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Lost in Space: An Exploration of the Current Gaps in Space Law

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Space is for everybody. It's not just for a few people in science or math, or for a select group of astronauts. That's our new frontier out there, and it's everybody's business to know about space.
~Christa McAuliffe

I. INTRODUCTION

The Outer Space Treaty of 1967 and other galactic treaties fail to account for increasing advancements in the space industry, such as the unregulated fields of resource mining and the future colonization of space. As a result of the gaps in international law and regulations, individual countries and companies have taken innovative steps toward space exploration.

An individual State action may conflict with the United Nations (U.N.) Outer Space Treaty, but it is difficult to enforce the treaty and prosecute violations, especially when space-leading countries are not parties to all treaties. Additionally, private actors are only limited by rules of their home country, as well as international law insofar as the State must comply.

The rapidly changing environment and advancements in outer space technology have created a pressing need for a new Outer Space Treaty, or at the very least a drastic change in space law and regulations. A new treaty must consider the technological advances over the last fifty years and address the inevitable advancements and needs that will face the planet.

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While the entire Outer Space Treaty and space law from the U.N. needs to be reworked, the most urgent sections to modernize are the articles regarding debris from asteroid mining and eventually, human debris from a colony, and the militarization of celestial bodies (including defining celestial bodies more narrowly as not to hinder future resource demand). The Outer Space Treaty needs to be amended prior to colonization because it is short-sighted to encourage colonization of space while simultaneously ignoring the possible issues with sending humans to live in a confined, lawless society.

Only a minority of countries (most without space-faring capabilities) have adopted the subsequent Moon Agreement. The international Space Community must adopt a new agreement that includes negotiations with the leading countries, updates the provisions to give all countries some freedom in the development of space, and ensures its peaceful exploration. Once humans begin to establish colonies, those colonies must become their own independent "nations" and govern themselves. It is illogical to have people in space governed by countries on Earth who have no real power over space, as no nation can claim or own anything in space. If the U.N. and international community are not prepared to directly address the eventual need for a separate space enforcement program, then they must find a way to bring private companies to the table while simultaneously holding the companies accountable for their actions in the meantime.

This article first explores the history of international space law from its roots in airspace law to the adoption of the Outer Space Treaty. This article then discusses other international policies that shaped the modern space law doctrine, such as the Moon Agreement, the Antarctica Treaty, and the U.N. Convention on the Law of the Sea. After a discussion of these binding and non-binding principles; this article then turns to the national regulatory schemes of several individual countries and their various stages in the space exploration process. Additionally, this article considers the ever-increasing presence of private companies in the world of space exploration and addresses the influence of private companies and individual countries. This article concludes with a critique of the current gaps in global regulation and current limitations on future space achievement if drastic changes are not made to the existing global space law régime.

II. HISTORY & BACKGROUND OF INTERNATIONAL SPACE LAW

International space law has developed in subtle ways ever since the international community realized that humans are capable of going to space. The treaties and principles that originated in the 1960s and '70s

have not changed over time. However, individual countries have more frequently updated and modified their own regulatory schemes to account for the sharp rise in private companies entering the space exploration market.[1]

Most people would be surprised to learn that the origins of space law predate the 1957 orbit of Sputnik-I by almost fifty years.[2] International space law is quite broad and includes all laws that may "govern or apply" to outer space and related activities.[3] While as a practice area space law is broad, much of the literature from the pre-Space Race era analyzed the law of space through a domestic lens, with references to comparative analyses between other nations and international law.[4] Furthermore, at times, the basis for space law can be seen in the historical foundation of international air law.[5] The distinction between airspace and outer space is essential for a comprehensive understanding of State control and influence over outer space.[6] It is worth noting that in terms of international law and, specifically the law of outer space, the term "State" refers to countries, not individual states within a given country.[7] States have exercised territorial sovereignty rights in the space above land since the Roman Empire.[8]

Nations recognized that a State's territorial sovereignty extends above the physical land into its airspace, or the portion of the Earth's atmosphere below the beginning of outer space but above the minimum altitude required for flight for a long period of time.[9] However, the upper boundary of airspace and the boundaries of outer space are far less defined and precise than those of terrestrial sovereignty.[10] The boundaries of outer space include the known and unknown areas of the universe that are beyond airspace.[11] As a result of this ill-defined scope of boundaries, the international community found it necessary to form the U.N. Office for

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[1] Paul Stephen Dempsey, *National Laws Governing Commercial Space Activities: Legislation, Regulation, & Enforcement,* 36 NW J. INT'L L. & BUS. 1, 4 (2016).

[2] Stephen E. Doyle, ORIGINS OF SPACE LAW AND THE INTERNATIONAL INSTITUTE OF SPACE LAW OF THE INTERNATIONAL ASTRONAUTICAL FEDERATION 1 (2002), https://www.iislweb.org/docs/Origins_International_Space_Law.pdf [https://perma.cc/TK42-ZZ3B].

[3] A GUIDE TO SPACE LAW TERMS 120 (Henry R. Hertzfeld ed., Space Policy Institute, George Washington University, & Secure World Foundation 2012) (citing FRANCIS LYALL & PAUL B. LARSEN, SPACE LAW: A TREATISE 2 (2009)), https://swfound.org/media/99172/guide_to_space_law_terms.pdf [perma.cc/F2ES-VJ4V].

[4] Doyle, *supra* note 2, at 2.

[5] *Id.*

[6] Dean N. Reinhardt, *The Vertical Limit of State Sovereignty,* 72 J. Air L. & Com. 65, 66-67 (2007).

[7] *State*, Oxford's Learners Dictionary (a country considered as an organized political community controlled by one government), https://www.oxfordlearnersdictionaries.com/us/definition/english/state_1 [perma.cc/Z7BP-7JC7].

[8] Reinhardt, *supra* note 6, at 69.

[9] *Id.* at 70; A GUIDE TO SPACE LAW TERMS, *supra* note 3, at 15.

[10] A GUIDE TO SPACE LAW TERMS, *supra* note 3, at 82; Reinhardt, *supra* note 6, at 77.

[11] A GUIDE TO SPACE LAW TERMS, *supra* note 3, at 82.

Outer Space Affairs (UNOOSA) in 1958.[12] Initially, UNOOSA was part of the Committee on the Peaceful Uses of Outer Space (COPUOS).[13]

UNOOSA, in one of its many roles, serves as the secretariat for COPUOS to "promote international cooperation in the peaceful uses of outer space."[14] UNOOSA is also responsible for maintaining the U.N. Register for Objects Launched into Outer Space and implementing the Secretary-General's duties under space law.[15] As an administrative body, UNOOSA works to educate and train developing nations and prepare reports and studies relating to the many field of space science, technology applications, and international space law.[16] Under UNOOSA, the general definition of "space law" is refined and expands on the general understanding of space law as all laws governing or applying to outer space and related activities. Further, UNOOSA's definition includes the principles and rules that regulate general space activity, which are created by the international community.[17] With UNOOSA's guidance, the international community explored space but with very little uniformity from global treaties and agreements.

III. GLOBAL TREATIES & AGREEMENTS

International space regulation is shaped by five treaties: The Outer Space Treaty, the Moon Agreement, the Rescue Agreement,[18] the Liability Convention,[19] and the Registration Convention.[20] While each treaty has significance, none are quite as influential as the Outer Space Treaty and

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[12] *History,* U.N. OFF. OUTER SPACE AFFAIRS, http://unoosa.org/oosa/en/aboutus/history/index.html [perma.cc/S4BZ-M5M7].
[13] *Id*.
[14] *About Us,* U.N. OFF. OUTER SPACE AFFAIRS, http://unoosa.org/oosa/en/aboutus/index.html [https://perma.cc/5FJG-F9WS].
[15] *Id.*
[16] *Id.*
[17] *Space Law,* U.N. OFF. OUTER SPACE AFFAIRS, http://unoosa.org/oosa/en/ourwork/spacelaw/index.html [perma.cc/23CP-9L8C]. Space law is commonly associated with "the rules, principles and standards of international law appearing in the five international treaties and five sets of principles governing outer space which have been developed" by the U.N. and the national regulations developed by individual nations. *Id.* Activities that fall under the guise of space law include, but are not limited to, "the preservation of the space and Earth environment, liability for damages caused by space objects, the settlement of disputes, the rescue of astronauts, the sharing of information about potential dangers in outer space, the use of space-related technologies, and international cooperation." *Id.*
[18] *Treaties,* U.N. OFF. OUTER SPACE AFFAIRS, https://www.unoosa.org/oosa/en/aboutus/history/treaties.html ("The Rescue Agreement of 1968 requires States to assist an astronaut in case of accident, distress, emergency or unintended landing")..
[19] *Id.* ("The Liability Convention of 1972 establishes the standards of liability for damage caused by space objects").
[20] *Id.* ("The Registration Convention of 1975 requires States to register all objects launched into outer space with the United Nations")*; see also*, *Space Law Treaties and Principles,* U.N. OFF. OUTER SPACE AFFAIRS, http://unoosa.org/oosa/en/ourwork/spacelaw/treaties.html [perma.cc/ZTL3-HDAV]. International space regulation is also modeled by five principles: the "Declaration of Legal Principles," the "Broadcasting Principles," the "Remote Sensing Principles," the "Nuclear Power Sources" principles, and the "Benefits Declaration. *Id.*

the Moon Agreement. Additionally, when examining the regulatory nature and development of international space law, one cannot ignore the similarities and influence of other global agreements such as the Antarctic Treaty and the U.N. Convention on the Law of the Sea.[21]

