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Regulation of Space Resources Mining: the Creation of an International Legal Custom / Регулирование добычи космических ресурсов: создание международного правового обычая

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Аннотация: Работа посвящена анализу современного состояния дел по созданию для экономических субъектов «правовой определенности» в сфере разведки, добычи, использования и присвоения космических ресурсов. В исследовании применялся параллельный анализ различных событий (правовых, политических, экономических)в области регулирования добычи космических ресурсов, а также релевантных актов. Источниками являются релевантные акты международного и национального космического права, «серая» литература российские и зарубежные публикации. Процесс трансформации международных представлений о возможности национального и/или частного присвоения космических ресурсов предлагается рассматривать не только на основе анализа норм и доктрины, но также с учетом институциональных изменений и технологических достижений различных стран Обсуждаемый с начала 1960-х гг.

теоретический вопрос о собственности на внеземные ресурсы и территории из отдаленного будущего перешёл в практическую плоскость. Действующее международное космическое право представляется для частных компаний недостаточно однозначным, а потому требует уточнения. Однако темпы модернизации международного права отстают от потребностей развития космической экономики, не отвечают интересам космических инвесторов и предпринимателей. Сделан вывод, что цепочка событий 2014-2022 гг. свидетельствует о согласованных действиях группы стран, направленных на преднамеренное формирование международного правового обычая – источника международного космического права. Показано, что принятие некоего универсального, разделяемого всеми государствами решения в сфере космических ресурсов затруднено существованием равно значимых, но конкурирующих между собой принципов права. Сегодня экономические вызовы являются определяющими в развитии международного космического права: правовая определенность в сфере добычи космических ресурсов необходима для обеспечения экономического приоритета и конкурентоспособности в космосе технологически развитых государств.

Ключевые слова:

Космические ресурсы, Разведка космических ресурсов, Добыча космических ресурсов, Присвоение космических ресурсов, Международное космическое право, Космическая экономика, Договор о космосе, COPUOS, Адаптивное регулирование, Обычное международное право

Introduction

Space law seems one of the youngest and brightest "points" of creative activity in the legal universe.

The number and variety of external challenges associated with changes in space activities, the increasing importance of space and space technologies for the Earth, and the emergence of new, increasingly ambitious space exploration projects are constantly growing.

Since about 2011, ideas about the fourth industrial revolution and the "new cosmos" philosophy have been formed. The emergence of the phenomenon of "new space" is manifested by a sharp expansion of the circle of participants in the exploration of outer space, the emergence and registration of a special type of entrepreneurial activity for the creation and use of products and services related to space involving mainly private financing of initial developments. At the same time, special social values and the resulting opinions on new types of space activities are being formed and consolidated [1–4].

With the transition to the practical plane of ideas that once seemed fantastic for the extraction of space resources, the creation of lunar settlements, and the exploration of other planets of the solar system, further changes are taking place in the relationship between public and private subjects of space activities, in the pace of developing international and national space law, in approaches to the results of space exploration as a public good, which allows experts to conclude that the stage of the "newest space" [5], and the accelerated development of the space sector of the economy.

According to Merrill Lynch forecasts, the space industry, including the extraterrestrial mining

industry, will be worth $2.7 trillion in the next 30 years [6]. The space transformation of the economy that has begun [7] and the emergence of new opportunities for space exploration have accelerated the change in the guidelines of space policy at global and national levels, which, in turn, generates a great demand for legal innovations.

This article presents the results of monitoring legal and institutional innovations (2015–2022) implemented by different countries in connection with the needs of the development or creation of the space sector of the economy. Particular attention is paid to evidence of replication of the approaches of the United States, Luxembourg, and other states to create legal certainty in the regulation of exploration, production, use, and appropriation of space resources and emerging effects.

Methodology

The study used a parallel analysis of events (legal, political, economic) taking place at international and national levels in the field related to the regulation of the extraction of space resources and space exploration.

The source base consists of relevant acts of international and national space law, "gray" literature (space policy documents, reports, expert opinions), and Russian and foreign publications from 2015–2022 devoted to understanding the problems arising as a result of changes in public relations related to global space activities.

