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IS THERE A LEGAL PATH TO COMMERCIAL MINING ON THE MOON?

Paul B. Larsen*

ABSTRACT

The introduction describes how current lunar mining strengthens political incentives for commercial lunar activities. The present Chinese explorative excavation may bring greater clarity about the extent of commercial mining opportunities. It also raises issues regarding the lack of coordination between the lunar Artemis Program of the United States and the independent Chinese Lunar Exploration Program and raises uncertainties regarding the legal framework for lunar mining.[1]

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* © Paul B. Larsen. The author taught air and space law for more than 40 years respectively at Southern Methodist University and at Georgetown University. He is co-author of Francis Lyall & Paul B. Larsen, Space Law: A Treatise (2d ed. 2018) and of Paul B. Larsen, Joseph Sweeney & John Gillick, Aviation Law: Cases, Law, and Related Sources (2d ed. 2012). An early version of this paper was presented at the November 6, 2020, Space Law Colloquium at the University of Washington. The author thanks Professor Tanja Masson-Zwaan for sending him the Masson-Zwaan and Sundahl article, *The Lunar Legal Landscape: Challenges and Opportunities*, 46 J. Air L. & Space L. 29 (2021) (Kluwer Publishers). Whereas the author agrees with Masson-Zwaan and Sundahl that international and national law may evolve in parallel forms, he calls attention to the existing uncertainties in lunar mining regulation.

[1] SECURE WORLD FOUND., SPACE POLICY AND SUSTAINABILITY: ISSUE BRIEFING FOR THE BIDEN ADMINISTRATION 33 (2020), https://swfound.org/media/207084/swf_space_policy_issue_briefing_2020_web.pdf [https://perma.cc/G7ZV-S3PD] [hereinafter SPACE POLICY AND SUSTAINABILITY] ("[C]onsiderable uncertainty exists around the legal framework that would enable rational and sustainable space resources activities.").

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Part I examines the fundamental law of the 1967 Outer Space Treaty (OST)[2] regarding lunar mining. It briefly reviews the 1979 Moon Agreement,[3] the Liability Convention,[4] lunar environmental protection, peaceful uses, and applicable law of treaty interpretation.[5]

Part II discusses efforts to implement the OST in a way that makes mining on the Moon possible. It examines the Building Blocks for the Development of an International Framework on Space Resource Activities (Building Blocks Proposal),[6] which results from a three-year international interagency, an interdisciplinary working group at the Institute of Air and Space Law, University of Leiden. Within the scope of existing space law, the working group prepared an extensive international framework for states to authorize and supervise space resource activities, including lunar mining by private companies. It proposes reasonable safety zones around each mining project. The Building Blocks Proposal is now before the United Nations Committee for the Peaceful Uses of Outer Space (COPUOS).

Part II also describes the Artemis Accords,[7] initiated by National Aeronautics Space Administration (NASA), an independent agency of the United States (U.S.).

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[2] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty or OST]; *see also* Convention on Registration of Objects Launched Into Outer Space, Sept. 15, 1976, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter UN Registration Convention]; Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119 [hereinafter The Rescue and Return Agreement].

[3] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 18, 1979, 1363 U.N.T.S. 3 [hereinafter 1979 Moon Agreement].

[4] Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention].

[5] Vienna Convention on the Law of Treaties, May 23, 1969, 1155 U.N.T.S. 331 [hereinafter Vienna Convention].

[6] THE HAGUE INTERNATIONAL SPACE RESOURCES GOVERNANCE WORKING GROUP, BUILDING BLOCKS FOR THE DEVELOPMENT OF AN INTERNATIONAL FRAMEWORK ON SPACE RESOURCE ACTIVITIES (2019), https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimterecht/space-resources/bb-thissrwg--cover.pdf [https://perma.cc/253J-Q6V8] [https://perma.cc/ NUU-EWYC] [hereinafter BUILDING BLOCKS PROPOSAL]; *see also* OLAVO DE O. BITTENCOURT NETO ET AL., BUILDING BLOCKS FOR THE DEVELOPMENT OF AN INTERNATIONAL FRAMEWORK FOR THE GOVERNANCE OF SPACE RESOURCE ACTIVITIES: A COMMENTARY (2020), https://boeken.rechtsgebieden.boomportaal.nl/publicaties/9789462361218#152 [hereinafter BUILDING BLOCKS COMMENTARY].

[7] The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes, Oct. 13, 2020, https://www.nasa.gov/specials/artemis-

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As of October 2021, twelve national space agencies have entered into bilateral accords with NASA to establish basic rules for lunar mining by commercial companies.[8] The parties simply agree to respect each other's lunar mining activities.[9] Through the Artemis Accords, space agencies agree on operating rules for mining which include reasonable safety zones.[10] Part II briefly discusses the Moon as a Commons as it affects lunar mining. It also examines possibilities for soft law regulation of lunar mining.

The conclusion stresses the need for multilateral regulation of lunar mining. It urges COPUOS to adopt guidelines on lunar mining. It also recommends that the United States should eliminate the Wolf Amendment, which is a barrier to the coordination of lunar mining between the two space powers currently most active in lunar exploration and use.

accords/img/Artemis-Accords-signed-13Oct2020.pdf [https://perma.cc/6ZUU-Z5PE] [hereinafter Artemis Accords].

[8] *The Artemis Accords: Principles for a Safe, Peaceful, and Prosperous Future*, NASA, https://www.nasa.gov/specials/artemis-accords/index.html [https://perma.cc/CV5C-NMRJ].

[9] Artemis Accords, *supra* note 7.

[10] *Id.*

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INTRODUCTION

The Moon is barren, bombarded by cosmic rays and solar radiation from outer space.[11] The lunar environment is generally not considered friendly;[12] however, recent exploration[13] shows reliable evidence of water on the Moon.[14] An availability of water makes future human habitation and activities like lunar mining possible.[15] Currently, the United States and China are active on the Moon[16] and have plans to undertake activities in the polar regions of the Moon where water is available.[17] Additionally, they both have plans for their nationals to settle on the Moon, but these plans are independent of each other and do not coordinate.[18] The NASA Artemis Program was developed jointly with the European Space Agency (ESA) and other

[11] Andrew Griffin, *Voyager Spacecraft Find Entirely New 'Unique Physics' Outside the Solar System*, INDEPENDENT (Dec. 4, 2020), https://www.independent.co.uk/life-style/gadgets-and-tech/voyager-electron-burst-solar-system-spacecraft-nasa-b1766237.html [https://perma.cc/3JR4-P6RJ].

[12] Lunar dust is a major hazard on the moon. *See* Leonard David, *Dealing With Dust: A Back-to-the-Moon Dilemma*, SPACE NEWS (Dec. 25, 2020), https://spacenews.com/dealing-with-dust-a-back-to-the-moon-dilemma [https://perma.cc/WW7T-VU5J].

[13] Press Release, NASA, NASA's SOFIA Discovers Water on Sunlit Surface of Moon (Oct. 26, 2020), https://www.nasa.gov/press-release/nasa-s-sofia-discovers-water-on-sunlit-surface-of-moon [https://perma.cc/C57D-7RNN?type=image].

[14] Kenneth Chang, *There's Water and Ice on the Moon, and in More Places Than NASA Thought*, N.Y. TIMES (Oct. 26, 2020), https://www.nytimes.com/2020/10/26/science/moon-ice-water.html [https://perma.cc/QK98-UW4M].

[15] *See Water on the Space Station*, NASA (Nov. 1, 2000), https://science.nasa.gov/science-news/science-at-nasa/2000/ast02nov_1 [https://perma.cc/F4JK-G827].

[16] *See Exploration: Overview*, NASA, https://moon.nasa.gov/exploration/overview/ [https://perma.cc/F2KA-FP66].

[17] *See* Leonard Davis, *NASA's Hunt for Lunar Water Intensifies*, SCI. AM. (June 24, 2020), https://www.scientificamerican.com/article/nasas-hunt-for-lunar-water-intensifies/ [https://perma.cc/BE7A-74PY]; Mike Wall, *China Eyes Robotic Outpost at the Moon's South Pole in Late 2020s*, SPACE.COM (July 18, 2019), https://www.space.com/china-moon-south-pole-research-station-2020s.html [https://perma.cc/68B2-M2DN].

[18] *See* Ryan Woo, *China Eventually Wants Astronauts to Stay on Moon for Long Periods of Time*, REUTERS (Mar. 14, 2021), https://www.reuters.com/article/us-space-exploration-china-moon-idUSKBN2B605Z [https://perma.cc/FY3V-5DSE]; *see also NASA's Plan for Sustained Lunar Exploration and Development*, NASA, https://www.nasa.gov/sites/default/files/atoms/files/a_sustained_lunar_presence_nspc_report4220final.pdf [https://perma.cc/2N9Z-UAMA]; Bryan Bender, *A New Moon Race Is On. Is China Already Ahead?*, POLITICO (June 13, 2019), https://www.politico.com/agenda/story/2019/06/13/china-nasa-moon-race-000897/ [https://perma.cc/QPL3-6YQM].

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partners; it includes plans to build a habitable Gateway space station in lunar orbit for human activity on the Moon.[19]

Both NASA and ESA are consulting with commercial satellite operators regarding commercial projects on the Moon.[20] The Artemis Accords anticipate commercial mining activities on the Moon and the establishment of safety zones around mining sites.[21] On the other hand, China has been sending a series of Chang'e space exploratory spacecrafts, Chang'e-1 through Chang'e-5, to the Moon.[22] In 2020, China sent Chang'e-5 to the Moon to dig a two-meter deep hole[23] and bring two kilograms of lunar materials back to Earth for analysis.[24] Russia and the U.S. have also brought lunar materials back to Earth.[25] Before, lunar excavations were exploratory,[26] but now both the U.S. and China plan to establish permanently inhabited bases on the Moon.[27]

The issue of mining on the Moon raises fundamental questions about lunar mining rights. For example, can a commercial mining company secure a mining site free of competing claims and subsequently sell the mining proceeds? The company must consider the laws on lunar mining when deciding whether to engage in a mining

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[19] NASA, ARTEMIS PLAN: NASA'S LUNAR EXPLORATION PROGRAM OVERVIEW (2020), https://www.nasa.gov/sites/default/files/atoms/files/artemis_plan-20200921.pdf [https://perma.cc/829Z-QTC4] [hereinafter THE ARTEMIS PLAN].

[20] *Lunar Satellites*, THE EUR. SPACE AGENCY, https://www.esa.int/Applications/Telecommunications_Integrated_Applications/Lunar_satellites [https://perma.cc/6DRM-ZUNQ].

[21] *See* THE ARTEMIS PLAN, *supra* note 19.

[22] Adam Mann, *China's Chang'e Program: Missions to the Moon*, SPACE.COM (Feb. 1, 2019), https://www.space.com/43199-chang-e-program.html [https://perma.cc/996C-6HPX].

[23] Mike Wall, *China's Chang'e 5 Capsule Lands on Earth with the 1st New Moon Samples in 44 years*, SPACE.COM (Dec. 16, 2020), https://www.space.com/china-chang-e-5-moon-samples-capsule-landing [https://perma.cc/8UDG-SZJV].

[24] *China Plans to Bring Back the First Moon Rocks for 40 Years*, THE ECONOMIST (Nov. 21, 2020), https://www.economist.com/science-and-technology/2020/11/21/china-plans-to-bring-back-the-first-moon-rocks-for-40-years [https://perma.cc/T728-7QJA]. The Chinese project involved the use of four different modules: a lunar lander, a module for ascending from the surface of the Moon, a lunar service module, and a return module. *Id.*; ESA supported the Chang'e-5 mission by tracking the satellite during its critical phase. *ESA Tracks Chang'e-5 Moon Mission*, THE EUR. SPACE AGENCY (Nov. 18, 2020), https://www.esa.int/ESA_Multimedia/Images/2020/11/ESA_tracks_Chang_e-5_Moon_mission#.YKFSFVrQHQM.lin [https://perma.cc/TS9C-N9HP].

[25] *China Plans to Bring Back the First Moon Rocks for 40 Years*, *supra* note 24.

[26] *Id.*

[27] *Id.*

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enterprise. A U.S. commercial company should not be under the illusion that the Federal Aviation Administration (FAA) launch license entitles them to mine on the Moon. The FAA does not regulate the Moon.[28] It only authorizes the launch and reentry of satellites.[29] It does not have the legal authority to tell a competing Chinese mining operator to remove itself from a mine chosen by a U.S. company.[30] Both are subject to the OST.[31]

Mines on the Moon are not subject to U.S. sovereignty.[32] The 1967 OST regulates outer space activities, including mining on the Moon and celestial bodies;[33] the OST applies universally.[34] Its Article VI requires individual states to respect the terms of the OST.[35] The OST applies not only to governmental activities in outer space, but also to authorized non-governmental entities such as private mining companies.[36] Governments are responsible for holding non-governmental entities, such as private companies, to the terms of the treaty through the process of authorizing each outer space activity.[37] Governments must continually supervise all authorized activities for continued compliance with the treaty.[38] In outer space, non-governmental companies are the representatives of their states.[39]

In the 1960s, the United States and Russia, the space superpowers of the time, negotiated the OST during their so-called "cold war."[40] Russia became the first to

[28] *See* OST, *supra* note 2.

[29] *Id.*; *Commercial Space Transportation Activities*, FEDERAL AVIATION ADMINISTRATION (June 19, 2020), https://www.faa.gov/newsroom/commercial-space-transportation-activities?newsId=19074 [https://perma.cc/6P4P-TQV7].