A. *The Outer Space Treaty*

In 1967, the U.N. and its members enacted the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, more commonly referred to as the Outer Space Treaty.[22] The Outer Space Treaty is the foundation for current space law and is effectively a constitution for outer space because it sets out basic principles for governing various state activities in outer space.[23] One of the key principles of the Outer Space Treaty is the freedom to use space and that such use will be for the common heritage of humankind.[24] The phrase "for the common heritage of mankind (or humankind)", is understood to mean the parts of earth and the cosmos that belong to all humanity and therefore should be protected for the benefit of humanity.[25] While the use and exploration of space is for the benefit of humankind, in practice, this principle can be difficult to achieve because only a handful of signatory states actually have the capabilities to effectively explore, utilize, and research in outer space.[26]

Beyond the broad principle of benefiting all of humankind, the Outer Space Treaty also prohibits appropriation of space or celestial bodies, meaning no state can claim sovereignty by means of occupation or otherwise.[27] Additionally, Articles III and IV of the Outer Space Treaty address the safe and peaceful use of outer space, including but not limited to the prohibition of weapons of mass destruction and military bases and the like on celestial bodies.[28] In furtherance of the peaceful purposes of

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[21] Reinhardt, *supra* note 6, at 79; Brian Wessel, *The Rule of Law in Outer Space: The Effects of Treaties and Nonbinding Agreements on International Space Law,* 35 HASTINGS INT'L & COMP. L. REV. 289, 293 (2012).

[22] 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].

[23] Wessel, *supra* note 21, at 292.

[24] Ruwantissa Abeyratne*, Satellite Distribution in Meteorological Forecasts for Air Navigation*, 31 J. SPACE L. 247, 260 (2005).

[25] A GUIDE TO SPACE LAW TERMS, *supra* note 3, at 26; The phrase the "common heritage of all mankind" is not to be confused with the phrase "province of all mankind", which is not clearly defined in formal documents, but some understand the phrase as distinguishable from common heritage, referring to activities in or territorial bounds of Outer Space. *Id.* at 97-98.

[26] David A. Koplow, *The Fault is Not in Our Stars: Avoiding an Arms Race in Outer Space,* 59 HARV. INT'L L.J. 331, 349 (2018).

[27] Outer Space Treaty, *supra* note 22, Art. II.

[28] *Id.* at Art. III, IV. *See also The Outer Space Treaty at a Glance,* ARMS CONTROL ASSOCIATION (Aug. 2017), https://www.armscontrol.org/factsheets/outerspace [https://perma.cc/T7MX-GAMZ].

space, the Outer Space Treaty states that Parties to the agreement shall render aid to astronauts from other states, in distress, even upon re-entry to earth.[29] Not only do states have a duty to rescue, the Outer Space Treaty also contains a duty to conduct outer space activities with care and to avoid harming and contaminating space or celestial bodies.[30] Although this treaty acts as a way to implement guiding principles, it also establishes liability for states.[31] States are responsible and liable for any damages they may cause individually or the damage caused by a non-government entity.[32] Furthermore, each signatory State is responsible for the actions of those spacecrafts launched from its land.[33] This responsibility also means that the state retains jurisdiction and control of the personnel and property while in space.[34] The articles of the Outer Space Treaty play an important role in space law because this treaty is one of only a few binding agreements between States.[35]

B. *The Moon Agreement*

Unlike the binding Outer Space Treaty, the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the Moon Agreement) is only binding on those states that have signed the agreement.[36] Furthermore, while the Outer Space Treaty is general in nature, the Moon Agreement is more specific in its articles, but also more problematic.[37] The Moon Agreement was adopted by eighteen States but failed to gain the support of the two largest players in the space race at the time of the adoption in 1979: the United States of America (U.S.) and the Union of Soviet Socialist Republics (USSR), now the Russian Federation.[38]

Weapons of mass destruction are not defined but typically include nuclear, chemical, and biological weapons. *Id.*

[29] Outer Space Treaty, *supra* note 22, at Art. V. *See* A GUIDE TO SPACE LAW TERMS, *supra* note 3, at 88 (peaceful in the context of space law implies non-aggressive behavior; untroubled by conflict, agitation, or commotion).

[30] *Id.* at Art. IX.

[31] Wessel, *supra* note 21, at 292.

[32] Abeyratne, *supra* note 24, at 262.

[33] Outer Space Treaty, *supra* note 22, at Art. VII.

[34] *Id.* at Art. VIII.

[35] Wessel, *supra* note 21, at 292.

[36] *Id.* at 292-93; Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 18, 1979, 1363 U.N.T.S. 187 [hereinafter Moon Agreement].

[37] Kevin V. Cook, Note, *The Discovery of Lunar Water: An Opportunity to Develop a Workable Moon Treaty*, 11 GEO. INT'L ENVTL. L. REV. 647, 665 (1999).

[38] Paul B. Larsen, *Minimum International Norms for Managing Space Traffic, Space Debris, and Near Earth Object Impacts,* 83 J. AIR L. & COM. 741, 744 (2018); Michael Listner, *The Moon Treaty: Failed International Law or Waiting in the Shadows?*, THE SPACE REVIEW (Oct. 24, 2011), https://www.thespacereview.com/article/1954/1 [https://perma.cc/3F6X-SYLX] (explaining that the People's Republic of China has also neither signed nor adopted the Moon Agreement).

The lack of support for the Moon Agreement from the "Big Three"—the U.S., the Russian Federation (Russia), and the People's Republic of China (China)—leads to the conclusion that the agreement is a failed agreement, though it is still valid international law, even if not binding on the "Big Three."[39] The Moon Agreement contains several articles that tighten restrictions on state activities and powers.[40]

The very first article and section of the Moon Agreement contain provisions that apply to other celestial bodies, not just the Moon.[41] Like the Outer Space Treaty, the Moon Agreement reiterates that the Moon shall be used only for peaceful purposes by State Parties and reinforces that there are to be no threats or hostile acts on the Moon and military personnel are only allowed on the Moon for research purposes.[42] The Moon Agreement provides that State Parties must communicate their efforts with the U.N. and not interfere with another State Party's operations.[43] In an effort to ensure research obtained from the Moon and elsewhere promotes international cooperation, State Parties have the ability to collect and retain mineral samples from the Moon only if such samples are for scientific purposes and portions are shared with the scientific and international community.[44] Interestingly, in the event of a scientific investigation, State Parties may use minerals and other lunar substances "in quantities appropriate for the support of the mission." This broad language has the potential to lead to the exploitation of the Moon's resources, an act that would directly conflict with the Outer Space Treaty.[45]

Two important provisions for the furtherance of space exploration are Articles 8 and 9 of the Moon Agreement.[46] These provisions allow State Parties to not only land space objects on the Moon, but also allow State Parties to launch objects from the Moon, place facilities and installations anywhere on or below the surface of the Moon. Additionally, the provisions allow State Parties to establish manned and unmanned stations, so long as such stations do not impede free access to the Moon or conflict with any other provisions of the Moon Agreement or the Outer Space Treaty.[47]

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[39] Listner, *supra* note 38; Cook, *supra* note 37, at 668 (the Moon agreement remains binding on those States that have ratified it, and while only a small number of States have done so, the number of participants has increased since 1979).
[40] Leslie I. Tennen, *Towards a New Regime for Exploration of Outer Space Mineral Resources*, 88 NEB. L. REV. 794, 811 (2010).
[41] *Id.*; Listner, *supra* note 38. Article 1 § 1 applies to all other celestial bodies, except earth, until specific legal norms are created for any other celestial body. Tennen, *supra* note 40, footnote 80.
[42] The Moon Agreement, *supra* note 36, Art. 3.
[43] *Id.* at Art. 5, 6.
[44] *Id.* at Art. 6 § 2.
[45] *Id.*; The Outer Space Treaty, *supra* note 22, Art. IX.
[46] The Moon Agreement, *supra* note 36, Art. 8, 9.
[47] *Id.*

The most controversial provision of the Moon Agreement addresses the issue of non-appropriation.[48] Article 11, § 3 of the agreement states in part:

> Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person. The placement of personnel, space vehicles, equipment, facilities, stations and installations on or below the surface of the moon, including structures connected with its surface or subsurface, shall not create a right of ownership over the surface or the subsurface of the moon or any areas thereof. The foregoing provisions are without prejudice to the international regime referred to in paragraph 5 of this article.[49]

Article 11 reinforces the express designation of the Moon and its natural resources as part of the common heritage of humankind.[50] In addition, paragraph 5 establishes an international regime to govern the exploitation of natural resources of the Moon when such exploitation is feasible.[51] Paragraph 5 gives rise to concerns that private innovation and enterprise would be stifled by the limits on exploration.[52] Additionally, paragraph 7 raises concerns regarding the management and implementation of the regime, as the language seems to favor less-developed nations by suggesting that all benefits must be shared equally, and fails to provide a definition for the term "resources."[53] As a result of lack of international support and the cumbersome provisions of the Moon Agreement, international space law appears to be in serious need of revision and must be separated from the structure of similar terrestrial agreements of the Seas and Antarctica.[54]