The problem of assigning space resources

As many know, the question of the possibility of national or private appropriation of space resources became the subject of discussion in the late 1950s—long before the adoption of the Treaty on the Principles of the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (hereinafter, the Outer Space Treaty) of 1967 [8].

Since 1958, the UN General Assembly (hereinafter referred to as the UNGA) has adopted more than 170 resolutions on international cooperation in the peaceful uses of outer space resources.

In 1959, the UNGA established the Committee on the Peaceful Uses of Outer Space (COPUOS) to manage the exploration and use of outer space for the benefit of all humanity: in the interests of peace, security, and development.

Over the past few decades, the official position of the global community regarding the principles of the use of outer space and its resources has not changed in comparison with the principles set out in early documents on this topic.

For example, UN General Assembly Resolution A/RES/1721 (XVI) of December 20, 1961, "International cooperation in the peaceful uses of outer space," establishes that "outer space and celestial bodies are free for exploration and use by all states in accordance with international law and are not subject to national appropriation" [9].

Paragraph 3 of the "Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space" (UN General Assembly Resolution A/RES/1962 (XVIII of December 13, 1963) states that "outer space and celestial bodies are not subject to national appropriation either through the proclamation of sovereign rights or through use or occupation, nor by any other means" [10]. Declaring outer space and celestial bodies open

"for exploration and use by all states on the basis of equality," the Declaration postulates that states should carry out such activities in accordance with international law, including the Charter of the United Nations. The Declaration also establishes diverse principles concerning the responsibility of states and international organizations in relation to various aspects of space-related activities and their consequences.

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies [11] prohibits the use of space resources. However, this document was not signed by the largest space powers: Russia, the United States, and China.

The analysis of documents and literature has shown that for more than sixty years, the list of subjects discussed has remained unchanged, but the development of space technologies and the commercialization of space have led to the fact that many issues have moved from purely speculative to practical. It is worth noting that the positions and arguments of international lawyers of the early 1960s not only remain relevant but require a new careful reading.

For example, in 1966, the American lawyer Eugene Brooks wrote: "It is unlikely that any nation will claim sovereignty over an entire celestial body, like the Moon, risking the ridicule of the whole world, or symbolically attach a disproportionately large part of it. But such a question as the nature and degree of control over specific areas of celestial bodies can become a reality" [12, p. 315]. And so it happened.

Thus, when deciding on the principles of controlling the planets and celestial bodies outside the Earth, jurists debated whether the celestial territory was *res nullius* or *res communis*. The UN has adopted the concept of *res communis* (*territorium communis omnium*) [12, p. 317]—a space for the common use of all peoples to which the sovereignty of no state can extend and whose legal regime is determined by international custom and multilateral agreements. Such a decision met the criteria of justice and the intentions of non-space States, but it was and remains controversial. The principle of the free use of celestial bodies by all states contains the germ of a conflict in relation to a situation when a particular state, exercising its right, has begun the practical operation of a section of a celestial body.

As you know, the United States and the USSR submitted separate drafts of the future Outer Space Treaty to the UN, albeit in different formulations, but equally proposed to give states exclusive powers over their objects and personnel on celestial bodies, including ownership of the objects placed. But such a model inevitably leads to a discussion about national appropriation.

To circumvent the issue of sovereignty, the American lawyer and statesman Nicholas Katzenbach (US Attorney General in 1965–1966), appealing to the joint interest of states in creating space objects on planets, proposed using a "new hybrid principle," which does not mean sovereignty, in the implementation of "the basic rights of citizens on a geographically limited (localized) object created by his own efforts" [13 p. 78].

These ideas were not accepted because, as the same Eugene Brooks wrote, an international treaty prohibiting "national appropriation" but allowing actual acquisition and use "would ultimately mean only an agreement on the exercise of sovereignty, without calling it sovereignty" [12, p. 324].

The problem of how to harmonize the principle of freedom of exploration and use of space

by all states with the free exploration and use of space by any particular state remains theoretically unsolvable to this day. Despite numerous discussions and various legal constructions, it is still unclear whether it is worth it for private entrepreneurs to risk their own capital to get involved in expensive projects to develop the territories of celestial bodies and space resources if any other state can claim the same site as a public area and extracted resources.

