SPACE TRAFFIC MANAGEMENT AS A TOOL FOR THE MITIGATION OF SPACE DEBRIS: INTERNATIONAL LEGAL BASIS

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ABSTRACT

All space activities presuppose the simultaneous presence in outer space of a large number of space objects with different service life, characteristics, etc. At the same time, from the very beginning of the implementation of space activities, mankind has left its mark in the form of space debris, which, given the specifics of space activities associated with a high risk of damage, often leads to collisions with functioning spacecraft. In the 60 years since the beginning of the space era, more than 6,000 launches of artificial spacecraft have been carried out. Since 2019, their number has more than doubled, from 583 launches to 1,250. the number of debris objects in orbit in 1980 was about 4,800, by 2000 this number had increased to an approximate number of 8,000. After an explosive growth, in 2010 there were already about 15,000 debris objects in outer space. According to current data, as of May 20, 2021, their number reached 28,600 objects. In addition, according to the latest data, the number of debris objects in orbit that are larger than 10 cm is 34,000, from 1 cm to 10 cm in size - 900,000, and from 1 mm up to 1 cm - 128 million.

In the context of further efforts by the international community to combat space debris, various proposals are voiced, including the idea of creating a space traffic management system

The problem of developing space traffic management rules is complex - it combines technical and legal aspects, which should be developed taking into account the rapidly changing conditions and a sharp increase in space activity. Currently, various approaches to creating a STM system are proposed, the main ones are the bottom-up approach and top-down approach. Regardless of which of the approaches will ultimately be supported by the international community, it is clear that in the process of achieving the intended goal, many complex issues will have to be solved, some of which are associated not only with difficulties in the technical field, but mainly with unwillingness on the part of states to lose complete freedom in terms of the implementation of space activities and limit themselves in the pursuit of their ambitious plans and projects.

Taking into account the above, as a first step towards the establishment of a global STM system, it is proposed to adopt an international treaty, which, defining the main parameters of the behavior of subjects, can be supplemented with various applications that will take into account changing conditions and emerging challenges. In order to urgently ensure safe activities in outer space, including combating space debris as one of the main elements, it is necessary to adopt such document specifically at the level of an international treaty. The adoption of this kind of regulations will make it possible to regulate activities in space more efficiently already at the present stage, including the implementation of the provisions of the existing five space

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treaties. The development of such regulations can be based on the rules that are already applied by space powers in various segments of space activities, but it should also be accompanied by a search for solutions to issues that require new approaches, including the adoption of due diligence rules for various types of operations, provisions on liability, etc. At the same time, the analogy with the existing international legal regimes (in air or sea space) can be very useful, but it cannot be considered as a ready-made solution to the problem, taking into account all the specifics of outer space. In any case, the main driving element in development in this difficult direction is the readiness of states to seek compromises, which is to be assessed in the very near future.

Keywords: Space Traffic Management, Space Debris, Space Law, Sustainability, UNCOPUOS, Space Safety, Liability.

INTRODUCTION

Despite the fact that mankind has relatively recently discovered the possibility of using outer space, an increasing number of states and non-state actors are gaining access to various types of space activities. In particular, these are the scientific research, navigation, direct television and radio broadcasting, remote sensing of the Earth, resource extraction, construction of space stations and much more. All these activities presuppose the simultaneous presence in outer space of a large number of space objects with different service life, characteristics, etc. At the same time, from the very beginning of the implementation of space activities, mankind has left its mark in the form of space debris, which, given the specifics of space activities associated with a high risk of damage, often leads to collisions with functioning spacecraft. Here, we are talking about both the damage incurred by states as a result of the failure of multi-million dollar spacecraft, and the damage that is caused to the entire space industry as a whole, since as a result of the increased pollution, access to space is hampered for everyone, regardless of the purposes of activities. In this sense, the use of outer space can be compared with the use of airspace - with an increase in activity; it becomes necessary to regulate the activities of all who are involved in it. First of all, this refers to traffic management. Nevertheless, with regard to outer space, this kind of regulation is still lacking, which creates obstacles to ensuring sustainable activities in space for all actors and stakeholders. There are many reasons for the absence of provisions related to space traffic management (STM), among them: the reluctance of states to restrict the freedom of activity in outer space in any way; unwillingness to allow control over the launch of space objects (primarily for military purposes), and others. Nevertheless, given that space traffic management is aimed directly at prevention and combat of space debris, the need to adopt clear rules in this area is becoming more and more obvious to everyone. We cannot say that states are not making any efforts - recently, separate international legal documents have appeared at the level of the United Nations and other interstate associations, as well as acts of national legislation. Nevertheless, given that outer space is a common territory, a solution to the emerging problems should be found in the international legal field by adopting a binding document. Despite the high relevance of these issues, there is still uncertainty regarding the legal content of such categories as "*space debris*", "*space traffic management*", which, among other things, complicates the development of approaches to the regulation of the corresponding legal relations. The international legal doctrine and the acts of "*soft law*" offer various options for a possible