C. *Antarctica Treaty & the U.N. Convention on the Law of the Sea*

Similar to the Outer Space Treaty and Moon Agreement, the U.N. Convention on the Law of the Sea and the Antarctica Treaty contain provisions that employ the doctrine of Common Heritage of Mankind.[55] Like the guiding international agreements of the laws of outer space, the Laws

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[48] Listner, *supra* note 38; The Moon Agreement, *supra* note 36, Art. 11.
[49] The Moon Agreement, *supra* note 36, Art. 11, ¶ 3.
[50] Cook, *supra* note 37, at 666.
[51] The Moon Agreement, *supra* note 36, Art. 11, ¶ 5.
[52] Cook, *supra* note 37, at 667.
[53] *Id.*; Listner, *supra* note 38.
[54] Listner, *supra* note 38.
[55] U.N. Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397; Antarctic Treaty, Dec. 1, 1959, [1961] 12 U.S.T. 794, T.I.A.S. No. 4780; Cook, *supra* note 37, at 680.

of the Sea and Antarctica Treaty state that the areas will not be owned by any one country, but rather by the international community.[56] It should come as no surprise that both Antarctica and the high seas are beacons of scientific research and contain a plethora of recourses that the international community thought it necessary to preserve.[57]

As a result of the severe restrictions limiting the ability for States and private companies to "collect" resources in both outer space and the high seas, some States, such as the U.S., have chosen to reject the Convention of the High Seas.[58] In addition to the restrictive limitations on the collection of resources, the Moon Agreement and the Convention of the High Seas share a similar critique of the international regime suggested to limit the exploitation of resources.[59] Both treaties implement a system that focuses on the imbalance of power between developing countries that wish to share the technological and economic benefits of resource collection (mining) and developed nations, who have the necessary technology, private enterprise, and capital to invest in such operations.[60] The treaties concerned developed countries, such as the U.S., because they required developing countries to receive part of the mined resources collected by private companies and developed countries.[61] As a result of unequal trade and to promote equal scientific advancement, some developed countries have taken unilateral action to preserve their property rights in mined resources from the sea. Accordingly, if presented the opportunity, most developed countries would likely do the same to preserve their interest in galactically-mined resources.[62]

While the Antarctica Treaty similarly focuses on activities for the common heritage of humankind, it is slightly less restrictive compared to the Moon Agreement and the Convention of the Seas. The Antarctica Treaty is also the foundation for the Outer Space Treaty.[63] The Antarctica Treaty addresses areas like the high sea and outer space which are considered "international space," meaning there is no one country that can claim

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[56] Ty S. Twibell, Note, *Space Law: Legal Restraints on Commercialization and Development of Outer Space,* 65 UMKC L. REV. 589, 592 (1997).

[57] *The Antarctic Treaty Explained,* BRITISH ANTARCTIC SURVEY, https://www.bas.ac.uk/about/antarctica/the-antarctic-treaty/the-antarctic-treaty-explained/ [https://perma.cc/R7Q8-PWH3]; Matt McGrath, *UN Treaty Would Protect High Seas From Over Exploitation,* BBC (Sept. 4, 2019), https://www.bbc.com/news/science-environment-45397674 [https://perma.cc/DAZ4-FAF6]; A GUIDE TO SPACE LAW, *supra* note 3, at 58 (the term High Seas refers to "rough water" past territorial jurisdiction. More broadly, the seabed and ocean floor, and the subsoil beneath, which is beyond the limits of national jurisdiction).

[58] McGrath, *supra* note 57.

[59] Listner, *supra* note 38.

[60] Cook, *supra* note 37, at 681.

[61] Listner, *supra* note 38.

[62] *Id.*; Cook, *supra* note 37, at 682.

[63] Cook, *supra* note 37, at 677; Andrew R. Brehm, Note and Comment, *Private Property in Outer Space: Establishing a Foundation for Future Exploration,* 33 WIS. INT'L L. J. 353, 357 (2015).

sovereignty.[64] The terms of the Antarctica Treaty and the Outer Space Treaty similarly evidence the international response to the Cold War and the fears of nuclear war by limiting a single country's ability to exploit unexplored areas. However, the Antarctica Treaty has the added difficulty of addressing the fact that seven nations had previously laid claim to the frozen tundra prior to its creation.[65] As a result of the pre-existing claims to the landmass, the Antarctica Treaty lacks the same provisions regarding non-appropriation of mineral resources but rather prohibited the practice in the "interest of 'freedom of scientific investigation' in Antarctica and cooperation toward that end."[66]

The Antarctica Treaty expressly prohibits similar activities as the Outer Space Treaty, such as nuclear explosions, weapons testing, and military bases, while advancing the continued importance of scientific research.[67] However, these similarities are not significant enough to lead to the assumption that the Outer Space Treaty and Moon Agreement can be analyzed in the same fashion or for the same gaps in enforcement.[68] Besides the mere nature of Antarctica also being physically located on Earth, the rules regarding jurisdiction and claims of sovereignty differ so drastically, any comparisons would need to be qualified. While members of the Antarctica Treaty cannot lay claims to Antarctica,[69] a problem arises when a non-member of the treaty decides to assert a claim. Under the Antarctica treaty, there can be no new claims of jurisdiction. While under the Outer Space Treaty, there can be no claims to jurisdiction over celestial bodies, the challenge arises when a State eventually claims jurisdiction in outer space. Unlike Antarctica, the culprit will be in a different orbit and regulation enforcement is difficult.[70]

IV. STATE/COUNTRY-SPECIFIC REGULATIONS

The space race originated between the U.S. and the USSR. Since then, countries such as Japan, Italy, Spain, China, and the United Kingdom have also heavily invested in space exploration. However, the heavily populated States with large landmasses are not the only States which regulate and promote State-specific space exploration. "Small countries" (small in area but with large capital investment capabilities) have also entered the

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[64] Benjamin Perlman, Note, *Grounding U.S. Commercial Space Regulation in the Constitution*, 100 GEO. L. J. 929, 958 (2012).
[65] Amanda M. Leon, *Mining for Meaning: An Examination of the Legality of Property Rights in Space Resources,* 104 VA. L. REV. 497, 532 (2016).
[66] *Id.* at 533 (referencing FRANCIS LYALL & PAUL B. LARSEN, SPACE LAW: A TREATISE 55-56 (2009).
[67] The Antarctic Treaty Explained, *supra* note 57.
[68] Cook, *supra* note 37, at 697.
[69] *Id.;* CGP Grey, *Who Owns Antarctica?(Bizarre Boarders Part 3),* YOUTUBE (Dec. 31, 2015), https://www.youtube.com/watch?v=DbKNlFcg02c [https://perma.cc/AML8-4JCV].
[70] Cook, *supra* note 37, at 697.

international and commercial space community.[71] Many countries have developed or are developing robust space programs for the first time. The first section explores the space programs and regulations of three smaller countries, which are not traditionally considered space pioneers. The next section explores the space programs and regulations of the "Big Three," which have long been the leaders of international space exploration and development.[72] The disparity between the regulatory frameworks of countries varies greatly regardless of size. Such disparities invite conflicting practices and schemes, both among countries and with the Outer Space Treaty.

A. *"Small Countries"*

While the Outer Space Treaty does not require that individual States establish their own domestic space policies, many states are doing so because of an increase in the number of private space companies.[73] These laws and regulations vary greatly from State to State.[74] By establishing domestic regulations, States have more control over private companies and can ensure that they are not in violation of the Outer Space Treaty, while also continuing to establish or develop State-run space agencies.[75]

A relatively recent addition to the international space stage is the United Arab Emirates (UAE).[76] The UAE Space Agency was established in 2014 and turned its attention to Mars, with goals of building a habitable settlement on Mars by 2117.[77] The first step to achieving this goal was the launch of the unmanned Hope probe on July 19, 2020.[78] This launch marked the first mission to another planet by the Arab world.[79] The mission will study the Martian atmosphere, both daily and seasonally, and evaluate the ways in which the planet is ill-suited to support human life.[80] The UAE was highly motivated to reach its ambitious goal of launching the probe only six years after creating the UAE Space Agency. The UAE

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[71] Dempsey, *supra* note 1, at 4.
[72] *Id.* at 43.
[73] *Id.* at 14-15, 43.
[74] *Id.* at 42.
[75] *Id.* at 15.
[76] *10 Things to Know About the UAE Space Program,* SMITHSONIAN MAG. (July 2, 2019), https://www.smithsonianmag.com/sponsored/10-Things-to-Know-UAE-Space-Program-Future-Space-Exploration-180971672/ [https://perma.cc/YEG3-AGLL] [hereinafter *10 Things to Know*].
[77] Jeremy Rehm, *Home Mars Mission: Launching the Arab World into the Space Race*, SPACE.COM (Oct. 21, 2019), https://www.space.com/hope-emirates-mars-mission.html [https://perma.cc/UY5P-R4AY].
[78] *Hope, the United Arab Emirates' First Mission to Mars*, PLANETARY SOC'Y, https://www.planetary.org/space-missions/uae-hope [https://perma.cc/2FFK-HZ8K].
[79] *Id.*
[80] *10 Things to Know, supra* note 76.

is confident that with the nation's support and "its visionary leadership," the country will solidify its place in the international space community.[81]