Since the development of the space economy is proceeding at a very fast pace, the states for which the issue of the development of space territories and resources from distant intentions has become part of the medium-term strategy are purposefully working to create legal certainty at the national and regional levels for private space entrepreneurs and investors. In earlier works of the author, the point of view was expressed that the actions of the United States and Luxembourg, which adopted laws guaranteeing entrepreneurs the right to freely engage in the development of planets and asteroids, own and dispose of the resources received (the US Law on the Competitiveness of Commercial Space Launches (Commercial Space Launch Competitiveness Act of 2015)[14]; the Law of the Grand Duchy of Luxembourg on Exploration and the use of space resources (*Loi sur l'exploration et l'utilisation des ressources de l'espace*, 2017) [15]), are marginal and look like attempts to create a kind of "legal offshore" in the system of international law. However, monitoring of institutional and legal events from 2015 to 2022 shows that, taken together, the chain of actions of various actors indicates the unintentional emergence or deliberate creation of an *international legal custom*.

V. L. Tolstykh, who considers the laws of the USA, Luxembourg, and a number of expert documents to be part of the reform of international space law initiated by the USA, wrote in 2021 that an international custom may arise before our eyes, legalizing the appropriation of extracted space resources [16, p. 179].

In this article, it is proposed to consider the process of transformation of international ideas about the possibility of national and/or private appropriation of space resources not only on the basis of an analysis of norms and doctrine but also by taking into account institutional changes and technological achievements of various countries.

Results

Table 1. Institutional and legal changes in the sphere of regulation of exploration, production, and use of space resources

Date	Institutional developments	Legal developments	Notes
19.12.1966		Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, or "Treaty on Space" (Treaty on Principles Governing the	The foundations of international space law (the period of the Third Industrial Revolution) have been formed. The contract was open for signature on 27.01.1967.

		Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, in short - "Outer Space Treaty") [8].	
05.12.1979		Agreement on the Activities of States on the Moon and Other Celestial Bodies, or "Agreement on the Moon" (Agreement Governing the Activities of States on the Moon and Other Celestial Bodies) [17].	The Agreement effectively prohibits the commercial use of space resources. The largest space powers – Russia, the USA, China – have not signed the document.
30.10.1984		The US Commercial Space Launch Act of 1984 [18]	A precedent has been set for the formation of *national* (American) commercial space legislation dedicated to the promotion of private entrepreneurship in the commercialization of space and space technologies.
01.12.2014	The Hague Working Group on Space Resource Management was established to create a *framework for legal regulation of the use of space resources* found on asteroids and other celestial bodies.		The Group was created as a result of the work of the Round Table on Space Resource Management. The organizer was the Hague Institute of Global Justice [19].
25.11.2015		The US Law on the Competitiveness of Commercial Space Launches, or the law on the promotion of	Chapter IV "Space Resource Exploration and Utilization" allows US citizens to freely engage in the

		Private Space Competitiveness (Commercial Space Launch Competitiveness Act of 2015) [20].	development of planets and asteroids, own and dispose of the resources obtained, including water and minerals (but not living objects).
20.12.2015		The official position of the International Institute of Space Law on the extraction of space resources has been formulated: In view of the "absence of a clear prohibition on the appropriation of space resources in the 1967 Outer Space Treaty, it can be concluded that their *use is allowed*. From this point of view, the new US law is a possible *interpretation* of the Outer Space Treaty. However, it remains to be seen whether other states share this interpretation, and to what extent" [21].	In fact, the *critical state* of the international space law system has been recorded, associated with an increase not only in the number of new challenges, ideas, concepts and original solutions, but also previously non-existent risks and unforeseen consequences
02.2016	The Government of Luxembourg: launched the *initiative* for the extraction of space fossil resources (Space Resources Mining Initiative). The essence of the initiative is a declaration on the creation of a legal		The initiative to create "legal certainty" in regulating the extraction and use of space resources has dramatically changed the *rules of the game* (game changing) in the emerging competitive space