[30] OST, *supra* note 2; *Commercial Space Transportation Activities*, *supra* note 29.

[31] OST, *supra* note 2.

[32] *Id.* art. I.

[33] *Id.*

[34] OST, *supra* note 2; FRANCIS LYALL & PAUL B. LARSEN, SPACE LAW: A TREATISE 49 (2d ed. 2018).

[35] OST, *supra* note 2, art. VI.

[36] *See generally* OST, *supra* note 2.

[37] *Id.* art. VI.

[38] *Id.*

[39] LYALL & LARSEN, *supra* note 34, at 172.

[40] *Id.* at 49.

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enter outer space when it launched Sputnik in 1957.[41] This then raised the prospect of a Russian claim of sovereignty and consequent outer space control of the high grounds over the United States,[42] giving Russia a military advantage.[43] Using the model of the Antarctic Treaty, the two space superpowers came to an agreement in the 1967 OST that outer space could not be subject to national appropriation by claim of sovereignty.[44] The agreement effectively neutralized outer space and thus prevented individual state ownership of the Moon. It also enabled the space powers to use satellites to observe the interior of each other's countries from outer space, preventing military surprises, an advantage that the United States did not and still does not want to lose.[45] Outer space is nobody's territory. Outer space, including mining on the Moon, is subject to the specific terms of use stated in the OST.[46] 110 states, including all the space powers such as the United States, Russia, China, India, and Japan, are parties to the OST.[47]

China's exploration of lunar resources is a related story. It evidences competition with the United States and its U.S.-authorized commercial companies. China has ambitions to lead exploration and is becoming the leading non-U.S. location and source for venture funding of space companies; they are thus a rival of the United States.[48] One reason for China's independent lunar competition is a U.S.

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[41] U.S. DEP'T OF STATE, *The Launch of Sputnik*, 1957, https://2001-2009.state.gov/r/pa/ho/time/lw/103729.htm (last visited Aug. 22, 2021).

[42] LYALL & LARSEN, *supra* note 34, at 49–73.

[43] *Id.* at 452 ("The negotiators of the two space powers were mainly interested in keeping its adversary from occupying the higher ground."); *see* SUN TZU, THE ART OF WAR 84 (Lionel Giles trans., Luzac & Co. 1910).

[44] OST, *supra* note 2; U.S. DEP'T OF STATE, *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, https://2009-2017.state.gov/t/isn/5181.htm [https://perma.cc/9M9F-JJSW].

[45] OST, *supra* note 2; U.S. DEP'T OF STATE, *supra* note 44.

[46] OST, *supra* note 2.

[47] LYALL & LARSEN, *supra* note 34, at 49.

[48] SECURE WORLD FOUNDATION, LOST WITHOUT TRANSLATION: IDENTIFYING GAPS IN U.S. PERCEPTIONS OF THE CHINESE COMMERCIAL SPACE SECTOR 7 (2021) ("Chinese commercial space activity has increased in scope, scale, number of companies, and amount of investment capital in recent years."); *see also* Elliot Ji et al., *What Does China Think About NASA's Artemis Accords?*, DIPLOMAT (Sept. 17, 2020), https://thediplomat.com/2020/09/what-does-china-think-about-nasas-artemis-accords/ [https://perma.cc/WW3S-GQ6B].

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law adopted in 2011: the so-called Wolf Amendment.[49] It restricts NASA from dealing with Chinese space authorities and tends to limit dialogue between the U.S. and Chinese commercial space stakeholders.[50] Its purpose is to protect U.S. technology from appropriation by China.[51] Regardless, the independent Chinese Lunar Exploration Program (CLEP) has developed extensive, sophisticated outer space technology.[52] Lunar resources sought by China are precious metals and Helium-3, which are used for fuel by future Chinese nuclear power plants.[53] A Chinese satellite named Chang'e-1 initiated the program in 2007, but Chang'e-5, launched in 2020, is the most recent development.[54] China plans to send Chang'e-6 and Chang'e-7 to explore lunar resources near the lunar South Pole in 2024.[55] By

[49] The Wolf Amendment restricts NASA's ability to engage with China regarding space exploration.

> (a) None of the funds made available by this division may be used for the National Aeronautics and Space Administration or the Office of Science and Technology Policy to develop, design, plan, promulgate, implement, or execute a bilateral policy, program, order, or contract of any kind to participate, collaborate, or coordinate bilaterally in any way with China or any Chinese-owned company unless such activities are specifically authorized by a law enacted after the date of enactment of this division.
> (b) The limitation in subsection (a) shall also apply to any funds used to effectuate the hosting of official Chinese visitors at facilities belonging to or utilized by the National Aeronautics and Space Administration.

Department of Defense and Full-Year Continuing Appropriations Act, Pub. L. No. 112-10, § 1340, 125 Stat. 38, 123 (2011) [hereinafter Wolf Amendment].

[50] *Id.*

[51] William Pentland, *Congress Bans Scientific Collaboration with China, Cites High Espionage Risks*, FORBES (May 7, 2011), https://www.forbes.com/sites/williampentland/2011/05/07/congress-bans-scientific-collaboration-with-china-cites-high-espionage-risks/?sh=601c20e94562 [https://perma.cc/L6CR-3DCU].

[52] *See* Peter Wood et al., *China's Ground Segment: Building the Pillars of a Great Space Power*, 2021 CHINA AEROSPACE STUD. INST., https://www.airuniversity.af.edu/PORTALS/10/CASI/DOCUMENTS/RESEARCH/SPACE/2021-03-01%20CHINAS%20GROUND%20SEGMENT.PDF?VER=Z4OGY_MRXADURWVT-R9J6W%3D%3D [https://perma.cc/CYQ8-BTU7].

[53] *See* Fabrizio Bozzato, *Moon Power: China's Pursuit of Lunar Helium-3*, DIPLOMAT (June 16, 2014), https://thediplomat.com/2014/06/MOON-POWER-CHINAS-PURSUIT-OF-LUNAR-HELIUM-3/ [https://perma.cc/E7RB-5ZJL].

[54] Mann, *supra* note 22.

[55] *See Future Chinese Lunar Missions*, NASA, https://nssdc.gsfc.nasa.gov/planetary/lunar/cnsa_moon_future.html [https://perma.cc/5GVH-RLJQ].

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agreement with Russia, China will launch Chang'e-8 to test the possible construction of a base on the Moon.[56] China plans to send people to the Moon by 2030.[57]

Evidently, China is ready for long-term commercial competition with the United States for lunar resources.[58] It is likely that the competing U.S. and Chinese searches for resources will clash.[59] The U.S. is now apprehensive that China may "seize the lunar strategic high grounds and become the world's pre-eminent spacefaring nation."[60] Space law and policy experts expect NASA's lunar Artemis Program to escalate the commercial competition and rivalry between the two space powers.[61] Like the United States, China plans for cislunar space to become a major economic generator based on lunar and other economic resources.[62] China has plans similar to those of the U.S. Artemis Program to establish a lunar base for explorations of more distant outer space.[63]

Lunar mining operations of different nationalities will eventually require the use of telecommunication on the Moon, which will be subject to international regulation.[64] Lunar mining on the dark side of the Moon, which is presently a quiet zone reserved for radio astronomy, may require changes in current international

[56] Andrew Jones, *Russia, China hope to secure partners for moon base project*, SPACE NEWS (May 31, 2021), https://spacenews.com/russia-china-hope-to-secure-partners-for-moon-base-project/ [https://perma.cc/UE4U-EC7Q].

[57] Steven Lee Myers, *The Moon, Mars and Beyond: China's Ambitious Plans in Space*, N.Y. TIMES (June 17, 2021), https://www.nytimes.com/article/china-mars-space.html.

[58] Steven Lee Myers & Kenneth Chang, *China Brings Moon Rocks to Earth, and a New Era of Competition to Space*, N.Y. TIMES (Dec. 16, 2020), https://www.nytimes.com/2020/12/16/science/china-moon-mission-rocks.html [https://perma.cc/KD8F-KEVM]; Chang'e-5 displayed a small Chinese flag on the Moon. *Id.*

[59] *Id.*

[60] *Id.* (quoting then-Vice President Mike Pence).

[61] Almudena Azcárate Ortega, *Artemis Accords: A Step Toward International Cooperation or Further Competition?*, LAWFARE (Dec. 15, 2020, 10:25 AM), https://www.lawfareblog.com/artemis-accords-step-toward-international-cooperation-or-further-competition [https://perma.cc/4C6S-ZUY8].

[62] Cislunar space is the space between the Earth and the Moon. *See* Myers & Chang, *supra* note 58.

[63] *Id.*

[64] OST, *supra* note 2, art. II.

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regulation by the International Telecommunication Union.[65] Continued exploration of outer space remains the primary objective precluding interfering lunar mining.[66]

I. OUTER SPACE TREATY PROPERTY RIGHTS ON THE MOON

Article VI of the OST requires states to authorize and supervise outer space activities of non-governmental entities for OST compliance.[67] Unauthorized lunar mining activities by non-governmental entities are therefore illegal.

A. Does the OST Allow Property Rights to Lunar Mines?

Whether the OST allows property rights to lunar mines is the most intriguing legal issue pertaining to lunar mining. What is the existing law with respect to property rights for lunar mining sites and related activities? How can lunar mining be legally secure for doing business? The Moon is not free for unlimited commercial exploitation.[68] Mining on the Moon is subject to Article II of the OST, which states that:

> Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.[69]

That means that no government, including that of the United States, can legally grant property rights to mining sites on the Moon. This creates uncertainty as to the legal right to mine on the Moon. If a Chinese company moves in on a mining site worked by a U.S. company, the U.S. Government cannot expel the Chinese company.[70]

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[65] *See* Meghan Bartels, *Alien Hunters Need Radio Silence on the Moon. Future Lunar Missions Could Wreck It.*, SPACE.COM (Dec. 17, 2019), https://www.space.com/moon-farside-radio-astronomy-protection.html [https://perma.cc/4JFP-XXW4].

[66] *Id.*

[67] OST, *supra* note 2, art. VI.

[68] *See* Antonino Salmeri, *No, Mars Is Not a Free planet, No Matter What SpaceX Says*, SPACE NEWS (Dec. 5, 2020), https://spacenews.com/op-ed-no-mars-is-not-a-free-planet-no-matter-what-spacex-says/ [https://perma.cc/77WW-L35J].

[69] OST, *supra* note 2, art. II (emphasis added).

[70] Tanja Masson-Zwaan & Mark J. Sundahl, *The Lunar Legal Landscape: Challenges and Opportunities*, 46 AIR & SPACE L. 29, 31 (2021) ("One of the tasks of a future lunar governance will be to clarify this matter.").

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Furthermore, suppose the Chinese company mines for Helium-3 on the Moon and wishes to trade its mining products in other countries. Some countries may interpret Article II of OST to mean that the prohibition on appropriation precludes property rights to the mining products and that the product is therefore illegal. Companies would then have to be cautious about internationally marketing its mining products because they could be held responsible and have their product seized, which would reduce the value of the products.

Some states and space law experts interpret OST Article II literally to preclude lunar property rights, including ownership of mines.[71] States that are parties to the 1979 Moon Agreement attach benefit-sharing conditions to the property rights and marketing of lunar products.[72] Consequently, some countries will recognize property rights in lunar mining products, and some will not. That uncertainty will limit the marketing of mining products.

B. Use of the Moon but without Ownership of the Mining Site

Article I of the OST speaks to the free use of the Moon, but the language is ambiguous.[73] Mining exploitation is required by OST Article I: (1) to be "carried on for the benefit" of all countries; (2) to be based on equality among using states and their non-governmental entities; (3) to recognize that the Moon is "the province of

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[71] OST, *supra* note 2, art. II; *see also* STEPHAN HOBE, SPACE LAW (2019); Jack Wright Nelson, *The Artemis Accords and the Future of International Space Law*, AM. SOC'Y OF INT'L L.: INSIGHTS (Dec. 10, 2020), https://www.asil.org/sites/default/files/ASIL_Insights_2020_V24_I31.pdf [https://perma.cc/6KX2-VLAY].

[72] 1979 Moon Agreement, *supra* note 3, art. 2.

[73] Article I of the OST is ambiguous with regard to free use of the Moon.

> The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind. Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies. There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigations.

OST, *supra* note 2, art. I (repeating U.N. General Assembly Resolution 1962 (XVIII) (Dec. 13, 1963), which Professor Bin Cheng famously pronounced to become "instant" customary international law. *See* Bin Cheng, *United Nations Resolutions on Outer Space: "Instant" International Customary Law?*, 5 INDIAN J. INT'L L. 23 (1965)).

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mankind" and must be treated accordingly;[74] (4) to establish that sites must be freely accessible for all users "on the basis of equality" among states;[75] and (5) to ensure that commercial lunar activities must make room for international and national scientific investigation.[76] Use of the Moon is also subject to all the other provisions of the OST.[77] The authors of the Building Blocks Proposal and the Artemis Accords interpret OST Article II to allow the use of lunar mines without claiming property rights.[78] Several legal experts are of the opposite point of view.[79] Mining of the Moon without the assurance of property rights in the products creates legal uncertainty ranging from access to lunar mining to the right to freely trade the mined products.