The UAE partners and collaborates with other States, such as the U.S., Japan and India, as well as private companies abroad, such as Advanced Space.[82] In addition to global support, the UAE does not seem to have much regional competition that will impede its progress in becoming the first Arab and Islamic Country to send a spacecraft to Mars.[83] Even though it collaborates with foreign governments and private companies for its mission, the UAE Space Agency is still working to solidify its space law, despite the program being only seven years old.[84] Current UAE space law focuses on five common areas: registration for space objects, investigations of accidents, space activities permits, manned space flights, and audit framework.[85] While the development of laws is still in progress, the existing laws are consistent with the typical regulatory policies of the international community and aim to promote its goal of attracting foreign investors.[86] Once further developed, UAE space laws will also address modern concepts and commercial activity issues such as space mining and ownership of natural space resources.[87]

One country that has already addressed the upcoming issues regarding outer space commercial activities is Luxembourg.[88] Luxembourg was the first European country to establish "a legal framework for space exploration and the uses of space resources," assuring private operators of their ownership of the resources they extract in space, which is essential to the viability of space mining.[89] As a party to the Outer Space Treaty, Luxembourg is forbidden from claiming sovereignty over a celestial body.[90] However, Luxembourg did not sign the Moon Agreement and

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[81] Rehm, *supra* note 77; *UAE Mars Mission's Hope Probe is Now 85% Complete*, GULF NEWS (Apr. 22, 2019), https://gulfnews.com/uae/uae-mars-missions-hope-probe-is-now-85-complete-1.63485777 [https://perma.cc/XG3Q-62LD] [hereinafter UAE Mars Mission].

[82] Huma Siddiqui, *Big thumbs up for India! ISRO to work with UAE for its first spacecraft "Hope Probe" launch*, FIN. EXPRESS (Aug. 23, 2019), https://www.financialexpress.com/lifestyle/science/big-thumbs-up-for-india-isro-to-help-uae-launch-its-first-spacecraft-hope-probe/1680757/ [https://perma.cc/RT73-QH55]; https://www.emiratesmarsmission.ae/hope-probe/ground-segment/ *see also Hope, the United Arab Emirates' First Mission to Mars*, *supra* note 78.

[83] *10 Things to Know, supra* note 76; UAE Mars Mission, *supra* note 81.

[84] *National Space Sector Laws,* UAE SPACE AGENCY, https://www.space.gov.ae/Page/20122/20171/National-Space-Sector-Laws [https://perma.cc/S5HP-P3ZY].

[85] *National Space Legislation,* UAE SPACE AGENCY, https://www.space.gov.ae/Page/20122/20218/National-Space-Sector-Regulations [https://perma.cc/2BZH-YKVC].

[86] *Id.*; Dempsey, *supra* note 1.

[87] *National Space Sector Laws, supra* note 84.

[88] *Space Policy and Strategy,* LUX. SPACE AGENCY (Sept. 23, 2019), https://space-agency.public.lu/en/agency/mission-vision.html [https://perma.cc/JGW5-KDVG].

[89] *Id.; What are the Legal Issues?, Frequently asked Questions*, LUX. SPACE AGENCY, https://space-agency.public.lu/en/space-resources/faq.html [https://perma.cc/WP8U-MR4V].

[90] *Id.*

maintains that the Moon Agreement does not "impede the exploitation of lunar resources."[91]

The focus of the Luxembourg Space Agency (LSA) is to promote business and economic advancements in the space sector.[92] The LSA engages in the research and development of the space sector, not for exploration but for the commercialization and mining of resources in space that are invaluable to the substance needed to sustain human life and deep space exploration.[93] The LSA recognizes that the international space sector is growing and trending toward privatization; in response, the LSA enacted the Law on the Exploration and Use of Space Resources.[94] The law reiterates that the ownership of celestial bodies is not permitted, but with proper licensing, registration, and approval, resources can be extracted from such bodies.[95]

As an independent nation, Luxembourg has been a pioneer and advocate for the commercialization of space and the mining of resources. As a member of the European Union, Luxembourg also cooperates and coordinates with the European Space Agency (ESA).[96] The ESA is a conglomerate of European nations dedicated to advancing the science and technology of space and the European economy.[97] To further these goals, the ESA created a common political framework where the EU, ESA, and EU member States commit to increasing coordination of programs and activities within their respective roles relating to space.[98] While the ESA is an independent entity with its own regulations, member states also have their own national programs and policies.[99] The many independent laws

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[91] *Id.*

[92] *A New Era for Space Development,* LUX. SPACE AGENCY, https://space-agency.public.lu/en/agency/lsa.html# [https://perma.cc/J8CV-YL3F].

[93] *Resources in Space,* LUX. SPACE AGENCY, https://space-agency.public.lu/en/space-resources/ressources-in-space.html [https://perma.cc/T9XW-V77W].

[94] *Legal Framework*, LUX. SPACE AGENCY, https://space-agency.public.lu/en/agency/legal-framework.html [https://perma.cc/VC3X-UEB5]; *Law of July 20th 2017 on the Exploration and Use of Space Resources*, LUX. SPACE AGENCY (July 28, 2017), https://space-agency.public.lu/en/agency/legal-framework/law_space_resources_english_translation.html [https://perma.cc/Q9A7-CW8K] (translating from the original French version).

[95] *Legal Framework*, *supra* note 94.

[96] *ESA and LSA Confirm Strategic Partnership for European Space Resources Innovation Centre*, LUX. SPACE AGENCY, https://space-agency.public.lu/en/news-media/news/2019/ESA_and_LSA_confirm_space_resources_partnership.html [https://perma.cc/6X9G-DVB8] [hereinafter Strategic Partnership].

[97] European Space Agency, *This is ESA*, YOUTUBE (Aug. 6, 2020),https://www.youtube.com/watch?v=hbD_-9Nc698 [https://perma.cc/KX6B-7WNJ].

[98] *ESA BR-269 Resolution on the European Space Policy*, EUROPEAN SPACE AGENCY (June 30, 2007), https://www.esa.int/About_Us/Corporate_news/ESA_BR-269_i_Resolution_on_the_European_Space_Policy_i [https://perma.cc/FE7G-WJ6E].

[99] *Id.*

typically do not conflict, as the ESA is a strategic partner on many members' projects, emphasizing the culture of collaboration in the space community.[100]

A. *The Big Three*

Collaboration is essential for the advancement of space exploration and use. The "Big Three"—Russia, China, and the U.S.—are the most influential and potentially collaborative nations. These nations are arguably the three largest State actors involved in space exploration. If any one of the three decided to put its support behind the Moon Agreement, the rest of the world likely would have no choice but to comply or face serious diplomatic consequences.[101] The Big Three each possess reputable, government-run space programs, collaborates with smaller nations, and financially supports "private" companies.

1. Russia

The USSR was the first country to successfully reach outer space, and it has not slowed down its exploration efforts. Although Russia did not sign the Moon Agreement, it is still an active participant in the Outer Space Treaty. It is also among the U.N. members that has enacted national space legislation.[102] Formerly known as the Russian Federal Space Agency, the Roscosmos State Corporation for Space Activities ("Roscosmos") coordinates Russia's space activities, including civilian and military launches, with the Ministry of Defense.[103] In addition, Roscosmos (1) issues licenses for all individuals who fall under Russian jurisdiction for *all* space activities; (2) requires extensive documentation for approval of all activities; and (3) follows the required Russian space and safety standards.[104]

Upon the breakup of the Soviet Union in 1991 and the formation of Roscosmos in 1992, Russia began implementing new national laws such as the Law of the Russian Federation "About Space Activity."[105] Similar to the laws of other nations, Russia's foundational legal framework not only established onerous licensing policies, but also a space fund.[106] Moreover, it incorporated the Ministry of Defense into securing the safety of

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[100] Strategic Partnership, *supra* note 96; *see also, Legal Framework*, *supra* note 94.
[101] Listner, *supra* note 38.
[102] Dempsey, *supra* note 1, at 16.
[103] Elizabeth Howell, *Roscosmos: Russia's Space Agency,* SPACE.COM (Jan. 30, 2018), https://www.space.com/22724-roscosmos.html [https://perma.cc/J3SE-DN4R].
[104] Dempsey, *supra* note 1, at 27, 30-31.
[105] Howell, *supra* note 103; Law of the Russian Federation "About Space Activity", Decree No. 5663-1 of the Russian House of Soviets, https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/russian_federation/decree_5663-1_E.html [https://perma.cc/858S-RHSP].
[106] Law of the Russian Federation "About Space Activity", *supra* note 105, Art. 13.

the nation as needed.[107] Since 1992, Russia has continued to cooperate on the international stage and recently agreed to work with the U.N. on reducing and combating space debris, or man-made objects that are no longer functioning in Earth's orbit.[108] Russia's collaboration with the U.N. mitigation standards reflects a willingness to cooperate with the international community. However, this cooperation should not be oversold, as relationships with individual nations are still heavily impacted by political tensions.[109]

2. China

As with Russia and other nations, China's space goals have been hampered by disagreements with competing nations while attempting to coordinate exploration efforts within the confines of the Outer Space Treaty.[110] These disagreements must be reconciled to conform with the guidelines and laws that the Chinese government will establish as it pertains to licensing and commercial aerospace.[111] As recently as 2019, China began to formulate new guidelines for commercial launching based on a top-down approach and no indication of involvement from commercial space actors.[112] Somewhat surprisingly, China does not yet have a wider, national space law but plans to introduce one to China's Parliament before 2023.[113] With reportedly twenty commercial launch-related companies in China, new regulations for research and development, safety, and clarification on qualifications required by commercial aerospace enterprises are welcomed.[114] One strategic advantage China may have in the implementation of national regulations is its seemingly singular national approach to the development of space technologies.[115] This national regulatory scheme would help advance its goal of becoming the dominant power in