	framework for guarantees of rights for private operators to space resources that they can explore, extract and use [22].		market
12.04.2016	Meeting of the UN Committee on the Peaceful Uses of Outer Space (Legal Subcommittee). Report of the Chairman of the Status Working Group and the application of the five UN treaties on outer space [23]. According to the Outer Space Treaty, its participants bear international responsibility for national activities in outer space.		Providing guarantees for the protection of international principles of space exploration and exploration in some cases is a way of "*packaging*" legal norms aimed at stimulating promising types of space activities or at attracting already established space players to national jurisdiction. In fact, there is a process of expanding the use of political and legal technologies to create *competitive advantages* for a particular country.
20.07.2017		The Law of the Grand Duchy of Luxembourg on the Exploration and Use of Space Resources (*Loi sur l'exploration et l'utilisation des ressources de l'espace*) [24].	In fact, the first "offshore" international space law has been created, which guarantees legal certainty in matters of assigning space resources to companies operating in the jurisdiction of Luxembourg.
13.09.2017	The project of "Building Blocks" for the development of the international	Draft Building Blocks for the Development of an International	A precedent has been created for stimulating promising types of

	framework of activities in the field of space resources, prepared by the Hague Working Group [25], has been published, Information is presented in COPUOS [26].	Framework on Space Resource Activities	space activities by using a formally internationally approved *legal constructor* [27] to regulate activities in the field of space resources
15.10.2019	The UAE Space Agency and the Dubai South SEZ signed a memorandum on the establishment of a specialized free economic zone for companies specializing in space exploration.		Foreign companies registered in the jurisdiction of the "space FEZ" receive the right to 100% ownership of the business without the need to involve a local partner. Following the experience of Luxembourg, the UAE leadership offers potential investors the benefits of legal certainty [28].
19.12.2019		The UAE Federal Law on the Regulation of the Space Sector (On the Regulation of Space Sector) [29].	Article 14 "Permits for space activities" actually allows you to own a space object, if there is a permit from the UAE Space Agency.
			Article 18. "Research, development and use of space resources" - by decision of the UAE Council of Ministers or its authorized body, exploration, exploitation and use of space resources, including their acquisition, purchase, sale, trade,

		transportation, storage, is permitted…
13.10.2020	The directors of the national space agencies of the USA, Australia, Great Britain, Italy, Canada, Luxembourg, the UAE and Japan signed the Artemis Agreements developed by NASA [30]. Currently, the number of signatories has increased from eight to twenty-one [31]. The agreements remain open for signatures indefinitely.	The agreements contain a provision that the extraction and use of space resources should be carried out in accordance with the 1967 Outer Space Treaty and in support of safe and sustainable activities. The parties to the Agreement believe that the extraction and use of space resources is not a national appropriation, which is prohibited by the Outer Space Treaty. The intention was expressed to contribute to multilateral efforts to further develop international practice and rules on this issue.
04.2020	The Outer Space Institute presented the Vancouver Recommendations on Space Mining [32], which specify the "Building Blocks" of the Hague Working Group.	More than 30 experts from different countries stated that the existing regime for space management does *not correspond* well to new opportunities in space exploration. The lack of clear international rules regarding commercial mining of space minerals creates problems for the relevant companies arising in

			many countries of the world. Therefore, states adopt national acts to support them and regulate their activities. It is concluded that states with a "flag of convenience" will appear in this area, seeking to attract business with the help of facilitated regulatory and supervisory regimes.
15.12.2020		The Law of the Grand Duchy of Luxembourg on Space Activities (Loi portant sur les activités spatiales) [33].	Regulates the procedure for issuing *permits* and supervising space activities. Permits and supervision are assigned to the Ministry of Economy and the Luxembourg Space Agency, which simultaneously *register* objects launched into outer space. The law also clarifies the tax benefits for the investments of space object operators and exempts their insurance contracts from taxation.
18.11.2020	As part of the SpaceResources initiative.The European Space Resources Innovation Centre (ESRIC) was established [34]. Organizers: Luxembourg Space Agency, Luxembourg Institute of Science		ESRIC is an example of the first *research, business and innovation center* fully focused on the use of space resources.