C. United States Government Authorization of Non-governmental Mining Proceeds

International space law, as well as national law, will govern lunar mining. OST Article VI requires states to license and supervise non-governmental activities in outer space, and Article VIII provides that federal law governs nationally registered space objects and personnel on those objects.[80]

1. The 2015 U.S. Commercial Space Launch Competitiveness Act[81]

OST Article VI gives the U.S. the power to authorize non-governmental activities in outer space and on the Moon, but that authorization is subject to the

[74] *See infra* Part II.D.

[75] Masson-Zwaan & Sundahl, *supra* note 70, at 34; *see also* G.A. Res. 51/122, annex, Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and Interest of All States, Taking into Particular Account the Needs of Developing Countries (Feb. 4, 1997), https://www.unoosa.org/oosa/en/ourwork/spacelaw/principles/space-benefits-declaration.html [https://perma.cc/L7DU-UXNS].

[76] N. Jasentuliyana, *Article I of the Outer Space Treaty Revisited*, 17 J. SPACE L. 129, 141 (1989); *see also* Paul B. Larsen, *Asteroid Legal Regime: Time for a Change*, 39 J. SPACE L. 275, 289 (2014).

[77] *See* OST, *supra* note 2.

[78] BUILDING BLOCKS PROPOSAL, *supra* note 6.

[79] *Id.*; BUILDING BLOCKS COMMENTARY, *supra* note 6. Professor S. Hobe is of the view that any occupation of the Moon, including use, is prohibited by OST Art. II. He states that "in the context of Article I OST, Article II OST contains a prohibition of appropriation by way of use." HOBE, *supra* note 71, at 96.

[80] OST, *supra* note 2; Masson-Zwaan & Sundahl, *supra* note 70, at 50.

[81] 51 U.S.C. § 50901(b)(3).

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terms of the Outer Space Treaty.[82] Whereas Article I of the treaty allows free *use* of the Moon, it does not authorize any state to appropriate the Moon, or any part of it, by claim of sovereignty or by any other means.[83] It continues to be in interest of the U.S., for reasons of national security, that outer space remains free of sovereignty, but the OST Article II prohibition on appropriation goes further than that by prohibiting lunar mining appropriation "by any other means."[84] Thus, the Article II prohibition creates legal uncertainty as to whether the proceeds of lunar mining can be used and traded.[85]

The OST Article VI requires that governments authorize and supervise all non-governmental activities by their nationals in outer space.[86] In the U.S., the Commercial Space Launch Act has partially delegated that authority to the Department of Transportation (DOT). 51 U.S.C. § 50901 provides authority: "to oversee and coordinate the conduct of commercial launch and reentry operations, issue permits and commercial licenses and transfer commercial licenses authorizing those operations, and protect the public health and safety, safety of property, and national security and foreign policy interests of the United States."[87]

U.S. law defines *launches* and *launch sites* to mean the location on Earth from which a launch takes place.[88] The law also requires the valid issuance or transference of a license to operate commercial space objects to and from the United States.[89]

Under the Commercial Space Launch Act, 51 U.S.C. § 50901, the DOT delegated its statutory authority to the FAA.[90] Thus, the FAA authorizes all launch and reentry operations to and from outer space.[91] *However, no U.S. governmental department has yet been authorized or funded by Congress to license commercial mining operations at specific locations on the Moon or to trade in commercial*

[82] OST, *supra* note 2, art. VI.

[83] *Id.* art. I.

[84] *Id.* art. II.

[85] Larsen, *supra* note 76, at 277–90.

[86] OST, *supra* note 2, art. VI.

[87] 51 U.S.C. § 50901(b)(3).

[88] *Id.* § 50902(7)–(8).

[89] *Id.* § 50904.

[90] 49 C.F.R. § 1.83(b) (2012).

[91] *See id.*; 51 U.S.C. § 50901(b)(3).

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mining products excavated on the Moon.[92] The State Department remains responsible for the parts of the OST not implemented by statute.[93] The Trump Administration proposed that the Department of Commerce receive such implementing authority,[94] but Congress has not yet legislated this legal authority to them. NASA does not have statutory authority to authorize commercial mining on the Moon.[95]

U.S. Congress adopted the Commercial Space Launch Competitiveness Act, 51 U.S.C. § 51303, to promote commercial mining on the Moon.[96] The statute provides that:

> A United States Citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource in accordance with applicable law, including international obligations of the United States.[97]

However, Congress also expressed in the statute that under the Act, the U.S. does not assert jurisdiction nor ownership over the celestial bodies.[98] The Act does not establish the regulation of mining.[99] Article VI of the OST limits lunar mining

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[92] In 2016 the FAA, Department of Commerce, Department of State, Department of Defense, NASA, and the FCC jointly approved a landing on the Moon by a private satellite operator. *See* Mike Wall, *Moon Express Approved for Private Lunar Landing in 2017, a Space First*, SPACE.COM (Aug. 3, 2016), https://www.space.com/33632-moon-express-private-lunar-landing-approval.html [https://perma.cc/8G5Z-5CVC].

[93] *See Treaty Affairs*, U.S. DEP'T OF STATE, https://2009-2017.state.gov/s/l/treaty/index.htm [https://perma.cc/QK74-DAT4].

[94] Michael Sinclair, *What You May Have Missed in the new National Space Policy*, BROOKINGS (Dec. 14, 2020), https://www.brookings.edu/blog/order-from-chaos/2020/12/14/what-you-may-have-missed-in-the-new-national-space-policy/ [https://perma.cc/TLY5-A5D6].

[95] *See id.*

[96] 51 U.S.C. § 51303.

[97] *Id.*

[98] U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, § 403, 129 Stat. 704, 722 (2015).

[99] 51 U.S.C. § 51303; *see also* Masson-Zwaan & Sundahl, *supra* note 70, at 37; LYALL & LARSEN, *supra* note 34, at 172.

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because it requires States that are parties to the Treaty to issue authorizations in accordance with the terms of the Treaty.[100]

In 2020, the U.S. adopted the One Small Step to Protect Human Heritage Act, requiring NASA and commercial companies working with NASA on the Moon to adopt and exercise best practices for the protection of historic lunar landing sites.[101] The Act is limited by the OST.[102]

2. Evaluation

The OST Article VI assignment of responsibility to States Parties for national activities and their consequent obligation to license commercial operators is interpreted differently by the various States Parties.[103] For example, Luxembourg law recognizes property rights to lunar mining materials,[104] 1979 Moon Agreement members do not recognize national property rights in principle,[105] and the United States recognizes such property rights but at the same time expresses adherence to the OST Article II prohibition on appropriation.[106]

The United States' failure to designate a governmental decisionmaker for commercial outer space mining activities causes legal uncertainty. No domestic government agency exists to license and supervise lunar mining.[107] Uncertainty

[100] OST, *supra* note 2, art. VI.

[101] One Small Step to Protect Human Heritage in Space Act, Pub. L. No. 116-275, 134 Stat. 3357 (2020); *see also* Michelle L.D. Hanlon & Apollo Landers, *Neil Armstrong's Bootprint and Other Human Artifacts on Moon Officially Protected by New US Law*, CONVERSATION (Jan. 12, 2021), https://theconversation.com/apollo-landers-neil-armstrongs-bootprint-and-other-human-artifacts-on-moon-officially-protected-by-new-us-law-152661 [https://perma.cc/4RX9-7URK].

[102] OST, *supra* note 2.

[103] *See id.*

[104] Loi du 20 julliet 2017 sur l'exploration et l'utilisation des ressources de l'espace [Law of 20 July 2017 on the Exploration and Utilization of Space Resources], JOURNAL OFFICIEL DU GRAND-DUCHÉ DE LUXEMBOURG [OFFICIAL GAZETTE OF THE GRAND DUCHY OF LUXEMBOURG], No. 674, July 28, 2017 [hereinafter Luxembourg Law]. Luxembourg further strengthened its laws in favor of lunar mining in 2020. *See* Clive Cookson, *Luxembourg Space Programme to Work on Moon Mining*, FINANCIAL TIMES (Feb. 16, 2021), https://www.ft.com/content/3ced3460-abf2-4048-bce4-66f01e16ade4 [https://perma.cc/P6MU-YYMQ].

[105] *See* Justin Parkinson, *Can Anyone 'Own' the Moon?*, BBC (Jan. 20, 2019), https://www.bbc.com/news/science-environment-46877417 [https://perma.cc/WQB4-XN2U].

[106] *See* Nahal Toosi, *Who Owns the Moon?*, POLITICO (June 13, 2019), https://www.politico.com/agenda/story/2019/06/13/space-travel-moon-resources-000899/ [https://perma.cc/LM5K-WB3C].

[107] SPACE POLICY AND SUSTAINABILITY, *supra* note 1.

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prevails concerning whether the U.S. Government has authority to prevent U.S. commercial mining operators and/or international operators from conflicts over lunar mining.[108] The continuing uncertainty is rooted in the legal difficulty of interpreting OST Articles I and II as authorization for the U.S. Government to grant commercial operators necessary control of lunar mining sites.[109] If the legal authority to engage in lunar mining is dubious, how can the title to lunar materials become free and clear?[110]

D. The 1979 Moon Agreement Is a Source of Uncertainty

1. U.S. Problems with the 1979 Moon Agreement

The Moon Agreement (MA), to which the United States is not a party,[111] is in effect in the eighteen countries that have ratified it.[112] They have agreed that "the Moon and its natural resources are the common heritage of mankind."[113] MA Article 11(3) provides, "neither the surface nor the subsurface of the Moon, nor any part thereof or natural resources in place, shall become property of any State or non-

[108] *See* Nahal Toosi, *supra* note 106. Note that parties to the Artemis Accords promise to respect the claims of participating partners. Artemis Accords, *supra* note 7.

[109] *See* OST, *supra* note 2, arts. I–II.

[110] The U.S. Space Launch Competitiveness Act, which assures compliance with the OST, differs from the Luxembourg law which does not assure OST compliance. Luxembourg Law, *supra* note 104.

[111] U.S. commercial companies, interested in lunar mining for a profit, objected to sharing of benefits. Consequently, the United States has not joined the 1979 Moon Agreement, neither have China and Russia. Wide adoption of the 1979 Moon Agreement by the space powers is unlikely. The Moon Agreement is merely preparatory for a second diplomatic conference to establish the actual international framework of an international licensing council that could potentially assign mining sites based on a plan that is like the one contemplated by the Building Blocks Proposal. *See* 1979 Moon Agreement, *supra* note 3, art. 11, ¶ 7. Such an arrangement could become a Protocol to the OST or to the Moon Agreement.

[112] Parties to the Moon Agreement include Australia, which has also signed a bilateral Artemis Accord with NASA. *The Artemis Accords: Principles for a Safe, Peaceful, and Prosperous Future*, *supra* note 8.

[113] 1979 Moon Agreement, *supra* note 3. The UN Committee for the Peaceful Uses of Outer Space (COPUOS) drafted the 1967 Outer Space Treaty to establish agreement on use of the Moon with the expectation that wide use of the Moon would follow immediately after the landing of the first astronauts in 1969. The negotiators immediately faced the question of who owns the Moon. However, in the 1970s another major global treaty negotiation was going on which influenced the 1979 Moon Agreement. The Law of the Seas negotiation, urged by the developing countries, adopted the legal principle that the mineral resources of the deep ocean seabed are the common heritage of humankind. Consequently, the 1979 Moon Agreement, with the strong support of the developing countries, adopted the Law of the Seas common heritage principle by stating that the Moon is the common heritage of mankind, and that the Moon and its natural resources shall not become the property of any state or non-governmental entity.

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governmental organization."[114] The MA holds States responsible for the activities of their non-governmental entities on the Moon[115] and institutes terms for lunar mining, which include equitable sharing of mining benefits (profits).[116] The MA has not yet established an international body to assign mining sites[117] but will do so by treaty in a diplomatic conference sometime in the future.[118] The countries participating in such a diplomatic conference would be free to establish different terms for lunar mining than those presently provided in the MA because of the independent sovereignty of a diplomatic conference.[119] Neither Russia nor China is a party to the MA, but the MA parties represent a decision-making block in the Committee on the Peaceful Uses of Outer Space (COPUOS), which operates by consensus of all States.[120] The MA parties are thus able to block the consensus of countries on new treaty terms that differ from the MA.[121] The MA parties are a powerful force that could block oppositional activities by non-members.

2. Evaluation

Article 11 of the MA provides that when it becomes possible to exploit lunar resources, the parties will establish a legal regime for exploitation.[122] It is possible that the U.S., and the other space powers, could participate in a follow-up diplomatic conference anticipated by Article 18 of the MA if that conference were to adopt a treaty acceptable to the U.S.[123] Such a treaty would be binding only on the parties to the MA. A diplomatic conference would be the opportunity to resolve commercial

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[114] *Id.* art. 11, ¶ 3. See the five conditions listed in Article 11(7). *Id.* art. 11, ¶ 7.

[115] *Id.* art. 14, ¶ 1.

[116] *Id.* art. 11, ¶ 7(*d*).

[117] *Id.* art. 11, ¶ 7.; T. Masson-Zwaan and M. Sundahl are of the view that it is not clear whether preliminary exploration of lunar resources is precluded by Article 11(3). Masson-Zwaan & Sundahl, *supra* note 70, at 32.

[118] 1979 Moon Agreement, *supra* note 3, art. 11, ¶ 5, art. 18; *see also* Antonella Bini, *The Moon Agreement: Its effectiveness in the 21st century*, EUROPEAN SPACE POL'Y INST. 4 (2008), https://www.files.ethz.ch/isn/124689/espi_%20perspectives_14.pdf ("The establishment of the international regime would be the task of a conference convened at the request of one third of the State Parties to the Moon Agreement.").

