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Asset-Based Financing For Space Activities

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**ASSET-BASED FINANCING FOR SPACE ACTIVITIES:
PROBLEMS AND PROPOSALS**

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ABSTRACT

The space industry—whose numbers are already substantial—has undeniable potential for further growth. However, because it no longer consists of only multibillion-dollar companies, the industry needs access to traditional financing. Venture capital alone is insufficient. This Article discusses some difficulties for the space industry’s access to traditional—and especially asset-based—financing. Some are common to all space activities, while some exist only for novel space activities. These difficulties cover a broad range of legal, regulatory, and factual issues (including insurance). While the problems are difficult, ideas to solve them are plentiful, a number of which the paper discusses. The paper also presents ways in which the industry can do much to advance its own interests. In addition, actions by governments, both at the domestic and the international level, are recommended.

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I. INTRODUCTION

The revenues of the space industry are substantial, as is the number of companies operating in the industry.¹ In May 2021, 5,582 companies operated in the U.S., and more than 10,000 operated globally—resulting in a combined value of over \$4 trillion.² These numbers are only going to increase³ due to the lowering cost of space activities⁴ and the many opportunities

¹ In 2019, the global space industry accounted for \$360B. Hamza Hameed, *Asset-based Financing in the Space Industry*, United Nations/Turkey/APSCO Conference on Space Law and Policy (Sept. 2019), https://www.unoosa.org/documents/pdf/spacelaw/activities/2019/Hamza_Hameed_-_UN_Turkey_APSCO_-_Space_Protocol_Presentation.pdf [<https://perma.cc/5KSK-828T>].

² John Koetsier, *Space Inc: 10,000 Companies, \$4T Value . . . And 52% American*, FORBES (May 22, 2021, 11:16 PM), <https://www.forbes.com/sites/johnkoetsier/2021/05/22/space-inc-10000-companies-4t-value—and-52-american/?sh=5b6a97c355ac> [<https://perma.cc/GQG4-XC7Q>].

³ See *Creating Space, The Space Economy's Next Giant Leap*, MORGAN STANLEY, <https://www.morganstanley.com/Themes/global-space-economy> [<https://perma.cc/Z6BN-SFC9>].

⁴ See Koetsier, *supra* 2 (“Launch technology continues to improve, bringing orbital delivery costs down to an estimated \$500/kilogram in SpaceX’s Starship, as opposed to \$20,000/kilogram on NASA’s iconic Space Shuttle.”).

offered by new space.⁵ Accordingly, the industry will likely surge in the next few years.⁶ However, an increasing number of companies in the space industry face a credit problem.⁷

Until now, space companies have financed their operations in various (but not always efficient) ways: government funds, financial capacity of their founders, equity finance, unsecured financing, project finance, and most of all, with seed and venture capital.⁸ Space companies seeking financing—when they are not multibillion-dollar companies that have been operating in the space business for decades—have significant problems in accessing credit.

This Article argues that space companies should have access to more traditional credit, primarily for activities in Earth’s orbit. For these activities, asset-based financing should be available, but factual⁹ and legal problems exist that hinder access.¹⁰ Understandably, in the short term, cislunar, lunar, asteroid, and Mars activities—and all the activities that have a return on their investment that begins more than ten years in the future—are likely to face reluctance in the traditional financing system. However, as

⁵ “New space” usually includes activities like rendezvous and proximity operations, space resource utilization, and space tourism. (See, e.g., Kaitlyn Johnson, *Key Governance Issues in Space*, CTR. FOR STRATEGIC & INT’L STUD. 18-24 (Sept. 1, 2020), https://aerospace.csis.org/wp-content/uploads/2020/09/Johnson_GovernanceInSpace_WEB_FINAL-1.pdf [<https://perma.cc/73C7-GBSE>]; Gerald B. Sanders, *Space Resource Utilization: Technologies and Potential Synergism with Terrestrial Mining*, NASA (May 2015), <https://ntrs.nasa.gov/api/citations/20150003499/downloads/20150003499.pdf> [<https://perma.cc/MZ4Q-2XN4>]; Malgorzata Polkowska, *Space Tourism Challenges*, 45 REV. EUR. & COMPAR. L. 153 (2021).

⁶ See Michael Sheetz, *The Space Industry is on its way to Reach \$1 Trillion in Revenue by 2040*, *Citi says*, CNBC (May 21, 2022, 7:00 AM), <https://www.cnbc.com/2022/05/21/space-industry-is-on-its-way-to-1-trillion-in-revenue-by-2040-citi.html> [<https://perma.cc/L9B3-AL8D>].

⁷ See Edward Hearst, *America’s SPAC-Funded NewSpace Industry is Crashing*, SPACE-NEWS (May 10, 2023), <https://spacenews.com/op-ed-americas-spac-funded-newspace-industry-is-crashing/> [<https://perma.cc/2G54-ZCR3>].

⁸ Hameed, *supra* note 1, at 5; see Nathan Whigham & Charles Stotler, *It’s Time for Private Credit to Lend to the Space Industry*, FOUND FOR THE FUTURE (2021), <https://www.dropbox.com/s/za0vr4uta493vav/It%27s%20Time%20For%20Private%20Credit%20to%20Lend%20to%20the%20Space%20Industry.pdf?dl=0> [<https://perma.cc/3WZT-RHEQ>]. See also Tereza Pultarova, *After a Year of Bust, Will Space Investment Rebound in 2024?* (FEBRUARY 20, 2024), available at https://interactive.satellitetoday.com/via/march-2024/after-a-year-of-bust-will-space-investment-rebound-in-2024/?utm_source=Via+Satellite+Email&utm_medium=email&utm_campaign=DNF+Email (arguing that venture capital has become more elusive for space companies recently, the trend is expected to continue in 2024 with a gradual improvement anticipated, particularly for companies with robust business plans.).

⁹ See *id.* at 13–17.

¹⁰ See *id.* at 3–25.

the time horizon changes (either as the horizon becomes closer or because of a sudden and unexpected acceleration), this Article argues that these activities should also have access to traditional financing.

Part II deals with the ways space companies currently finance their operations, the limitations of this structure, and how space companies need access to more traditional financing, focusing on asset-based financing. Part III.A deals with several hurdles that impede this type of financing. Part III.B deals with some additional problems for financing new space. Part III also offers some legal solutions, for example, amendments to Article 9 of the Uniform Commercial Code (U.C.C.) and ratification of the 2012 Space Protocol of the Cape Town Convention.¹¹ For activities beyond Earth's orbit, this Article recommends clarifications of some legal issues and adjustments to frequency regulations. This Article suggests that domestically—in the United States—it is necessary to resolve the issue of rulemaking and licensing authority for activities in earth orbit and beyond.

Part IV discusses the ways in which the space industry could proactively help solve some of its financing difficulties. Besides lobbying for forward-thinking regulation, the industry could improve its financial worthiness by helping to establish practices or using special technologies (e.g., blockchain) to reassure lenders.

II. SPACE COMPANY FINANCING: THE WAYS SPACE COMPANIES ARE CURRENTLY FINANCED AND LIMITATIONS

To understand the financing problem space companies face, it is useful to divide the industry into three categories. The first category—which until now has comprised the bulk of the space industry—consists of well established, typically large, and often public, companies.¹² These large, publicly held companies do not

¹¹ Protocol to the Convention on International Interests in Mobile Equipment on Matters Specific to Space Assets, *opened for signature* Mar. 9, 2012, UNIDROIT [hereinafter Space Protocol].

¹² Hameed, *supra* note 1, at 5. This category includes well-known companies such as Boeing, Northrup Grumman, and Lockheed Martin to name a few. *See, e.g., Space Overview*, BOEING, <https://www.boeing.com/space/> [<https://perma.cc/889Z-YQDN>] (last visited Feb. 07, 2024); *Space*, NORTHROP GRUMMAN, <https://www.northropgrumman.com/space> [<https://perma.cc/DC7Q-RZ24>] (last visited Feb. 07, 2024); *Space*, LOCKHEED MARTIN, <https://www.lockheedmartin.com/en-us/capabilities/space.html> [<https://perma.cc/2LR8-JPFF>] (last visited Feb. 07, 2024).

have a credit problem for their space ventures.¹³ In many cases, they finance these activities out of retained earnings or obtain financing based on their general creditworthiness.¹⁴ The second category consists of startups, which hardly receive—in space and elsewhere—asset-based financing.¹⁵ The third category includes companies that are more mature than startups and have a reasonable business that is currently profitable or likely to be so within a reasonable period of time. Both the second and third categories have financed their operations in a variety of (often) inefficient ways: government funds (or other types of benefits), financial contributions of their founders, equity finance, unsecured financing (if the entity is creditworthy), project finance, and primarily seed/venture capital.¹⁶ To give an example, in 2021 the majority of the private investment in space (“\$9 billion of the \$15 billion” that was raised) came from venture capital.¹⁷ Alternative financing structures exist but are specific to certain types of space objects or activities and do not compare in importance with venture capital.¹⁸

In established industries, companies that are more mature than startups generally do not finance themselves only through venture capital¹⁹ because this type of financing is temporary²⁰ and selective. Venture capitalists tend to invest only in certain types of companies, in particular, early-stage companies having certain characteristics such as scalability or technology that may be of in-

¹³ See Hameed, *supra* note 1, at 5.

¹⁴ Hameed, *supra* note 1, at 5. Traditional space companies (e.g., military contractors and/or GEO constellation operators) are “triple-A rated companies” that do not rely on seed money and VC to finance their operations. *Id.*

¹⁵ See Whigham & Stotler, *supra* note 8, at 8–9.

¹⁶ See Hameed, *supra* 1, at 5.