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[107] Law of the Russian Federation "About Space Activity", *supra* note 105, Art. 13, 22.
[108] A GUIDE TO SPACE TERMS, *supra* note 3, at 114; Russian Federation Space Debris Mitigation Standards, https://www.unoosa.org/documents/pdf/spacelaw/sd/RF.pdf [https://perma.cc/ZGW2-WFU5].
[109] Russian Federation Space Debris Mitigation Standards, *supra* note 108; Marina Koren, *The Chill of U.S.-Russia Relations Creeps into Space,* THE ATLANTIC (Jan. 11, 2019), https://www.theatlantic.com/science/archive/2019/01/nasa-roscosmos-russia-bridenstine-rogozin/579973/ [https://perma.cc/U497-DQLV].
[110] Jose Monserrat Filho & Alvaro Fabricio dos Santos, Chinese-Brazilian Protocol on Distribution of CBERS Products, 31 J. OF SPACE L. 247, 271 (2005).
[111] Dempsey, *supra* note 1, at 32 (noting that for purposes of this article The People's Republic of China does not include Hong Kong and any independent restrictions Hong Kong may have independent of China).
[112] Andrew Jones, *Chinese Commercial Launch Sector Regulations Released, New Launch Vehicle Plans Unveiled,* SPACE NEWS (Jul. 2, 2019), https://spacenews.com/chinese-commercial-launch-sector-regulations-released-new-launch-vehicle-plans-unveiled/ [https://perma.cc/2TAY-DG2V].
[113] *Id.*
[114] *Id.*
[115] Steven L. Kwast, *The Urgent Need for A United States Space Force,* 49 IMPRIMIS 1, 3-4 (2020).

space by 2049.[116] China has already shown its individualistic ambitions by building its own space station, which will be approximately one-fifth the mass of the International Space Station, a project China was barred from by the U.S.[117] Additionally, China became only the second nation to operate a spacecraft on Mars for an extended period of time.[118] The entirely China-led mission was developed by the China National Space Administration and launched atop a Chinese rocket.[119] If other countries follow China's lead by moving toward a more individualistic approach and continuing exploration within industry silos, China will have a distinct economic and strategic advantage, subject only to global regulations.[120]

3. The United States of America

Outer space laws and regulations in the U.S. are not the responsibility of just one agency, but four: the Department of Defense (DoD), the National Aeronautics and Space Administration (NASA), the Department of Transportation (DoT), and the Department of Commerce (DoC).[121] As the primary regulator of space activities, NASA is a civilian agency that exercises control over non-military and non-weapon based space activities.[122] NASA is responsible for carrying out programs involving human space flight, robotic missions, and scientific advancement. NASA must fulfill this responsibility while simultaneously working with other countries' space agencies, even ones with which the U.S. does not typically have stable relations, such as Russia.[123]

Like Russia and China, the U.S. never adopted the Moon Agreement and instead enacted its own legislation. In 2015, the U.S. became the first country to enact a national law regulating the mining of minerals found in outer space with the passage of the SPACE Act.[124] The SPACE

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[116] *Id.*
[117] Andrew Jones, *China's first space station module is ready for flight*, SPACE.COM (Feb. 10, 2021), https://www.space.com/china-space-station-module-tianhe-ready [https://perma.cc/EVV3-PFPL].
[118] Mike Wall, *China's first Mars mission, Tianwen-1, successfully enters orbit around Red Planet*, SPACE.COM (Feb. 10, 2021) https://www.space.com/china-first-mars-mission-tianwen-1-enters-orbit [https://perma.cc/8CM9-UQDU].
[119] *Id.*
[120] Kwast, *supra* note 115.
[121] Twibell, *supra* note 56, at 605.
[122] *Id.* at 606; National Aeronautics and Space Act of 1958, Pub. L. No. 85-568, 72 Stat., 426 (1958) (codified as amended at 42 U.S.C. § 2451 (1994)).
[123] Twibell, *supra* note 56, at 624; *see also National Space Policy*, OFF. SPACE COM., https://www.space.commerce.gov/policy/national-space-policy/ [https://perma.cc/P8MD-DGBA].
[124] *What Are the Legal Issues?*, *supra* note 89.

Act[125] gives private U.S. citizens and space firms the right to own and sell natural resources they have mined from celestial bodies.[126]

Debate persists whether the SPACE Act violates the larger Outer Space Treaty and the Moon Agreement.[127] At a basic level, those that suggest that the SPACE Act violates the Outer Space Treaty do so under the doctrine of the common heritage of all humankind. In other words, by authorizing private citizens to have property rights over space resources, private citizens likely would use these resources for personal gain instead of the betterment of the global community. The allowance of private space property rights would conflict with the Outer Space Treaty's core doctrine of exploration in the interest of the common heritage of all humankind.[128] Other potential violations include the non-appropriation principle. However, the Outer Space Treaty only provides that there may be no claim of a celestial body, not the resources it contains.[129] Had the U.S. been a party to the Moon Agreement, the Space Act would likely violate the Moon Agreement, as the language of the Agreement provides permissible uses of resources.[130]

The Space Act is not the only reason that the U.S. may be in violation of the Outer Space Treaty. Although NASA has traditionally been the agency to send astronauts into space, then-U.S. President Donald Trump announced on December 20, 2019, the creation of the U.S. Space Force, a sixth branch of the U.S. military, in partnership with the U.S. Air Force.[131] Previously a division of the Air Force called Space Command, Space Force was established in response to the fear that a division of the Air Force alone is not sufficient to keep the Russian and Chinese space advancement at bay.[132] The Space Force will be responsible for training forces to respond to a crisis, defend satellites, and support the broader

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[125] Space Resource Exploration and Utilization Act of 2015, Pub. L. No. 114-90, § 402, 129 Stat. 720, 721 (2015) (codified as amended at 51 U.S.C. § 51302(b) (2012)).

[126] Kurt Taylor, Comment, *Fictions of the Final Frontier: Why the United States Space Act of 2015 is Illegal,* 33 EMORY INT'L L. REV. 653, 655 (2019); Legal Framework, *supra* note 94 (explaining that Luxembourg was the second nation to recognize such property rights).

[127] Gbenga Oduntan, *Who Owns Space? US Asteroid-Mining Act is Dangerous and Potentially Illegal*, THE CONVERSATION (Nov. 25, 2015), https://theconversation.com/who-owns-space-us-asteroid-mining-act-is-dangerous-and-potentially-illegal-51073 [https://perma.cc/V5YC-983T]; Taylor, *supra* note 126, at 666.

[128] Oduntan, *supra* note 127.

[129] Craig Foster, Note, *Excuse Me, You're Mining My Asteroid: Space Property Rights and the U.S. Space Resource Exploration and Utilization Act of 2015,* U. ILL. J. L. TECH & POL'Y 407, 423 (2016).

[130] The Moon Agreement, *supra* note 36.

[131] *U.S. Space Force Fact Sheet*, U.S. SPACE FORCE, https://www.spaceforce.mil/About-Us/Fact-Sheet [https://perma.cc/H3KJ-ZE3V]; *Air Force Tries to Set Record Straight on what the Space Force is Really About,* SPACE NEWS (Sept. 18, 2019), https://spacenews.com/air-force-tries-to-set-record-straight-on-what-the-space-force-is-really-about/ [https://perma.cc/Q5WB-NTST].

[132] Lara Seligman, *One Small Step for Trump's Space Force,* FOREIGN POL'Y (Aug. 29, 2019), https://foreignpolicy.com/2019/08/29/one-small-step-for-trump-space-force-space-command/ [https://perma.cc/4LW2-MYWD].

space goals of the nation.[133] Should such a threat arise, such as an attack on a satellite, the U.S. will need to ensure compliance with the Outer Space Treaty, which prohibits the militarization of space along with other provisions.[134]

In 2020, the U.S. again challenged the bounds of the Outer Space Treaty by releasing the Artemis Accords.[135] The Accords aim "to ensure international cooperation and a 'safe, peaceful, and prosperous future' for everyone on the moon".[136] However, the language of the Accords and an executive order issued by President Trump, which declares that "outer space is a legally and physically unique domain of human activity, and the United States does not view it as a global commons," suggest that the U.S. seeks to unilaterally define the more vague and controversial aspects of space law.[137]

B. *Private Companies*

No company is able to operate in a purely private capacity and without State partnerships because of a need for government funding and the government's need for additional research due to decreases in funding and resources.[138] Private companies fall into two categories: (1) those focused on commercial space travel and (2) those focused on mining and space resources.