	and Technology (together with the European Space Agency as a strategic partner).		
27.01.2021		The Grand Duchy of Luxembourg has formed a Register (national register) of objects launched into outer Space.	The Register is formed in accordance with the Luxembourg Law on space activities. At the same time, the ratification of the UN Convention was carried out on Registration of Objects Launched into Outer Space (Registration Convention 1974) [35].
01.2021		The model agreement on the implementation of the 2021 Moon Treaty, drawn up within the framework of the Space Treaty Project, is aimed at filling the alleged gaps and creating a certain legal regime that ensures safe investment activities [36].	According to paragraph 3, the parties to the agreement recognize that any mission authorized by an individual State will acquire priority rights to exploit resources at its location. But these rights are lost if the mission does not fulfill the obligations stipulated in international treaties.
04.2021	Shenzen Origin Space Technology Co. Ltd. (China) has launched NEO-1, the first commercial spacecraft designed to extract resources from any objects in space – from asteroids to the lunar surface [6].		
27.05.2021	Meeting of the UN		Australia, Belgium

27.05.2021	Meeting of the UN Committee on the Peaceful Uses of Outer Space (Legal Subcommittee). A report on the results of an in-depth interview with representatives of 14 COPUOS member states on the value of considering common issues and coordination in the exploration, production and use of space resources as a *topic of interest* to the international community [37].	Australia, Belgium, China, Germany, Luxembourg, the Netherlands, Saudi Arabia, Finland and Switzerland stated that they support the topic, but consider it important to link new issues with existing treaties, including through a *new interpretation of terms* (for example, utilization) and the *development of a new legal framework* as a result of multilateral cooperation.
07.2021	A Working Group on Potential Legal Models for Activities in Exploration, Development and Use of Space Resources (Working Group on Potential Legal Models for Activities in Exploration, Exploitation and Utilization of Space Resources) has been established [38].	
31.08.2021	Meeting of the UN Committee on the Peaceful Uses of Outer Space. Report of the Working Group on the 2030 Agenda for Sustainable Development "Cosmos-2030" [39].	The necessity of the speedy implementation of the project "*Space Law for new participants in space activities*", implemented as methodological and advisory assistance in accordance with the needs and

	Four general objectives are formulated: (1) increasing the socio-economic benefits of space activities, (2) using astronautics to solve everyday problems, (3) expanding access to outer space for all, (4) establishing partnerships and expanding international cooperation in the field of global space management.		requests of government and regulatory authorities of countries that are starting to engage in space activities for the first time or are moving to a new stage of its development, was recognized.
19.10.2021	China has conducted a test launch of the world's most powerful solid-fuel rocket engine (500 tons thrust) for heavy-lift rockets designed for various space missions, including the extraction of extraterrestrial resources [6].		
23.12.2021		The Law of Japan No. 83 of 2021 on the Promotion of entrepreneurial activities related to the Exploration and Development of Space Resources (Act on Promotion of Business Activities Related to the Exploration and Development of Space Resources (Act No. 83 of 2021)) [40].	According to paragraph 1 of Article 2, space resources are water, minerals and other natural resources that exist in outer space, including on the Moon and other celestial bodies. Permission for the extraction of space resources is issued by the Prime Minister of Japan in consultation with the Minister of

			Economy, Trade and Industry. According to Article 5, the person who received the permit owns space resources, which he uses in accordance with the approved activity plan.
09.2022	The China National Space Administration (CNSA) has announced its intentions to accelerate the implementation of programs to explore the Moon and its resources [41].		
28.11.2022	Korean Space Forum (South Korea, Seoul)	A memorandum of "Challenges of the Space Economy" understanding on the organizing future cooperation exchange of in space was information, signed between personnel and Luxembourg and experience, the task South Korea [42].	In addition to is to conduct *joint developments in the field of regulating space exploration* and the sustainable *use* of space resources.

Discussion

In 2018, the International Law Commission (a subsidiary body of the UN General Assembly) presented a document containing practical recommendations on how to identify (reveal) the existence of customary international law and its content [43].

According to this document, customary international law is an unwritten law arising from the practice adopted as law. Customary international law is among the sources of international law listed in paragraph 1 of article 38 of the Statute of the International Court of Justice, subparagraph (b) of which refers to "international custom as evidence of generally accepted practice as law." This formulation reflects two constituent elements of customary international law: general practice and its recognition as law (the latter is often called *opinio juris*) [43].