¹⁷ *Start-Up Space, Update on Investment in Commercial Space Ventures*, BRYCE TECH 4 (2022), https://brycetech.com/reports/report-documents/Bryce_Start_Up_Space_2022.pdf [<https://perma.cc/B4LQ-QDM7>] (arguing that in 2021, a notable influx of funding for space startups came from the public market, with space startups raising over \$4 billion, constituting 28% of the total investment throughout the year).

¹⁸ See, e.g., Maria Buzdugan, *Satellite Financing through Hosted Payloads: Benefits and Challenges*, 36 AIR & SPACE L. 139, 140 (2011) (explaining “the role hosted payload arrangements can play in satellite financing”).

¹⁹ Whigham & Stotler, *supra* note 8, at 8–9; see also, Koetsier, *supra* note 2.

²⁰ Bob Zider, *How Venture Capital Works*, HARV. BUS. REV., Nov.–Dec. 1998, <https://hbr.org/1998/11/how-venture-capital-works> [<https://perma.cc/F9YV-FTDX>] (arguing that venture funding operates on a short-term basis, aiming to infuse capital into a company’s financial framework until it reaches a substantial scale and credibility, at which point a sale becomes feasible or institutional public equity market can intervene to offer financial support).

terest to a bigger company.²¹ They hope to find a “unicorn.”²² Companies without these characteristics struggle to obtain funds.²³

The described way of financing space has worked until now because space has been a relatively niche industry, comprised mostly of large and established companies with no problem of access to credit.²⁴ Today, the industry is evolving²⁵ and needs more access to traditional financing,²⁶ which has the advantage of being able to utilize the equity that companies have invested—or will invest—in space objects. In other industries, companies generally proceed from seed money to venture capital and then benefit from bank financing (e.g., asset-based financing); lastly, they access institutional public equity or private equity investment.²⁷ This progression is not the same for every industry or company,²⁸ and in space, this last phase of progression might not be desirable.²⁹ Nevertheless, space companies should retain the option to advance in this manner.

²¹ See Nicole Gravagna & Peter K. Adams, *Venture Capital and Scalability: Growth Potential*, DUMMIES (Mar. 26, 2016), <https://www.dummies.com/article/business-careers-money/business/financing/venture-capital-and-scalability-growth-potential-160896/> [<https://perma.cc/RDD5-PBYR>] (last visited Feb. 7, 2024).

²² In venture capitalists’ jargon, a “unicorn” is a “privately held startup company with a value of over \$1 billion.” James Chen, *Unicorn: What It Means in Investing, With Examples*, INVESTOPEDIA (Apr. 29, 2023), <https://www.investopedia.com/terms/u/unicorn.asp> [<https://perma.cc/DJC8-Q2XU>] (last visited Feb. 7, 2024); see also Markus Berger-de León et al., *How to Build a Unicorn: Lessons from Venture Capitalists and Start-Ups*, MCKINSEY (Oct. 19, 2022), <https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/how-to-build-a-unicorn-lessons-from-venture-capitalists-and-start-ups> [<https://perma.cc/F7LN-9DWZ>] (last visited Feb. 7, 2024).

²³ See Whigham & Stotler, *supra* note 8, at 13.

²⁴ See *id.* at 12–13.

²⁵ See Koetsier, *supra* note 2.

²⁶ See Whigham & Stotler, *supra* note 8.

²⁷ *Id.* at 8–9.

²⁸ For example, some companies could obtain sufficient financing through series B and C funding rounds without going public. See, e.g., Nathan Reiff, *Series Funding: A, B, and C*, INVESTOPEDIA (Dec. 22, 2023), <https://www.investopedia.com/articles/personal-finance/102015/series-b-c-funding-what-it-all-means-and-how-it-works.asp> [<https://perma.cc/NVA7-YV9R>].

²⁹ For example, the founder of Space X, Elon Musk, made clear that he would never want to take his space launch company public because “the short-term demands of shareholders conflict with his long-term ambitions.” Melissa Parretti, *Will Elon Musk’s SpaceX Go Public*, INVESTOPEDIA (Mar. 19, 2022), <https://www.investopedia.com/articles/markets/121515/will-elon-musks-spacex-go-public.asp> [<https://perma.cc/D5UR-USA9>]. SpaceX raised nearly \$10B in funding over 31 rounds and has institutional investors such as Threshold Ventures, Bank of America, Baillie Gifford, NASA, Google, Founders Fund, and many others. Vipin Singh, *Top 10 Startups Innovating the Space Tech Industry*, GREYB, <https://www.greyb.com/blog/space-tech-startups/> [<https://perma.cc/BMC9-8ZVA>].

This Article focuses on asset-based financing and why it is difficult for space companies to access it. “Asset-based lending refers to a loan . . . collateralized with an asset (or assets) of the borrower.”³⁰ Of course, more articulated versions of asset-based lending exist, such as asset-backed lending³¹ and collateralized loan obligations (CLOs),³² but this is outside the scope of this Article. However, the general concepts discussed in this Article may also apply to these more articulated asset-based financing.

III. THE HURDLES FOR SPACE COMPANIES TO OBTAIN ASSET-BASED FINANCING

A. COMMON HURDLES TO FINANCING OF SPACE COMPANIES

Space companies face several hurdles in obtaining asset-based financing. Some of the issues are financial or factual (e.g., value of collateral, debt coverage, insurance, re-useability of collaterals), while some are legal (e.g., perfection of collateral).³³ This Article generally focuses on some significant legal problems and offers several possible solutions.

1. Intellectual Property Issues

Intellectual property (IP) rights are territorial in nature.³⁴ There is uncertainty regarding the location of IP developed in

³⁰ *Asset-based Lending*, CORP. FIN. INST., <https://corporatefinanceinstitute.com/resources/knowledge/credit/asset-based-lending/> [https://perma.cc/HLS2-UTEP] (last visited Feb. 7, 2024).

³¹ “Asset-backed” financing generally refers to securities in which the investment is “collateralized by an underlying pool of assets” with the emission of a “bond or note.” James Chen, *Asset-Backed Security (ABS): What It Is, How Different Types Work*, INVESTOPEDIA (Sept. 29, 2023), <https://www.investopedia.com/terms/a/asset-backedsecurity.asp> [https://perma.cc/SC46-WC4P].

³² See, e.g., William Sokol, *Demystifying Collateralized Loan Obligations*, NASDAQ (Jul. 10, 2022, 10:00 AM), <https://www.nasdaq.com/articles/demystifying-collateralized-loan-obligations> [https://perma.cc/WRQ2-HF6A]; see also Matt Phillips, *Risky Borrowing Is Making a Comeback but Banks Are on the Sideline*, N.Y. TIMES (June 11, 2019), <https://www.nytimes.com/2019/06/11/business/risky-borrowing-shadow-banking.html> [https://perma.cc/B5J2-CH5V] (discussing risks associated with C.L.O.s); see generally Chris Droussiotis, *Lecture 7 – Structured Finance (CDO, CLO, MBS, ABL, ABS)*, PROFESSOR DROUSSIOTIS’S WEB PLATFORM, http://www.celeritymoment.com/sitebuildercontent/sitebuilderfiles/ib_lecture_7.pdf [https://perma.cc/ZE8Q-2P3Y] (providing an overview on the “several main types of structured finance instruments”).

³³ Whigham & Stotler, *supra* note 8, at 13–17.

³⁴ Clark W. Lackert & Jonathan Goodwill, *Outer Space, Time to Address the Real-World IP Issues*, ABA (June 30, 2021), https://www.americanbar.org/groups/intellectual_property_law/publications/landslide-extra/outer-space/; see also Clark W. Lackert, *Trademarks in Outer Space: Supporting the Off-World Economy*, WIPO MAG.

space.³⁵ In a paper on IP and space activities³⁶ prepared in 2004 by the International Bureau of the World Intellectual Property Organization (WIPO),³⁷ the authors noted that the growth of private space activity has caused an increase in the need for IP protection.³⁸ The 2004 WIPO paper on Intellectual Property and Space Activities (WIPO Paper) offers useful concepts for dealing with the recognition of intellectual property in space objects. While the WIPO Paper is almost two decades old, the situation has not significantly changed.³⁹

The benefits of having a regime that effectively protects intellectual property are evident (including the possibility “to establish and maintain security interests in intellectual property . . .”).⁴⁰ Conversely, “[I]ack of legal certainty will influence the advancement of space research and international cooperation.”⁴¹ Currently, no IP treaty mentions IP in space.⁴² Also, no space

(Dec. 2021), https://www.wipo.int/wipo_magazine/en/2021/04/article_0005.html [<https://perma.cc/34S9-AK GK>].

³⁵ Lackert & Goodwill, *supra* note 34.

³⁶ *Intellectual Property and Space Activities*, WIPO (Apr. 2004), https://www.wipo.int/export/sites/www/patent-law/en/developments/pdf/ip_space.pdf [<https://perma.cc/WC6Q-766J>] [hereinafter *WIPO Paper*].

³⁷ *Id.* para. 4 (“WIPO is an intergovernmental organization” based in Switzerland “responsible for the promotion of the protection of intellectual property throughout the world . . .”).

³⁸ *Id.* para. 18 (explaining that “non-governmental entities are more conscious [than state-owned agencies] of their ‘property’, both in tangible and intangible forms.”).

³⁹ See, e.g., Lackert & Goodwill, *supra* note 34; Lackert, *supra* note 34.

