

New Frontiers of Sustainable Human's Activities: Challenges for Legal Order of Space Mining Economy

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The exponential development of space activity due to plans to expand space activity on the Moon and other celestial bodies raises many legal tasks to solve in the future. There are a lot of international and national initiatives to build the legal framework of a future sustainable space mining economy. This article is focused on reviewing such initiatives for the aim to reveal the main issues concerning fostering the sustainable development of the space activities on the Moon and other celestial bodies. As a result, the common procedure of the advancing governance, safety zones establishing criterions, the institutionalization of the general recognition of the property rights, benefit-sharing model, interoperability of the internal authorization procedures and technical standards enabling safe and sustainable space mining activities, authoritative dispute resolution procedures have been distinguished. They should become as main conceptual mechanisms for further international and national law-making process.

Keywords: space mining, sustainable space activity, safety zones, global commons, space resources.

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Introduction

The main feature of the economy is that consumption is expending resources taken into production. Decades of combating this paradigm emanated from the “Our Common Future” report that was the focal point for developing the avalanche of international treaties, arrangements, national environmental policies, programs, and laws, showing persistence of the concept of consumption and paucity of the measures against them. The evidence is the statement of Sheila Aggarwal-Khan, Director of Economy Division at UNEP: “planetary crises of pollution, climate change, and biodiversity loss are caused by unsustainable consumption and production” (Aggarwal-Khan, 2021).

Exhaustion of the resources pushes humanity to find solutions beyond the Earth and even near-Earth space that also has suffered and continues to be suffering from unprecedented littering (ESAs, 2021). This scenario was predictable, so the authors of the Moon agreement prescribed that State Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the explorations of natural resources of the Moon as such exploration is about to become feasible. Such procedures shall meet the purposes with ecological connotation, such as orderly and safe development of natural resources of the Moon, rational management of those resources, the expansion of opportunities in the use of resources. The obstacle became the recognition as a common heritage of humankind the Moon and its natural resources (Agreement, 1979). It is different than the recognition of the exploration and use of outer space, including the Moon and other celestial bodies as a province of all mankind according to the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Treaty, 1967). As a result, when the time has come, the law-making process went the other way than prescribes the provisions of the Moon Agreement.

Initially, USA and Luxembourg adopted national legislation for fostering private space mining activities. Then the Legal Subcommittee of the Committee of Peaceful Uses of Outer Space (COPUOS), starting from its 56th session, in 2017, considered the agenda item on the general exchange of views on potential legal models for activities in exploration, exploitation, and utilization of space resources (Annotated, 2020). The global scientific community reacted by developing different models of space mining global legal order, like Hague Building Blocks for the Development of an International Framework on Space Resource Activities (Building, 2019), Moon Village Association Principles (Moon, 2020), EAGLE Lunar Governance Charter (Effective, 2021a), some especially focus on environmental issues as Vancouver Recommendations on Space Mining (Vancouver, 2020) and Declaration of the Rights of the Moon (Declaration, 2021).

A new cycle of potential models, rules, and norms development, for activities in the exploration, exploitation, and utilization of space resources, including with respect to related activities and benefit-sharing, starts from US governmental initiatives Artemis Program (Artemis, 2020) and China-Russian's International Scientific Lunar Station (China, 2021) with intergovernmental arrangements and legal framework. The level of necessity of elaboration common legal framework concerning such issue led to submitting a proposal for a Working Group on Space Resources to be established by the Legal Subcommittee at its 60th session in 2021 under a five-year work plan (The Establishment, 2021).

This article aims to highlight the most important legal mechanisms for the Working Group on Space Resources. To the aim, authors plan to focus on reviewing the abovementioned policy,

legal and scientific suggestions and then, in conclusion, to reveal the main issues concerning fostering the sustainable development of the space activities on the Moon and other celestial bodies.

