ARTIFICIAL INTELLIGENCE AND SPACE LAW

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ABSTRACT

Despite all the advantages that the use of artificial intelligence brings in the process of space exploration, this phenomenon poses a serious challenge to the key principles of international space law. The most acute issues in this context are related to the liability of states for damage caused by space objects with artificial intelligence, as well as ensuring confidentiality and data protection.

This article analyzes the consequences of the use of artificial intelligence from the perspective of international space law, including the extent to which the current provisions of international law generally meet the challenges associated with the use of the latest technologies based on artificial intelligence. In particular, the article explores the approaches existing in international legal documents and doctrine to the definition of the concept of "artificial intelligence", the problem of the possible legal personality of artificial intelligence and contains the assessment of risks associated with the use of artificial intelligence technologies in space activities.

The article emphasizes inter alia the thesis that the current international legal provisions on outer space do not suffice to fully regulate relations involving artificial intelligence technologies, and that the international community needs to focus its efforts on the development of relevant documents in the very near future.

Keywords: Artificial Intelligence, Machine Learning, Space Law, Liability, Responsibility, Autonomy, Legal Personality.

INTRODUCTION

Modern technologies based on artificial intelligence have great potential for use in space activities due to the specifics of outer space itself. Outer space, in spite of more than decades that have passed since the beginning of the space age, remains a largely unexplored area for mankind. Any activity in outer space is associated with a high risk of damage, whether it is the launch of space objects, the placement of space modules, the extraction of resources on the Moon and other celestial bodies (Galloway, 1981). In this regard, the use of autonomous systems (i.e. without human participation in decision-making) based on artificial intelligence and machine learning technologies (A form of AI that allows programs to more accurately predict outcomes without being directly programmed to do so) is considered as a potential solution to many problems arising in the process of space exploration. Such technologies are already beginning to be used in relation to various aspects of space activities, be they government programs or projects implemented through private partnerships, the share of which is increasing (for example, KubeSat-a project providing opportunity to build and launch satellites through various platforms,

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or AILEO-an Artificial Intelligence Learning Earth Observation to automatically deliver facts on land use in near real-time; Fujitsu developed a solution that uses artificial intelligence and quantum-inspired computing to optimize different elements involved in Active Debris Removal missions and others). These are areas such as data collection and analysing, space traffic management, space debris removal, resources exploitation, satellite management, missions to planets, collecting samples on celestial bodies, etc. In particular, "*artificial technologies being used in the space sector include a variety of tools as deep learning, machine learning, artificial neural networks, deep neural networks, computer vision and the rule based expert system which are sometimes combined with [...] virtual reality and 3D printing"* (Samal, 2020). Advances in the latest technologies are aimed at ensuring the long-term sustainability of outer space activities and achieving Sustainable Development Goal (SDG) 9: Industry, Innovation and Infrastructure. Thus, artificial intelligence technologies and space activities are high-tech science-intensive areas, the joint use of achievements in which can give humanity an impetus to move to a completely different level of development, both in terms of space exploration and in general.

Despite the scientific and technological progress, it should be noted that international law in general, and international space law, in particular, lack adequate regulation of this sphere of activity fraught with serious risks. The results of development in the scientific and technical sphere should be used in such a way as to minimize all potential negative consequences, which mean that the corresponding legal regulation should to some extent anticipate events. With regard to artificial intelligence technologies, this consideration is extremely relevant. Here it would be reasonable to highlight the key aspects in relation to the entire cycle of using artificial intelligence technologies in the implementation of space activities, which need legal comprehension: the legal content of the *"artificial intelligence"* concept; identifying areas in which artificial intelligence technologies can be most effectively used, and the risks that arise in this regard; establishing the potential legal consequences of using artificial intelligence technologies in space activities, and analysing approaches to solving problems of legal regulation (Solum, 1992).

DISCUSSION

Approaches to the Definition of Artificial Intelligence

The doctrine provides different approaches to defining what constitutes artificial intelligence. What was initially considered more like science fiction is already a reality. Humanity has long wondered whether machines can think, and if a machine can think, whether it really is a "*machine*". The answer to this question is especially relevant in the context of development of legal regulation of the relevant relations.

Despite the disagreement on certain aspects, most researchers agree that artificial intelligence is computer systems that are somewhat similar to the human mind (Carrillo, 2020). Artificial intelligence technologies are not robots and self-driving machines like Tesla, but rather existing cognitive technology that mimics the human mind (UNESCO, 2019).