⁴⁰ *WIPO Paper*, *supra* note 36, para. 21. In addition, the *WIPO Paper* mentions the following as benefits from strengthening protection of IP: fostering the participation of private actors, improving the image of a company, proof of “technical competence” and possibility “to negotiate a cross-license with other parties” so consolidating the respective technologies. *Id.*

⁴¹ *Id.*

⁴² See Paris Convention for the Protection of Industrial Property art. 5, Mar. 20, 1883, 21 U.S.T. 1583, 828 U.N.T.S. 305 [hereinafter Paris Convention] (Although it is the most important treaty for industrial property, the Paris Convention does not mention inventions in outer space. However, it discusses the use of patented inventions on board of vessels at sea.); Berne Convention for the Protection of Literary and Artistic Works, Sept. 9, 1886, 1161 U.N.T.S. 3 [hereinafter Berne Convention] (also does not mention outer space); WIPO Copyright Treaty, art. 4, art. 8, Dec. 20, 1996 S. Treaty Doc. No. 105-17, 2186 U.N.T.S. 121, [hereinafter Copyright Treaty] (While not discussing outer space IP directly, the Copyright Treaty protects computer programs and databases.); Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, 1869 U.N.T.S. 3 [hereinafter TRIPS] (also does not mention IP in outer space). Notably, the Copyright Treaty also protects the exclusive right of an author to authorize communication to the public, which WIPO points out, is also applicable to outer space. See *WIPO Paper*, *supra* note 36, para. 6. Further, WIPO noted how according to Article 27.1 of the

agreement—except the International Space Station Intergovernmental Agreement (ISS IGA) of 1998⁴³—contains an express mention of IP:⁴⁴ not the Outer Space Treaty (OST),⁴⁵ the Rescue Agreement,⁴⁶ the Liability Convention,⁴⁷ the Registration Convention,⁴⁸ or the Moon Agreement.⁴⁹ Besides the ISS IGA, only Declaration 51/122 mentions IP.⁵⁰ The Artemis Accords—bilateral arrangements signed by NASA with the space agencies of more than thirty other countries⁵¹—mention IP,⁵² but they are neither signed by all the space-faring countries nor a treaty.

TRIPS Agreement, “patents shall be available and patents rights enjoyable without discrimination as to the place of invention.” *Id.* para. 28 (citing TRIPS, *supra* note 42, art. 27 para. 1). “Therefore, national law has to ensure that, with respect to inventions created in outer space, patents must be granted and enforceable in the territory in which it applies under the same conditions applicable to inventions created elsewhere.” *Id.*

⁴³ Agreement Among the Government of Canada, Governments of the Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America Concerning Cooperation on the Civil International Space Station, Jan. 29, 1998, T.I.A.S. No. 12927 [hereinafter ISS IGA].

⁴⁴ See Lackert, 34 (arguing that ISS IGA allows participating nations to establish jurisdictional zones on the ISS, corresponding to different sections. Jurisdiction is determined by the location of activities involving IP within specific pods or areas controlled by each nation’s ISS activities).

⁴⁵ 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 OST].

⁴⁶ Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Dec. 3, 1968, 19 U.S.T. 7570 [hereinafter Rescue Agreement].

⁴⁷ 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].

⁴⁸ Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

⁴⁹ Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 5, 1979, 1363 U.N.T.S. 22 [hereinafter Moon Agreement].

⁵⁰ G.A. Res. 51/22, ¶ 2 (June, 1996) (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).

⁵¹ *The Artemis Accords, Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes*, NASA (Oct. 13, 2020), <https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf> [<https://perma.cc/A2CF-UMMP>] [hereinafter Artemis Accords].

⁵² *Id.* § 2(1)(b) (“The Signatories’ bilateral instruments referred to above are expected to contain other provisions necessary to conduct such cooperation, including those related to liability, intellectual property, and the transfer of goods and technical data”); *Id.* § 8 (exempting private parties from the duty to release information).

On Earth, IP protection is generally (but not always) territorial.⁵³ Under this perspective, Article VIII of the OST could be interpreted as expressing a general principle of quasi-territoriality:

A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth.⁵⁴

As long as a space object is registered in a country's national registry, that country has jurisdiction over it, be it in empty outer space or on a celestial body; therefore, the argument that IP is created and protected under the law of this country is viable.⁵⁵ However, uncertainties remain, and WIPO discussed how Article VIII alone is insufficient.⁵⁶ For example, while Article 21 of the ISS IGA clearly uses the "quasi-territoriality" principle and adequately regulates the intellectual property created on the several countries' flight elements,⁵⁷ without a similar treaty provision, difficulties can ensue in the case of international missions.

The WIPO Paper discusses several possible approaches to dealing with the issue of intellectual property in space.⁵⁸ Paragraph 41 deals with the possibility of using the state of registration as the state having jurisdiction over intellectual property.⁵⁹ This approach is consistent with Article VIII of the OST.⁶⁰ If more than one state is a registrant, the states can agree on which state has

⁵³ See *WIPO Paper*, *supra* note 36, para. 42–50.

⁵⁴ OST, *supra* note 45, art. VIII.

⁵⁵ See *id.*

⁵⁶ *WIPO Paper*, *supra* note 36, para. 44. ("Some argue that, in the absence of an explicit legal provision, the applicability of national intellectual property law on space objects registered by that State is doubtful." (citing Anna Maria Balsano, *Industrial Property Rights in Outer Space in the International Governmental Agreement (IGA) on the Space Station and the European Partner*, 35 COLLOQUIUM ON THE L. OF OUTER SPACE (1992); Glenn H. Reynolds, *Legislative Comment: The Patents in Space Act*, 3 HARV. J.L. & TECH. 13 (1990)).

⁵⁷ ISS IGA, *supra* note 43, art. 21 ("Subject to the provisions of this Article, for purposes of intellectual property law, an activity occurring in or on a Space Station flight element shall be deemed to have occurred only in the territory of the Partner State of that element's registry, except that for ESA-registered elements any European Partner State may deem the activity to have occurred within its territory.").

⁵⁸ See *WIPO Paper*, *supra* note 36.

⁵⁹ *Id.* para. 41.

⁶⁰ *Id.*

jurisdiction.⁶¹ Paragraph 42 distinguishes activities carried out in outer space and activities related to outer space but carried out in the territory of a country.⁶² The second category of activities could be subject to traditional territorial jurisdiction for IP purposes.⁶³ Paragraph 43 refers with approval to U.S. legislation on the issue of intellectual property on space objects,⁶⁴ but only a few other countries—as discussed below—have enacted similar legislation.⁶⁵

Also, uncertainty exists not only in the field of patents but for trademarks and industrial designs as well.⁶⁶ Copyright protection may be less problematic because the nationality of the copyright author should control no matter where the activity takes place.⁶⁷

The WIPO Paper concludes that “[t]he determination of the jurisdiction as far as intellectual property is concerned should be clearly defined, particularly where more than one country is involved in the launching of the elements at the space station.”⁶⁸ The WIPO Paper refers with approval to various examples of joint governmental administration.⁶⁹

In conclusion, WIPO seems to favor a quasi-territoriality approach, but it recognizes some difficulties: (1) it depends on “registration of ‘all’ the space objects”⁷⁰ and (2) quasi-territoriality may not work well with regard to space objects where components of the object may come from different countries with different intellectual property regimes.⁷¹ Also, the WIPO Paper discusses the difficulties of enforcement of IP in space objects.⁷²

Therefore, at the international level, a problem of insufficient protection of IP in space exists, so a space company seeking financing relying on its IP might face considerable challenges. Some countries have enacted legislation — for example, the

⁶¹ *Id.*

⁶² *Id.* para. 42.

⁶³ *Id.*

⁶⁴ See *WIPO Paper*, *supra* note 36 at para. 43 (“Section 105 of 35 U.S.C. (Inventions in outer space) . . . provides quasi-territorial effect on a space object that is carried on the registry of the United States of America, unless otherwise agreed by an international agreement.”).

⁶⁵ See *id.*

⁶⁶ *Id.* para. 45.

⁶⁷ *Id.* para. 46.

⁶⁸ *Id.* para. 47.

⁶⁹ *Id.*

⁷⁰ See *WIPO Paper*, *supra* note 36 at para. 49.

⁷¹ See *id.* para. 50 (noting how quasi-territoriality is a problem in international endeavors because of the “proximity” in which every element is located).

⁷² *Id.* para. 51–56.

United States passed the Patents in Space Act of 1990 (35 U.S.C. §105), which broadened U.S. national patent protection to cover ownership of inventions created, utilized, or sold in outer space, whether on a space object or any component thereof under the jurisdiction or control of the United States.⁷³ The Act also provides for U.S. jurisdiction when specifically agreed to between the U.S. and the country of registration of the space object or component.⁷⁴ Similarly, in 2008, France passed a law extending French patent protection to inventions made in outer space under certain conditions.⁷⁵ The E.U. Directive 96/9⁷⁶:

[Protects] databases which do not meet the requirement of originality as long as they are individually accessible and require a substantial investment to be generated As a result, data derived from activities in outer space and assembled in an original database are protected within the territory of the European Union member states.⁷⁷

Finally, a Taiwan law grants property rights in information about Earth, outer space, or celestial bodies to the individual or legal entity that obtained it.⁷⁸

Without international coordination, this patchwork of laws—which, in addition, does not govern all the types of IP—does not solve the uncertainty of IP in space because of choice of law issues.⁷⁹ Commentators suggested several solutions: (1) modification of the space agreements to acknowledge the expanding presence of private entities in outer space and establish procedures for addressing conflicts related to intangible assets, such as

⁷³ Lackert & Goodwill, *supra* note 34.

⁷⁴ 35 U.S.C. §105(a).

⁷⁵ Loi no. 2008-518 du 3 juin 2008 relative aux opérations spatiales [Law 2008-518 of June 3, 2008 relating to space operations]; 34 J. SPACE L. 453, 467 (2008) (“Article L. 611-1 of the Intellectual Property Code is completed by a paragraph draft as follows: . . . ‘the provisions of the present article apply to the inventions made or used in outer space, including onto celestial bodies and into or onto space objects placed under national jurisdiction according to article VIII of the [OST].’”).

⁷⁶ Directive 96/9/EC, of the European Parliament and of the Council of 11 March 1996 on the Legal Protection of Databases, 1996 O.J. (L 77).