Sources of Establishment Legal Order of Space Mining Economy

National law and policy

As two hundred years ago, the news about valuable resources (water, regolith, platinum, etc.) induced private actors to find the possibility to occupy them. There are many startups that arose with seeking funding for projects of exploitation of space resources. Recognizing international responsibility for such activities and possible budget revenues in consequence of them, some States use their public power for fostering private initiatives. For instance, Japan has created the Space Exploration Prize, Innovation Network Corporation of Japan (a public-private investment fund), and the Development Bank of Japan (which is government-owned) (Brunswick, 2021). The Grand Duchy provides funding via LuxIMPULSE, the national program, or the different State aids for the promotion of Research, Development, and Innovation is participating in the establishment of a space fund and established the cooperation with European Investment Bank (National, 2019). The same steps were made by such Middle East States as UAE (Emirates, 2021) and Saudi Arabia (Public, 2021). Four States adopted their national legislation in this sphere: the US, Luxembourg, UAE, and Japan. The main feature of such legal frameworks are a statement of legality (for proving the accordance with art. 2 of OST) of extraction of space resources, grant the property rights for miners as a ground for their motivation to spend the money for such ventures, authorization or permission system that surely emanated from the obligation prescribed by art. 6 of OST. However, approaches to regulation were different and in common sense to complement global understanding of the legal order of the space mining economy.

By authorizing US citizens to extract materials from asteroids through the Commercial Space Launch Competitiveness Act 2015, the United States has started down a path in which property rights in space flow from the jurisdiction of individual severing nations (Heise, 2018). This act first limited the space resources only by abiotic in situ extracted resources and enshrined by a wide range of titles, including to possess, own, transport, use, and sell the asteroid resources or space resources obtained in accordance with applicable law, including the international obligations of the United States. Herewith authorization and continuing supervision by the Federal Government are integrated into the general system of authorization over space activities. Nevertheless, as practice showed, this was not enough for fostering private space activities. The Federal Government promotes an environment that encourages investment in the space economy, which can reduce risk to the private sector for new technologies such as space mining and manufacturing. For instance, NASA uses commercial service contracts within the Artemis Program, including those governing transportation, communications, and power systems to facilitate the return of manned missions to the lunar surface and encourage their permanent operation there (Exploring, 2021). Reorientation from the encouraging private initiatives to the strong Governmental support of space mining activities is reflected in Executive Order (EO) 13914 issued by US President Donald Trump on 6 April 2020. This act rejected the concept of global commons and Moon Agreement as an international instrument and officially enshrined to negotiate a set of international arrangements regarding safe and sustainable operations for the public and private recovery and use of space resources under the auspices of the Artemis

Program (Encouraging, 2020). The same aim facilitating the active space-mining activities pursues by the Space Policy Directive 6 National Strategy for Space Nuclear Power, Propulsion (Memorandum, 2020) and National Strategy for Space Nuclear Power and Propulsion the Executive Order (Promoting, 2021). These acts draw the model of functioning on the base of the clear roadmap of the space nuclear power and propulsion system that is based on the safety, security, sustainability principles. Noticeable the provision about planning and conducting operation and disposition of such systems in a manner that protects human and environmental safety and national security assets that could be evidence of the formation of some environment protection norms for space mining activities.

The Luxembourg Act about the exploration and utilization of space resources 2017 create the legal background from scratch. It grants the ownership rights for exact types of companies of Luxembourg law or a European Company having its registered office in Luxembourg. It also requires the robust scheme of financial, technical, and statutory procedures and arrangements through which the exploration and utilization mission, including the commercialization of space resources, are planned and implemented, including the risk assessment and all such information as may be useful for the assessment thereof as well as by a mission program (Loi, 2017). However, there is no exact requirement concerning the protection of the environment of the celestial bodies or rational, reusable exploitation of space resources.

UAE's Federal Law on the regulation of space sector 2019 stated that "space resources as non-living resources present in outer space, including minerals and water and Space Nuclear Energy Sources as services used in Space Activities to generate energy and using nuclear materials, radioisotopes or a nuclear reactor." This Act also prescribes the obtaining permits for the exploration, exploitation, and use of Space Resources, including their acquisition, purchase, sale, trade, transportation, storage, and any Space Activities aimed at providing logistical services (Law, 2019), but is not provide any details for requirements need to be fulfilled for this. On 15 June 2021, the Law Concerning the Promotion of Business Activities Related to the Exploration and Development of Space Resources grants Japanese companies permission to prospect for, extract and use various space resources (Foust, 2021).