In general, there are several approaches to defining the concept of "*artificial intelligence*" (Chesterman, 2020): act as a human (which includes the Turing test); think as a human (cognitive behaviour modeling); think rationally; act rationally (Chesterman, 2020).

The first stage of artificial intelligence-the level of such technologies, at which we are now - is the so-called 'weak' artificial intelligence or artificial narrow intelligence, which mimics

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the human cognitive process (Surden, 2019). Such technologies can demonstrate brilliant results, but at the same time, they are completely "*unaware of what they are doing*" (UNESCO, 2019). The next level is general or strong artificial intelligence (artificial general intelligence), which corresponds to or even surpasses the level of human intelligence and can solve a wide range of problems (Surden, 2019). A significant part of the available research is devoted to the consideration of issues related to the potential use of this particular type of artificial intelligence.

Despite the fact that there is no universally accepted definition of the concept of *"artificial intelligence"* enshrined in an international legal document (UNESCO, 2019), and scholars determine its content based on the objectives of a particular study, they, in general, come to a consensus on its common basic characteristics (UNESCO, 2019). For example, within the framework of UNESCO, artificial intelligence (or artificial intelligence technologies) is defined as "*a machine capable of imitating or even exceeding human cognitive capacities, including sensing, language interaction, reasoning and analysis, problem solving, and even creativity"* (UNESCO, 2019). As scholars fairly note (Shestak & Volevodz, 2019), the definition of artificial intelligence, formulated by prof. Yastrebov, appears to be one of the clearest: *"The result of human activity, which is a complex set of communication and technological interconnections, with the ability to think logically, manage their actions and correct their decisions in the event of a change in external conditions"* (Yasterbov, 2018).

The problem of defining the concept of "*artificial intelligence*" is also touched upon in the framework of the activities of international intergovernmental and non-governmental organizations. Among the intergovernmental organizations, the following ones should be particularly noted: United Nations, World Intellectual Property Organization, Council of Europe (Council of Europe, 2019) and others.

Along with the term "*artificial intelligence*", the term "*machine learning*" is also frequently used in research. Machine learning, as a kind of artificial intelligence, refers to a whole system of computer programs with similar characteristics. Such technologies are defined by the fact that, analysing a large amount of data and highlighting the necessary patterns in them, they apply the results obtained to perform various tasks and find effective automated solutions (Surden, 2019). The results obtained are similar to the results of intellectual activity. In other words, machine learning refers to the ability of a computer to improve its performance without being specially programmed to do so (Chesterman, 2020). Currently, it is machine learning that is the most significant and effective approach in the development of artificial intelligence technologies. It is the machine learning that underlies most of the existing artificial intelligence systems that affect modern society (Surden, 2019; Balukhto & Romanov, 2019).

Considering the issues of terminology (artificial intelligence, machine learning), it is necessary to proceed from the fact that the terms intelligence and learning are used not in their direct meaning, but rather in a metaphorical one. Modern artificial intelligence systems are not intelligent or thinking in the literal sense. Likewise, the machine does not learn. Such technologies are capable of arriving at reasonable (intellectual) results without using intelligence, as we define it in relation to people. That is why the terms imitation or simulation often appear in the proposed definitions - such technologies do not come to results in the same way as the human mind, but simply imitate mental activity in such a way that a computer makes a decision he most suitable for the given conditions (algorithms) based on the information received and the identified patterns. This type of algorithms has shown its efficiency in performing tasks with

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clear and specific parameters that do not require abstract thinking, as is the case with the human mind.

Without touching on the prospect of the emergence of "*strong*" intelligence systems in the near future, it should be noted that currently existing technologies are, as a rule, related to "*weak*" intelligence and are adapted to solve only specific types of problems with certain characteristics. Understanding this is key for the development of legal regulation of the use of such technologies in general, and in the space industry, in particular.