⁷⁷ Frans G. von der Dunk, *European Satellite Observation: Law, Regulations, Policies, Projects, and Programmes*, 42 CREIGHTON L. REV. 397, 431 (2009).

⁷⁸ Space Development Act, Ch. 3, art. 13, FAWUBU QUANGUO FAGUI ZILIAOKU [MINISTRY OF JUSTICE LAWS AND REGULATIONS DATABASE].

⁷⁹ Lackert & Goodwill, *supra* note 34 (“To determine what, if any, IP rights are available, it is first necessary to know what country’s jurisdiction they were in when the IP was created or violated.”).

intellectual property ;⁸⁰ (2) amendment of IP treaties under the auspices of WIPO⁸¹ (specifically, there have been suggestions to extend trademark registration protection into space through the existing WIPO Madrid Protocol by introducing a new protocol to designate areas like LEO, the Moon, and Mars as “countries” for eligibility to join the registration system);⁸² and (3) creation of an enforcement system to be included in contracts (in addition to choice of law).⁸³

Some of those solutions (i.e., modification of the treaties) are now politically unrealistic.⁸⁴ Of course, a modification of the IP treaties⁸⁵ would be a solution, as it would be a new treaty specifically dealing with space IP, but this Article argues that it would be more realistic for WIPO to simply take a more active role. On the basis of the WIPO Paper—which contains useful elements for dealing with recognition of intellectual property in space objects—WIPO should perform a comprehensive and updated study of the intellectual property issue with a view towards making recommendations for dealing with IP issues. WIPO could then issue guidelines, which hopefully will be adopted by as many states as possible. Since WIPO already administers the Madrid Protocol,⁸⁶ a new “Space Protocol” would certainly be a natural extension of its work, but it could be difficult to achieve; therefore, WIPO should focus on the adoption of soft laws (guidelines). Until a development of this sort occurs, it is difficult for space companies to obtain financing based on their IP as collateral.

⁸⁰ *Id.*

⁸¹ *Id.*

⁸² *Id.*

⁸³ *Id.* The International Court of Aviation and Space Arbitration in Paris, France is mentioned as a possibility and the Uniform Domain-Name Dispute-Resolution Policy (UDRP) for domain names administered by the WIPO Arbitration and Mediation Center is cited as a possible analogy. *See id.*

⁸⁴ Melissa J. Durkee, *Interstitial Space Law*, 97 WASH. U. L. REV. 423, 434 (2019) (“The era of multilateral treaty-making may now be coming to a close as major geopolitical rifts divide former allies and seem to diminish the possibilities for meaningful multilateral agreements.”).

⁸⁵ *See* Paris Convention, *supra* note 42; Berne Convention, *supra* note 42; Copyright Treaty, *supra* note 42; TRIPS, *supra* note 42.

⁸⁶ *Madrid Protocol: Is it the Correct Choice for You?*, KASHISH INTELLECTUAL PROPERTY GROUP, <https://www.kashishworld.com/blog/madrid-protocol-is-it-the-correct-choice-for-you/> [<https://perma.cc/65WG-3REB>] (“The Protocol Relating to the Madrid Agreement Concerning the International Registration of Marks—the Madrid Protocol (concluded in 1989) is one of two treaties comprising the Madrid System for international registration of trademarks. The protocol is a filing treaty and not a substantive harmonization treaty.”).

2. *The Problem of Perfecting Security Interests*

a. Uniform Commercial Code Article 9

Another major hurdle for space companies seeking asset-based financing is the difficulty for creditors to effectively perfect their security interests.

In other industries, Article 9 of the U.C.C. provides an effective method for asset-based financing through a contract between the creditor and debtor, creating a security interest in a debtor's collateral by agreement, which then can be perfected.⁸⁷ Article 9 generally defines "goods" as "all things that are movable when a security interest attaches."⁸⁸ Almost all personal property may be the subject of a security interest, which would include many space assets such as satellites.⁸⁹ Perfection of the security interest grants the secured creditor priority rights in the collateral against most subsequent lenders, buyers of the property, and lien holders.⁹⁰

The system has been quite successful in the U.S. and a model for legislation abroad,⁹¹ but some consider it "complicated and inefficient in numerous respects."⁹² Unfortunately, for space companies, the inefficiency affects the possibility of security interests in space assets. In broad terms, two major types of problems exist when applying Article 9 to space assets: (1) the location of the debtor, and (2) the location of the collateral.⁹³

i. The Problem of the Location of the Debtor

The location of the debtor poses problems for financing of space assets, particularly when the debtor is not a U.S. person.⁹⁴ The most common mechanism of perfection of a security interest in goods is the filing of a financing statement in the state

⁸⁷ See Robert DiNozzi et. al., *How Asset-Based Lenders Can Leverage Article 9 to Generate Business, Mitigate Loss*, ABF JOURNAL (Oct. 15, 2021), <https://www.abfjournal.com/articles/how-asset-based-lenders-can-leverage-article-9-to-generate-business-mitigate-loss/> [<https://perma.cc/PB39-W8FA>].

⁸⁸ U.C.C. § 9-102(a) (44).

⁸⁹ See generally Richard D. Cunningham, *Space Commerce and Secured Financing—New Frontiers for the U.C.C.*, 40 BUS. LAW. 803 (1985) (providing an early discussion of the application of Article 9 to space). In fact, "Equipment" (as a satellite would be) means "goods." U.C.C. § 9-102(a) (33).

⁹⁰ Christopher G. Bradley, *Disrupting Secured Transactions*, 56 Hous. L. REV. 965, 968–69 (2019).

⁹¹ See Hans Kuhn, *Multi-State and International Secured Transactions under Revised Article 9 of the Uniform Commercial Code*, 40 VA. J. INT'L L. 1009, 1011 (2000).

⁹² Bradley, *supra* note 90, at 968.

⁹³ See *id.* at 968–69.

⁹⁴ See *id.* at 980.

where the debtor is located.⁹⁵ Currently, financing statements are indexed under the name of the debtor.⁹⁶ Therefore the general rule is that the specific location where the financing statement needs to be filed is where the debtor is located.⁹⁷ U.C.C. § 9-301(1) in fact provides the local law of the jurisdiction in which the debtor is located governs perfection, the effect of perfection or non-perfection, and priority; therefore, “all financing statements . . . [must be] filed in the jurisdiction of the debtor’s location.”⁹⁸ It might be difficult for a creditor to determine whether a security interest encumbers a particular asset.⁹⁹ When a debtor changes jurisdiction, the U.C.C. allows a secured party to refile in the debtor’s new jurisdiction within four months of relocation.¹⁰⁰ However, when the debtor is not located in the U.S.—which is often the case because the space industry is worldwide—conflict of law issues arise.¹⁰¹

Conflict of law is also difficult when litigation is brought in the United States. This is because the conflict rules of U.C.C. are not comprehensive. Certainly, the parties can choose the law that governs their transaction. In fact, U.C.C. § 1-301(a) (which applies to every Article of the U.C.C. unless a special rule exists in one of the articles) gives the parties the right to choose the law of the jurisdiction with which the transaction bears a “reasonable relation.”¹⁰² If the agreement is silent, the forum state law applies to “transactions bearing an appropriate relation to [the] state.”¹⁰³ U.C.C. § 1-301(c)¹⁰⁴ closes the circle by providing that “[i]f one of the following provisions of [the U.C.C.] specifies the applicable law, that provision governs, and a contrary agreement is effective

⁹⁵ *See id.* at 968.

⁹⁶ *See id.*

⁹⁷ U.C.C. § 9-301(1) U.C.C. § 9-307 establishes the rules for determining where a debtor is considered located for the purpose of Article 9: individuals are considered located at their “principal residence”, while an organization is “located at its place of business” and in case it has more than one “at its chief executive office.”

⁹⁸ David Frisch, *The Recent Amendments to UCC Article 9: Problems and Solutions*, 45 U. RICH. L. REV. 1009, 1019 (2011).

⁹⁹ Bradley, *supra* note 92, 979-980 (“the system is riddled with loopholes, gaps, and exceptions. As a result, creditors remain unsure of how secure their interest in collateral really is.”)

¹⁰⁰ U.C.C. § 9-316(a)(2).

¹⁰¹ Tracy Springer & Roshell A. Nagar, *Cross-Border Lending: A Brief Guide for U.S. Secured Creditors to the UCC Rules for Perfecting Security Interests in Assets of Foreign Obligor*, ABA (May 14, 2020), https://www.americanbar.org/groups/business_law/resources/business-law-today/2020-may/cross-border-lending-a-brief-guide/.

¹⁰² U.C.C. § 1-301(a).

¹⁰³ *Id.* § 1-301(b).

¹⁰⁴ *Id.* § 1-301(c).

only to the extent permitted by the law so specified.” U.C.C. § 1-301(c) makes specific reference to U.C.C. § 9-301 through U.C.C. § 9-307.¹⁰⁵

U.C.C. § 9-301 establishes the general rule that the law of the jurisdiction in which the debtor is located governs “perfection, the effect of perfection or nonperfection, and the priority of a security interest in the collateral.” U.C.C. § 9-301(1). However, U.C.C. § 9-301(3)(C) contains an exception that applies to space assets, which are a form of “goods” under the U.C.C. U.C.C. § 9-301(3)(C) provides that in that case, the location of the collateral (and not the debtor’s location) determines “the effect of perfection or *nonperfection* and the *priority* of a nonpossessory security interest in the collateral;”¹⁰⁶ which leaves the location of the debtor only relevant for the aspect of perfection under U.C.C. § 9-301(1).¹⁰⁷ This paper discusses how the location of the collateral creates significant problems for space assets in the following section.¹⁰⁸

except in the case of a possessory security interest—

Financing transactions that have a foreign nexus create particular uncertainty. For example, suppose the financier, debtor, or collateral has a foreign connection. What law governs the creation, perfection, priority, and enforcement of a security interest? Even determining whether something is a security interest under foreign law might be difficult.¹⁰⁹ The situation is even more difficult if the litigation is brought in other countries without secured transactions law like Article 9.

ii. The Problem of the Location of the Collateral

While it is clear that Article 9 covers space assets, which are as moveable as other “[g]oods,”¹¹⁰ numerous questions arise regarding the application of Article 9 to space assets.