Thus, national legislation as an upstream source for the future global legal order of space mining economy is valuable by granting the property rights or titles based on the authorization conditions according to respect the OST rule for international responsibility of the national space activities, and rule emanated from the sovereign rights of the States. Since sovereign rights over space, resources cannot be posed according to art. 2 OST, the international legal framework could be elaborated because of the mutual recognition of the legality of activities of private space entities through soft international law instruments such as arrangements, memorandums of understanding (the core of Artemis Accord or China-Russian's International Scientific Lunar Station). In this context, enhancing the sustainable space mining economy can be provided by harmonizing technical and legal requirements to space resource extraction and using motivated by comprehension of limitations and exhaustiveness thereof.

Soft law and intergovernmental arrangements

For the first time, the concept of sustainable development was reflected in the Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space adopted by the COPUOS in June 2019. Special attention should be paid to Guidance D.1 prescribes that States and international intergovernmental organizations should promote the development of technologies that minimize the environmental impact of

manufacturing and launching space assets and that maximize the use of renewable resources and the reusability or repurposing of space assets to enhance the long-term sustainability of those activities (Guidelines, 2018). This norm could be considered as a starting point for taking into consideration ecological issues within the space mining economy.

Further progressive development of international law and policy in this sphere is connected with the formation of two coalitions of like-minded partners within the Artemis Program (Artemis, 2020) or International Lunar Research Station (International, 2021). The legal framework of the first ones is formed and still forming through the numerous bilateral arrangements regarding distribution tasks for implementation of the joint project under the auspices of the common principles, known as Artemis Accords (yet 12 State Parties: Australia, Brazil, Canada, Italy, Japan, Korea, Luxembourg, New Zealand, Ukraine, United Arab Emirates, United Kingdom, United States of America).

The second program only starts to elaborate a legal framework with potential partners that is divided into 5 categories of cooperation (space mining, space system, subsystem, equipment, ground, and application). Joint Working Group consists only of China and Russian Space Agencies, but it plans to develop within Legal Group to analyze applicable international law, make the inter-governmental agreement planning, inter-agency agreement planning, and agreement drafting and signing. Both programs provide interoperability of standards in the field of launch vehicles and spacecraft technology development scientific and technical data sharing within the Parties of each Program, taking into consideration export control requirements.

This bipolar legal framework for the space mining economy makes the efforts of the COPUOS. Legal Subcommittee extremely important to promote the sustainable exploration and use of space resources for future generations through dialogue, transparency, and capacity building based on shared values, the key to which should be the protection of the natural environment of celestial bodies. Significantly, both Programs did not reject multilateral efforts to further develop international practices and rules applicable to the extraction and utilization of space resources within the COPUOS.

In this context, it should be noted that Artemis Accords orient their Parties for establishing the sustainable human exploration of the solar system exclusively for peaceful purposes and in accordance with relevant international law through such modes of behavior. First, utilization of space resources should serve the purpose to provide critical support for safe and sustainable operations. Second, informing the public and the international scientific community of space resources extraction activities. Thirdly concentration the precautionary principle and requirement for rational usage of natural resources within article 11 concerning deconfliction of space activities. Reflection of the precautionary principle is the rule about the obligation to refrain from any intentional actions that may create harmful interference with the use of outer space in activities under these Accords. On the other hand, orbital debris mitigation measures as much as principles related to safety zones are the bright manifestation of the rational approach to the use of space resources. As a criterion of the rationality of the extraction and utilization of space resources operations were highlighted scientific and engineering principles and time.