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solution to the problem, which need to be assessed in order to identify the most effective approach. Thus, for the purpose of research it is necessary 1) to establish the legal content of the concepts of "*space traffic management*" and "*space debris*"; 2) establish what approaches to solving the problem of space debris through the adoption of legal regulation in the field of space traffic management exist at the level of international legal acts, as well as in the national legislations of states, and give them an international legal assessment; 3) determine the best options for solving the problem, taking into account the practice of international organizations and states.

DISCUSSION

The Essence of the Problem and Approaches to Combating Space Debris

Today, the problem of contamination of outer space with artificial objects is obvious, which is reflected in the works of various scientists (Lee & Sproule, 1989; Li, 1990; Diederiks-Verschoor, 1990). The main negative consequence of space exploration is its progressive contamination with man-made products accompanying the implementation of space activities. In the 60 years since the beginning of the space era, more than 6,000 launches of artificial spacecraft have been carried out. Since 2019, their number has more than doubled, from 583 launches to 1,250. This result is explained by the increasing interest in satellite broadband services from commercial entities such as SpaceX and OneWeb. According to the Index of Objects Launched into Outer Space, provided by the United Nations Office for Outer Space Affairs, there are currently 7,793 objects in orbit (United Nations Office for Outer Space Affairs, 2008), including inoperative spacecraft.

According to the Space Environment Report, published by ESA Space Debris Office (2019), the number of debris objects in orbit in 1980 was about 4,800, by 2000 this number had increased to an approximate number of 8,000. After an explosive growth, in 2010 there were already about 15,000 debris objects in outer space. According to current data, as of May 20, 2021, their number reached 28,600 objects. In addition, according to the latest data, the number of debris objects in orbit that are larger than 10 cm is 34,000, from 1 cm to 10 cm in size - 900,000, and from 1 mm up to 1 cm - 128 million. Basically, this debris consists of paint stains from spaceships; the ships themselves; parts of satellites and missiles that are either lost or have long been inactive (Space Debris, 2021). Based on the aforementioned statistics, we can conclude that the numbers are growing rapidly, and this trend causes concern of the entire world community for a good reason.

It becomes obvious that it is necessary to ensure safety in space and to establish regulations for the movement of space objects, taking into account the data obtained from monitoring of space debris movement. The solution to this problem requires regular interaction at the international level, the creation of an international legal framework for space traffic management and information exchange, the maintenance of an up-to-date information base on the space situation, uniting national and international information resources of states and organizations engaged in space activities, practical implementation and control over the observance of international legal provisions in the space sphere. Problems of national and international regulation over activities in space will also arise. There is already the need to assign telecommunication wavelengths to communications with satellites and space objects. Other types

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of regulations having serious security implications will have to be worked out for the identification of space objects and for some type of traffic control to prevent congestion and interference.

The potential for collisions, accidents, misunderstandings and conflicts is growing. Each accident releases garbage that threatens the space activities of another state. In 2007, the Chinese anti-satellite weapon test created tens of thousands of fragments that caused geopolitical problems. Such actions not only opened the way for an arms race, but also created a threat to all space activities, provoking the emergence of a cloud of space debris in the valuable orbital plane. In 2012, the crew of the International Space Station was forced to take refuge in the saving capsules of the Soyuz spacecraft when debris flew next to it because of a 2009 satellite collision. Moreover, in order to avoid collisions with space debris, it is necessary to regularly adjust the trajectory of the International Space Station, which has a major impact on the efficiency of its operation.