One important issue deals with the exception to the general rule of the location of the debtor discussed above¹¹¹ whose application for space assets is problematic. As mentioned, the basic rule of Article 9 governing perfection is section U.C.C. § 9-301,

¹⁰⁵ *Id.* § 1-301(c)(8).

¹⁰⁶ U.C.C. § 9-301(3)(C) (emphasis added).

¹⁰⁷ U.C.C. § 9-301(1).

¹⁰⁸ Part III(A)(2)(a)(ii) of this Article.

¹⁰⁹ See Iryna Ivashchuk & David K. Black, *Cross-Border, Asset-Based Loans: Transforming Challenges Into Opportunities*, ABF JOURNAL (Aug. 22, 2014), <https://www.abfjournal.com/articles/cross-border-asset-based-loans-transforming-challenges-into-opportunities/> [https://perma.cc/7GS6-7AEX].

¹¹⁰ U.C.C. § 2-105.

¹¹¹ Part III(A)(2)(a)(i) of this Paper.

which provides that “[e]xcept as otherwise provided in this section,” the law of the jurisdiction where the debtor is located governs perfection, nonperfection, and priority.¹¹² However, U.C.C. §9-301(3)C provides that with regard to goods, the effect of perfection or non-perfection and priority in nonpossessory security interests are governed by the jurisdiction in which the collateral is located.¹¹³ Since space assets would involve nonpossessory security interests, these sections mean that the law where the debtor is located governs perfection (i.e., the place of filing), while the law where the collateral is located governs the effect of perfection or non-perfection and priority.¹¹⁴ However, this creates a major problem for a financing entity seeking a security interest in a space asset. Since the space asset is a good and the security interest would be generally nonpossessory, the law of the jurisdiction where the space asset is located governs the effect of perfection or nonperfection and priority.¹¹⁵ For financing of space objects (such as satellites, landers, rovers, capsules, and modules), this rule creates uncertainty because: (i) when the objects are moved from the manufacturing facility to the launching facility, the creditor would face a change in the law governing the effect of perfection or nonperfection and priority, and (ii) after launch, the space object is not “located” in any jurisdiction.¹¹⁶ In fact, outer space is not subject to the jurisdiction of any state.¹¹⁷

iii. Solutions

Article 9 contemplates possible (although incomplete) solutions to the problems arising from the debtor’s location and movement of collateral. U.C.C. § 9-310 provides that filing is not required for certain security interests.¹¹⁸ In particular, filing is not necessary to perfect a security interest “in property subject to a statute, regulation, or treaty.”¹¹⁹ Therefore, if the 2012 Space Protocol is ratified,¹²⁰ its provisions would preempt Article 9.

¹¹² *Id.* § 9-301(1).

¹¹³ *Id.* §9-301(3)(C). This paper does not deal with possessory security interests because less relevant for space assets. For possessory security interests, § 9-301(2) provides that the location of the collateral is the only relevant factor, governing “perfection, the effect of perfection or nonperfection, and the priority” of those security interests.

¹¹⁴ *See id.* §§ 9-301(1), (3)(c).

¹¹⁵ *See* Cunningham, *supra* note 89, at 823-25.

¹¹⁶ *See id.*

¹¹⁷ OST, *supra* note 45, art. II.

¹¹⁸ U.C.C. § 9-310(b).

¹¹⁹ U.C.C. § 9-310 (b)(3) (citing U.C.C. § 9-311(a) for the description of this exception); *see* U.C.C. § 9-311(b) (determine priority of such securing interest).

¹²⁰ Space Protocol, *supra* note 11. *See infra*-Part III(A)(2)(b).

Absent ratification of the Space Protocol, a possibility worth exploring is amending Article 9 to include a section giving special treatment to security interests in space assets. The U.C.C. has a long history of amendments accounting for changes in business practices and types of collaterals.¹²¹ The development of financing of space assets is another such development that could be accommodated by a modification of Article 9. For example, U.C.C. § 9-303, “Law Governing Perfection and Priority of Security Interest in Goods Covered by a Certificate of Title,” provides that “[t]he local law of the jurisdiction under whose certificate of title the goods are covered governs perfection, the effect of perfection or nonperfection, and the priority of a security interest.” This provision would be an excellent model for space assets which, like automobiles, are inherently movable.¹²²

The Permanent Editorial Board of the U.C.C. should consider adopting an amendment that defines space assets as subject to certificates of title and indicates the law of the jurisdiction that issued the certificate of title would govern perfection and priority.¹²³ This Article suggests the District of Columbia—as the seat of the federal government—should be regarded as the place for issuing certificates of title on space assets. As is the case for other certificates of title, there would be no need to file a financing statement to perfect the security interest—the notation on the certificate of title would be enough.¹²⁴

The suggested modification of the law would not have an effect in other countries, but parties to a financing transaction could adopt D.C. law by contract choice in their security agreement.¹²⁵ This would be similar to the common adoption of New York law and New York courts for international business transactions and

¹²¹ See *Uniform Commercial Code*, UNIFORM LAW COMMISSION, <https://www.uniformlaws.org/acts/ucc> [<https://perma.cc/M2DD-97L8>].

¹²² U.C.C. § 9-303(c).

¹²³ This could also possibly apply to contracts with the Government where not prohibited by the contract itself or by law.

¹²⁴ Even without a modification of Article 9, the District of Columbia could issue a law allowing space companies to obtain a certificate of title on their space assets. A VIN system number for space assets, similar to the one in 49 C.F.R., Chapter V, Part 565 (“Vehicle Identification Number (VIN) Requirements”) could be introduced to allow the certificate of title to be issued.

¹²⁵ As discussed above in Part III.A.2(i), there is of course a choice-of-law problem but as an additional step Article 9 could be amended (and hopefully this amendment would be adopted by all the jurisdictions) to have a specific provision on choice-of-law regarding security interest in space assets, for example stating that in the absence of an agreement, the location of the debtor is deemed to be the District of Columbia.

would create a sort of “lex mercatoria” in asset-based financing for space. It would take time, but the industry could evolve to give special consideration to the D.C. law.¹²⁶

Another solution involves the Space Protocol. Scholars have correctly pointed out that “[t]he perfection and enforcement of security interests in mobile equipment that moves across national borders in the ordinary course of business have always been a concern for secured creditors because there is no assurance that other jurisdictions will recognize and enforce rights obtained under Article 9.”¹²⁷ The Cape Town Convention—which came into force on March 1, 2006—aimed at “facilitat[ing] asset-based financing . . . of high value, mobile, and uniquely identifiable pieces of equipment” with specific uses, particularly for transportation.¹²⁸ Unlike other treaties, it did not have “governmental interests” in mind but the “needs of private financiers” such as “priority of secured parties, title to purchased assets, and remedies upon default.”¹²⁹ Four protocols to the Convention were signed at different times for specific equipment: (1) protocol for aircraft; (2) protocol for railway rolling stock; (3) protocol for space assets; and (4) protocol for mining, agricultural and construction equipment.¹³⁰ Only the Aircraft Protocol is in force¹³¹ and has been very beneficial to the industry.

¹²⁶ Discussion inside organizations like the American Bankers Association (ABA) and similar associations in other regions would be useful.

¹²⁷ Cindy J. Chernuchin, *Securing Mobile Assets: The Cape Town Convention And The Proposed Protocol On Security Interests In Space Assets*, THE PRAC. LAW. 9 (Dec. 2011), https://www.willkie.com/-/media/files/publications/2011/12/securing-mobile-assets-the-cape-town-convention-___/files/securingmobileassetspdf/fileattachment/securing-mobile-assets.pdf [<https://perma.cc/HG7U-LJZ8>].

¹²⁸ Hameed *supra* 1, at 6. Convention on International Interests in Mobile Equipment (adopted 16 November 2001, entered into force 1 March 2006) 2307 UNTS 285 (Hereinafter Cape Town Convention).

¹²⁹ Mark J. Sundahl, *The Cape Town Convention and the Law of Outer Space: Five Scenarios*, CAPE TOWN CONV. J. 109, 109–10 (Nov. 2014) (arguing that some conflicts exist within the Protocol and the space treaties of 1960s and 1970s).

¹³⁰ Protocol to the Convention on International Interests in Mobile Equipment on Matters Specific to Aircraft Equipment (adopted 16 November 2001, entered into force 1 March 2006) 2367 UNTS 517 (‘Aircraft Protocol’); Luxembourg Protocol to the Convention on International interests in Mobile Equipment on Matters Specific to Railway Rolling Stock (adopted 23 February 2007) (‘Luxembourg Protocol’); Space Protocol, *supra* note 11; and Protocol to the Convention on International interests in Mobile Equipment on Matters Specific to Mining, Agricultural and Construction Equipment (adopted 22 November 2019) (‘Pretoria Protocol’). See Roy Goode, *Issues of Interpretation under the Cape Town Convention and its Protocols*, 8 CAPE TOWN CONV. J. 3, 4 (Apr. 2022).