1. Commercial Space Travel and Colonization

A growing need for regulation persists in the U.S. as more civilians are able to travel to space without governmental control.[139] SpaceX, a U.S. based company founded in 2002, has grown in popularity over the years. This popularity is partly due to the corporation's founder and CEO Elon Musk, and his well-publicized plan to establish a Martian colony. The company's historic milestones, such as being the only private company to possess a spacecraft capable of returning from low Earth orbit and

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[133] Erwin, *supra* note 131.
[134] The Outer Space Treaty, *supra* note 22.
[135] Leonard David, *NASA Proposes New Rules for Moon-Focused Space Race*, SCI. AM. (May 21, 2020), https://www.scientificamerican.com/article/nasa-proposes-new-rules-for-moon-focused-space-race/?print=true [https://perma.cc/TJ4Q-GCLF].
[136] *Id.*
[137] *Id.*
[138] Benjamin Perlman, Note, *Grounding U.S. Commercial Space Regulation in the Constitution*, 100 GEO. L. J. 929, 940 (2012).
[139] Tunku Varadarajan, *The New 'Gold Rush in Space'*, WALL ST. J. (Aug. 8, 2020, 2:47 PM), https://www.wsj.com/articles/the-new-gold-rush-in-space-11596826062 [https://perma.cc/7569-DJKA].

creating the first commercial spacecraft to deliver cargo to the International Space Station, have increased the company's notoriety.[140] SpaceX is constantly reusing portions of previous rockets and making new improvements to lower the cost of each launch, which in turn lowers the cost of a commercial ticket to outer space.[141] SpaceX's advancements simultaneously demonstrate the potential of space tourism and the need for regulatory measures because the people who will be traveling to space as civilians will hardly be trained government actors.[142]

As more private companies embark on privately funded space exploration, the U.S. must regulate the space tourism industry. The entire international community will also eventually need more consistent and binding regulations. This necessity became evident with the emergence of space travel company Blue Origin, owned by Amazon founder Jeff Bezos.[143] Blue Origin became the first company to launch a rocket into space, land it upright, and repeat the process two months later.[144] The Blue Origin rockets use liquid fuel for precision landing, for reusable rockets, and for powering in-space systems.[145] Like SpaceX, Blue Origin aims to decrease costs and increase access by operating rockets like airplanes.[146] Eventually, Bezos foresees heavy industry moving to space in order to protect the Earth, which would remain residential.[147] For now, Blue Origin's primary customer is the United Launch Alliance, which contracts with clients such as NASA and the U.S. military, because of their advanced engine technology.[148]

The need for international regulation of the commercialized space industry is more apparent when the U.S. is not the only participant. The privately-owned Chinese company Land Space Technology Corporation Ltd. (Land Space) is devoted to providing low-cost commercial launch vehicles.[149] Similar to Blue Origin, Land Space also uses liquid-fuel rocket

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[140] SpaceX, *Elon Musk: The Case for Mars*, YOUTUBE (July 9, 2013), https://www.youtube.com/watch?v=Ndpxuf-uJHE&feature=emb_title [https://perma.cc/8W93-PRBU]; *About,* SPACEX, https://www.spacex.com/about [https://perma.cc/MF43-WBQR].

[141] Darrell Etherington, *Elon Musk says SpaceX's Starship Could Fly for as Little as $2 Million per Launch,* TECHCRUNCH (Nov. 6, 2019), https://techcrunch.com/2019/11/06/elon-musk-says-spacexs-starship-could-fly-for-as-little-as-2-million-per-launch/ [https://perma.cc/89HL-BVKY].

[142] Perlman, *supra* note 138, at 941.

[143] Charles Fishman, *Is Jeff Bezos' Blue Origin the Future of Space Exploration?,* SMITHSONIAN MAG. (Dec. 2016), https://www.smithsonianmag.com/innovation/rocketeer-jeff-bezos-winner-smithsonians-technology-ingenuity-award-180961119/ [https://perma.cc/WBE2-PRJR].

[144] *Id.*

[145] *Engines*, BLUE ORIGIN, https://www.blueorigin.com/engines/ [https://perma.cc/KE7B-Z5PL].

[146] *Our Mission*, BLUE ORIGIN, https://www.blueorigin.com/our-mission [https://perma.cc/VRB2-VNFK].

[147] Fishman, *supra* note 144.

[148] *Id.*

[149] *About Us*, LANDSCAPE, http://landspace.com/site/about [https://perma.cc/LPY4-CQ44].

engines and works to provide the global market with a consistent and reusable product.[150]

2. Privatization of Space Resources and Debris

The commercialization of space is not limited to tourism or engine development but extends to probable for-profit activities.[151] Such for-profit space activities include mining of outer space resources such as water and minerals.[152] The Japanese company ispace is working on the use of lunar resources to create a lunar city by 2040.[153] While a lofty goal, the company recognizes the potential behind lunar water as both a propellant and catalyst for a space-based economy.[154] Although ispace is based in Japan, the company has offices in the U.S. and Luxembourg. Additionally, ispace has signed project agreements with the Japan Aerospace Exploration Agency (JAXA) and the Government of Luxembourg.[155] Recently, ESA selected ispace to support the mission of extracting water at the Lunar South Pole by 2024 or 2025.[156] Before that mission occurs, ispace is taking its first two lunar missions, using SpaceX's Falcon 9 rocket, to lay the groundwork for high-frequency commercial missions.[157] The business plan of ispace is supported by other countries beyond its home country—this is a business style that many of the well-known or successful private companies follow.

Canadian start-up, NorthStar Earth and Space, is successful with just the backing of its home nation, whose government has already invested almost $13 million to develop the ability to track and monitor space debris.[158] NorthStar aims to combat the possibility of space collisions by tracking and monitoring objects in Near Earth Orbit (NEO).[159] Companies, such as NorthStar, are able to take advantage of the gaps created by the Outer Space Treaty because under current international policy spacefaring

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[150] *Id.*
[151] A GUIDE TO SPACE TERMS, *supra* note 3, at 24 (explaining how space commercialization includes both the for-profit activities in space and the prefatory to space activities).
[152] *Expand our planet. Expand our future,* ISPACE, https://ispace-inc.com/ [https://perma.cc/8ASU-G7JZ]; *Home*, TRANS ASTRONAUTICA CORP., https://www.transastracorp.com/ [https://perma.cc/C3YQ-Y75H] [hereinafter TransAstra].
[153] ispace, *ispace 2040 Vision Movie,* YOUTUBE (Dec. 12, 2017), https://www.youtube.com/watch?v=r7CW92i0z_o&feature=emb_title [https://perma.cc/5KQF-GGW3].
[154] *About Us,* ISPACE, https://ispace-inc.com/aboutus/ [https://perma.cc/UV62-J3MN].
[155] Joint Press Release, ispace ESA, ispace Selected by European Space Agency to Support Lunar Mission (July 25, 2019).
[156] *Id.*
[157] *Id.*
[158] Neel V. Patel, *This Company Wants to Deal with Space Junk by… Sending More Stuff into Space,* MIT TECH. REV. (Sept. 16, 2019), https://www.technologyreview.com/s/614313/this-company-wants-to-deal-with-space-junk-by-sending-up-more-space-junk/ [https://perma.cc/L2JJ-BUDD].
[159] NORTHSTAR EARTH & SPACE, https://northstar-data.com/ [https://perma.cc/BB6Z-TR8H].

nations are prevented from removing debris left in space by other actors.[160] NorthStar Earth and Space uses space imaging to aid navigation in space and to detect collision of space debris.[161] It is essential that the company has a strong backing from its government, especially if its industry within the space sector, such as space traffic management (STM), can only be regulated by States, not private companies.[162] This mission will be increasingly difficult as NorthStar begins commercial operations in 2021. Even if the control of STM was not exclusive to states, there is no international standard for managing STM.[163] Additionally, no one State has exclusive sovereignty in outer space—to do so would require international cooperation.[164]

Without an international agency to coordinate the entrance and exit of spacecrafts through Earth's atmosphere and the movement of spacecrafts and satellites once in outer space, it is important that as many private companies as possible coordinate their mission with States which can better coordinate standards for STM.[165] As more private companies make plans to enter space the need for more resources in space increases, which is where the efforts of Trans Astronautica Corporation (TransAstra) come in.[166]

TransAstra is a private company focused on providing an outer space transportation system limited exclusively within outer space alone, using resources in space to fuel the transportation system.[167] With the scale of the project and the plan to create a cislunar railway between Earth and

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[160] Theresa Hitchens, *US Needs New Policies With Move To Cislunar: Aerospace Corp.*, BREAKING DEF. (June 16, 2020), https://breakingdefense.com/2020/06/us-needs-new-policies-with-move-to-cislunar-aerospace-corp/ [https://perma.cc/5P5V-4LGA].

[161] NORTHSTAR EARTH & SPACE, *supra* note 159.

[162] Larsen, *supra* note 38, at 747; Space Traffic Management is the regulatory provisions set in place to endure the safe access to and from outer space, among other duties. A GUIDE FOR SPACE TERMS, *supra* note 3, at 129; STM was formally recommended to the U.N. General Assembly in 2007. *A/RES/62/101*, U.N. OFF. OUTER SPACE AFFAIRS (2007), https://www.unoosa.org/oosa/oosadoc/data/resolutions/2007/general_assembly_62nd_session/ares62101.html [https://perma.cc/J7TM-M4DT].

[163] Amanda Morrow, *Why Tracking Space Junk is a Big Business,* RADIO FRANCE INTERNATIONALE (Sept. 19, 2019), http://www.rfi.fr/en/economy/20190918-northstar [https://perma.cc/H49M-H3W4]; Patel, *supra* note 158; Larsen, *supra* note 38, at 747.