Collisions of space objects lead to the formation of fragments, which can generate more and more pieces of space debris, colliding with each other. Because of these processes an exponential increase in the number of objects should be expected, which together form a so-called "*debris belt*" around the Earth (Donald et al., 1978). This theory (the so-called "*Kessler Syndrome*") was formulated by NASA consultant Donald Kessler in 1978. The theory suggested that space debris in low-Earth orbit, which appeared as a result of numerous launches of artificial satellites, could lead to complete unavailability of the near space for practical use.

The topic of combating space debris began to be discussed at the UN level in the late 1970s. Between 1977 and 1988, the UN Committee on the Peaceful Uses of Outer Space provided information on the situation in the geostationary orbit, in particular, on the likelihood of a collision, on several occasions (Perek, 1991).

It is important to note that since 1979 no new international treaties have been adopted in the field of space law. Thus, the process of deviation from "*rigid*" international legal norms towards a new interpretation of legally binding rules is evident through the adoption of recommendations on specific aspects of space activities (Hobe et al., 2017). For example, the Space Debris Mitigation Guidelines were developed by the Inter-Agency Space Debris Coordination Committee (IADC) and were first presented to the Committee in 2002, and then, jointly with the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space, were revised in 2007. In 2020 and 2021, the IADC also made adjustments to the Space Debris Mitigation Guidelines. This document defines the concept of "*space debris*", which means "*all human made objects including fragments and elements thereof, in Earth orbit or re-entering the atmosphere that are non-functional*" (Benkö & Kai-Uwe, 1997).

For many years, the topic of space debris had been discussed exclusively in the Committee's Scientific and Technical Subcommittee, although some delegations recommended that the Legal Subcommittee be engaged, convinced that the growing space debris problem would have to be addressed from both a technical and legal point of view. Unlike the various Principles, the COPUOS SDM Guidelines, endorsed by the UN General Assembly, have never been discussed in the Legal Subcommittee and remain a technical document of a recommendatory nature and content. The lack of participation of the Legal Subcommittee in the development of this document means that the issues of liability and the legal definition of "*space debris*", like many other legal issues, remain open (Schick, 1961).

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The main provisions governing the protection of outer space from space debris pollution are contained in the 1967 Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. According to Article IX of the Outer Space Treaty, states "*shall pursue the study of outer space, including the Moon and other celestial bodies, so as to avoid their harmful pollution, as well as adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter*".

Paragraph 3 of Art. V of the Outer Space Treaty is also of some interest. In accordance with this paragraph, the States Parties to the Treaty shall immediately inform the other States Parties to the Treaty or the Secretary-General of the United Nations of any phenomena they discover in outer space, including the Moon and other celestial bodies, which could constitute a danger to the life or health of astronauts (Morin, 2019).

Article VII of the Outer Space Treaty limits liability to damage caused by space objects. The concept of "*space object*" is not defined in any of the treaties, including the 1972 Liability Convention, despite all efforts made in this direction during the development of the original text of the Convention (Cheng, 1995). The definition of this term requires the determination of the content of the concepts "*object*" and "*outer space*". Article I of the 1972 Liability Convention includes in this term "*component parts of a space object as well as its launch vehicle and parts thereof*", but this only indicates that the individual parts or components should be included in the definition, and their definition of is not given (Hobe et al., 2017).

The term "*space object*" was introduced as a generic term referring to any object that is planned for launch, is launched or has already been launched into outer space, including the Moon and other celestial bodies (Cheng, 1995). At the same time, there are no legal restrictions on the size and purposes of use of the space object. Therefore, some scientists are of the opinion that parts of space debris are included in the concept of objects for which the state is "*responsible*" (Benkö & Kai-Uwe, 1997; Kerrest, 2016; Faraminan & Crowther, 1997; Hacket, 1994).