¹³¹ *Id.*

The Protocol to the Convention on International Interests in Mobile Equipment on Matters Specific to Space Assets (Space Protocol) was adopted in 2012¹³² under the umbrella of the International Institute for the Unification of Private Law (UNIDROIT), seeking to resolve the lack of clear recognition and inconsistency of methods of international enforcement of security agreements covering space assets.¹³³ The Space Protocol does not replace existing financing options, but instead provides an additional method by which financiers can protect their collateral from other claimants.¹³⁴ The Space Protocol does not create a security interest, lien, or other interest in the collateral; the creation of the interest (as opposed to recordation of the interest) is a matter of local law chosen under principles of private international law; alongside the Cape Town Convention, it merely offers the creditor a set of fundamental remedies for defaults and insolvency situations¹³⁵ Also, it allows “international enforceab[ility]” of the interest “in States [that are] parties to the [Cape Town] Convention and [the Space] Protocol.”¹³⁶

The Space Protocol allows a creditor to record their interests in an “electronic international registry,” which provides notice of the interest to third parties, gives priority over the interests of “subsequently registered interests,” and protects the interest “against unregistered interests and creditors” during bankruptcy.¹³⁷ In addition, as said, the Cape Town Convention and the Space Protocol provide for a number of remedies (including interim remedies) in case of default or insolvency.¹³⁸

The Space Protocol applies to a “space asset,” defined as “any man-made uniquely identifiable asset in space or designed to be launched into space,” including spacecraft, payload, or a part of a spacecraft or payload such as accessories of space assets and data, manuals, and records.¹³⁹

¹³² Space Protocol, *supra* note 11.

¹³³ Ignacio Tirado, The Space Protocol of the Cape Town Convention: An International Secured Transactions Regime for Space Assets, United Nations/Germany High Level Forum Session 3: Legal Regime of Outer Space and Global Space Governance 2–3 (Nov. 14, 2018), https://www.unoosa.org/documents/pdf/hlf/HLF2018/Pres/4_Tirado_UN_HLF_Presentation_-_Space_Protocol.pdf [<https://perma.cc/UUC9-M2WZ>].

¹³⁴ *Id.* at 5.

¹³⁵ Hameed, *supra* note 1, at 10.

¹³⁶ Tirado, *supra* note 129 at 6.

¹³⁷ *Id.*

¹³⁸ *Id.*

¹³⁹ Space Protocol, Article I – Defined terms, 2(k). *See also* Tirado, *supra* note 129 at 8.

Because of the difficulty of repossession, the Space Protocol provides substitute remedies that allow constructive repossession by gaining control, including: assignment of the debtor's rights (in particular, of the revenue stream that the debtor is receiving or expects to receive from the space asset), and "Tracking, Telemetry, and Control (TT&C)" of the space asset.¹⁴⁰

Even if some conflicts between the Space Protocol and the space treaties would require analysis,¹⁴¹ the Space Protocol would still be a useful framework to improve access to asset-based financing for the space industry. To date, only four countries have ratified the Space Protocol, and ten ratifications are needed for the Protocol to become effective.¹⁴² UNIDROIT continues to work actively for the adoption of the Space Protocol—in particular, it is currently working on the development of the International Registry of Space Assets.¹⁴³

3. *The Importance of Insurance in Financing*

Generally, lenders require insurance.¹⁴⁴ Space is no exception,¹⁴⁵ but insurance is becoming difficult to obtain.¹⁴⁶ This Article

¹⁴⁰ Tirado, *supra* note 129 at 9.

¹⁴¹ Sundahl, *supra* note 125, at 112–21 (explaining that the Protocol intersects with the space treaties and there are some conflicts).

¹⁴² Space Protocol, *supra* note 11, art. XXXVIII(1)(a); *see also* Status - Unidroit Protocol to the Convention on International Interests in Mobile Equipment On Matters Specific to Space Assets (Berlin, 2012), <https://www.unidroit.org/instruments/security-interests/space-protocol/status/>

¹⁴³ *See* Hameed, Update on the Space Protocol of the Cape Town Convention on International Interests in Mobile Equipment: Perspective on the Space Economy, United Nations/Chile Conference on Space Law and Policy: Governance and Legal Perspectives on Space Activities in Earth Orbit and Beyond (May 2022), https://www.unoosa.org/documents/pdf/spacelaw/workshops/SLC2022/presentations/I_Hamza_Hameed_-_United_Nations_-_Chile_Conference_on_Space_Law_and_Policy.pdf [<https://perma.cc/8C3E-8ACZ>] [hereinafter Update on the Space Protocol].

¹⁴⁴ *Lenders' Finance Arrangements*, ALLIANZ (Feb. 18, 2020), <https://www.allianz.co.uk/news-and-insight/insight-and-expertise/lenders-finance-arrangements.html> [<https://perma.cc/NS7Q-GMYV>].

¹⁴⁵ Philip Chrystal, *Space and Insurance: Handling the Launch and In-Orbit Satellite Claim*, 45 ANNALS AIR & SPACE L. 381, 383 (2020).

¹⁴⁶ Noor Z. Hussain & Carolyn Cohn, *Insurers Pull Back as Risks of Satellite and Space Debris Collisions Surge*, INSURANCE JOURNAL (Sept. 1, 2021), <https://www.insurancejournal.com/news/national/2021/09/01/629684.htm> [<https://perma.cc/9TTN-D282>] (reporting the opinion of an Axa's executive regarding the fact more than 50% of new satellites are covered by insurance, but this percentage is destined to shrink).

discusses “first-party property insurance,”¹⁴⁷ i.e., the insurance purchased by owners or operators of space objects to shield themselves from the risks linked to the potential loss of their satellite, and not third-party liability insurance.¹⁴⁸ A satellite business might have a “Pre-Launch Satellite insurance” policy to “cover the satellite from the moment it leaves the manufacturer’s premises until the moment of launch”¹⁴⁹ and a “Single Launch and In-orbit Satellite Insurance” whose coverage “attaches during the launch . . . and continues until the expiration of a defined period during the in-orbit or operational phase of the satellite.”¹⁵⁰

Several problems exist with first-party insurance in space. First, it is expensive, which is unsurprising since insurers and underwriters must hire experts to evaluate the risk and handle claims.¹⁵¹ Expertise is also needed to review cautionary reports of anomalies by insureds who are unable to “physically access the satellite” and tend to over-report.¹⁵² Second, the insurer’s subrogation rights in these policies are diminished because of “prelaunch waivers” signed by insureds for the benefit of “launch providers, manufacturers of satellites, their affiliates, subsidiaries, contractors, [and] subcontractors” so that the insurer, unless it can void the waiver, cannot recover from the negligent parties.¹⁵³ Third, the space insurance market has experienced volatility in the last few years: it incurred losses in 2018 and 2019 and rebounded but

¹⁴⁷ A first-party property insurance is “designed to cover the cost for the full replacement of a satellite and its relaunch in the event of its failure and in turn, to alleviate the concerns of those financing the launch and operations of the satellite.” Chrystal, *supra* note 141, at 385. Financers are generally the “assignees” identified in “endorsement.” *Id.* at 393.

¹⁴⁸ A third-party insurance is “designed to pay claims for which the insured is legally liable and arise from any damage or injury on the ground, in the air (e.g., to aircraft in flight) or to other orbiting satellites.” *Id.* at 386. It is generally required to obtain a license from the government. *See* 51 U.S.C. § 50914. Financers might also be interested in this type of insurance because a third-party claim might indirectly impact the possibility of the debtor to repay its debt.

¹⁴⁹ Chrystal, *supra* note 141, at 386.

¹⁵⁰ *Id.* at 385–86. The satellite is insured on a value agreed “prior to inception of the policy.” *Id.* at 387. That value is “paid in full in the event that the satellite is declared a Total Loss (TL) or in the event that the satellite is declared a Constructive Total Loss (CTL).” *Id.* A CTL is “either a loss of a specific percentage (e.g., 75%) or more of the lifetime of the satellite, or a percentage (e.g., 75%) of the measured performance of the satellite.” *Id.* Policies also provide for coverage of partial losses (PL). *Id.*

¹⁵¹ *See id.* at 388.

¹⁵² *Id.* at 389. This abundance of reporting requires underwriters and claim handlers to triage the data. *Id.*

¹⁵³ *Id.* at 395.

with doubling or tripling insurance premiums.¹⁵⁴ It remains to be seen if it will make economic sense for a space company to request a loan and be forced to buy insurance.¹⁵⁵ Fourth, common exclusions (such as “acts of war, terrorism, or cyber-attacks”) exist and might become relevant for space.¹⁵⁶ In the event a dual-use satellite was struck by an enemy using an anti-satellite weapon (ASAT), there would be no insurance indemnification. Recent events, like the Ukrainian war, have highlighted this problem.¹⁵⁷ Fifth, except for accidents happening before the space object is in orbit (e.g., at launch), the timing for obtaining indemnification is substantial.¹⁵⁸ Sixth, because of the overcrowding of Earth’s orbits (both due to the number of satellites and the amount of debris), insurers are pulling back,¹⁵⁹ and finding insurance is becoming more difficult.¹⁶⁰

In conclusion, insurance is becoming difficult to obtain, and the lack of insurance is a major impediment to asset-based

¹⁵⁴ Whigham & Stotler, *supra* note 8, at 16 (discussing the volatility in launch insurance costs: in 2021, it was about 7.5% of insured value, significantly lower than 2004’s 20% but higher than 2019’s 2.5%, primarily due to fewer providers. Also, arguing that ongoing satellite constellation insurance typically equals about 1% yearly of insured value.).

¹⁵⁵ *See id.*

¹⁵⁶ Chrystal, *supra* note 141, at 390 n. 20.

¹⁵⁷ Christian Davenport, *Commercial Satellites Test the Rules of War in Russia-Ukraine Conflict*, THE WASH. POST (Mar. 10, 2022, 8:52 AM), <https://www.washingtonpost.com/technology/2022/03/10/commercial-satellites-ukraine-russia-intelligence/> [<https://perma.cc/Q8W6-WABG>]. Dual-use space objects are at risk as legitimate targets by enemies. *See, e.g.*, David A. Koplow, *Reverse Distinction: A U.S. Violation of the Law of Armed Conflict in Space*, 13 HARV. NAT’L SEC. J. 25 (2022). While at the moment dual-use is common among all the spacefaring countries and beneficial to the space industry, as the latter matures and becomes more independent from the government, the industry may find it desirable to re-evaluate whether to continue to accept this practice.