Possible Legal Personality of Artificial Intelligence and its Autonomy

As artificial intelligence systems become more and more complex and play an increasing role in various spheres of society's life, the question of its possible legal personality, including in the context of international law, is becoming increasingly relevant. This question is based on the following considerations. The first and main legal problem arising in connection with the use of such systems is the establishment of legal responsibility for the occurrence of harmful consequences as a result of the use of artificial intelligence. The second problem concerns the issue of obtaining the benefits derived from the use of artificial intelligence, in particular, the protection of intellectual property rights (Chesterman, 2020). It is believed that the starting point for determining when a machine has reached a level of necessary autonomy (comparable to that of a human) is to pass the Turing test (Turing Test is an empirical test invented by the English mathematician Alan Turing, the purpose of which is to test the ability of artificial intelligence, namely, when true "*intelligence*" is actually achieved). For example, the European Parliament in 2017 in its resolution with Recommendations to the Commission on Civil Law Rules on Robotics urged the Commission to consider creating a *"specific legal status for robots in the long run, so that at least the most sophisticated autonomous robots could be established as having the status of electronic persons responsible for making good any damage they may cause".*

Until recently, the question of the responsibility of the machine itself for its actions did not even arise, since it was not considered a subject as such, but only as an object or instrument of the person who created or programmed it (Morhat, 2017). This approach is traditional and does not require any changes to the existing legal norms (Morhat, 2017). However, with the gradual spread of such technologies, taking into account scientific and technological development, as well as the transition from automated activities to full autonomy, this problem arises from a completely different angle. Here we mean that autonomy implies the ability to make decisions without human participation, and automation is controlled by a person in real time (Chesterman, 2020). Because of this, other approaches appear to address the issue of the status of artificial intelligence.

In particular, since such technologies are capable of performing autonomous actions, it is proposed to establish their legal status by analogy with animals, namely, as legal objects endowed with legal personality (Shestak & Volevodz, 2019).

A much more controversial approach has also been put forward, according to which artificial intelligence is considered as a full-fledged subject of legal relations. In favour of the argument that the status of artificial intelligence is comparable to that of a legal entity, the researchers cite the fact that, as the artificial intelligence system achieves autonomy at the human level, it should be entitled to a status comparable to individuals (Chesterman, 2020). Therefore, for example, S. Bayern points out those autonomous systems can be similar to legal entities; and

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that under existing US law, it is possible to create a legal entity entirely and led by artificial intelligence in the form of a limited liability company, proving that such a structure gives artificial intelligence legal personality (Bayern, 2015; Burri, 2017).

This approach raises some concerns and is criticized on the basis that, firstly, such a comparison is incorrect, since people are behind the activities of such an entity in any case (Morhat, 2017; Nevejans, 2016), and, secondly, in the absence of a uniform approach to solving this issue, evasion and abuse of rights by such legal entities are possible in the event that they carry out illegal activities. Such fear is quite justified, since such entities can be created in different states, which can significantly complicate the fight against their illegal activities if national legislation provides for a different regulatory regime (Burri, 2017).

According to another approach, which seems to be more reasonable, the legal status of a system with elements of artificial intelligence and a completely autonomous system should be different. Autonomous machines can be recognized as a *"full-fledged cyber subject of society",* but the range of rights and obligations should differ in accordance with the set of their functionality (Shestak & Volevodz, 2019). In addition, some scientists identify such concept as an "electronic person", where artificial intelligence is its important component (Yastrebov, 2018). Therefore, an electronic person, as the owner of artificial intelligence, that is, possessing a mind similar to a human, and endowed with the ability to make decisions not based on an algorithm laid down by the creator or operator in advance, can be endowed with certain rights and obligations, and therefore be considered a subject of law (Shestak & Volevodz, 2019).

Nevertheless, despite the fact that machines with artificial intelligence can obtain the so-called "*reasonable*" results based on data through independent decision-making, as such, they are not related to intelligence or reason in the direct (human) sense of the word, since the human cognitive process when making a decision, happens in a completely different way (Surden, 2019, p. 1308). Accordingly, this ability of "*smart*" machines cannot be equated with decision-making by an individual or legal entity (Gal et al., 2020). This means that decisions and actions made by artificial intelligence without human control do not take into account a number of human factors like consciousness, emotion and discretion (Gal et al., 2020).

It seems that the pros and cons of this or that approach can be established in the process of analysing the potential consequences of using artificial intelligence in space activities.

Use of Artificial Intelligence Technologies in Space Activities

At present, it is difficult to talk about the full realization of the potential associated with the use of artificial intelligence in space. Artificial intelligence technologies, and in particular machine learning, are still developing for the purposes of the space industry, but already now one can observe the gradual introduction of such elements into space activities.