As noted above, in addition to the Outer Space Treaty, the 1972 Convention on International Liability for Damage Caused by Space Objects also has relevance to space debris mitigation. Article II establishes cases of absolute responsibility of the launching state. Article III, in turn, establishes cases of liability solely in the presence of fault. In addition, Article XXI of this Convention can also be used as a basis for eliminating the negative effects caused by space debris - it provides for the institution of immediate provision of appropriate assistance to the damaged state when the latter requests it. However, the provisions of the Convention are insufficient to resolve the issues of liability for damage resulting from collisions with space debris.

Reducing the contamination of near-Earth space with space debris and cleaning up heavily contaminated orbits will allow future generations to freely use space for various purposes in accordance with the Outer Space Treaty. To date, the international legal framework for regulating mechanisms aimed at combating space debris is limited. When developing projects that do not lead to pollution of outer space, it is necessary to combine legal, operational and design solutions that contribute to the achievement of the goal of subsequent limitation of orbital debris in the course of any space activity. It should also be noted that although the overall contamination of outer space will increase, it is necessary to combat space debris using a complex of technical and legal mechanisms, as well as the joint efforts of the entire international

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community. In the context of further efforts by the international community to combat space debris, various proposals are voiced, including the idea of creating a space traffic management system.

Concept and Approaches to Creating a Space Traffic Management (STM) System

Discussion on the need to establish regulations for the control of space traffic began in 2000, but no decisive steps in this direction have yet been made. Since 2016, the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space has taken up these issues on a regular basis.

Initially, the STM problem was discussed mainly as a technical issue, which is quite logical, given the complexity of the implementation of such processes in outer space. First, it is necessary to determine what the technical capabilities of states and other actors in this area are, and only then take steps towards the development of legal regulation. To date, a number of studies on STM have been prepared, which reflect various aspects of this issue, namely, these are: Cosmic Study on Space Traffic Management 2006 and "*Space Traffic Management towards a roadmap for implementation*" 2018, prepared by the International Academy of Astronautics (IAA); Towards a European Approach to Space Traffic Management 2020, conducted by the European Space Policy Institute (ESPI) etc.

There are various definitions of STM, but most often the definition is used that was formulated as part of the 2006 study of the International Academy of Astronautics and that remained unchanged in the 2018 study: "*Space Traffic Management means the set of technical and regulatory provisions for promoting safe access into outer space, operations in outer space and return from outer space to Earth free from physical or radio-frequency interference*" (Contant-Jorgenson et al., 2006). In our case, regulatory provisions are of particular interest.

Separate elements are usually distinguished in the legal aspect of the issue, which together form the so-called space traffic management system. This includes, in particular, the creation of a common space situational awareness (SSA) database; adoption of common rules for sharing on-orbit maneuver information; traffic management rules for collision avoidance; and responsibility and liability rules against breach of the common rules (Takeuchi, 2019).

SSA is the technical capacity to "*detect, track, identify, and catalog objects in outer space, such as space debris and active or defunct satellites, as well as to observe space weather and monitor spacecraft and payloads for maneuvers and other events*" (Schrogl et al., 2018). It is key for the implementation of STM, but there are still no international legal mechanisms for the implementation of interstate cooperation in this area. Establishing such a global database requires the commitment of states to move in this direction, including the adoption of legal obligations and the creation and use of the appropriate infrastructure. Taking into account the difference in the levels of economic, scientific and technological development of states, not to mention considerations of national security and strategic interests, the implementation of provisions in this area is obviously fraught with many obstacles. It is clear that in order to implement the relevant provisions, it is necessary to establish a global monitoring system for activities carried out in outer space, which, first of all, involves the acquisition and analysis of reliable data that for obvious reasons may be considered by some states as an attempt to limit their rights reflected in the fundamental principles of international space law. This conclusion is also true for the rest of the above-mentioned elements of the system. Thus, a certain balance is