¹⁵⁸ *See* Chrystal, *supra* note 141, at 398.

¹⁵⁹ Noor Zainab Hussain & Carolyn Cohn, *Focus: Launching into Space? Not so Fast. Insurers Balk at New Coverage*, REUTERS (Sept. 1, 2021, 2:55 PM), <https://www.reuters.com/lifestyle/science/launching-into-space-not-so-fast-insurers-balk-new-coverage-2021-09-01/> (mentioning space debris one of the reasons why insurers are pulling back).

¹⁶⁰ This Article suggests that to improve insurability the space industry should voluntarily comply with space debris mitigation guidelines. *See, e.g.*, G.A. Res. 62/217, Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space (Dec. 22, 2007). It also suggests compliance with debris mitigation best practices. *See, e.g.*, *National Orbital Debris Implementation Plan*, WHITE HOUSE 9 (July 2022), <https://www.whitehouse.gov/wp-content/uploads/2022/07/07-2022-NATIONAL-ORBITAL-DEBRIS-IMPLEMENTATION-PLAN.pdf> [<https://perma.cc/D3WV-BKEZ>] (“Improve Shielding, Impact Resistance, and Overall Resilience of Spacecraft Surfaces”).

financing for space ventures. Because space is a strategic industry and the proliferation of commercial services serves national security interests,¹⁶¹ the government should support the industry by offering reinsurance programs, which would enable insurers to transfer a portion of the risk to the reinsurer (here, the government).

Several examples of government reinsurance programs when private reinsurance is not available exist. For example, the National Flood Insurance Program (NFIP), managed by the federal government through Federal Emergency Management Agency (FEMA), offers insurance to property owners in more than 23,000 participating communities.¹⁶² This method of reinsurance can be complex and can vary depending on the type of insurance, but it should not, in principle, be difficult to construct. Three significant factors for constructing the reinsurance program would include: (1) the “attachment point,” which is the level at which the reinsurance would set in, (2) the “reinsurance cap,” which is the maximum amount the insurer would pay, and (3) the “coinsurance rate,” which is the proportion of the loss that the reinsurer would pay in excess of the attachment point.¹⁶³ The idea of the government as a re-insurer has some analogies in space: there is the precedent of the government sharing liability with private companies for third-party damages resulting from commercial space launches.¹⁶⁴ This demonstrates a historical willingness of

¹⁶¹ See, e.g., John J. Klein, *Industry Vital for Deterring Aggression in Space*, NAT'L DEF. MAG. (July 27, 2021), (arguing that commercial space launch and satellite services increase deterrence by bolstering mission assurance and resilience through the utilization of space-enabled capabilities and services, which is partly to be credited to the “distributed and diversified nature” of the industry).

¹⁶² *National Flood Insurance Program's Reinsurance Program*, FEMA, <https://www.fema.gov/flood-insurance/work-with-nfip/reinsurance> [https://perma.cc/92QJ-SX8Y] (last visited Feb. 9, 2024); *Flood Insurance*, FEMA, <https://www.fema.gov/flood-insurance#:~:text=The%20NFIP%20works%20with%20communities,almost%2023%2C000%20participating%20NFIP%20communities> [https://perma.cc/C322-GYFT] (last visited Feb. 9, 2024).

¹⁶³ Sarah Lueck, *Reinsurance Basics: Considerations as States Look to Reduce Private Market Premiums*, CTR. ON BUDGET AND POL'Y PRIORITIES (Apr. 3, 2019), <https://www.cbpp.org/research/health/reinsurance-basics-considerations-as-states-look-to-reduce-private-market-premiums> [https://perma.cc/HR32-4ADF].

¹⁶⁴ See, e.g., T. J. Brennan *et al.*, *More than a Wing and a Prayer: Government Indemnification of the Commercial Space Launch Industry* (September 2009), <https://media.rff.org/documents/RFF-DP-09-38.pdf> (discussing the three-tiered approach outlined in the Commercial Space Launch Act, where the launch company is responsible for losses below a certain limit, the government covers losses above that limit and between a certain range, with responsibility reverting back to the launch company above that range. *Id.* at 2).

the government to engage in risk-sharing arrangements with the private sector to facilitate the growth and development of commercial space activities.¹⁶⁵

A. SOME ADDITIONAL PROBLEMS FOR NEW SPACE ACTIVITIES

1. *Legal Uncertainty Surrounding Some Space Activities*

The international framework, most prominently the OST, provides a supportive environment for space activities; however, traditional financing would benefit from clarifications at the international level because the OST and other space agreements lack clear answers to numerous questions, which can lead to lower levels of certainty for investors.¹⁶⁶ As space companies plan more ambitious missions to space which go beyond the traditional satellite business—such as in-orbit serving and manufacturing, and space resource utilization—the uncertainty about some legal issues may constitute a hurdle to financing.

An important example (and the focus of this section) is the problem of the legality of space resource utilization, which could determine the availability of financing.¹⁶⁷ The problem is Article II of the OST, which provides that “[o]uter 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.”¹⁶⁸ While some argue otherwise—usually focusing on the language “by any other means”¹⁶⁹—according to the majority opinion of scholars, space organizations, and working groups,¹⁷⁰ Article II does not prohibit appropriation of space

¹⁶⁵ *Id.* at 1.

¹⁶⁶ Durkee, *supra* note 84 at 433.

¹⁶⁷ For a discussion of the situation of investors in an activity of uncertain legality, but potential high profits, see the case of the cannabis industry. *See, e.g.*, Mike Schuster & Robert C. Bird, *Legal Strategy During Legal Uncertainty: The Case of Cannabis Regulation*, 26 *STAN. J.L. BUS. & FIN.* 362 (2021).

¹⁶⁸ OST, *supra* 45, art. II.

¹⁶⁹ *See, e.g.*, Zachos A. Paliouras, *The Non-Appropriation Principle: The Grundnorm of International Space Law*, 27 *LEIDEN J. INT’L L.* 37, 43, 50 (2014) (arguing that Article II OST precludes “appropriation of any part of outer space . . . by private individuals” and that if a country “confers proprietary rights . . . [it] would commit an internationally wrongful act”).

¹⁷⁰ In 2015, the International Institute of Space Law (IISL) issued a position paper which concluded that “in view of the absence of a clear prohibition of the taking of resources in the Outer Space Treaty one can conclude that the use of space resources is permitted.” Tanja Masson-Zwaan & Neta Palkovitz, *Regulation of Space Resource Rights: Meeting the needs of States and private parties*, *QUESTIONS OF INT’L*

resource once extracted.¹⁷¹ Several reasons, including the following, support this position.

First, Article II must be read together with Article I(2) of the OST, providing “free[dom] [of] exploration and use by all States,” where the word “use” must imply the possibility of extraction and appropriation of resources otherwise it is a duplication of “exploration.”¹⁷² Therefore, a coordinated reading of Articles I and II supports the conclusion that nations have the freedom to utilize space but are prohibited from claiming ownership of it.¹⁷³

What about private entities? Article VI of the OST establishes the right of a State to authorize and continuously supervise non-governmental entities engaging in space activities.¹⁷⁴ Correspond-

L. (Jan. 30, 2017), <http://www.qil-qdi.org/regulation-space-resource-rights-meeting-needs-states-private-parties/> (quoting *Position Paper of the International Institute of Space Law on Space Mining*, IISL (Dec. 20, 2015)). In 2019, after three years of work, an international, interagency, and interdisciplinary working group at the Institute of Air and Space Law of the University of Leiden published the “Building Blocks for the Development of an International Framework on Space Resource Activities” which interpret Article II as allowing space mining. *Building Blocks for the Development of an International Framework on Space Resource Activities*, UNIV. OF LEIDEN (Nov. 12, 2019), <https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht—en-ruimte-recht/space-resources/final-bb.pdf> [<https://perma.cc/CS6Y-6GDT>].

¹⁷¹ See, e.g., Frans von der Dunk, *The US Space Launch Competitiveness Act of 2015*, JURIST (Nov. 30, 2015, 6:52 PM), <https://www.jurist.org/commentary/2015/11/frans-vonderdunk-space-launch/> [<https://perma.cc/T3HD-J88D>]; Paul B. Larsen, *Is There a Legal Path to Commercial Mining on the Moon?*, 83 U. PITT. L. REV. 1 (2021); Eng Teong See, *Commercialization of Space Activities - The Laws and Implications*, 82 J. AIR L. & COM. 145, 159 (2017); Han Taek Kim, *Fundamental Principles of Space Resources Exploitation: A Recent Development of International and Municipal Law*, 11 J. E. ASIA & INT’L L. 35, 51 (2018). See also Francesca Giannoni-Crystal, *Jurisdictional Choice for Space Resource Utilization Projects; Current Space Resource Utilization Laws*, SANTA CLARA JOURNAL OF INTERNATIONAL LAW, forthcoming (Spring 2024).

¹⁷² Scot W. Anderson et al., *The Development of Natural Resources in Outer Space*, 51 ENV’T L. REP. 10835, 10840 (2021) (quoting OST, *supra* 45, art. I.) (arguing that “[t]he word ‘use’ seems to indicate that the drafters of the Outer Space Treaty expressly considered and authorized the development and deployment of space resources”).

¹⁷³ Bryant A. Mishima-Baker, *Moon Wars: Legal in Space and Moon Law*, THE REPORTER 4, (Mar. 4, 2021) <https://www.afjag.af.mil/Portals/77/documents/Reporter/20210304%20Mishima%20Baker.pdf?ver=SNGv8IQGp4wlKwQYTAz7Bg%3D%3D> [<https://perma.cc/8TFP-MQBT>] (“It is well-recognized that the use of these resources and these lunar locations is permitted by custom and the Outer Space Treaty, but the universal right to use space resources is still not fully tested because no nation has yet attempted to extract resources on a large scale. The time of that testing . . . appears to be approaching.”).