Remote sensing satellites are one example of how artificial intelligence technology can transform activities in space (Harebottle, 2019). The amount of data obtained through the use of the latest satellite technologies such as Copernicus (European Space Agency, 2018) or Smart Sat (Harebottle, 2019) greatly increases the need for data processing. The satellites collect data, which are then transmitted to the ground station. The use of artificial intelligence technologies on Earth and in outer space can open a new era in working with information and data. With the help of artificial intelligence, the received data can be immediately checked and processed by the satellite, and then only the most relevant and necessary data will be transmitted, which will

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reduce transmission costs, and will make it possible to focus on analysing the most important information (Harebottle, 2019).

According to Gaetano Volpe, co-founder and CEO of Latitudo40, a startup that applies AI algorithms to satellite Earth Observation (EO) images, artificial intelligence will affect all sectors of the space industry, from launch to constellation control and satellite performance analysis (Harebottle, 2019). Moreover, in the not-too-distant future most of the operations associated with satellite services will be based on some form of artificial intelligence (Harebottle, 2019). Thus, satellites based on artificial intelligence will become more and more independent from humans, which will ultimately reduce the volume of data transmitted to Earth from outer space.

In addition to working with data, artificial intelligence is actively used to monitor the operation of space objects, the actions of other satellites, planets and space debris, and, if necessary, to take corrective actions (Bratu et al., 2021). Such devices are used, for example, by SpaceX to prevent collisions of satellites with other objects (Bratu et al., 2021).

Another example of the use of artificial intelligence in space is the so-called 'assistant robots' for the crew of space stations. For example, the SpaceX robot (Clark, 2018) or the CIMON assistant robot (Eisenberg & Walcott, 2019). CIMON assists astronauts in their daily work, in accessing documents and information, and helps operate and repair equipment at the station (Bratu et al., 2021; Agreement on the Rescue of Astronauts, 1969).

Artificial intelligence devices are becoming indispensable in the process of exploring spaces in space that can be dangerous to humans.

So, the NASA rover was launched to explore Mars (Weiss, 2021). Artificial intelligence gives rovers the ability to collect and analyze data and decide for themselves what information to send back to Earth, and what can be done without human intervention (Soroka & Kurkova, 2019). Since 2016, NASA has tested the AEGIS autonomous system on a rover that was originally designed to identify and photograph boulders and was sent to explore the Gale Crater on Mars (Soroka & Kurkova, 2019). NASA also created the Artificial Intelligence Group, which is engaged in fundamental research in artificial intelligence planning using scientific analysis, spacecraft operation, mission analysis, deep-space network operations and space transportation systems. For deep space exploration, NASA is exploring the possibility of developing spacecraft that are more autonomous so that decisions can be made on the spot immediately in order to eliminate the delay caused by the time spent on signal transmission.

Separately, it is worth noting the use of the latest technologies for the removal of space debris. The European Space Agency (ESA) plans to launch the world's first space debris removal mission, ClearSpace-1, equipped with an artificial intelligence camera to locate debris.

The development of artificial intelligence technologies and their introduction into space activities open up new horizons for the subsequent exploration of deep space. The huge distances in outer space make it very difficult for operators to transmit information from outer space to Earth. In such cases, we are talking not only about collecting data and their processing, but also about simple assistance in case of malfunctions on board or equipment breakdown, which is also hindered due to difficult accessibility. The solution to such problems can be intelligent systems capable of predicting and diagnosing problems and making further independent decisions (Soroka & Kurkova, 2019).

The above examples indicate that space exploration using artificial intelligence technologies needs due legal assessment.

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Artificial Intelligence in International Space Law Instruments

Until recently, the development of artificial intelligence technologies took place in a kind of normative vacuum, and now there are still very few provisions that touch upon the specifics of this problem directly.

As part of the activities of the Committee on Space, issues related to the use of artificial intelligence technologies in outer space are increasingly being raised, in particular, the use of artificial intelligence to process satellite imagery that was used to generate highly precise and quickly available information on crop yields (Report of the Committee on the Peaceful Uses of Outer Space, 2018), an autonomous astronaut assistant featuring artificial intelligence, etc. However, unfortunately, the issue of artificial intelligence is not currently being discussed as a separate item on the agenda of the meetings of the Committee and its subcommittees. The need for a separate understanding of issues related to the use of artificial intelligence in space activities at the international legal level is conditioned by the rapid development of technologies in this area, which can radically affect the process of space exploration and the diversification of types of space activities. In this area, separate national legal initiatives are already emerging at the level of individual states (for example, Executive Order 13859, *"Maintaining American Leadership in Artificial Intelligence",* 84 Fed. Reg. 3967 (Feb. 11, 2019); Order of the Government of the Russian Federation No. 2129-r of August 19, 2020 *"On approval of the Concept for the development of regulation of relations in the field of artificial intelligence and robotics technologies for the period up to 2024"*), which, on the one hand, contributes to the development of legal regulation, but, on the other hand, can potentially lead to the dominance of the interests of individual states when carrying out activities in outer space. In particular, already long ago some states initiated special programs through national space agencies, the purpose of which is the development of science and technology in the field of artificial intelligence (Friedland & Lum, 1987). In the United States, among other things, there are proposals to create a federal agency for artificial intelligence that would "*flexibly, thoroughly and knowledgeably regulate artificial intelligence"* (Toews, 2020).