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needed in terms of ensuring freedom of activity in outer space and taking measures aimed at preventing damage resulted from collisions of space objects with each other, with space debris, etc. This problem cannot be solved with the approaches that are used to solve similar problems in other spaces - air or sea - due to the specifics of outer space itself and the diversity of those activities that are available to states in the present and in the future. "*There are major differences between the control of space and of air traffic. Unlike most aircraft, satellites are not required to transmit their identification, speed, direction or altitude. Establishing ownership is hard. The positions of craft are uncertain and some of the best data are kept private for commercial or governmental reasons. Expired satellites and debris can remain in orbit and go uncontrolled for centuries*". The same conclusion was already made back in 1959 by the ad hoc Committee on the Peaceful Uses of Outer Space: "*It was acknowledged that outer space activities were distinguished by many specific factual conditions, not all of which were known, that would render many of its legal problems unique*" (Jessup & Taubenfeld, 1959). While "*geographically*" speaking such international airspaces covered the greater part of the globe, in terms of actual aircraft operations they were much less relevant than the totality of sometimes heavily used national airspaces. International air law, including on ATM as developed under ICAO auspices, was thus allowed to develop almost organically from the handling of most aviation needs at a national level (von der Dunk, 2016). It is necessary to develop an independent approach that will be effective, taking into account the specifics of the industry. In this sense, the view of the problem of the so-called "*space powers*", whose activities will be directly affected by the relevant regulations, is of particular importance for the development and adoption of regulation. It is also confirmed by the fact that at present the control of movement in outer space in relation to a specific space object is carried out by the national space agencies - in fact, unilaterally. In particular, in 2016, the Russian Federation proposed to create an information platform within the UN framework "*as a mechanism that integrates efforts made by States, international intergovernmental organizations, spacecraft operators, specialized national and international non-governmental organizations in collecting, systemizing, sharing and analyzing information on monitoring of objects and events in outer space*". This is an important step towards ensuring safety of space activities, since this initiative is primarily aimed at creating a unified centralized system for collecting and analyzing information on situations in outer space. The United States, in a statement of June 2021, indicates that "*the United States Government continues to share space situational awareness (SSA) information and services with governmental, intergovernmental, and non-governmental entities to improve the safety and sustainability of space flight*" (Statement by Gabriel Swiney, 2021), without offering to establish unified information centers. Also recently, part of the powers of the U.S. Department of Defense on ensuring safety of space flights was transferred to the U.S. Department of Commerce - this should potentially increase access to various data for all stakeholders. In addition, in 2018, the United States adopted the U.S. Space Policy Directive - 3 (SPD-3) "*National Space Traffic Management Policy*", which states that "t*he U.S. should lead the world in developing improved space situational awareness (SSA) data standards, develop a set of standard techniques for mitigating collision risks, and internationally promote a range of norms of behavior, best practices, and standards for safe operations in space*" (Gleason, 2020). In other words, the United States relies above all on the national legal regulation in solving the STM problem and claims to have the leading role in this process.

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Thus, at present, we can say that, in general, there are two main approaches to solving the problem of establishing a STM system. This is a top-down approach and a bottom-up approach, each with its own pros and cons. As a first step, it is necessary to figure out what each of them offers.

The top-down approach assumes that the work on the development and establishment of a STM system should be carried out based on the interstate cooperation - first of all, at the level of the United Nations - and should ideally end with the adoption of a comprehensive convention on outer space with the abolition of the existing space treaties. We are talking about a document that similarly to the 1982 Convention on the Law of the Sea will regulate all the most important aspects of space activities. The bottom-up approach, on the other hand, is based on the assumption that the regulations regarding STM should be developed on the basis of the existing rules and practices of individual states, covering individual segments of the future system, which will better take into account the interests of all actors (Takeuchi, 2019), respond flexibly to changing conditions and, thus, avoid the adoption of "*non-working*" rules: "*a broad international consensus emerges on the best way to conduct safe, secure, and sustainable space activities, not based on a treaty, but based on congruent domestic law and customary practice*" (Gleason, 2020). "*This approach describes the co-existence of normative instruments of different nature and purpose (whether legally binding or non-binding, technical or political), some of which provide for higher level principles and some tackling pressing issues*" (Schrogl et al., 2018). This includes elements such as SSA, space debris mitigation and remediation, development of standards for space safety, single traffic rules, National Space Legislation, etc. (Schrogl et al., 2018).