[119] 1979 Moon Agreement, *supra* note 3, art. 11, ¶ 5, art. 18.

[120] *Id.*

[121] *See* BUILDING BLOCKS PROPOSAL, *supra* note 6; Artemis Accords, *supra* note 7.

[122] 1979 Moon Agreement, *supra* note 3, art. 11, ¶ 5, art. 18.

[123] *Id.* art. 18.

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mining issues, including the profit-sharing provision of the MA.[124] Such an internationally agreed framework could establish a commercially secure basis for lunar mining.[125]

E. Liability of Mining Companies and Their Insurance Requirements

Lunar mining by authorized U.S. commercial mining companies may result in damages to other governments and to other national or foreign non-governmental companies. The United States is a party to the Convention on International Liability for Damage Caused by Space Objects (Liability Convention);[126] Article III makes the U.S. government responsible for the damages caused by the fault of its authorized non-governmental mining companies.[127] Some argue that the establishment of safety zones around mining sites, as proposed by the Artemis Accord Section 1, will make it more difficult to prove liability based on the fault of the mining operator.[128] The Liability Convention is a treaty that binds states; thus, only states can bring claims for damages.[129] Therefore, foreign commercial mining companies have to persuade their governments or another government to bring action against the United States for damages caused. Whether governments would actually bring such a claim, however meritorious, remains subject to other political considerations. No liability claims have been brought under the Liability Convention since it entered into force in 1972.[130] Claims for damages caused by a U.S. company to other U.S. companies are subject to domestic tort laws.[131] Because of the difficulties of bringing an action

[124] *See* Maureen Williams, *The Moon Agreement in the Current Scenarios*, 53 INT'L INST. SPACE L. 117 (2010).

[125] The U.S. has expressed approval of the 1994 Law of the Seas Protocol, although it has not yet adopted it. *See* Bernard H. Oxman, *The 1994 Agreement and the Convention*, 88 AM. J. INT'L L. 687 (1994). Thus, the U.S. might accept the adoption of a Protocol to the Moon Agreement along the lines of the 1994 Protocol to the Law of the Seas Agreement, described *infra* note 339.

[126] Liability Convention, *supra* note 4.

[127] *Id.* art. 3.

[128] Masson-Zwaan & Sundahl, *supra* note 70, at 47.

[129] Liability Convention, *supra* note 4.

[130] Russian nuclear satellite, COSMOS 954, disintegrated over northern Canada in 1978. Russia settled Canadian claim of damages for $6 million. The Settlement was based on the Liability Convention. *See* LYALL & LARSEN, *supra* note 34, at 107.

[131] *See* Liability Convention, *supra* note 4, at art. VII.

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under the Liability Convention, claims by foreign commercial entities are likely to be brought in domestic U.S. courts; however, this has not yet occurred.

U.S. statute, 51 U.S.C. § 50914, requires governmental entities to have liability insurance or otherwise meet financial requirements in order to obtain an FAA launch or reentry license.[132] The amount of insurance is determined by the FAA.[133] The statute provides that damages in excess of the insured amount[134] must be presented to Congress for payment by the Department of Transportation.[135]

F. Lunar Environmental Protection Affecting Lunar Mining

1. Due Regard and Precautionary Principle[136]

The footprints of the first U.S. astronauts from 1969 are still visible and will remain so for many years.[137] A practical environmental issue is that the Moon is fragile;[138] it does not heal itself as the Earth does.[139] The Moon has many unique environmental and geological features in need of special consideration. One feature is its dusty surface;[140] accumulation of mining debris would be detrimental.[141] The

[132] 51 U.S.C. § 50914(a)(1).

[133] 51 U.S.C. § 50914(a)(2); *see* 49 C.F.R. § 1.83(b) (2012) (delegating the functions vested in the Secretary by chapter 509 of title 51, U.S.C. to the FAA).

[134] 51 U.S.C. § 50914(a)(3).

[135] 51 U.S.C. § 50914(b)(2).

[136] OST, *supra* note 2, art. IX. *See also* Paul B. Larsen, *Application of the Precautionary Principle to the Moon*, 71 J. AIR L. & COM. 295 (2006); One Small Step to Protect Human Heritage in Space Act, *supra* note 101.

[137] *Apollo 11—First Footprint on the Moon*, NASA (July 8, 2004), https://www.nasa.gov/audience/forstudents/k-4/home/F_Apollo_11.html [https://perma.cc/34G3-8EB4].

[138] *See* Patrick Barry, *NASA Mission to Study the Moon's Fragile Atmosphere*, NASA (Oct. 23, 2009), https://science.nasa.gov/science-news/science-at-nasa/2009/23oct_ladee [https://perma.cc/GM5X-9K3T].

[139] *See id.*

[140] David, *supra* note 12.

[141] Sarah Scoles, *Dust from Asteroid Mining Spells Danger for Satellites*, NEWSCIENTIST (May 27, 2015), https://www.newscientist.com/article/mg22630235-100-dust-from-asteroid-mining-spells-danger-for-satellites/ [https://perma.cc/F2V9-349Y] ("According to Casey Handmer of the California Institute of Technology in Pasadena and Javier Roa of the Technical University of Madrid in Spain, 5 per cent of the escaped debris will end up in regions traversed by satellites. Over 10 years, it would cross geosynchronous orbit 63 times on average. A satellite in the wrong spot at the wrong time will suffer a damaging high-speed collision with that dust.").

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Moon, therefore, needs greater environmental legal protection than the Earth. Non-governmental operators are required by OST Article IX to "be guided by the principle of cooperation and mutual assistance and shall conduct 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."[142]

States are required to continually supervise their authorized non-governmental operators to assure that they comply with the OST.[143] The standard of "due regard"[144] was first recognized by the International Court of Justice in the Icelandic Fisheries case, in which the Court required the UK fishermen to pay due regard, i.e., respect, to the fishing rights of the Icelandic fishermen within Icelandic territorial waters.[145] Similarly, mining on the Moon is subject to environmental protection under OST Article IX, which requires states to engage in international consultations before proceeding with all activities; this includes mining that may cause "harmful interference with activities of other states."[146] Although rarely used, OST Article IX intends to minimize potential conflicts.[147]

The MA also protects the lunar environment.[148] Its Article 7 provides that parties to the MA shall not disrupt the lunar environmental balance by stirring up lunar dust.[149] The Precautionary Principle requires mining operators, to pause, re-investigate, and reconsider the scientific basis and consequences of their mining operations when uncertain about whether their activities may cause environmental

[142] OST, *supra* note 2, art. IX (emphasis added).

[143] *Id.* art. VII.

[144] *Id.* art. IX.

[145] Fisheries Jurisdiction (U.K. v. Ice.), Judgment, 1974 I.C.J. 3 (July 25). See an excellent discussion in John S. Goehring, *Can We Address Orbital Debris with the International Law We Already Have? An Examination of Treaty Interpretation and the Due Regard Principle*, 85 J. AIR L. & COM. 309, 315 (2020).

[146] OST, *supra* note 2, art. IX.

[147] Mark Sundahl & Jeffrey Murphy, *Set the Controls for the Heart of the Matter: Is Existing Law Sufficient to Enable Resource Extraction on the Moon?*, 48 GA. J. INT'L & COMP. L. 683, 694 (2020).

[148] *See generally* 1979 Moon Agreement, *supra* note 3.

[149] *Id.* art. 7.

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damage to the Moon.[150] In addition, the 2007 COPUOS Space Debris Guidelines apply to satellites on their way to the Moon for lunar mining.[151]

2. Evaluation

Legal uncertainty concerning environmental regulation of lunar mining has commercial consequences. Is the OST Article IX provision on paying due regard combined with the Precautionary Principle sufficient to protect the fragile lunar environment? Will states apply national environmental laws to lunar mining? If so, might that be the spur to require states to adopt special environmental laws to evaluate the lunar environment before permitting non-governmental operators to mine on the Moon? A useful addition to the COPUOS Space Debris Guidelines would be an environmental guideline for commercial lunar mining activities.

G. OST Article IV, Use of the Moon Is Limited to Peaceful Uses[152]

1. Effect on Lunar Mining

As a hypothetical scenario, suppose that, one day, a Chinese company challenges a lunar mining site selected by a U.S. mining company. Suppose then that the U.S. company asks the Department of Defense (DOD) for protection. In response, the Chinese company may seek protection for itself from the Chinese government. The conflict described in this scenario would make it difficult to do business. Commercial confrontations could begin a war in outer space.[153] OST Article IV states that "[t]he Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes."[154] The Article effectively prohibits military installations on the Moon[155] and means that military authorities cannot mine the Moon for military purposes. A recent project by the Defense

[150] Larsen, *supra* note 136.

[151] *See* G.A. Res. 62/217 (Dec. 22, 2007), https://www.unoosa.org/pdf/publications/st_space_49E.pdf (The UN "General Assembly endorsed the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space and agreed that the voluntary guidelines for the mitigation of space debris reflected the existing practices as developed by a number of national and international organizations, and invited Member States to implement those guidelines through relevant national mechanisms.").

[152] OST, *supra* note 2, art. IV.

[153] *Id.*; *see also* Chris Johnson, *Returning to the Moon: Legal Challenges to Human Rights as Humanity Begins to Settle the Solar System—Full Transcript*, 9 GLOB. BUS. L. REV. 1, 42 (2021).

[154] OST, *supra* note 2, art. IV.

[155] *Id.*

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Advanced Research Projects Agency (DARPA) of the United States Department of Defense, "seeks to pioneer technologies for adaptive, off-earth manufacturing to produce large space and lunar structures"; the project is an effort by DARPA's Defense Science Office to engage in research of communications antennas and solar power arrays.[156] The study may involve testing technology for civilian and military purposes, which may conflict with Article IV prohibition on weapons testing on the Moon.[157] Article IV would also prohibit the use of military personnel to protect a U.S. company from trespass by another country.[158] Some find this project's cause similar to the 2019 NASA-Space Force agreement, as "unnecessarily provocative," "blurring [the lines] of civil, military, and commercial capabilities and intentions in space."[159] The recent establishment of the U.S. Space Force came up against unsettling "bombastic language and posturing which has caused considerable misperceptions" causing legal uncertainty for commercial ventures like lunar mining.[160]

2. Evaluation

OST Article IV limits commercial lunar activities to be "exclusively for peaceful uses."[161] Does that preclude military uses of mining proceeds? Does this provision preclude the national protection of their authorized commercial mining operator? Does OST, Article IV preclude mixed civilian and military lunar mining activities? The increasing volume of "warfighting" preparations in outer space raises both commercial and national security questions about whether the space powers will

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[156] *Orbital Construction: DARPA Pursues Plan for Robust Manufacturing in Space*, DEF. ADVANCED RSCH. PROJECTS AGENCY (Feb. 5, 2021), https://www.darpa.mil/news-events/2021-02-05 [https://perma.cc/QR97-VJCD].

[157] Theresa Hitchens, *DARPA Space Manufacturing Project Sparks Controversy*, BREAKING DEF. (Feb. 12, 2021), https://breakingdefense.com/2021/02/darpa-space-manufacturing-project-sparks-controversy/ [https://perma.cc/GN66-EWL5].

[158] *See Orbital Construction*, *supra* note 156. *See also* Christina Morales, *The Newest Guardians of the Galaxy Are Run by the U.S. Military*, N.Y. TIMES (Dec. 19, 2020), https://www.nytimes.com/2020/12/19/us/space-force-guardians-mike-pence.html [https://perma.cc/FH7H-M7KW]. The U.S. Space Force is intended "to monitor commercial traffic." *Id.* However, note UN Charter Article 103, which can be used to override the OST, 1970 Yearbook of the United Nations 1001.

[159] Hitchens, *supra* note 157.

[160] The Secure World Foundation staff, *Op-ed | Building Back Better: Critical first issues for a successful Biden space policy*, SPACE NEWS (Dec. 4, 2020), https://spacenews.com/op-ed-building-back-better-critical-first-issues-for-a-successful-biden-space-policy/ [https://perma.cc/4AB9-EMC3].

[161] OST, *supra* note 2, art. IV.

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respect the legal boundaries of the OST.[162] The new U.S. Administration needs to clarify U.S. military intentions on the Moon in a new space policy statement.[163]

H. The Law of Treaty Interpretation

1. Reinterpretation of OST Article II to Permit Mining on the Moon by Reflecting Subsequent Practice

Outer space technology and political circumstances of countries have developed since 1967 when the Outer Space Treaty was concluded.[164] The OST was negotiated during the cold war.[165] Can the treaty now be reinterpreted to permit mining on the Moon, giving universal recognition to individual property rights in mining proceeds? Basic international law on treaty interpretation under the Vienna Convention on the Law of Treaties, Article 31(1), requires individual words in treaties to be given their meaning "in their context and in the light of its object and purpose."[166] For example, OST Article II, which prohibits States from appropriating the Moon by any means, does not specifically mention non-governmental companies.[167] Could that now be interpreted to mean that Article II only applies to governments, leaving commercial non-governmental entities free to appropriate lunar mining sites and trade the mining proceeds? Not so, because Article VI clearly expresses the intent that the States shall be responsible for treaty compliance by their authorized non-governmental companies.[168] Furthermore, if one country fails to make its authorized companies comply with the Treaty, it is in the interest of other States to force compliance with the Treaty demanding that they do so because it infringes on their treaty rights.[169]

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[162] Kyle Mizokami, *NATO Is Preparing for War in Space*, POPULAR MECHANICS (Oct. 30, 2019), https://www.popularmechanics.com/military/a29566355/nato-space-war/ [https://perma.cc/ZH99-8CGV].