Thus, in order to identify an international custom, it is necessary, as M. V. Ratushny writes,

to have a common and consistent practice of states ("a well-established or systematically applied uniform practice [continuity and repetition] of relevant subjects and bodies"), which is widely recognized among the states participating in the relevant activities. At the same time, "the practice should be general, uniform and stable" [44].

In addition, the international community needs an established belief in the obligation of such behavior and a sense of legal obligation (*opinio juris sive necessitatis*). States follow a certain practice because they are convinced that international law requires it and not simply because they consider it a good idea, politically sound, or otherwise desirable [45].

In its 2018 recommendations, the International Law Commission emphasized that there are still no or very few applicable treaties in many important areas of international law. Therefore they are governed mainly by customary international law. But even where the treaty is in force, the norms of customary international law continue to regulate issues not regulated by the treaty and continue to apply in relations with and between states that are not parties to the treaty.

According to V. S. Vereshchetin and G. M. Danilko, a custos has historically been the first source of international space law, as we are talking about the emergence of a permanent and uniform practice of states in a new area of international relations. Whereas a contract "can be used as a tool for proactive legal regulation of future activities or future situations that do not exist at the time of conclusion of the contract" [46, 47].

In the mid-1960s, experts pointed out that to apply international law to planets, it was necessary to refer to international treaties and customs as the main sources of law [12, p. 118]. However, to date, there are still no international treaties that would meet the needs of the new space in achieving legal certainty on the development of planets and space resources. As G. G. Shinkaretskaya has repeatedly noted, the era of international treaties in the field of space activities ended more than forty years ago, and to regulate the relations of economic entities in the process of space exploration (research and use), "the national legislation of states is widely used, based primarily on the 1967 Treaty on the Principles of State Activity, other existing treaties and taking into account the recommendation norms contained in the resolutions of the UN General Assembly and representative international conferences" [48, p. 117, 128]. According to Shinkaretskaya's position, international space law in new spheres of relations (including exploration, production, use, and appropriation of space resources) can be formed or updated by generalizing national legislation [48, p. 125].

The British authority in air and space law, Bin Chen, insists on the possibility of the *instant emergence* of international customs. In his opinion, customs have only one constituent element (*opinio juris*) and, therefore, can arise immediately, as exemplified by the resolutions of the UN General Assembly on outer space [49; 50, pp. 535–536].

Another way to instantly (and intentionally) create an international custom may be the accession of major players to documents that do not initially have an international legal status. This situation was discussed, for example, by Michael Listner, in the context of assessing the legal consequences for the United States in the event of joining the draft International Code of Conduct for Outer Space Activities. The question was whether the Code could become customary international law if the US signed it. In other words, whether the US could inadvertently create customary international law by signing the Code [45].

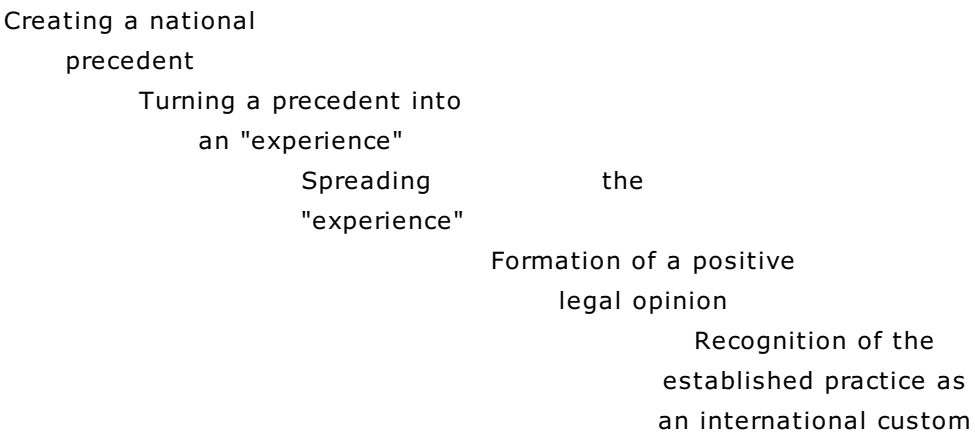
Despite the described potential possibilities of the instantaneous emergence of customary

law, most experts tend to believe that the term "custom" itself implies the existence of a certain period of time necessary for the formation of this phenomenon [51].