The existing major treaties on outer space adopted in the 60s and 70s, for obvious reasons, do not contain provisions governing the use of artificial intelligence technologies and establish only general principles covering any activity in outer space and on celestial bodies. In particular, we are talking about the following provisions: the exploration and use of outer space is carried out for the benefit and in the interests of all countries; space is not subject to national appropriation; space activities are carried out in accordance with international law; states are responsible for all national activities; space activities are based on the principle of cooperation and the requirement to take due account of the relevant interests of all other states (Kopal, 1966); states should inform the public and the international scientific community about the nature, course, places and results of their space activities, etc. Acts of "soft law", which play a large role in the regulation of space activities, also do not contain provisions regarding the use of artificial intelligence technologies. Taking into account the specifics of artificial intelligence and its areas of application, the absence of special regulation in this area is fraught with the emergence of many difficult situations in the future. In particular, the increasing use of artificial intelligence technologies in space activities raises questions in areas such as data protection; transparency and non-discrimination; cybersecurity; intellectual property; international responsibility and liability, etc.

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Legal Risks Concerning the Deployment and Use of Artificial Intelligence in Space

Liability issues concerning the deployment and use of artificial intelligence in space

The introduction of autonomous systems based on artificial intelligence into space activities cannot do without legal consequences, especially regarding issues of liability. Liability issues are governed primarily by the provisions of the 1967 Outer Space Treaty, namely Articles VI and VII, and the 1972 Liability Convention, namely Articles II and III (Foster, 1973).

The liability regime under the 1967 Treaty is based on the provisions of general Article VI, which establishes the responsibility of states for an international wrongful act (Article VI uses the term responsibility, which refers to international legal responsibility in general, which may not always mean that any damage was done), and on the provision of Article VII, which is clarified by the provisions of the 1972 Liability Convention (the authors of this article use the term 'liability' to mean damages). Thus, according to Article VII of the Outer Space Treaty, international responsibility rests with the launching state. A launching state is a state that launches or procures the launching of an object into outer space, or a state from whose territory or facility an object is launched. The provisions of Article VII of the Outer Space Treaty are detailed in Articles II and of the Liability Convention, which establish a regime of absolute (or objective) liability for damage caused by a space object on Earth or an aircraft in flight, and liability depending on the fault for damage caused in outer space or on a celestial body. The determining criterion for establishing liability is the place where the damage was caused, i.e. on the surface of the Earth or beyond (Bratu et al., 2021). In addition, the responsibility rests solely with the states, since non-state actors cannot be held accountable under international space law.

The development of artificial intelligence technologies creates the potential for complex activities in the notoriously hazardous environment of outer space. With regard to the implementation of liability for damage caused as a result of the use of such technologies in outer space, a number of questions arise.

Firstly, the Liability Convention lacks a definition of the concept of "*fault*", just as there are no clear criteria for its assessment (Bratu et al., 2021). Establishing fault in a particular case under Article III is a rather difficult task, and in none of the known cases of damage in outer space because of a collision has the Liability Convention been applied (Hobe et al., 2013). Moreover, the establishment of fault presupposes the existence of due care standards, which is quite problematic in the case of using such new technologies. It also appears that in this case, the extent to which the use of artificial intelligence has led to the damage will matter. In other words, it is important to determine at what stage and to what extent such technologies were used in the implementation of space operations - whether the damage was caused by decisions made by artificial intelligence (quite possibly in the near future) or based on data obtained using artificial intelligence technologies (such programs are already available).