[163] SPACE POLICY AND SUSTAINABILITY, *supra* note 1, at 34; *see also* Paul Larsen, *Outer Space Arms Control: Can the USA, Russia and China Make This Happen?*, 23 J. CONFLICTS & SEC. L. 137 (2018).

[164] Christopher Daniel Johnson, *The Outer Space Treaty*, OXFORD RSCH. ENCYCLOPEDIAS (Jan. 24, 2018), https://oxfordre.com/planetaryscience/view/10.1093/acrefore/9780190647926.001.0001/acrefore-9780190647926-e-43 [https://perma.cc/VXT9-LKX4].

[165] *Id.*

[166] Vienna Convention, *supra* note 5, art. 31, ¶ 1.

[167] OST, *supra* note 2, art. II.

[168] *Id.* art. VI.

[169] Vienna Convention, *supra* note 5; *see also* LYALL & LARSEN, *supra* note 34, at 171.

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However, there is a larger context for the OST. The Vienna Convention on the Law of the Treaties, Article 31(2), requires that the "context" of a treaty interpretation shall consider "any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation."[170] The question arises whether changes in space technology in the time between the negotiation of the OST in 1967 and its interpretation in 2021 entitle parties to the OST to mine the Moon and sell the proceeds of their mining activities. The argument would be that because negotiators in 1967 did not specifically consider lunar mining, the individual states parties are free to allow lunar mining in 2021. Against that argument is that the diplomatic conference which negotiated the 1979 MA involved virtually the same parties that negotiated the 1967 OST and that they both considered lunar mining.[171] That conference indicates continued international feeling and thinking about lunar mining.[172]

2. Has There Been a Subsequent Fundamental Change of Circumstances Regarding Mining of the Moon?[173]

The Vienna Convention on Law Treaties, Article 62, with its exceptions, makes it possible for the United States to terminate or withdraw from the OST and from the OST Article II provision prohibiting appropriation of the Moon if there has been a fundamental change of circumstances.[174] The development of lunar mining technology for the use of lunar mining resources would not be a fundamental change of circumstances. International lawyers tend to hold a strict point of view about justifying treaty changes by reference to subsequent practice.[175] As Lord McNair expresses in his Law of Treaties, the argument is used more by politicians than by lawyers.[176]

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[170] Vienna Convention, *supra* note 5, art. 31, ¶ 2.

[171] 1979 Moon Agreement, *supra* note 3, pmbl. The Moon Agreement's preamble records that the States Parties "recalled" the Outer Space Treaty. They confirmed OST Art. II by adopting Moon Agreement Art. II. *Id.*

[172] 1979 Moon Agreement, *supra* note 3, art. 11.

[173] Vienna Convention, *supra* note 5, art. 62. Note the fundamental treaty interpretation of compliance with the OST by the BUILDING BLOCKS PROPOSAL, *supra* note 6, and by section 10 of the Artemis Accords, *supra* note 7, ¶ 4, regarding the right to utilize space resources, like extracted mining resources.

[174] OST, *supra* note 2, art. II; Vienna Convention, *supra* note 5, art. 62.

[175] Vienna Convention, *supra* note 5, art. 62.

[176] LORD MCNAIR, THE LAW OF TREATIES 682–83 (1962).

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II. WHAT CAN BE DONE TO RESOLVE OR REDUCE LEGAL UNCERTAINTIES OF LUNAR MINING? THE BUILDING BLOCKS PROPOSAL,[177] ARTEMIS ACCORDS,[178] PROVINCE OF MANKIND,[179] AND COPUOS SOFT LAW[180]

International coordination is needed to avoid conflicting mining claims on the Moon. Renegotiation of the OST or negotiation of another international space law treaty to establish international regulation of lunar mining would be difficult to accomplish in present times. The failure of states to adopt the most recent space law treaties confirms that conclusion.[181] Another reason is the importance of non-sovereignty in outer space. Not all states would accept the wider authorization; the parties to the 1979 Moon Treaty might object.[182]

A. Options Within the Scope of the Outer Space Treaty

There are deep legal uncertainties attached to the question of whether a lunar mining issue is or is not within the scope of the OST. The legal authority to issue non-governmental licenses to mine on the Moon may simply rest on the national interpretation of the OST.[183] This observation also applies to the Proposed Building Blocks for Development of an International Framework for Space Resource Activities (hereinafter the Building Blocks Proposal)[184] and to the Artemis Accords,[185] discussed below, both of which claim to comply with the OST. The Building Blocks Proposal and the Artemis Accords promote lunar mining by suggesting guidelines and recommended practices for lunar mining.[186] Guidelines that assume control of mining sites such as safety zones may be interpreted as a

[177] BUILDING BLOCKS PROPOSAL, *supra* note 6.

[178] Artemis Accords, *supra* note 7.

[179] *See infra* Part II.D.

[180] *See infra* Part II.E.

[181] LYALL & LARSEN, *supra* note 34, at 509–23.

[182] Vienna Convention, *supra* note 5, art. 62. Note the fundamental treaty interpretation of compliance with the OST by the BUILDING BLOCKS PROPOSAL, *supra* note 6, and by section 10 of the Artemis Accords, *supra* note 7, ¶ 4, regarding the right to utilize space resources, like extracted mining resources.

[183] *See, e.g.*, Luxembourg Law, *supra* note 104.

[184] BUILDING BLOCKS PROPOSAL, *supra* note 6.

[185] Artemis Accords, *supra* note 7.

[186] *See* BUILDING BLOCKS PROPOSAL, *supra* note 6; *see* Artemis Accords, *supra* note 7.

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prohibited appropriation under OST Article II. But the two proposals also rest on the assumption that these guidelines will not be challenged by those countries that accept the Building Blocks regulations and by parties to the Artemis Accords.[187] Acceptance of guidelines would significantly reduce the number of legal challenges because only outside states would object. Widely accepted voluntary international guidelines like the COPUOS Space Debris Guidelines,[188] or the 2019 Long-Term Sustainability Guidelines (LTS),[189] which are enforced by national states, may be sufficiently recognized to make lunar mining commercially viable.

B. Proposed Building Blocks for Development of an International Framework for Space Resource Activities[190]

1. The Proposal

There are presently no internationally agreed-upon rules governing lunar mining.[191] A detailed proposal (20 sections), the *Building Blocks for the Development of an International Framework on Space Resource Activities* (also called the "Proposal"), establishes an international legal framework that provides agreed-upon rules for space resource activities, which include commercial use of lunar mining resources.[192] The Proposal intends to become the basis for future negotiations;[193] it was the product of the Hague International Space Resources Governance Working Group, which was founded in 2016 by Professor Tanja Masson-Zwaan of the International Institute of Air and Space Law, University of Leiden, Netherlands.[194] One objective is to bring a wide range of interests into lunar

[187] *See* BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 19; Artemis Accords, *supra* note 7, § 11, ¶ 4.

[188] G.A. Res. 62/217, *supra* note 151.

[189] Comm. on the Peaceful Uses of Outer Space, Sci. & Tech. Subcomm., Guidelines for the Long-term Sustainability of Outer Space Activities, at I-3, U.N. Doc. A/AC.105/C.1/L.366 (2019).

[190] BUILDING BLOCKS PROPOSAL, *supra* note 6; *see also* Sundahl & Murphy, *supra* note 147, at 684.

[191] *See* Jacob Gershman, *The Moon Is a Huge Potential Resource. But Who Owns It?*, WALL ST. J. (July 14, 2019), https://www.wsj.com/articles/the-moon-is-a-huge-potential-resource-but-who-owns-it-11563152580 [https://perma.cc/B8VK-W6NS].

[192] BUILDING BLOCKS PROPOSAL, *supra* note 6.

[193] Masson-Zwaan & Sundahl, *supra* note 70, at 43.

[194] BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 1. The working group consisted of 32 experts from a variety of developed and developing countries, commercial companies, universities, and interest groups. The group worked intensely for three years, 2016–2019. *See also* BITTENCOURT NETO ET AL., *supra* note 6.

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mining actions: commercial, non-governmental, and environmental as well as governmental.[195] The final report was submitted to the UN Committee for the Peaceful Uses of Outer Space (COPUOS) at the end of 2019 by the Netherlands and Luxembourg.[196] COPUOS has scheduled forthcoming consultations for the Proposal.[197]

While the working premise of the Hague working group was to organize and make possible development of all space resources, the objective of this paper is to apply the Building Blocks Proposal specifically to lunar mining resources.[198] The working group resolved that they should gradually implement the Building Blocks as science and technology evolve.[199] Thus, the Hague working group intended the international framework of recommendations and guidelines of the Building Blocks Proposal to be adopted by individual states to govern the distribution of space resources such as mining on the Moon. The Hague working group envisioned the subsequent establishment of an international body to supervise and implement the Building Blocks Proposal.[200] The next step for the Building Blocks Proposal is to be discussed by COPUOS. Major recommendations that apply to lunar mining follow:

Section 4 provides recommendations for implementing the OST.[201] International lunar mining framework should:

a. Remain within the scope of existing international space law space law[202]

b. Promote predictable and compatible domestic regulation of lunar mining by commercial companies[203]

c. Promote safety[204]

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[195] Masson-Zwaan & Sundahl, *supra* note 70, at 40.

[196] *See* Comm. on the Peaceful Uses of Outer Space, Annotated Provisional Agenda of the 2020 Meeting of the UNCOPUOS Legal Subcomm., U.N. Doc. A/AC. 105/C.2/L.312 (2020).

[197] Masson-Zwaan & Sundahl, *supra* note 70, at 48.

[198] BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 1.

[199] *Id.*

[200] *Id.*

[201] *Id.* ¶ 4.3(c).

[202] *Id.* ¶ 4.1.

[203] *Id.* ¶ 4.2(b).

[204] *Id.* ¶ 4.2(e).

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d. Develop lunar mining technology[205]

e. Support science[206]

f. Be used for peaceful purposes[207]

g. Be for the benefit of humankind[208]

h. Pay due regard to and engage in international consultation with each other as required by OST Article IX[209]

i. Authorize and be responsible for authorized lunar activities[210]

Section 5 recognizes that states are responsible for the lunar mining activities of their authorized non-governmental entities, including the personnel on board authorized space objects.[211] Legal authority exists in OST Article VI and in Article 14(1) of the MA.[212] The section is implemented by the 2015 U.S. Space Launch Competitiveness Act, 51 U.S.C. § 51303, and the Luxembourg law on the exploitation of Space Resources.[213]

Section 6 recommends that the international framework, to be established, should recognize that states have jurisdiction to regulate the disposal of the proceeds of mining operations.[214] It recognizes that OST Article VIII prohibits the national appropriation of celestial bodies but suggests that since the individual states have jurisdiction over activities of their space objects and personnel in outer space,[215] that includes state-authorized jurisdiction over activities like the products of mining

[205] *Id.* ¶ 4.2(g).

[206] *Id.* ¶ 4.2(j).

[207] *Id.* ¶ 4.3(a).

[208] *Id.* ¶ 4.3(b).

[209] *Id.* ¶ 4.3(c).

[210] *Id.* ¶ 4.2(a).

[211] *Id.* ¶ 5.

[212] OST, *supra* note 2, art. VI; 1979 Moon Agreement, *supra* note 3, art. 14, ¶ 1.

[213] Luxembourg Law, *supra* note 104.

[214] BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 6.

[215] OST, *supra* note 2, art. VIII.

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activities. Article 12 of the MA further supports this by stating that states retain jurisdiction over activities of their authorized personnel and lunar installations.[216]

Section 7 accepts the OST Article II rule of law prohibiting outer space appropriation and therefore prohibits mining companies from acquiring property rights in mining sites.[217] However, it opines that the lunar mining companies should be assigned priority rights for specific locations for specified lengths of time, which all countries should respect.[218] Their descriptions in an international registry would be the basis of the priority rights.[219] Priority rights are founded on the interpretation of right of use, provided in OST Article 1 and in MA Article 8(1), as well as on analogy to ITU's assignment of use of radio frequencies pursuant to Article 44 of the ITU Constitution.[220]

Section 8 accepts the legality of mining companies' right to use and trade their mining products.[221] This conclusion is based on interpreting OST Article I as allowing countries to enter into international agreements and, in such agreements, recognize right of use and trade in celestial resources.[222] Domestic regulations should respect the companies' legal rights to mine proceeds, and other countries should recognize such rights. While this section accepts the OST Article II prohibition of appropriation of the Moon, it reasons that OST Article I authorizes free use of celestial bodies on the basis of equality and subject to international law.[223] Furthermore, Section 8 argues that OST Article IX encourages states to coordinate their use of celestial bodies.[224] The section also finds legal authority in MA, Article 11(5), which envisions future exploitation of lunar resources.[225]

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[216] 1979 Moon Agreement, *supra* note 3, art. 12.

[217] BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 7.

[218] *Id.*

[219] *Id.*

[220] OST, *supra* note 2, art. I; 1979 Moon Agreement, *supra* note 3, art. 8, ¶ 1; *see also* INT'L TELECOMM. UNION, COLLECTION OF THE BASIC TEXTS ADOPTED BY THE PLENIPOTENTIARY CONFERENCE art. 44, at 49 (2019).