It should be noted that with all the abundance of literature, the plot about the ratio of objective and subjective (unintentional and intentional) in the formation of custom remains in the zone of silence. The categories of ethics can hardly be instrumental in analyzing various manifestations of the will of states. Still, the formation of international customs in some natural way (there were no other options for action, objectively established practice of relations, etc.) is more ethical to the world community than the deliberate creation of custom through political and legal technologies.

An approximate algorithm (political and legal technology) for the intentional creation of an international legal custom is presented in Fig. 1.

Figure 1. An approximate algorithm for the intentional creation of an international custom



If we consider international institutional and legal developments in the proposed context of space resources, then the first precedent was created by the USA in 2015 (followed by Luxembourg, the UAE, and Japan), and the process of legalization (official recognition) by the international community of the proposed principles for regulating relations on exploration, production, use, and appropriation of space resources as a kind of permissible universal practice is developing right now, in 2022.

It is noteworthy that The Hague Space Resources Governance Working Group, created "to stimulate the creation of the foundations of legal regulation of the use of space resources," arose back in 2014—before the United States passed a law allowing citizens to freely engage in the development of planets and asteroids and own and dispose of the resources received, including water and minerals (but not living objects). And the Hague Group presented a project called "Building Blocks" for the development of an international framework for activities in the field of space resources, containing positions allowing for the possibility of private appropriation of space resources, in 2017—after the adoption of the laws of the United States and Luxembourg guaranteeing companies operating in the jurisdictions of these countries the possibility of private appropriation of space resources.

The "building blocks" of the Hague Group can be described as a set of programs, a kind of legal technology that allows for uniformity in the actions of national states and the interoperability of adopted national acts in the field of regulating issues related to space resources. Interestingly, the Hague Group promoted the principle of adaptive governance as a basic approach, which is widely used in conditions of uncertainty. Adaptive management involves the use of an iterative decision-making process taking into account complex feedback data (monitoring of changes resulting from the implementation of decisions

made). This approach is used in socio-environmental management and management of international development programs to provide reliable solutions in the conditions of complexity, uncertainty, and unpredictability of the modern world, the presence of polycentrism in the development of various strategies and policies, as well as the need to take into account the multiplicity of stakeholder interests [52–55].

Regarding the issue under discussion, we are talking about a gradual change in existing international law and the formation of new legal regimes by trial and error (by iteration). Subsequent expert documents (for example, the Vancouver Recommendations on Mining in Space) only concretize the approaches proposed by the Hague Group without changing their essence.

Conclusions

In light of the burgeoning space industry, the advent of "the newest space" phenomenon, and the transformative impact on the global economy as a whole [7], it appears restrictive and unfruitful to confine discussions on regulating relationships pertaining to the exploration, production, utilization, and allocation of space resources solely within legal frameworks.

To understand the causal relationships and trends in the further development of space law in this area, a broader approach (helicopter view) is needed, taking into account the economic, social, and political challenges arising from the transformation of potential prospects for the extraction of space resources into real opportunities.

A parallel analysis of legal, political, technological, and institutional developments in the regulation of exploration, production, use, and appropriation of space resources leads to the conclusion that there are concerted actions by a number of states to deliberately form an international custom.

According to V. L. Tolstykh, the adoption, since 2015, of national acts and various legal clarifications aimed at creating "legal certainty" in the field of space resources is part of the reform of international law promoted by the United States, which is aimed at legalizing the appropriation of first extracted space resources, and then, sections of celestial bodies and resources in situ [16].

It seems that the primary actions of the United States are not diplomatic interests (to change international law) but economic necessity (to create legal certainty for economic entities at a national level). The change of existing legal regimes (or the formation of new ones, including through custom creation) under the pressure of economic interests is objective and inevitable.

The trajectories of the development of international legal regulation in the space sphere are influenced by the affiliation of experts to various legal families and relevant business cultures. The commitment of actors to continental, traditional, or hybrid legal systems inevitably leaves an imprint on their choice of approaches, models, arguments, and logic of actions in the field of space resources regulation. Relatively speaking, for the British tradition, the usual model of action is the creation of precedents, whereas, for lawyers of the continental legal system, it is more natural and acceptable to develop a general rule, a universal rule that applies to an indefinite circle of persons.