In general, one should agree with the logic underlying the top-down approach that the creation of a STM system should be first discussed on the international level, given that outer space is a common area and, according to the provisions of space law, these are the states as subjects international law that bear international legal responsibility for national activities. The work on the establishment of a STM system will make sense only if all parties observe the relevant rules, and this is possible only at the level of international legal regulation based on interstate cooperation. Despite the concerns expressed (Takeuchi, 2019), this does not mean that the position of non-state actors, whose activity is constantly increasing in the space industry, will not be taken into account automatically. States have significant scientific and technical capabilities that can be successfully used to ensure compliance with STM provisions through the creation of common databases, information verification criteria, prompt reporting channels, etc. As part of the top-down approach, it is also proposed to create an international intergovernmental organization, which will coordinate all activities related to STM and respond in a timely manner to emerging challenges. Nevertheless, without separately touching upon the issue of the prospects for the adoption of a comprehensive treaty on outer space (a topic that has been discussed for a very long time), we can draw the obvious conclusion that it is urgently necessary to take the first step towards the development of regulation in this area, taking into account provisions of the current space law. The main questions here arise regarding the form and content of the corresponding legal regulation.

Regarding the form, it is necessary to decide on the following aspects: 1) whether the 1967 Treaty should be revised and the necessary amendments should be made, or efforts should be directed towards the development of a separate treaty; or 2) as in other cases, it is advisable to be limited to the adoption of acts of "*soft law*".

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The 1967 Treaty does not contain explicit provisions regarding the STM. However, its individual provisions can be considered as the basis for the regulation of legal relations in the field of STM - first of all, we are talking about Art. 9, according to which, "*in the exploration and use of outer space, including the moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty*". For the most part, states oppose the "*revision*" of the provisions of the 1967 Treaty in view of the fact that this could undermine the stability of the current international legal regime in outer space. Generally agreeing with this opinion, a separate treaty should be adopted, which will develop the provisions of the 1967 Treaty in the right direction, as was the case with the regulation of issues of liability, registration of space objects, etc. This can be compared to the so-called system of the Antarctic Treaty, which is based on the fundamental treaty of 1959, which establishes the main provisions, and subsequent international treaties supplementing it, which together form an integral system for regulating the activities of subjects of international law in Antarctica (which, like outer space, is a common territory). Of course, the development of a separate international treaty is associated with the solution of many tasks and debatable issues, but only in this case it will be possible to create a truly universal instrument based on international cooperation in accordance with the fundamental provisions of the 1967 Treaty. Regarding the regulation of STM at the "*soft law*" level, it should be noted that such approach can be considered only as a preliminary stage of work towards the development of an international treaty. Despite the significant role of "*soft law*" acts in the regulation of space activities, they will not be sufficiently effective in relation to STM (there are many examples when states do not follow the provisions of "*soft law*"), which in the case of a catastrophically complicated situation in the field of space traffic will only create a false sense of security. Of course, an intensive preliminary discussion of these issues with the involvement of the widest possible number of interested parties, specialists and experts, including the scientific community, will play an important role for the successful work in the development of an international treaty. Only a common understanding of the essence of the problem and the need to resolve it as soon as possible can help to come to a consensus on the most pressing problems.

Concerning the content of a future international treaty: it should be noted that a STM system, as mentioned above, implies the inclusion of a number of elements, each of which is a separate process. It seems that the primary purpose of STM should be safe operational activities in space at all stages of their implementation (stages of launching, being in orbit and returning to Earth). First of all, it is necessary to ensure the timely receipt of reliable data on the location and trajectory of objects, data on the density and location of space debris, etc. in the common databases. Provisions of a technical nature regarding the type of data provided characteristics of objects, etc., can be incorporated and modified in annexes to a future treaty, like in air law (1944 Chicago Convention on International Civil Aviation and 19 annexes to it). This will make it possible to take into account the rapidly changing conditions both in outer space itself (the growth of debris in orbits, the activity of the private sector, etc.) and in the scientific and technical field (including the so-called aerospace flights, etc.).