[221] BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 8.

[222] OST, *supra* note 2, art. 1. *See also id.* arts. VII, IX.

[223] BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 8.

[224] *Id.*

[225] 1979 Moon Agreement, *supra* note 3, art. 11, ¶ 5.

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Section 10 urges states to review applications for lunar mining carefully to assess the following before authorization: safety, possible harmful interference to persons and to the lunar environment, adequacy of planetary protection, the likelihood of space debris damage, and at designated locations protection of cultural heritage and science.[226]

Section 11 of the international framework encourages the development of international procedural and technical standards and recommended practices.[227] This section urges the establishment of reasonable safety zones around mining sites. However, it is still subject to OST Article I freedom of access and use and OST Article II on non-appropriation.[228] OST Article VI requires states to assume international responsibility for the outer space activities of their governments and their authorized non-governmental activities.[229] Legal authority is also found in the MA, Article 14 (1), containing the same message regarding legal responsibility.[230]

Section 12 recognizes that the Moon is fragile and does not heal itself.[231] The international framework, therefore, must carefully monitor mining activities in order to avoid environmental harm. OST Article IX gives legal authority to paying due regard to the interests of other countries, as well as the MA Article 7 instruction to avoid disturbing the Moon's environmental balance.[232]

Section 13 recognizes that the sharing of benefits (profits) from mining operations is a sensitive issue because it is one of the reasons the 1979 MA is not widely adopted.[233] Yet, it is an adopted principle of the eighteen States which were parties to the 1979 Moon Agreement.[234] Thus, Section 13 of the Building Blocks framework provides that mining operations "shall provide for benefit-sharing through the

[226] Section 10 of the Building Blocks Proposal implements the Precautionary Principle. BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 10.

[227] BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 11.2.

[228] *Id.* ¶ 11.3.

[229] OST, *supra* note 2, art. VI.

[230] 1979 Moon Agreement, *supra* note 3, art. 14, ¶ 1. The OST provides that "maximum precautions may be taken to assure safety and to avoid interferences with normal operations." OST, *supra* note 2, art. XII.

[231] *See* BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 12.

[232] *Id.*; OST, *supra* note 2, art. IX; 1979 Moon Agreement, *supra* note 3, art. 7.

[233] *See* BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 13.

[234] 1979 Moon Agreement, *supra* note 3, art. 11, ¶ 7(*d*).

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promotion of the participation in space resource activities by all countries, in particular developing countries."[235] However, the international framework does not recommend compulsory sharing of benefits (profits).[236]

Section 14 on the registration of mining sites provides that the international framework should provide an international public registry for designating priority rights, as well as a database listing lunar mining activities and information about the best safety practices.[237] States should be responsible for the registration of mining sites in accordance with the Registration Convention.[238] The ITU Master International Frequency Register should record assigned radio frequencies for lunar mining purposes.[239] Registration should show the locations, duration, and results of mining operations; possible harmful contamination to Earth of extraterrestrial materials; and the state of the mining site after the termination of mining operations, including possible compensation for damages caused during mining.[240] Review,

[235] *See* BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 13.1.

[236] *Id.*; *cf.* G.A. Res. 51/122, Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries (Dec. 13, 1996).

[237] BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 14; *see also id.* ¶ 18.

[238] UN Registration Convention, *supra* note 2.

[239] ITU Constitution Article 44 provides that radiofrequencies must be used "rationally, efficiently and economically" in accordance with the ITU Radio Regulations. INT'L TELECOMM. UNION, *supra* note 220, art. 44, at 49. ITU is a Treaty Organization. Only States have voting rights. Such an international administrative framework for lunar mining sites could be modeled on the ITU Master International Frequency Register which assigns rights of use but avoids the issue of direct ownership. The radio spectrum is a limited natural resource. Radiofrequencies are a valuable natural resource similar to the lunar mining resources. However, they are not subject to ownership by commercial operators. The users are assigned rights to use specific frequencies. Pursuant to the ITU Radio Regulations, the ITU Radio Regulations Board maintains the Master International Frequency Register, which lists all the frequencies. Frequencies are not assigned directly to commercial companies. They are assigned to states, which in turn may assign them to their users. In the United States, they are administered by the Federal Communications Commission (FCC), which in turn assigns frequencies to individual users on the basis of what is in the public interest pursuant to 47 U.S.C. §§ 301–307. A similar international coordination of lunar resources could be established by which an international group of interested states would coordinate assignment of available lunar sites with rights to mine and extract resources just as communication companies now use the international radiofrequencies to do business. Under the ITU model, the assignments of mining sites would not involve the sharing of benefits or technology. The function of an international board making assignments of mining sites could become part of a protocol to one of the space law treaties. *See* LYALL & LARSEN, *supra* note 34.

[240] BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 14.

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monitoring, and implementation within the terms of the international framework could also be required.[241]

Finally, the international framework recommends settlement of disputes by the Permanent International Court of Arbitration Optional Rules for Arbitration of Disputes Relating to Outer Space Activities established in 2011.[242]

2. Evaluation

The purpose of the Building Blocks Proposal is to make lunar mining possible.[243] Much thought went into the Building Blocks Proposal for the exploitation of celestial resources. The Proposal is inclusive because the drafting group reflects the interests of all stakeholders in both developed and developing countries, including commercial industry as well as scientific interests. The drafting group hopes to implement the Building Blocks Proposal gradually, block by block.[244] The Proposal assumes and thus interprets international space law accordingly, in particular the OST Articles I, II, and VI, as well as Moon Treaty Article 11.[245] Some states may not agree with these legal assumptions. Some will be of the view that the proposal exceeds the OST, that Article II prohibits the appropriation of property rights.[246] Furthermore, there are environmental liabilities and military legal consequences to be considered.[247] Thus, the proposal may not eliminate some legal uncertainties. It would require international acceptance and administration to successfully remove the legal uncertainties in the Building Blocks Proposal.

Increasing lunar excavation promotion is an incentive for COPUOS to consider an international framework like the Building Blocks Proposal. An advantage of the Building Blocks Proposal is that it does not intend to require a new treaty. It is an agreed point of view that allows controlled lunar mining. Furthermore, the proposal

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[241] *Id.*

[242] Stephan Hobe, *The Permanent Court of Arbitration Adopts Optional Rules for Arbitration of Disputes Relating to Outer Space Activities*, 61 ZEITSCHRIFT FUR LUFT-UND WELTRAUMRECHT 4 (2012).

[243] BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 1.

[244] *Id.*, Introduction.

[245] OST, *supra* note 2, arts. I, II, VI; 1979 Moon Agreement, *supra* note 3, art. 11.

[246] SPACE POLICY AND SUSTAINABILITY, *supra* note 1, at 34 (stating that safety zones may not establish territorial control). *But see infra* note 313 and accompanying text.

[247] *See* BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 14.

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is not directly linked to or sponsored by the two space powers, the United States or China, which are now most active on the Moon.[248]

C. The 2020 Artemis Program[249]

The Artemis Accords is part of the much larger U.S. Artemis Program. The Artemis Program originated with the U.S. 2017 Presidential Directive-1, in which the Trump Administration directed NASA "to lead the return of humans to the Moon for long-term exploration and utilization."[250] Consequently, NASA initiated the Artemis Program to send human beings to the Moon to stay and utilize the Moon commercially.[251] The Artemis Program involves building an inhabited space station orbiting the Moon to direct and provide support for governmental and non-governmental activities on the Moon's surface.[252] Most current commercial lunar mining activities are related to the promotion of commercial activities by the Artemis Program.[253]

NASA is a partner in the Artemis Program with the Polish Space Agency (POLSA), the Japanese Aerospace Exploration Agency (JAXA), the Brazilian Space Agency (AEB), the Canadian Space Agency (CSA), the Korea Aerospace Research Institute (KARI), the Luxembourg Space Agency (LSA), the New Zealand Space Agency (NZSA), the State Space Agency of Ukraine (SSAU), the U.K. Space Agency (UKSA), the Italian Space Agency (AST), the Australian Space Agency (ASA), and the United Arab Emirates Space Agency (UAESA).[254] The international partners support the program actively, which is a basis for their acceptance of the

[248] *See Overview: The Hague International Working Group on the Governance of Space Resource Activity*, UNIVERSTEIT LEIDEN, https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-of-air-space-law/the-hague-space-resources-governance-working-group [https://perma.cc/K9V8-PA25].

[249] *Artemis Program*, NASA, https://www.nasa.gov/artemisprogram (last visited Sept. 19, 2021).

[250] Space Policy Directive-1, 82 Fed. Reg. 59,501 (Dec. 11, 2017).

[251] *See generally* NASA, ARTEMIS PLAN: NASA'S LUNAR EXPLORATION PROGRAM OVERVIEW (2020), https://www.nasa.gov/sites/default/files/atoms/files/artemis_plan-20200921.pdf [https://perma.cc/35MS-LN9N].

[252] *What is Artemis?*, NASA (July 25, 2019), https://www.nasa.gov/what-is-artemis [https://perma.cc/J67R-DN8J?type=image].

[253] *See generally* NASA, *supra* note 251.

[254] *The Artemis Accords: Principles for a Safe, Peaceful, and Prosperous Future*, *supra* note 8.

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Artemis Accords.[255] ESA did not sign the Artemis Accords because each of the European space agencies must sign independently.[256]

Space Directive-1 directs NASA to involve commercial operators in the Artemis Program.[257] Thus, the Artemis Accords seek to make commercial lunar mining by private companies possible. As a further incentive, NASA has established an award of $25,000 to the first commercial entity to bring lunar mining proceeds to NASA.[258]

NASA has announced its plan to land people on the Moon in 2024.[259] However, technical difficulties now delay the lunar landing until 2025.[260] NASA has requested that Congress appropriate $35 billion for the landing.[261] However, Congress has not yet appropriated the full amount.[262]

The 2020 Presidential election may affect the future of the entire Artemis Program because the new Presidential Administration may not agree with the Trump Administration's policy focus on the Moon.[263] The focus of the Obama

[255] *Id.*

[256] Alexander Stirn, *Do NASA's Lunar Exploration Rules Violate Space Law?*, SCI. AM. (Nov. 12, 2020), https://www.scientificamerican.com/article/do-nasas-lunar-exploration-rules-violate-space-law/ [https://perma.cc/ZA9E-QBZK] ("Only countries can sign the Artemis Accords, and the ESA is not a country.").

[257] Space Policy Directive-1, 82 Fed. Reg. 59,501.

[258] Eric Brothers, *NASA Selects Companies to Collect Moon Rocks*, AEROSPACE MFG. & DESIGN (Dec. 8, 2020), https://www.aerospacemanufacturinganddesign.com/article/nasa-selects-companies-collect-moon-rocks/ [https://perma.cc/676D-DDPZ].

[259] *NASA Publishes Artemis Plan to Land First Woman, Next Man on Moon in 2024*, NASA (Sept. 21, 2020), https://www.nasa.gov/press-release/nasa-publishes-artemis-plan-to-land-first-woman-next-man-on-moon-in-2024 [https://perma.cc/6Z44-2WR4?type=image].

[260] Jeff Faust, *Changing NASA Requirements Caused Cost Schedule Problems for Gateway*, SPACE NEWS (Nov. 12, 2020), https://spacenews.com/changing-nasa-requirements-caused-cost-and-schedule-problems-for-gateway/ [https://perma.cc/3DKY-H6WZ].

[261] Eric Berger, *NASA puts a Price on a 2024 Moon Landing—$35 Billion*, ARSTECHNICA (Feb. 10, 2020), https://arstechnica.com/science/2020/02/nasa-puts-a-price-on-a-2024-moon-landing-35-billion/ [https://perma.cc/X62J-W5GT].

[262] Press Release, House Comm. on Appropriations, Appropriations Committee Releases Fiscal Year 2021 Commerce-Justice-Science Funding Bill (July 7, 2020).

[263] Joey Roulette, *NASA Delays Moon Lander Awards as Biden Team Mulls Moonshot Program*, VERGE (Jan. 31, 2021), https://www.theverge.com/2021/1/31/22258815/nasa-moon-lander-awards-biden-spacex-blue-origin-moonshot [https://perma.cc/3EUH-F7K7]; *see also* Myers & Chang, *supra* note 58.

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Administration was on the planet Mars.[264] However, the wide international support for the Artemis Program may yet assure its continuance.

1. Artemis Accords on Lunar Mining

The Artemis Accords, by their specific terms, intend to implement the OST.[265] That will make OST compliance the responsibility of the individual parties to the Accords. The Accords are an attempt to move towards wide mining activity in outer space based on commercially acceptable practices. It is important to understand that the purpose of the bilateral Artemis Accords is, as explained in Section 1, to make "a political commitment to the principles described herein."[266] The Artemis Parties intend to contribute the results of their bilateral experiences toward multilateral rules in COPUOS.[267]

The Artemis Accords are not legally binding and authorizing law.[268] They are voluntary agreements among the partner space agencies.[269] The other major space powers such as China, Russia, India, Germany, and France have not yet signed any bilateral accords.

The first two sections state that the Artemis Accords are an effort to make lunar mining possible by recognizing the reality of the current times.[270] The objective "is to establish a common vision" of space authorities regarding the use of the Moon and other celestial bodies.[271] The vision entails shared principles, guidelines, and

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[264] Josh Lederman & Seth Borenstein, *Obama: Let's go to Mars!*, PBS (Oct. 11, 2016), https://www.pbs.org/newshour/science/obama-lets-go-mars [https://perma.cc/8N6E-QA5Z].