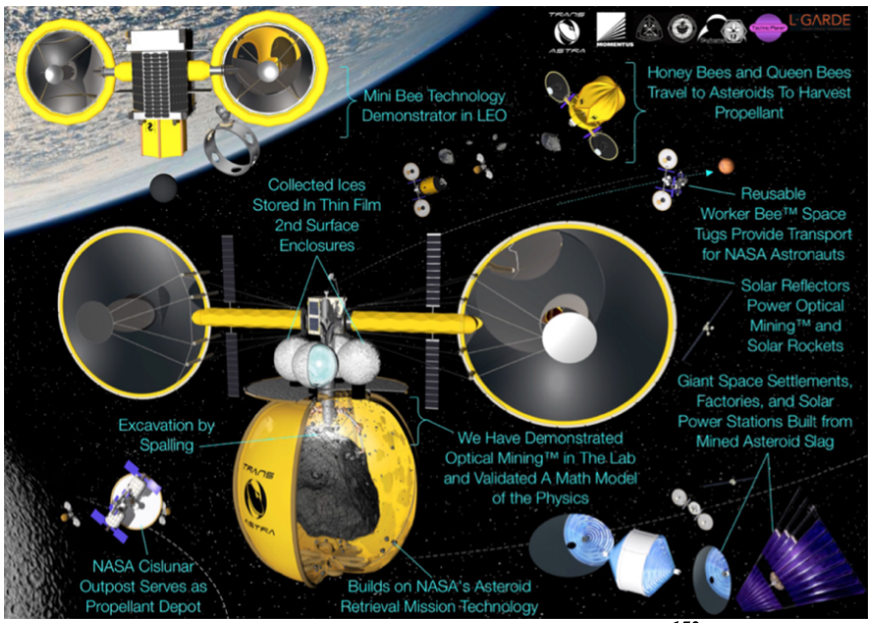
[164] *Id*.

[165] Larsen, *supra* note 38, at 748; Elizabeth Howell, *Avoiding Space Debris Might Require New Legal Framework, US Lawmakers Say,* SPACE.COM (Feb. 18, 2020), https://www.space.com/space-situational-awareness-house-hearing-february-2020.html [https://perma.cc/X4TC-47YB]. The need for an international STM system is even more pressing after "two large, defunct and uncontrollable satellites nearly collided" in early 2020 and at the end of 2019 the ESA was required to redirect a satellite to avoid a collision with a SpaceX satellite, who failed to respond to requests to move the machine. *Id.*

[166] TransAstra, *supra* note 152.

[167] Trans Astronautics Corporation, *TransAstra Linchpin to the New Industrial Revolution*, YOUTUBE (June 17, 2019), https://www.youtube.com/watch?v=hLijoedlE2A&feature=emb_title [https://perma.cc/4FQV-JCS3] [hereinafter TransAstra Linchpin].

the Moon,[168] it is evident why TransAstra is primarily funded by NASA as they provide access to the international STM network.[169] This public-private partnership will eventually result in the development of Apis™, which is a collection of flight systems, ranging in size, that are capable of capturing asteroids and extracting resources immediately to use as a propellant for the transportations systems.[170] Included in the Apis™ mission fleet is the Mini Bee (seen in the diagram below) which will use solar power to engulf the asteroid and mine the water; the Minibee will subsequently use the mined water as a propellant and energy source.[171]



Apis, Joel Sercel, TransAstra Corporation[172]

The range of diversity among the private space industry is astounding, and while the lack of regulation is not yet a problem, it soon will be. Advancements made by private companies and individual nations

[168] David, *supra* note 135. "There is no legal definition of cislunar space, but in general it refers to the orbits between Geosynchronous Orbit — 36,000 kilometers above the Earth — and the Moon. Some definitions include orbits slightly beyond the Moon. Hitchens, *supra* note 160.
[169] TransAstra Linchpin, *supra* note 167.
[170] Joel Sercel, *Mini Bee Prototype to Demonstrate the Apis Mission Architecture and Optical Mining Technology,* NAT'L AERONAUTICS & SPACE ADMIN. (June 11, 2019), https://www.nasa.gov/directorates/spacetech/niac/2019_Phase_I_Phase_II/Mini_Bee_Prototype/ [https://perma.cc/DDZ5-CHE3]; *Apis,* TRANS ASTRONAUTICA CORP., https://www.transastracorp.com/apis.html [https://perma.cc/Q3C6-VE2Z]; TransAstra Linchpin, *supra* note 167.
[171] *Apis, supra* note 170.
[172] *Id.*

are increasing. Too soon will inconsistent licensing regulations by individual governments, unpredictable recognition of property rights, and lack of a uniform STM and other safety regimes, lead to disastrous consequences that could have been avoided.[173]

V. GAPS IN GLOBAL REGULATION & THE CURRENT LIMITATIONS ON FUTURE SPACE ACHIEVEMENT

It is not just the lack of organization of private and public companies in the space sector that needs modification. The current international regulatory scheme employed by the space community is under-inclusive. Scientific advancements in individual countries are outpacing the generalized language and limitations of the treaties. Not only are major players only bound to the generalized Outer Space Treaty, but the regulatory system is based on the faulty assumption that the States will follow customary and traditional international law principles. Countries are not obligated to follow customary international law, as evidenced by the U.S. and Luxembourg being the first two nations to establish independent national legislation allowing private entities to retain property rights over items collected from space.[174] Because non-binding international agreements are rarely regarded as binding customary rules, the international space community needs a new agreement, akin to the Moon Agreement, that addresses the great advancements in space exploration and the future concerns that are no longer distant.[175] The new agreement should be accompanied by a code of ethics as an additional measure to hold states accountable and establish flexible but specific regulations addressing space resources, property, the fuel-creation process, and enforcement of compliance by State and private entities.

A. *Space Resources*

The current body of outer space law generally refers to all celestial bodies and typically does not provide any more specific designations, which has led to an interpretation that celestial bodies are considered to be anything not man-made.[176] The revised doctrines should create more specific categories of space objects for regulation, separating out objects that can be used for resource mining, such as asteroids.[177] Asteroids come in various classifications and offer different resources ranging from metals

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[173] Larsen, *supra* note 38, at 750.

[174] Wessel, *supra* note 21, at 297-98; A GUIDE TO SPACE LAW TERMS, *supra* note 3, at 37. Customary international law consists of the "general and consistent practice of States followed by them from a sense of legal obligation." *Id.*

[175] Wessel, *supra* note 21, at 299.

[176] The Outer Space Treaty, *supra* note 22.

[177] Adam Mann, *The Plan to Bring Asteroid to Earth,* WIRED (Oct. 5, 2011), https://www.wired.com/2011/10/asteroid-moving/ [https://perma.cc/H5T6-D5UN].

that can be used in space construction, to water that can be broken down into hydrogen and oxygen and used for fuel, and asteroid regolith which can be used as a shield around a spacecraft to prevent damage from radiation, necessary for deep space exploration and travel.[178] There is the potential for parties to generate significant wealth by mining lunar and asteroid water ice, gathering up helium-3 fuel for nuclear reactors, or even moving heavy industry to the moon.[179] With all the potential benefits and uses for the resources mined from asteroids, it is inevitable that people will attempt to lay claim to asteroids, especially if the extraction is lucrative, and a simple non-appropriation principle will not be sufficient.[180] The mining industry is commercial, and eventually States will likely need to participate, either to keep up with the scientific advancements for exploration purposes or for the sake of their own economies. Currently, if States themselves wish to enter into the space mining industry, without the partnership of a private company, they are prohibited from bringing anything from outer space back into Earth's orbit, and the State would have to share the samples for the advancement of scientific research for the international community, not for profit.[181]

Additionally, without regulations specific to mining practices, the ability for some individuals or companies to collect and possibly sell resources may decrease the rarity in the metal, therefore resulting in its devaluation.[182] For example, gold is abundant in space.[183] If mined and brought back to Earth, gold would become more common and therefore less valuable.[184] It is equally unsustainable if rare minerals found on Earth that have become depleted are found in space and then sold on Earth, possibly leading to inflation.[185]

Therefore, the new agreement must contain an article or provision that specifically regulates the sale of minerals collected from outer space and sold on Earth, rather than prohibiting the process entirely. Such regulation comes in the form of public-private partnerships, such as TransAstra and NASA in the development of the Apis program.[186] If international law

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[178] *Id.*
[179] Leonard David, *Is Earth-moon space the US military's new high ground?*, SPACE.COM (Sept. 17, 2020), https://www.space.com/earth-moon-space-us-military-high-ground.html [https://perma.cc/3E9X-NFWE].
[180] Leon, *supra* note 65, at 505.
[181] The Outer Space Treaty, *supra* note 22; Twibell, *supra* note 56.
[182] Alex Hern, *If you're going to mine in space, the last thing to do is bring minerals back down to earth,* NEW STATESMAN (Jan. 23, 2013), https://www.newstatesman.com/technology/2013/01/if-youre-going-mine-space-last-thing-do-bring-minerals-back-down-earth [https://perma.cc/R2UA-AB3N].
[183] *Id.*
[184] *Id.*
[185] *Id.*
[186] Sercel, *supra* note 170.

required States on a national and global level to work with private companies to mine space objects, the private company would fall under the purview of the agreement and the State would not necessarily be in violation of the Outer Space Treaty. Even if there was no concern about the resources affecting the global economy of Earth, there is still a need for the regulation of mining resources that never enter low-Earth orbit.[187] It will be important to solidify the public-private relationships before it is too late.[188] These public-private partnerships can be implemented across the space sector in conjunction with a code of ethics and international regulation to close the loophole a country or private company can use to evade the Treaty.