Of course, in the case of securing such obligations, the problem of international legal responsibility arises, which is especially important in relation to activities in outer space, where emergencies, failures, and other situations are possible. As mentioned above, the provisions of

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the 1972 Convention on International Liability for Damage Caused by Space Objects provide for fault-based liability in the event of a collision of space objects in outer space. At the same time, there are no clear rules indicating how to determine the degree of liability of each of the subjects in the absence of applicable standards of conduct. In this regard, the adoption of provisions in the field of STM can be considered, inter alia, as the creation of standards of proper behavior (standard of care) in outer space, which can facilitate the solution of the issue of liability. In addition, the adoption of such provisions can help with the implementation of liability for violation of due diligence obligations. Another interesting question is the one on the application of the provisions on circumstances precluding wrongfulness when it comes to internationally wrongful acts committed in outer space - should a different, softer or more stringent approach be applied with respect to the interpretation of circumstances such as force majeure, a state of necessity or a situation of distress; and the fact that space activities are classified as hazardous activities is in this case a "*mitigating*" or, conversely, "*aggravating*" factor. All these issues, as well as the issue of liability for damage caused by collisions with space debris, will need to be resolved in the near future.

CONCLUSION

Based on the results of the study, it can be concluded that at present the problem of combating space debris remains one of the most urgent. The pollution of outer space can be viewed as one of the main threats to sustainable activities in outer space. In view of the above, the international community is making active efforts to find optimal approaches to solving the problem, including the creation of a space traffic management system.

The problem of developing space traffic management rules is complex - it combines technical and legal aspects, which should be developed taking into, account the rapidly changing conditions and a sharp increase in space activity. Currently, various approaches to creating a STM system are proposed, the main ones are the bottom-up approach and top-down approach. Regardless of which of the approaches will ultimately be supported by the international community, it is clear that in the process of achieving the intended goal, many complex issues will have to be solved, some of which are associated not only with difficulties in the technical field, but mainly with unwillingness on the part of states to lose complete freedom in terms of the implementation of space activities and limit themselves in the pursuit of their ambitious plans and projects.

Taking into account the above, as a first step towards the establishment of a global STM system, it is proposed to adopt an international treaty, which, defining the main parameters of the behavior of subjects, can be supplemented with various applications that will take into account changing conditions and emerging challenges. In order to urgently ensure safe activities in outer space, including combating space debris as one of the main elements, it is necessary to adopt such document specifically at the level of an international treaty. The adoption of this kind of regulations will make it possible to regulate activities in space more efficiently already at the present stage, including the implementation of the provisions of the existing five space treaties. The development of such regulations can be based on the rules that are already applied by space powers in various segments of space activities, but it should also be accompanied by a search for solutions to issues that require new approaches, including the adoption of due diligence rules for various types of operations, provisions on liability, etc. At the same time, the analogy with the

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existing international legal regimes (in air or sea space) can be very useful, but it cannot be considered as a ready-made solution to the problem, taking into account all the specifics of outer space. In any case, the main driving element in development in this difficult direction is the readiness of states to seek compromises, which is to be assessed in the very near future.

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As an independent special subject "*International Space Law*" has been taught at RUDN University (earlier – the Patrice Lumumba People's Friendship University) since 1963. At different times, this subject was taught by outstanding researchers: Prof. V.S. Vereshchetin (former judge of the International Court of Justice of the United Nations), Prof. I.P. Blischenko (the UN expert, head of the Department of International Law from 1981 to 2000), prof. A.S. Piradov (represented the USSR at the UNESCO). Now the Department of International Law, RUDN University is following the traditions and after passing away of our leading professor Gennady Zhukov (1924-2014) we have founded Gennadiy Zhukov Space Law Centre, RUDN University. The Center is supporting researchers in Space Law as well we support and consult young scholars and engage them in framework of research projects. This paper is no exception, and we thank the junior research fellow of the Center - Daniil Volodin for his contribution to this research. This paper has been supported by the RUDN University Strategic Academic Leadership Program.

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