[265] Artemis Accords, *supra* note 7, § 10.

[266] *Id.* § 1.

[267] *Id.* § 10.

[268] NASA has contractual legal authority over commercial mining operators. NASA does not issue licenses to supervise commercial operators. The Artemis Accord "represents a political commitment to the principles" in the Accord. Artemis Accords, *supra* note 7, § 1. It is signed by the NASA Administrator on behalf of NASA and signed by the NASA Administrator's counterparts in ten other countries. It is therefore not a legal agreement or treaty eligible for U.N. registration. *Id.* § 13. The signatories are committed to the Artemis Accords. Nongovernmental commercial operators' commitment to the accords is voluntary. It depends on national regulation to which they are subject. NASA does not have regulatory authority over the commercial operators.

[269] *See supra* text accompanying note 268.

[270] *Id.* §§ 1–2.

[271] *Id.* § 1.

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recommended practices for lunar mining.[272] The shared principles, guidelines, and practices are intended to promote the safety and sustainability of outer space and to reduce the uncertainty of operations.[273] The space administrations of thirteen countries have signed the Artemis Accords as of the time of writing.[274] NASA states that all the accords will be within the existing legal frameworks of international treaties and national laws of the participants to the accords.[275] The agreed principles, guidelines, and recommended practices are found in the remaining sections:[276]

Section 3: The lunar mining activities should be peaceful and in compliance with OST Article IV, which reserves the Moon for peaceful purposes.[277]

Section 4: The Artemis signatories promise to be transparent in their regulation of mining activities to the extent allowed by national laws and policies.[278] The signatories agree to share scientific discoveries with the international scientific community.[279] However, commercial operators will not be required to share scientific information.[280]

Section 5: Signatories commit to interoperability of mining activities and will adopt and maintain common standards for all their space-based transportation, communication, and power systems.[281]

Section 6: Signatories commit to providing emergency assistance to all persons in outer space as provided by the Rescue and Return Agreement.[282]

[272] *Id.*

[273] *Id.*

[274] *The Artemis Accords: Principles for a Safe, Peaceful, and Prosperous Future*, *supra* note 8.

[275] Artemis Accords, *supra* note 7, § 2, ¶ 1, § 13, ¶ 1.

[276] Artemis Accords, *supra* note 7.

[277] *Id.* § 3.

[278] *Id.* § 4.

[279] *Id.*

[280] *See id.* § 8.

[281] *Id.* § 5.

[282] *Id.* § 6.

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Section 7: Signatories will determine which country should register jointly owned space objects.[283]

Section 8: Signatories commit to the transparency of scientific data but the originating state retains the right to make the public announcements of scientific discoveries and data.[284] As mentioned above, under Section 4, the commercial operators are not obligated to share scientific data.[285]

Section 9: Signatories commit to preserving outer space heritage sites such as the first lunar landing site in 1969 of the Apollo astronauts.[286]

Section 10: Signatories agree that lunar mining should comply with the Outer Space Treaty and "be in support of safe and sustainable space activities."[287] Furthermore, they express that the extraction of space resources does not inherently constitute national appropriation under Article II of the OST.[288] Contracts and other legal instruments relating to space resources should be consistent with that Treaty.[289] Furthermore, the signatories intend to share their lunar mining experiences with other states in COPUOS with the objective of developing international uniform rules on the utilization of outer space resources.[290]

Section 11: "Deconfliction" is the objective of the Artemis Accords.[291] The signatories reaffirm their commitment to the OST and their support for the UN Guidelines for Long-term Sustainability of Outer Space Activities.[292] In particular, they affirm their support for OST Article IX, requiring States Parties to pay due regard to each other's outer space activities and to consult in the event of harmful

[283] *Id.* § 7.

[284] *Id.* § 8.

[285] *Id.* § 4.

[286] *Id.* § 9. *See* One Small Step to Protect Human Heritage in Space Act, *supra* note 101 (regarding exercise of best practices for the protection of historic sites on the Moon).

[287] Artemis Accords, *supra* note 7, § 10.

[288] *Id.*

[289] *Id.*

[290] *Id.*

[291] *See id.* § 11.

[292] *Id.*

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interference with the activities of other OST Parties.[293] Signatories commit to explaining alleged harmful mining activities on the Moon.[294] They will also engage in multilateral negotiations towards developing international standards and recommended guidelines for mining on the Moon.[295] They intend to establish reasonable safety zones warning other signatories of lunar mining dangers in order to avoid harmful interferences.[296] The size of safety zones is to be determined by the extent of the danger involved.[297] Such safety zones would be made known to other signatories and the UN Secretary.[298] Safety zones are intended to provide public notice, avoid conflicts, and protect ongoing mining operations, not deny access.[299]

Section 12: Signatories commit to orbital debris mitigation.[300] They pledge to remove the evidence of mining on the Moon or at least make such debris passive.[301] The expectation is that each mining company would be responsible for the elimination of its own mining debris.[302] In view of the Moon's inability to heal itself, it may be difficult, if not impossible, to completely remove evidence of lunar mining after the fact.[303] Therefore, the agreement to eliminate space debris applies only "to the extent practicable."[304]

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[293] *Id.*

[294] *Id.*

[295] *Id.*

[296] *Id.* ("A safety zone should be the area in which nominal operations of a relevant activity or an anomalous event could reasonably cause harmful interference."). Regarding the establishment of safety zones, compare with NASA's recent establishment of Planetary Protection Policies for Robotic and Human Missions to Earth's Moon. *NASA Updates Planetary Protection Policies for Robotic and Human Missions to Earth's Moon and Future Human Missions to Mars*, NASA (July 9, 2020), https://www.nasa.gov/feature/nasa-updates-planetary-protection-policies-for-robotic-and-human-missions-to-earth-s-moon [https://perma.cc/4S33-TPZ6?type=image].

[297] Artemis Accords, *supra* note 7, § 11, ¶ 7.

[298] *Id.*

[299] *Id.*

[300] Artemis Accords, *supra* note 7, § 12.

[301] *Id.*

[302] *Id.*

[303] *Id.*

[304] *Id.*

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2. Evaluation

The Artemis Accords may appear to be a very simplified version of the Building Blocks Proposal.[305] As with the Building Blocks Proposal, the objective of the Accords is to make lunar mining possible on a small scale among the participants. The Artemis Accords may also be viewed as a possible follow-up to the Building Blocks Proposal because Artemis attempts to put into practice the idea of individual states engaging in and authorizing commercial operators to engage in mining on the Moon.[306] However, while the Building Blocks Proposal envisions the space-interested states developing the idea of making lunar mining possible through joint action within COPUOS, Artemis is an attempt to move the idea of lunar mining forward through bilateral action, one state at a time. The Accords envision their contribution to COPUOS as international regulatory action on lunar mining.[307] If incorporated by COPUOS guidelines and accepted by states, the bilateral Accords would become multilateral.

Under Artemis, both governmental and commercial lunar mining activities would allow the establishment of safety zones.[308] The legal question arises whether the safety zones constitute appropriation "by means of use or occupation," which is prohibited by OST Art II,[309] or whether they constitute a reasonable effort to warn of harmful interference but without any aspects of appropriation. The signatories evidently are of the view that safety zones do not violate the OST Article II. Another legal issue is whether the signatories themselves are entitled to determine whether safety zones are legal under the OST or whether the UN COPUOS must decide that issue.[310] The eighteen State Parties to the 1979 MA will likely claim that safety zones

[305] *See* BUILDING BLOCKS PROPOSAL, *supra* note 6.

[306] One of the participants in the Building Blocks Proposal, Mike Gold, also participated in forming the Artemis Accords. *See* Marcia Smith, *Mike Gold to Shepard NAC Extraterrestrial Resource Principles in New Job at NASA*, SPACEPOLICYONLINE.COM (Nov. 17, 2019), https://spacepolicyonline.com/news/mike-gold-to-shepherd-nac-extraterrestrial-resource-principles-in-new-job-at-nasa/ [https://perma.cc/KH8S-AUJT]; Mike Gold no longer works at NASA; he was appointed as Acting Associate Administrator for NASA's Office of International and Interagency Relations but resigned April 2021. *See* Ron Mochinski, *Mike Gold, Former Associate Administrator for Space Policy and Partnerships*, NASA (Apr. 7, 2021), https://www.nasa.gov/feature/Michael_Gold [https://perma.cc/H9TA-27NW?type=image].

[307] Artemis Accords, *supra* note 7, § 10.

[308] *Id.* § 11.

[309] OST, *supra* note 2, art. II.

[310] Stirn, *supra* note 256.

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could be contrary to the MA.[311] Another question is who is likely to make a legal challenge to a unilateral declaration of a safety zone. The signatories promise not to make such a challenge.[312] The likely challenger would be a state or a commercial company that feels excluded, such as China. Because no mining is presently taking place, nor is there an expectation of mining in the near future, a legal challenge to a U.S. company's mining zone around a commercial mining operation on the Moon is not immediately likely, that is unless a mining company deliberately decides to make a challenge on principle.

From the point of view of commercial operators contemplating lunar mining using the Artemis Accord as legal authority, the Artemis Accords raise some legal uncertainty concerns which the commercial operators should weigh in deciding whether to engage in lunar mining:

> (1) Some space law experts raise the legal issue of whether the establishment of safety zones envisioned by Section 11 of the Artemis Accord constitutes an appropriation in violation of OST Article II. In their view, Article II prohibits such safety measures by a commercial mining operator because they exclude outsiders from entry.[313] Furthermore, the small number of signatories establishing safety zones (presently ten), compared with the 110 parties to the OST, creates appropriation issues.
> (2) Some space powers such as China, Russia, and India, have the capability to engage in lunar mining activities.[314] They may not become parties to the Artemis

[311] The United States is not a party to the 1979 Moon Agreement. *See supra* note 111.

[312] Artemis Accords, *supra* note 7, § 11.

[313] Professor Hobe questions the legality of safety zones envisioned by section 11 of the Artemis Accords. Stirn, *supra* note 256. *See also* HOBE, *supra* note 71, at 96; Nelson, *supra* note 71, at 3–4. Michelle Hanlon raises the fundamental problem of how to balance the OST Art. II non-appropriation principle with ownership implied by registration. Johnson, *supra* note 164, at 99–100. Relevant is also OST Art. XII which assures open access to all parts of the Moon. It requires states to give reasonable notice of entry "in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety, and to avoid interference with normal operations in the facility to be visited." OST, *supra* note 2, art. XII.

[314] *See generally* Ajey Lele, *Should India Join China and Russia's Lunar Research Station?*, THE SPACE REVIEW (June 1, 2021), https://www.thespacereview.com/article/4185/1 [https://perma.cc/453V-PVHA]; Saritha Rai, *India Plans to Launch Moon Mission in July*, TIME (June 12, 2019), https://time.com/5605359/india-chandrayaan-moon-rover-mission/ [https://perma.cc/Q5C7-DUD8]; Pat Davis Szymczak, *ESA, Roscosmos To Mine Oxygen, Water from Moon Rocks as NASA Eyes First Artemis Lunar Mission*, J. OF PETROLEUM TECH. (Feb. 2, 2021), https://jpt.spe.org/esa-roscosmos-to-mine-oxygen-water-from-moon-rocks-as-nasa-eyes-first-artemis-lunar-mission [https://perma.cc/MJW4-V3YN].

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Accords. They may decide to exploit valuable mining sources on the Moon and may challenge mining sites selected by the participants in the Artemis Accord. In which case, there could be no protection left for a U.S. mining operator or other Artemis participant. OST Article IV would not permit the U.S. or other military forces to protect it because the OST provides that "[t]he Moon and other celestial bodies shall be used by all states exclusively for peaceful purposes."[315]

(3) NASA's inability to negotiate with China because of the Wolf Amendment causes uncertainty about lunar mining.[316] This contributes to the absence of China from the Artemis Accords.[317] The Artemis Accords appear to China as a U.S. strategy aimed to create favorable lunar mining regulation among NASA and its partners, willfully excluding China.[318] Consequently, China has the option to either proceed on a parallel course of its own or seek international regulation of lunar mining in COPUOS. China's failure to join the Artemis Accords results in legal uncertainty about which regulations are applicable to lunar mining. In the view of one expert, "[t]he ultimate result could be a 'fracturing' of the Moon along legal lines with different states operating under different rules."[319]

(4) Like mining on the Earth, mining on the Moon will need environmental regulation due to the inability of the Moon to heal itself. Each mining project needs careful environmental evaluation before approval. It is uncertain which environmental regulations would apply to mining on the Moon.

The Artemis Accords are a valuable initiative towards making commercial activities in outer space possible.[320] The Accords commit the United States to transmit the document to the United Nations for circulation among all the states as an official view towards multilateral adoption.[321] At this early stage, however, the Accords raise several legal uncertainties to be weighed by a commercial company before it decides to engage in lunar mining.

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[315] OST, *supra* note 2, art. IV.

[316] Wolf Amendment.

[317] *See* Ji et al., *supra* note 48.

[318] *Id.*

[319] Nelson, *supra* note 71, at 5.

[320] *See* Masson-Zwaan & Sundahl, *supra* note 70, at 48–49.