Such legal requirements are good ground for diversifying the measures of the international legal framework for sustainable space mining economy according to adaptive governance and probably the enabling concept of the global commons in a military or geopolitical context. The last one implies a focus on the use of an open-access domain and the consumption of that resource frequently used concerning seabed and even some overcrowded space orbits (Goehring, 2021). Such suggestions were reflected in the civil society and academia suggestions.

The first attempt to fill the gaps in international law concerning space mining activities on the basis of five space international treaties was the activity of the Hague International Space Resources Governance Working Group adopted the Building blocks for the development of an international framework on space resource activities (Building, 2019). The prejudice of their activity was the hypothesis that space resources activities should be incrementally addressed at the appropriate time based on contemporary technology and practices. Taking this into consideration, some progressive mechanisms were suggested. First, clear sustainable approach visible in the principles, i.e., prevention of disputes arising out of space resource activities; promotion and secure the orderly and safe utilization of space resources; promotion of the sustainable, rational, efficient, and economic use of space resources; promote the use of sustainable technology. Second, authors suggest harmonizing the public and private interest, namely the needs of developing countries and science with the contributions of the pioneer operators, suggesting to attribution of priority rights to the last one but under the condition of the registration of the priority rights, prior authorization, and advance notification of space resource activities (Building, 2019). Noticeable that sharing of benefits arising out of the utilization of space resources considering not from the shearing of property rights, but from the facilitating the free access to this activity for as many parties as possible (so-called enabling concept of the global commons).

The concept of safety zones and protective heritage sites emanated from such document, which prescribes more restrictive measures such as the possibility in accordance with the area-based safety measure to restrict access for a limited period, provided that timely public notice has been given setting out the reasons for such restriction. A progressive measure should also be noted establishing the list of designated and internationally endorsed outer space natural sites and technical requirements. They should ensure conformity assessment and standardization, avoiding harmful impacts consisting of detailed list, for instance, harmful contamination of celestial bodies, taking into account internationally agreed on planetary protection policies; harmful contamination of outer space; harmful effects of the creation of space debris; harmful interference with other on-going space activities, including other space resources activities, etc. (Building, 2019).

A similar, but less comprehensive document suggests the non-governmental organization Moon Village Association, so-called MVA Principles. The distinctive feature is promoting the development of private activities on the Moon and in cislunar space, including purely commercial activities, such as space tourism and resources extraction, as well as non-commercial private activities, such as science and exploration. Recently on the base of this organization was established the Global Expert Group on Sustainable Lunar Activities (or GEGSLA) consists of governmental and academic representatives all over the world. Their goal is preparation the Framework and Key Elements for Peaceful and Sustainable Lunar Activities and Guidelines for lunar activities implementation and operations addressing lunar debris mitigation, benefits sharing, sharing of information, registration of activities, regulating access to natural resources for the consideration of the 65th session of the Committee on the Peaceful Uses of Outer Space in 2022 (Report, 2021).

Recently on the base of the Space Generation Advisory Council was also established project named the Action Team on Effective and Adaptive Governance for a Lunar Ecosystem (EAGLE). Their aim is to elaborate the Lunar Governance Charter for restating the fundamental rules of international space law that should address ten aspects: 1) inclusiveness; 2) interoperability; 3) human life protection; 4) heritage preservation; 5) science/business

balance; 6) use of lunar resources; 7) safety zones; 8) registration and liability; 9) minimum coordination; 10) conflict resolution. Let's consider some most specific of them. Inclusiveness suggests understanding as involving all States in lunar operations to engage in capacity building and benefit-sharing activities, so the Charter needs to include an Annex laying down a protocol for internationally agreed benefit sharing and capacity building mechanisms for lunar activities. For implementation, the requirement of interoperability, the Charter should invite States to identify a global platform for the multi-stakeholder development (and subsequent regular updates) of multiple open international standards for lunar activities.