The analysis shows that the adoption of a universal decision shared by all states in the regulation of exploration, production, use, and appropriation of space resources is

complicated, among other things, by the existence of equally significant but competing principles of law, for example, the right of private property and the right (property) of all humanity, national interests and interests of all humanity, stimulating technological progress of developed countries and ensuring guarantees of equitable access of developing countries to the benefits derived from the use of technology, etc.

The race for space resources and the exploration of planets that have begun puts economic challenges at the forefront: legal certainty in space resource extraction is necessary to ensure the economic priority and competitiveness of technologically developed states in space.

One of the reasons for the acceleration of the process of creating an international custom regulating space resources (despite the opposition of non-space powers and the cautious position of Russia) is the behavior of states described by the so-called "prisoner's dilemma." This concept of game theory in economics describes the behavior of competitors (players) in an inelastic market. When acting formally and rationally, they eventually refuse to cooperate. The winning strategy, in reality, is to support those who commit at least *some actions* because the risk of remaining in the minority doing nothing is too great. Of course, collective action requires expenses but reduces overall losses. However, if you do not join in time, then those who remain in the minority lose too much [56].

The newest space not only persistently draws legal science into politics but also divides the international legal community into "national departments" as the solutions necessary for practitioners to ensure the competitive advantages of their countries' economies in the rapidly growing space market often contradict established international legal principles. As a result, legal science is forced to seek a compromise between equally significant but competing imperatives: protecting their country's national interests and the interests of all humanity.

Therefore, it is not surprising that numerous discussions about promising models of legal regulation in the field of space resources and trends in the development of international space law link the possibility of clarifying the situation either with the achievement of a global consensus of states or with the outgrowth of the number of national novels into a new quality [57]. Ultimately, it doesn't matter whether revolutionary changes take place "from above" or "from below" (the second scenario seems more likely), but one thing is obvious: they are inevitable. Moreover, national precedents arising as a result of the desire of states to "increase legal certainty" in regulating new areas of space activities can become a source of change in the very foundations of law and existing legal systems.

The technology described in the Discussion section, which allows states to create competitive advantages by adopting national acts that eliminate legal uncertainty in economically sensitive areas, is used today, not only in space. For example, the US Federal Law on Reducing Inflation (The Inflation Reduction Act of 2022, IRA), adopted in October 2022, creates competitive advantages for American manufacturers of "environmentally friendly" cars [58].

Russia is a space power capable of participating in the extraction of space resources. However, considering the cost of equipment, technology, and the difficulty of private agents entering the national space business, there is almost no entrepreneurial interest in this area. The Russian Federation adheres to a conservative position regarding attempts by other states to accelerate the creation of "legal certainty" in the field of exploration, production, use, and especially the appropriation of space resources. But since the UN

Committee on the Peaceful Uses of Outer Space adheres to objectivist approaches, the generalization of national practices in the field of regulation of space resources and expert opinions initiated by its structures will obviously lead to a solution that provides private companies with guarantees for the use and appropriation of resources extracted by them in space.

The new competition of states in space that has begun is more than just a competition for scientific and technological priority (although only advanced science and technologies can help in space exploration). Space is not only the competition of economies (although only strong economies can withstand such a resource-intensive project as space exploration). First, space is a competition of *management systems and models*. This is a question of who is better and more effectively able to regulate the development of their space sector so as to always be the first—both in space and on Earth. Based on this, the experience of creating legal certainty at a national level in the exploration, production, use, and appropriation of space resources is a way to ensure national competitiveness in the upcoming global space resources market. The positions according to which international space law "may not be in a hurry" in developing a legal framework for activities in the field of space resources [59] seem disconnected from reality, as the formation of new practices is taking place at a very rapid pace. However, international law can not rush but simply wait until a national practice of regulating the exploration, production, use, and appropriation of space resources is formed and international legal custom is reliably established, including in the way indicated in this work.

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Результаты процедуры рецензирования статьи

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