The term "*persons*" as used in Article III of the Liability Convention also raises questions. The term "*person*", as used in Article III, usually refers to an entity with legal rights and obligations, such as a natural or legal person (Bratu et al., 2021). The commentary to the article notes that liability for damage under Article III refers to a group or category of persons for which the launching state is responsible, in a broader sense, it includes all persons and types of space activities that are believed to fall within the scope of Article VI of the Outer Space Treaty (Hobe et al., 2013). At the same time, if there is no previous interpretation of the concept of responsibility for space activities and the procedure for bringing to such responsibility, it is

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impossible to interpret the Convention so to limit the scope of its application, since this contradicts the goals and objectives of this Convention, as stipulated in the Vienna Convention on the law of Treaties, 1969 (Hobe et al., 2013). The commentary to the article also notes that in practice everything will depend on the establishment of the fault of the launching state and the available means of proof (Hobe et al., 2013).

Considering the above, since liability under Article III of the Liability Convention provides for the establishment of *"fault of the state"* or "*fault of persons*", it is difficult to imagine how a decision made by an intelligent space object could fall under the notion of "fault". This means that in the event of a collision, bringing the launching state to responsibility for damage caused by such an object will be quite problematic.

Further, according to Article II of the Liability Convention, states shall be absolutely liable for damage caused by their space objects on the surface of the Earth. In this situation, there are no obstacles to prosecuting states that use artificial intelligence technologies, as such. The complexity of the implementation of such responsibility arises in the context of Article VI of the Convention, which provides for the abolition of the strict rule under Article II in the event that "a launching State establishes that the damage has resulted either wholly or partially from gross negligence or from an act or omission done with intent to cause damage on the part of a claimant State or of natural or juridical persons it represents". Such an exception is practically impossible in the case of an object with artificial intelligence. The concept of *"gross negligence*" is not defined either by the Convention or by the commentary to it, which only refers to "*standard of care".* Some scientists in this case proceed from the fact that "*gross negligence*" has, first of all, a mental component and is the result of human mental activity, which, in principle, cannot be characteristic of machines (Bratu et al., 2021; Gal et al., 2020). Thus, in the absence of clear criteria for "standard of care" and taking into account the fact that they are, of course, established depending on the level of scientific and technological development, the application of the relevant provisions of the Convention is very problematic.

A separate problem, in this regard, is the situation when not all states carrying out space activities have the necessary level of development that allows the use of artificial intelligence technologies. The question arises whether it is possible to regulate the activities of states in the same way in this case, or whether it is necessary to develop standards taking into account this difference in the form of the so-called "*sliding scale*" depending on technical capabilities.

Data privacy and other human rights issues related to the use of artificial intelligence in space

Despite all the benefits that the use of artificial intelligence technologies can bring, certain ethical and social risks also arise with their development. For instance, there is an acute issue of using artificial intelligence alongside with space technologies in the activities of law enforcement agencies (Soroka & Kurkova, 2019).

Undoubtedly, artificial intelligence and space technologies can help in the prevention or solution of crimes, as, for example, in a situation where, thanks to satellite images, the illegal cultivation of drugs is suppressed (Gal et al., 2020), etc. However, it should be borne in mind that the use of such technologies should not violate human rights; in particular, we are talking about discrimination, arbitrary interference with privacy, etc.

As scholars fairly point out, the use of technology for the wrong purposes and/or by the wrong persons can cause significant damage, and the damage can be both intangible (restriction

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of the right to freedom of expression and discrimination) and material, namely, damage to human health, including possible death (Gal et al., 2020). The consequences of the use of such technologies in outer space raise serious concerns since there are great opportunities for the application of such technologies in this area. These risks are also associated with the fact that in recent years an increasing role in space activities has been played by such individuals and legal entities, whose activities are covered, first of all, by the norms of national law. As for the use of artificial intelligence technologies, academics have identified two aspects that cause the greatest concern: ensuring confidentiality and protection of personal data, as well as their incorrect storage (Gal et al., 2020).

In particular, the ubiquity of "*facial recognition*"; lack of transparency (the subject is not informed that his or her personal data is being collected); tracking and de-anonymizing data; lack of access rights, correction and deletion of data (the so-called black-box effect); bias and discrimination, and, as a result, unreliable results and many others (Gal et al., 2020).

In this regard, there are already separate provisions aimed at solving the indicated problems. So, one of the important documents is the General Data Protection Regulation of the European Union, which entered into force in 2018. The Regulation quite broadly defines the concept of "*personal data",* which includes any information obtained through observation of the Earth, relating to an identified or identifiable person, including the location of the person (Gal et al., 2020). Also, Art. 22 states the following: "*The data subject shall have the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning him or her or similarly significantly affects him or her*".

