮 References

Agenția Spațială Română (2021) ROSA. Available online: http://www2.rosa.ro/index.php/ro/rosa

Aslund, Anders and Maria Snegovaya (2021) *The impact of Western sanctions on Russia and how they can be made even more effective*. CSFI. Available online: https://www.csfi.org/2021-04-14-western-sanctions-on-russia

Bostrom, Nick (2009) Dinosaurs, Dodos, Humans? *Review of Contemporary Philosophy*, Vol. 8, 85-89.

Brown, Mike (2019) *Blue Origin's Jeff Bezos Details His Radical Vision for Colonies in Space*. Inverse. Available online: https://www.inverse.com/article/55709-blue-origin-s-jeff-bezos-details-his-radical-vision-for-colonies-in-space

Deville, Jean (2021) A Recap of 2020 in Chinese Space. *The China Aerospace Blog (CAB)*. Available online: https://china-aerospace.blog/2020/12/30/a-recap-of-chinese-space-in-2020/

Dikhtyarenko, Andriy (2018) Putin's nuclear threats are forcing not only the United States but Ukraine as well. *Radio Liberty*. Available online: https://www.radiosvoboda.org/a/29090475.html

Gutman, Julius (2019) *Analytical Note on the State of the Rocket and Space Industry in Sweden*. Stockholm.

Halunko, Valentyn and Serhii Didenko (2019) Private International Space Law. Philosophical and Legal Factors of Approval by the World Community. *Philosophy and Cosmology.* Vol. 22, 16-23. https://doi.org/10.29202/phil-cosm/22/2.

Halunko, Valentyn, Oleksii Padun and Yevgen Rokytsky (2021) Space Islands in Orbit Around the Sun. *Future Human Image*, Volume 15, 24-38. https://doi.org/10.29202/fhi/15/3

Hurska, Alla (2020) Revival of Ukrainian Space Sector: A Viable New Prospect? *Eurasia Daily Monitor*, Vol. 17 Issue: 49. Available online: https://jamestown.org/program/revival-of-ukrainian-space-sector-a-viable-new-prospect/

Human Rights in Turkey: 2020 in review (2021) Stockholm Center for Freedom (SCF). Available online: https://www.amnesty.org/en/countries/europe-and-central-asia/turkey/report-turkey

Indonesia space agency takes a small step towards dream (2020) *Space Generation Advisory Council (SGAC)*. Available online: https://spacegeneration.org/regions/asia/indonesia

Inside Sudan's National Space Programme (2019) Space in Africa. Available online: https://africanews.space/inside-sudans-national-space-programme/

Kelland, Kate (2010) It's official: An asteroid wiped out the dinosaurs. *SCIENCE & SPACE*. Available online: https://www.reuters.com/article/us-dinosaurs-asteroid-idUSTRE6233YW20100304

Leiserowitz, Anthony, Edward Maibach, Seth Rosenthal, John Kotcher, Matthew Ballew,

Parrish Bergquist, Abel Gustafson, Matthew Goldberg and Xinran Wang (2020) *Support for Policies to Address the Pollution that Causes Global Warming*. Yale University and George Mason University. New Haven, CT: Yale Program on Climate Change Communication. Available online: https://climatecommunication.yale.edu/publications/politics-global-warming-april-2020/6/

Levenko, Alexander (2020) *Analytical note on missile technology of foreign countries*. Dnipro.

Levenko, Alexander (2021) Humanity must go to the Industrialization of outer Space – Industrial Space. *Science and Space.* Available online: http://scinspace.com.ua/new.html

Matsaberidze, David (2015) Russia vs. EU/US through Georgia and Ukraine. *Connections.* Vol. 14, No. 2, 77-86.

McGrath, Matthew and Daniel Wertz (2015) *North Korea's Ballistic Missile Program*. NCNK. Available online: http://www.worldinwar.eu/wp-content/uploads/2017/08/Missile_Issue_Brief.pdf

North, Douglass C., John Joseph Wallis and Barry R. Weingast (2009) *Violence and Social Orders: A Conceptual Framework for Interpreting Recorded Human History Reprint Edition*. Cambridge: Cambridge University Press. 308 p.

North Korea: What we know about its missile and nuclear programme (2021) *BBC*. Available online: https://www.bbc.com/news/world-asia-41174689

Productive activities (2021) Science and Space. Available online: http://scinspace.com.ua/Productive%20activities.html

Rogel, Mari Sese (2020) Space Research and Development in the Philippines. *Human Spaceflight Technology. Directorate*. Available online: https://iss.jaxa.jp/en/kuoa/news/pdf/06_APRSAF22_Philippines.pdf

Russian Aggression (2016) *Permanent Mission of Ukraine to the United Nations* (PMU). Available online: https://ukraineun.org/en/ukraine-and-un/russian-aggression/

Sokolski, Henry (1993) *Ending South Africa's Rocket Program: A Non-proliferation Success*. NPEC. Available online: http://npolicy.org/article.php?aid=458&tid=2

Space in South Africa (2020) *SpaceLab.* The University of Cape Town. Available online: http://www.spacelab.uct.ac.za/space-south-africa-0

Space Generation Advisory Council Vietnam (2020) Available online: https://spacegeneration.org/regions/asia/vietnam

Strelkova, Maria (2017) Brazil on its way to space. *BRASIL-RU.* Available online: https://brasil.ru/articles/space

Sudan Has Launched Its First Satellite (2019) Space in Africa. Available online: https://africanews.space/sudan-has-launched-its-first-satellite-a-remote-sensing-satellite/

Vietnam National Space Center (VNSC) (2021). Available online: https://vnsc.org.vn/en/about-vnsc