Following the attempt of the Hague building blocks, EAGLE suggests developing a list of internationally recognized scientific sites on the Moon, including appropriate preservation measures and recognizing the role of pioneering commercial operators (science/business balance). Like the conditions for establishing safety zones according to the Artemis Accords, this working group also suggests that Moon's territorial-based uses must be limited in time and size to ensure compliance with Articles I and II OST. The peculiarity of their proposal is a list of internationally recognized scarce resources and appropriate preservation measures as soon as scientific and technological occurrences that in our opinion is a good idea from an ecological point of view, but exceedingly difficult to achieve from the political side of such issue. To ensure uniformity in the national regulation of lunar activities, the Charter should invite all States to develop dedicated licensing systems for private lunar missions based on the principles of this Charter. To prevent contrasts among these missions, the Charter should invite all States to mutually recognize foreign licenses on the basis of reciprocity (Effective, 2021b).

Less ambitious, but not least for their significance, were so-called open letters of academicians that are deeply concerned about humanity's consumer approach to the natural environment of outer space. Vancouver Recommendations on Space Mining prepared by the Outer Space Institute, recommend multilateral negotiations on an international regime for Space mining and highlight that adoption of national legislation cannot ensure space mining activity safely and sustainably. This document suggests: to consider models or analogies from other areas such as deep seabed mining; to prevent potentially damaging activities even in the presence of scientific uncertainty; to encourage the application of the Committee on Space Research (COSPAR.) Planetary Protection Policy to all Space mining missions and further develop standards on planetary protection. The last one now is especially actual according to Beresheed mission led to tardigrades contamination. The recent NASA Planetary Protection Independent Review Board has led to the announcement of a reframing of the COSPAR guidelines for the Artemis program (Cheney et al., 2020). The authors of the Vancouver Recommendations on Space Mining also appeal to provide publicly available astrogeological surveys, astrodynamical analysis in advance of all Space mining, develop international standards for the prevention of fully consuming or destroying some celestial bodies, etc. (Vancouver, 2020).

In 2020 the Center for Democratic and Environmental Rights, space archeologist Dr. Alice Gorman and research/author Ceridwen Dovey to collaborate together on the drafting of the Declaration of the Rights of the Moon. The text recognizes the legal personhood of the Moon, from which emanated such rights: to exist, persist and continue its vital cycles unaltered, unharmed and unpolluted by human beings; maintain ecological integrity; be defined as a self-sustaining, intelligent, cohesive, intact lunar ecosystem, beyond current human comprehension; independently maintain its own life-sustaining relationship with the Earth's environments and living creatures; remain a forever peaceful celestial entity, unmarred by human conflict or warfare

(Declaration, 2021). The authors are not expecting the document to have an impact on current plans for the Moon, but this text signs the significance of the ecological approach to governing the space-mining economy (Dent, 2021). Both documents are not legal or political; their value lies in the deep scientific and ethical background needed to guide politicians and lawyers.

Such a brief overview of the academicians and civil society impute to the evolving of the legal framework of the space mining sustainable economy leads to the conclusion about the formation of the constant set of legal mechanisms in this sphere. This is not surprising because such working groups often consist of the same representatives. Nevertheless, the multi-stakeholder discussion is valuable according to sheds light on the different aspects (scientific, ecological, economic, ethical, etc.) of the same issue.

Conclusions

The main issues concerning fostering the sustainable development of the space activities on the Moon and other celestial bodies are:

1. The common procedure of advancing governance.
2. Safety zones establishing criteria.
3. Institutionalization of the general recognition of property rights.
4. Benefit-sharing model (based on the resources or facilitation the access to them).
5. Interoperability of the internal authorization procedures and technical standards enabling safe and sustainable space mining activities.
6. Authoritative dispute resolution procedures.

The study of existing legal, ethical, political frameworks and best practices for space mining activities shows that a sustainable development approach is reflected through precautionary measures, establishing requirements of the rational use of the resources, etc.

The great challenge is the bipolarization of the law-making process between the Artemis program and the International Scientific Lunar Station coalition. The main task of the Space Resources Working Groups of the COPUOS. Legal Subcommittee future activities will be to find an average solution acceptable to both in the each from abovementioned issues concerning fostering the sustainable development of the space activities on the Moon and other celestial bodies.

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