Of particular concern is the sharing of different technologies, which can lead to serious human rights violations. For example, data obtained through Earth observation can be analyzed using facial recognition technologies and combined with location data and data obtained from security cameras, which seriously raises the question of ensuring their confidentiality (Gal et al., 2020; Soroka & Kurkova, 2019). In this regard, it is worth noting the Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data (No. 108), adopted within the framework of the Council of Europe, which proceeds from a broad interpretation of the concept of "*personal data*" and defines the acceptable limits of the use of face recognition technologies. This Convention is the only data protection treaty, and any state can accede to it (UN OHCHR Report of the proceedings, 2020).

It is also noted at the United Nations level that before the widespread introduction of face recognition technologies, an assessment of human rights should be carried out at the stage of their conceptualization (UN OHCHR Report of the proceedings, 2020). The issues of data storage are considered separately, in particular, the problem of the lack of a specific regulatory framework for the activities of the private sector, which often neglects the protection of human rights. Given the growing share of the private sector in space activities, these problems are of serious concern.

There are more and more initiatives from non-governmental organizations and academia, which are also actively involved in the development of proposals to address the identified issues. For example, in 2017, the Future of Life Institute adopted the Asilomar Principles on Artificial Intelligence, the University of Montreal prepared the Montreal Declaration for a Responsible Development of Artificial Intelligence, Amnesty International and Access Now proposed the Toronto Declaration (2018) on the protection of the rights to equality and non-discrimination in machine learning systems. Taking into account the growth of activity in this area, it is necessary

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to carefully weigh the proposed approaches, and first of all, to adapt the already existing norms and principles for the protection of human rights and data protection when using artificial intelligence technologies. Given the interconnectedness of these areas of interstate cooperation, it is important to focus efforts on developing an intersectoral approach that will take into account the specifics of activities in outer space and, to the maximum extent, guarantee the observance and protection of human rights.

Currently, there is a rapid development of space activities and the space industry. Over the past decades, not only the number of states participating in space activities has increased, but the share of the private sector has also increased significantly. The development of artificial intelligence technologies has created unprecedented opportunities for space exploration and the implementation of new types of space activities. Space objects launched by both states and private actors are becoming more and more technologically complex and are increasingly equipped with artificial intelligence technologies, which enables them to function without human control. Such devices are used, in particular, for monitoring the operation of satellites, as assistants for astronauts, and for conducting research in conditions hazardous to people (The General Assembly, 1976).

CONCLUSION

At the same time, the introduction of artificial intelligence systems into space activities entails certain legal consequences. The use of space technologies capable of functioning completely autonomously from humans can lead to unpredictable results, which poses important issues for the international community to be solved. The following conclusions can be drawn:

1. The main difficulty is to establish the essence of the very concept of "*artificial intelligence*", which is currently very urgent, since in order to efficiently regulate relations, it is necessary to understand what the subject and object of these relations are. The doctrine and individual legal acts contain different approaches to the definition, including also different approaches to categorizing artificial intelligence depending on the degree of human control and other factors.
2. The legal status of artificial intelligence is currently not defined. Given its character that is autonomous from humans, artificial intelligence is an "*independent personality*" that makes decisions based, among other things, on the ability to learn by itself. In this context, it is inappropriate to apply the existing legal categories to determine the status of artificial intelligence. The question as to whether artificial intelligence can be considered as an independent subject of law may suggest different answers.
3. The use of artificial intelligence in space activities is fraught with risks that differ from those emerging when applying these technologies on Earth. First of all, this is due to the peculiarities of outer space - any activity in it is dangerous in itself. In this regard, the international community needs to focus its efforts on the development of special provisions regarding the use of artificial intelligence technologies in outer space.
4. The existing international treaties regulating the activities of states in outer space per se do not cover issues arising from the potential use of artificial intelligence technologies, be it the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, or the 1972 Convention on Liability for Damage Caused by Space Objects. States will have to consider the development of the text of a new international treaty; or the amendment of the existing treaties or the adoption of an interpretative declaration, if at least temporarily it may be an adequate measure to resolve relations arising from the use of artificial intelligence technologies in space activities. At

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the same time, space activity is understood not only as activity in outer space, but also as activity on Earth associated with outer space.

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