[321] Artemis Accords, *supra* note 7, § 13(2). The bilateral Artemis Accords were discussed in the Sixty-Fourth Session of the UN Committee on the Peaceful Uses of Outer Space on August 31, 2021. *See* Head of Delegation, Statement on Agenda Item 14: Space Exploration and Innovation in the Sixty-Fourth Session of the UN Committee on the Peaceful Uses of Outer Space (Aug. 31, 2021), https://vienna.usmission.gov/copuos-2021-us-on-space-exploration-and-innovation/ [https://perma.cc/SCU9-CNFF].

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D. Lunar Mining: Province of Mankind[322]

1. Lunar Mines as Part of Outer Space Commons

The universal commons created by the OST can view celestial resources like lunar mining to be part of it.[323] Article II of the OST forbids any appropriation of outer space.[324] OST Article I established that the Moon shall be free for use and that its use shall be: "for the benefit and in the interest of all countries irrespective of their degree of economic or scientific development and shall be the province of mankind."[325]

Space as the province of humankind translates into outer space commons.[326] Article I of the OST provides that everybody should benefit from the use of the Moon.[327] Article I further guarantees free access to all areas of the Moon.[328] OST Article XI provides for international consultations before engaging in the use of the Moon "to the greatest extent feasible and practicable."[329] OST Article XII establishes open access to all parts of the Moon based on consultations among the users to assure their safety and avoid interference.[330] Viewed as an outer space commons, the lunar mines would be subject to the international law established by the Outer Space Treaty. It would also be subject to the common management rules established by the states engaged in lunar mining as well as national laws and regulations imposed by

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[322] OST, *supra* note 2, art. I. *See also* Paul B. Larsen, *Outer Space: How Shall the World's Governments Establish Order Among Competing Interests*, 29 WASH. INT'L L.J. 1, 7–8 (2019). On April 6, 2020, President Trump signed Executive Order 13914, "Encouraging International Support for the Recovery and Use of Space Resources," declaring that the United States does not view outer space as a global commons. Exec. Order No. 13,914, 85 Fed. Reg. 20,381 (Apr. 10, 2020). This represents yet another difference with other countries and another potential uncertainty because the executive order is also subject to applicable international law, i.e., the OST. The OST accepts outer space as the "province of mankind." OST, *supra* note 2, art. I.

[323] OST, *supra* note 2, art. I.

[324] *Id.* art. II.

[325] *Id.* art. I.

[326] *Id.*

[327] *Id.*

[328] *Id.*

[329] *Id.* art. XI.

[330] OST, *supra* note 2, art. XII; HOBE, *supra* note 71, at 94–95 (stating OST Article I "indicates that in principle outer space is one of the international (global) commons and that the benefit from space activities should therefore be oriented towards the international community").

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the states which authorize and supervise their activities pursuant to OST Article VI and Article VIII.[331] Garrett Hardin expressed that common management of a commons by users would result in overuse and would lead to a "tragedy of the commons" situation.[332] He, therefore, expressed a preference for individual management.[333] However, the economist Elinor Ostrom disagreed.[334] She identified several management rules for commons that could apply to commercial lunar mining:[335] (1) the mines would be clearly identified, (2) management would be subject to collective management by the operators of the mines, (3) most of lunar mining operators would be able to participate, (4) management of the lunar mines would be transparent, (5) the basic management rules would be enforced, (6) dispute settlement would be available, (7) governments would accept commons management, (8) large global commons would have multiple circles of lunar mining management. These management requirements of outer space have not been established but could be in the future.

2. Evaluation

It is possible for governments to accept the lunar mines as part of a universal outer space commons and to regulate lunar mining on the legal foundation established by the OST.[336] In essence, the identified lunar mines would be organized and administered by the commercial proprietors of the mines, subject to the oversight of the governments involved. International management oversight, as described by Elinor Ostrom, would be necessary to avoid a "tragedy of the commons."[337] The Building Blocks Management Proposal[338] could be a way for COPUOS to establish cooperative lunar management rules. The 1994 Protocol to the Law of the Sea

[331] OST, *supra* note 2, arts. VI, VIII. Note that in the 1979 Moon Agreements, reference to the Moon as the common heritage of mankind envisions celestial bodies and their resources as Commons intended to be jointly managed. 1979 Moon Agreement, *supra* note 2, art. 11.

[332] Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243, 1244 (1968).

[333] *See id.*

[334] *See* Jay Walljasper, *Elinor Ostrom's 8 Principles for Managing a Commons*, ON THE COMMONS (Oct. 2, 2011), https://www.onthecommons.org/magazine/elinor-ostroms-8-principles-managing-commmons [https://perma.cc/3NFU-SXRP].

[335] *Id.*; *see also* Larsen, *supra* note 322.

[336] Larsen, *supra* note 322; OST, *supra* note 2.

[337] *See* Walljasper, *supra* note 334; Hardin, *supra* note 332.

[338] BUILDING BLOCKS PROPOSAL, *supra* note 6.

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Convention could model international management oversight by the States involved.[339] Nevertheless, legal uncertainties would exist in establishing new international management of lunar mines as part of the commons.

E. COPUOS: Soft Space Law Regulation of Lunar Mining[340]

1. COPUOS Action on Lunar Mining

Both the Building Blocks Proposal and the Artemis Accords are before COPUOS.[341] COPUOS has discussed the dangers of unilateral regulation of lunar mining and the advantages of international regulation for the purpose of assuring compliance with the OST.[342] Because of the scourge of COVID-19 around the world, there has been a delay in COPUOS activity.[343] The 2021 Meeting of COPUOS will discuss options and make a decision about the establishment of a COPUOS working

[339] Mining of the lands under the high seas as arranged by the Law of the Seas Protocol of 1994 is a possible model for international administration of lunar mining sites. *See* Bernard H. Oxman, *The 1994 Agreement and the Convention*, 88 AM. J. INT'L L. 687 (1994); Williams, *supra* note 124, at 117. The high seas are non-sovereign territory like outer space. Williams, *supra* note 124, at 123. States cannot unilaterally appropriate the deep seabed mining sites. *See id.* In 1994, the commercial companies interested in seabed mining managed to persuade the United States and other countries to agree on a Protocol to the Law of the Seas Convention establishing a mining licensing council, called the International Seabed Authority. Bernard H. Oxman, *The 1994 Agreement and the Convention*, 88 AM. J. INT'L L. 687, 689 (1994). Using Law of the Seas as a prototype, such a mining licensing council could be administered under the 1979 Moon Agreement or the OST. Lunar mining licenses would be based on the following Principles: (1) Mining resources would be excavated based on commercial principles. *See id.* at 693. (2) There would be no compulsory technology sharing. *See id.* at 691. (3) Mining sites would be assigned on a first come first served basis and states would not be required to pay money to develop mining sites other than their own. *See id.* at 692. The licensing council could not limit mining resource production unduly. The council would charge a reasonable management fee while adopting market-based management policies. *See id.* at 694. States that were not parties to the treaty would not be bound by such a protocol. *See id.* at 688. That might create legal uncertainty which the parties would have to suffer, and which could restrict trade in lunar resources.

[340] LYALL & LARSEN, *supra* note 34, at 47 ("By definition it is not binding, which makes lawyers uneasy, and its content is dependent on compliance rather than on enforcement."). *See also* IRMGARD MARBOE, SOFT LAW IN OUTER SPACE: THE FUNCTION OF NON-BINDING NORMS IN INTERNATIONAL SPACE LAW (2012).

[341] U.N. GA, Comm. On the Peaceful Uses of Outer Space, *Annotated provisional agenda*, ¶ 14, U.N. A/AC.105/C.2/L.317 (Apr. 12, 2021); Comm. On the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its Sixtieth Session, ¶¶ 12, 13, 15, U.N. Doc. A/AC.105/C.2/L.314 (June 3, 2021).

[342] U.N. GA, Comm. On the Peaceful Uses of Outer Space, *Annotated provisional agenda*, ¶ 14, U.N. A/AC.105/C.2/L.317 (Apr. 12, 2021).

[343] Masson-Zwaan & Sundahl, *supra* note 70, at 44.

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group to formulate international rules.[344] Such rules would contribute to greater legal certainty; assure compliance with international law, in particular the OST; and encourage commercial investment in outer space commerce. The first step for COPUOS might be to establish a central information data bank for lunar mining activities.[345]

Soft law describes non-binding rules for outer space.[346] Due to the increasing difficulty of negotiating new international law, soft law is increasingly regulating outer space. The 1986 UN General Assembly Principles Relating to Remote Sensing of the Earth from Outer Space[347] illustrates how COPUOS soft law could develop outer space activities. In 1986, the space powers had developed remote sensing space technology.[348] The universal benefit of using remote sensing technology was recognized in the UNGA Resolution to be in the interest of all countries, even if the remote sensing occurred by commercial satellites of the space powers;[349] The Outer Space Treaty, Article I, contemplates the use of the Moon.[350] Do we have a similar situation today, where we contemplate the fair use of lunar resources within the OST framework? Maybe this is the opportune time for COPUOS to engage in the negotiating and drafting of a UN Resolution on the use of outer space mining resources. The Building Blocks Proposal and the Artemis Accords contribute to this conclusion.

2. The 2019 Long Term Sustainability Guidelines[351]

Both the Building Blocks Proposal and the Artemis accords could strengthen the long-term economic sustainability of outer space. In 2019, the UN Committee for Peaceful Uses of Outer Space agreed on twenty-one guidelines towards establishing a sustainable economic environment for outer space.[352] These are

[344] *See id.*; Comm. on the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its Sixty-Second Session, U.N. Doc. A/74/20, at 22–23 (2019).

[345] BUILDING BLOCKS PROPOSAL, *supra* note 6, ¶ 18.

[346] LYALL & LARSEN, *supra* note 34, at 47; MARBOE, *supra* note 340.

[347] G.A. Res. 41/65, Principles Relating to Remote Sensing of the Earth from Outer Space (Dec. 3, 1986).

[348] *See id.*

[349] *Id.*

[350] OST, *supra* note 2, art. I.

[351] *See* Masson-Zwaan & Sundahl, *supra* note 70, at 36–37. The United States joined consensus in COPUOS approving the Sustainability Guidelines.

[352] Guidelines for the Long-Term Sustainability of Outer Space Activities, *supra* note 189.

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guidelines intended to be implemented by the individual states.[353] The guidelines include the establishment of international standards, transparency of commercial operations, and promotion of international cooperation in support of long-term sustainability (LTS).[354] The guidelines support the international coordination of commercial activities such as the use of lunar natural resources.[355] COPUOS could include consideration of the Building Blocks Proposal and the Artemis Accords as a basis for international LTS guidelines on the use of space resources for the benefit of all humankind.[356]

CONCLUSION

The business of mining in non-sovereign space is different from the business applicable to mining in sovereign space. Commercial mining operators need to take the increased legal uncertainties into consideration. Identification of the legal uncertainties may eventually lead to generally accepted international rules for lunar mining.

A multilateral regime for lunar mining is necessary to make commercial lunar mining safe and stable. Previous COPUOS attempts to establish law to make lunar mining possible resulted in the unfinished 1979 MA, which the space powers rejected.[357] COPUOS members will want to make another attempt at creating legal order.[358] This is in the shared interest of both the United States and China, as well as other space powers. It is also in the interest of non-governmental operators.[359] COPUOS is the established forum for international negotiations; it is the proper forum within which the diverse party states should coordinate and maintain a database on lunar activities.[360] COPUOS urgently needs to establish international

[353] *Id.*

[354] *Id.*

[355] *Id.*

[356] *Id.*

[357] 1979 Moon Agreement, *supra* note 3.

[358] *Id.* A tentative working group co-chaired by Prof. Steven Freeland, Australian representative to COPUOS, will begin consultations in 2021. *See* Johnson, *supra* note 164, at 95.

[359] Johnson, *supra* note 164, at 96. *See* SPACE POLICY AND SUSTAINABILITY, *supra* note 1, at 6. The author agrees with conclusion of Masson-Zwaan and Sundahl that "the preferred solution is a multilateral regime for lunar activities." *See* Masson-Zwaan & Sundahl, *supra* note 70, at 55.

[360] COPUOS presently maintains data banks on registration of space vehicles, per the Registration Convention, and on disasters, per the International Charter on Space and Major Disasters. *See* UN

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guidelines on lunar mining analogous to the COPUOS Space Debris guidelines so that states active in lunar mining will have a guide to avoid collisions with each other. Authorizing states would instruct their commercial mining operators to observe the COPUOS guidelines. That will also set a precedent for the exploitation of resources on Mars and other celestial bodies. In COPUOS, the U.S. and China are able to participate in multilateral negotiation without the constraint of the Wolf Amendment;[361] U.S. law should remove the Wolf Amendment.[362] U.S. commercial entities must be able to negotiate with their Chinese counterparts to establish an orderly commercial division of market opportunities.

Registration Convention, *supra* note 2; *International Charter Space and Major Disasters*, UN-SPIDER KNOWLEDGE PORTAL, https://un-spider.org/space-application/emergency-mechanisms/international-charter-space-and-major-disasters [https://perma.cc/6UKT-3KMN]. The 2021 COPUOS Meeting will provide the opportunity to raise issues concerning the Building Blocks Proposal, the Artemis Accords and 1979 Moon Agreement as well the legal uncertainties from developing parallel U.S. and Chinese legal regimes for lunar mining.

[361] Wolf Amendment, *supra* note 49.

[362] Jeff Foust, *Defanging the Wolf Amendment*, SPACE REV. (June 3, 2019), https://www.thespacereview.com/article/3725/1 [https://perma.cc/AF5L-UPES].

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