B. *Property*

The ability to mine asteroids and other resources also raises the issue of private property rights, even if interpreted to allow the mining of resources, because the existing space law régime prohibits ownership of the celestial body being mined.[189] Under the current Outer Space Treaty, any claim of property in space by a single country would alienate other countries and be a recognition of appropriation—even recognition of a small area.[190] This issue is especially problematic for any business that has an office, or wishes to establish a mine, on the Moon. A business would never own the land underneath, and the lack of an established régime can pose a substantial barrier to space exploration.[191] The grant of private property rights in space needs to be carefully constructed because traditional property law is insufficient. Property value does not carry the same weight as it would on Earth because the value of space property has not been established,.[192]

Applying the non-appropriation principle to States has clear benefits as no one country should have unbridled control over outer space. However, that is not to say that private actors should not be allowed to purchase land in space, if they can afford it. Although, it would be necessary to ensure that a State does not find a work-around and acquire land with the assistance of or by posing as a private company. To avoid one

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[187] Eventually, it would make sense to implement a space currency because outer space will become its own quasi-nation and what is mined will need regulation principles in existence before the possibility for an abuse of the lack of regulation occurs.
[188] Tennen, *supra* note 40.
[189] The Outer Space Treaty, *supra* note 22.
[190] *Id.*
[191] Taylor, *supra* note 126, at 361.
[192] Brandon C. Gruner, Comment, *A New Hope for International Space Law: Incorporating Nineteenth Century First Possession Principles into the 1967 Space Treaty for the Colonization of Outer Space in the Twenty-First Century,* 35 SEATON HALL L. REV. 299, 312 (2004); *see generally* Rand Simberg, *Property Rights in Space,* THE NEW ATLANTIS (2012), https://www.thenewatlantis.com/publications/property-rights-in-space [https://perma.cc/9JU9-7682].

company, or individual, from taking advantage of the market, the new space law régime should limit how much a person or business can own.[193] This is necessary because the market is relatively small and would have insufficient competition to produce a fair result in power.[194] Property ownership must be encouraged because it reduces outer space waste by promoting the use of space resources, enabling the ability to transfer or alienate property (which creates an incentive to productively develop space), and potentially leading to colonization that can possibly help solve population problems experienced on Earth.[195] Relaxing the non-appropriation principle for non-government agencies has more positive effects than negative ones. In fact, because all space activities must be for the betterment of all humankind, allowing some private ownership would further the benefit of research for the common heritage of humankind, maintaining the original intent of the Outer Space Treaty.[196]

C. *Fuel (to get to Mars and Beyond)*

Many people only talk about either the beginning of the space journey or the end, but what is possibly more important is how the people got there. It is clear that a voyage from Earth to a distant location is expensive and impractical because currently spacecrafts must carry all of their fuel with them.[197] For example, studies are exploring how spacecrafts might refuel after entering outer space, with nuclear materials or water.[198]

The international space sector has investigated using nuclear reactors to produce heat energy that can be converted to electricity to power the spacecraft's systems, or that can be harnessed into direct propulsion.[199] However, this process alone can be too limiting as a possible fuel choice, especially when considering the restrictions of nuclear weaponry in space. For example, the U.S. legislation that outlines the steps required to launch a nuclear-capable object into space is quite cumbersome and requires approval from several different departments and the White House.[200]

Once the resources are accessible, a simpler and more global approach would be to include a provision of the agreement that addresses the

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[193] Brehm, *supra* note 63, at 369-370.
[194] Thomas E. Simmons, *Deploying the Common Law to Quasi-Marxist Property on Mars,* 51 GONZ. L. REV. 25, 30 (2015/2016).
[195] Ezra Reinstein, *Owning Outer Space,* 20 NW J. INT'L L & BUS. 59, 75-76 (1999).
[196] Timothy Justin Trapp, Note, *Taking up Space by any Other Means: Coming to Terms with the Non-Appropriation Article of the Outer Space Treaty,* 2013 U. ILL. L. REV. 1681, 1713 (2013).
[197] Loren Grush, *Why Mining the Water on the Moon Could Open up Space Exploration,* VERGE (Aug. 23, 2018), https://www.theverge.com/2018/8/23/17769034/nasa-moon-lunar-water-ice-mining-propellant-depots [https://perma.cc/55GH-X56F].
[198] *Id.;* Steven A. Mirmina & David J. Den Herder, *Issues in Space Law: Nuclear Power Sources and Future Space Exploration*, 6 CHI. J. INT'L L. 149 (2005).
[199] Mermina & Den Herder., *supra* note 198, at 155.
[200] *Id.* at 166.

conversion of water to fuel. Water exists in many forms throughout the galaxy and has the potential to fuel a spacecraft beyond Mars and our solar system.[201] ispace, ESA, and other scientists are already exploring the use of water as a fuel source.[202] A spacecraft leaving Earth is currently able to reach both the Moon and nearby asteroids. Quick access to the Moon is essential if it is to be an option as a launch pad for further space exploration.[203]

However, this might be a problem because while the Moon can be used as a "launch site" and for scientific purposes, if water is successfully extracted without more concretely defined regulations, it will be more difficult to impose the limitation on scientific advancement, and the Outer Space Treaty would be pointless. Private companies and States alike would flock to the Moon and begin mining. Therefore, the implementation of stricter regulations regarding resources is necessary. Such regulations could include placing limits on how much can be extracted from a planet or the Moon and on how much one person can export. This restriction, along with a public-private partnership will aid in the preservation of space resources and celestial bodies while also using a cheaper (in the long run), necessary source of energy.[204]

D. *Limitations of the Current Treaty—No Police, No Enforcement*

The Outer Space Treaty, and the treaties that have followed, primarily only bind State actors and are limited in enforcement to civil action.[205] STM rules can only be created by States, meaning commercial operations have no policing power, and the enforcement of civilian treaties are kept separate from military treaties.[206] The problem exists both because commercial organizations have no policing power in space and because States have heavily relied on the benefits afforded by public-private partnerships and could have limited abilities without the assistance of com-

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[201] *Water Found for First Time in Atmosphere of Planet Outside Earth's Solar System,* EURONEWS (Sept. 12, 2019), https://www.euronews.com/2019/09/12/water-found-for-first-time-in-atmosphere-of-planet-outside-earth-s-solar-system [https://perma.cc/8UZJ-2S4P]; *Water for Rocket Fuel Extracted from Asteroids and the Moon,* KCBS RADIO (Sept. 23, 2019), https://kcbsradio.radio.com/media/audio-channel/water-rocket-fuel-extracted-asteroids-and-moon [https://perma.cc/3AKW-VPGU].

[202] ispace, *supra* note 154.

[203] Grush, *supra* note 197.

[204] *Id.*; *see also* Rob Davies, *Asteroid mining could be space's new frontier: the problem is doing it legally,* GUARDIAN (Feb. 6, 2016), https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues [https://perma.cc/3NFE-HQQV].

[205] *See generally* Jill Stuart, *The Outer Space Treaty has been remarkably successful – but is it fit for the modern age?*, CONVERSATION (Jan. 27, 2017), https://theconversation.com/the-outer-space-treaty-has-been-remarkably-successful-but-is-it-fit-for-the-modern-age-71381 [https://perma.cc/E44D-8ZDT].

[206] Larsen, *supra* note 38, at 743-746.

mercial operations. No one State can own space, and a State has no jurisdiction or sovereignty over celestial bodies.[207] Because of a lack of property interest, States may be less than willing to provide for the enforcement of property rights until they have some incentive.

However, there is an argument to be made that the language in the Outer Space Treaty specifically prohibiting States from owning property in space was also meant to include any private actors that may come forward.[208] There needs to be a military provision of the agreement that provides for an independent enforcement agency from any one State with the capabilities of regulating the activities of States that are not a part of treaties. This way there is an established policy for all individuals in space to follow, even if their specific country did not sign on.

VI. CONCLUSION

The advancements in space exploration have occurred seemingly overnight. The need for flexible and more specific laws and policies are apparent, especially as many countries and private companies have ambitious goals for the commercialization of outer space. These regulations, requiring public-private partnerships and addressing the mining of resources and fuel development, must be established and implemented as soon as possible. It is time that the international space sector takes a proactive, rather than reactive, approach to regulation.

Rapid changes in space advancements and contradictions in space policies set the stage for a major international crisis. Individual state action, such as the U.S. creating a specific branch of the military dedicated to protecting space, stresses the importance of a treaty or agreement with weight and consequences behind a violation. The new agreement must account for the dynamic space industry and the non-traditional players. With more participants in space exploration and feasible activities than the original treaty over fifty years ago, it is time for the U.N. to modernize the treaty and sufficiently address the inevitable issues of property rights, space debris, the militarization of celestial bodies, and colonization.

It is essential to address the potential future conflicts now. Once space becomes accessible for all humankind, new complications that cannot be solved by a treaty will inevitably arise, such as the development of an independent economic structure, space-specific laws, a new culture, and potentially even new species.

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[207] Abigail Pershing, Note, *Interpreting the Outer Space Treaty's Non-Appropriation Principle: Customary International Law from 1967 to Today*, 44 YALE J. INT'L L. 149, 155-56 (2019).
[208] The Outer Space Treaty, *supra* note 22.