¹⁷⁴ Michael J. Listner, *A Reality Check on Article VI and Private Space Activities*, SPACE NEWS (Jun. 6, 2017), <https://spacenews.com/a-reality-check-on-article-vi-and-private-space-activities/> [<https://perma.cc/T62D-S95G>].

ingly, private entities have the privilege to perform activities in space, pursuant to authorization and license obtained from the state.¹⁷⁵

Second, Article II must be interpreted in light of customary international law on treaty interpretation as codified in the Vienna Convention on the Law of Treaties (Vienna Convention).¹⁷⁶ The non-appropriation principle likely originated from a fear that colonization could take place in outer space as occurred on Earth.¹⁷⁷ The words used in Article II (“use or occupation’ and sovereignty”)—which would suggest a reference to land only—confirms this assumption.¹⁷⁸

Third, Article 31(2) of the Vienna Convention provides that the interpretation of a treaty must consider “any subsequent practice in the application of the treaty” demonstrating the parties’ mutual understanding of its meaning.¹⁷⁹ Considering the position of spacefaring countries on space resource utilization, we must conclude that the appropriation ban does not cover space resources once extracted, but only resources *in situ*.¹⁸⁰ Several countries passed specific laws governing space mining, including the U.S. Commercial Space Launch Competitiveness Act in 2015,¹⁸¹ and the Artemis Accords, which envision mining as one of the

¹⁷⁵ *Id.* (qualifying this as a “private interest”).

¹⁷⁶ Vienna Convention on the Law of Treaties art. 31, *opened for signature* May 23, 1969, 1115 U.N.T.S. 331 (entered into force Jan. 27, 1980).

¹⁷⁷ See Jack David Eller, *Space Colonization and Exonationalism: On the Future of Humanity and Anthropology*, 2 HUMANS 148, 152 (Sept. 15, 2022), <https://doi.org/10.3390/humans2030010> [<https://perma.cc/R2CK-QQGK>].

¹⁷⁸ See, *supra* note 165, at 159.

¹⁷⁹ Larsen, *supra* note 165, at 26.

¹⁸⁰ Brian J. Egan, *The Next Fifty Years of the Outer Space Treaty*, U.S. DEP’T OF STATE (Dec. 7, 2016), <https://2009-2017.state.gov/s/1/releases/remarks/264963.htm> [<https://perma.cc/X5QD-VEE6>] (explaining how this interpretation of the OST is in line with the “longstanding position” of the United States).

¹⁸¹ Commercial Space Launch Competitiveness Act, Pub. L. No. 114–90 (2015); see K.G. Orphanides, *American Companies could soon Mine Asteroids for Profit*, WIRED UK (Dec. 11, 2015, 10:09 AM), <https://www.wired.co.uk/article/how-to-mine-asteroids-for-fun-and-profit> [<https://perma.cc/7NKH-6KS3>] (allowing private companies to “engage in the commercial exploration and exploitation of ‘space resources’”); Loi du 20 juillet 2017 sur l’exploration et l’utilisation des ressources de l’espace [Law of July 20th 2017 on the Exploration and Use of Space Resources], JOURNAL OFFICIEL DU GRAND-DUCHÉ DE LUXEMBOURG [OFFICIAL GAZETTE OF THE GRAND DUCHY OF LUXEMBOURG], No. 674; Federal Law No. (12) of 2019, on the Regulation of the Space Sector, issued on 19 December 2019, Art. II (also containing provisions on space resource utilization); The Act on Promotion of Business Activities for the Exploration and Development of Space Resources (Act No. 83 of 2021) (Japan), Official Gazette on June 23, 2021).

activities that will be done on the Moon.¹⁸² Both the U.S. law and the Artemis Accords can be seen as state subsequent practice for the purpose of treaty interpretation. When actual mining begins, the absence of international objection would be an even stronger argument than legislation because it would count as acquiescence to the performance of the activity itself.¹⁸³

While this Article demonstrates that the appropriation ban of Article II of the OST does not prohibit space mining, uncertainty remains as the contrary position is not without followers.¹⁸⁴ Uncertainty might be a problem for financing resource utilization projects.¹⁸⁵ At the international level, a clarification would help. For example, the adoption of guidelines like the Building Blocks for the Development of an International Framework on Space Resource Activities¹⁸⁶ (Building Blocks) would improve the position of space companies in obtaining financing.

2. *The Problem of Frequencies for New Space Activities*

Imagine the following scenario: a space company plans to provide communication services from the moon in support of lunar activities. It presents the project to a bank seeking financing. The financier could have a legitimate concern—has the company been allocated the proper frequency to operate, and will it be able to operate without “harmful interference”?

¹⁸² See Jan Osburg & Mary Lee, *Governance in Space: Mining the Moon and Beyond*, RAND (Nov. 18, 2022), <https://www.rand.org/pubs/commentary/2022/11/governance-in-space-mining-the-moon-and-beyond.html> [https://perma.cc/4NCB-TA5K].

¹⁸³ See Stefan Kadelbach, *International Law Commission and Role of Subsequent Practice as a Means of Interpretation Under Articles 31 And 32 VCLT*, QUESTIONS OF INTERNATIONAL LAW (Jan. 31, 2018, 9:56 PM), <http://www.qil-qdi.org/international-law-commission-and-role-of-subsequent-practice-as-a-means-of-interpretation-under-articles-31-and-32-vclt/>.

¹⁸⁴ Larsen, *supra* note 165, at 13 (arguing that interpretations of Article II vary among states and experts, with some suggesting it bars lunar property rights and with signatories to the 1979 Moon Agreement requiring benefit-sharing arrangements and that this disagreement affects the recognition and marketing of lunar mining products, creating uncertainty in the industry).

¹⁸⁵ See Durkee, *supra* note 84, at 425 n.6 (citing to the example an asteroid mining company that encountered resource shortages and was compelled to downsize its operations because of the uncertain property rights in outer space, which restricted the range of investment options accessible to the company).

¹⁸⁶ UNIV. OF LEIDEN, *supra* note 164.

Radio frequencies are vital for the operation of a satellite.¹⁸⁷ More generally, frequencies are essential for the vast majority of space objects because, with the exception of a minority of passive satellites, “[E]very space object sent into space must incorporate a radiofrequency component, enabling the transmission and reception of space operations signals, which is indispensable to communication.”¹⁸⁸ Each object launched into space is allocated specific radio frequencies, coordinated in accordance with the Radio Regulations of the International Telecommunication Union to prevent signal interference.¹⁸⁹

The International Telecommunication Union (ITU),¹⁹⁰—a specialized U.N. agency—deals with the allocation of frequencies. This Article does not discuss the ITU rules¹⁹¹ or the ways in which frequencies are allocated¹⁹² But it is sufficient to highlight that the ITU’s coordination is fundamental to avoid “harmful interference.”¹⁹³

¹⁸⁷ *Managing Radio Frequency Spectrum Amid a New Space Race*, ITU NEWS (Nov. 12, 2021), <https://www.itu.int/hub/2021/11/managing-radio-frequency-spectrum-amid-a-new-space-race/> [<https://perma.cc/D7ED-BJ6T>].

¹⁸⁸ *Id.*

¹⁸⁹ *Id.*

¹⁹⁰ *About International Telecommunication Union (ITU)*, ITU, <https://www.itu.int/en/Pages/default.aspx> [<https://perma.cc/X5L2-MDB7>]. The International Telecommunication Union (ITU), is an international agency established in 1865 as the International Telegraph Union to interconnect telegraph systems. *Id.* It has been extremely successful, counting now 193 member states. *Id.* The ITU is tasked with allocating worldwide radio spectrum and satellite orbits, establishing technical standards to ensure smooth interconnection of networks and technologies, and working towards enhancing access to information and communication technologies for neglected communities. *Id.*

¹⁹¹ *See* Constitution and Convention of the International Telecommunication Union, Dec., 22, 1992, 1825 U.N.T.S. 330 [hereinafter ITU Constitution and Convention]; *Radio Regulations*, ITU, <https://www.itu.int/pub/R-REG-RR> [<https://perma.cc/HB4U-G44U>] (last visited Feb. 12, 2024).

¹⁹² ITU Constitution and Convention, *supra* 185, art. 44.2 (stating that radio frequencies and associated orbits are “limited natural resources,” and their use is inspired by principles of “rationality, efficiency, and cost-effectiveness”). Article 44.2 also contains reference to the principle of “equitable access.” Setsuko Aoki, *Efficient and Equitable Use of Orbit by Satellite Systems: “Paper Satellite” Issues Revisited*, 14 PROCEEDINGS OF THE INTERNATIONAL ASTRONAUTICAL CONGRESS 229, 233 (2013) (discussing the various ways Art. 44.2 may be construed).

¹⁹³ ITU Constitution and Convention, *supra* 185, art. 45. Also, the “main objective of the ITU Radio Regulations is . . . to prevent harmful interference between stations.” Anne-Sophie Martin, *The Relevance of ITU Rules For Regulating the Use of Radio Frequency and Associated Orbits in the Context of Space Mining Activities*, 43 J. SPACE L. 85, 94 (2019).

Much of the focus of the ITU has been on geostationary orbits (GSO)¹⁹⁴ and, more recently, on low-earth orbits.¹⁹⁵ The ITU does not coordinate radio frequencies for the Moon, Mars, or deep space exploration.¹⁹⁶ In fact, no international entity deals with possible “harmful interference” there.¹⁹⁷

Therefore, in the given example of the space company seeking to provide communication services from the Moon, it is highly uncertain whether it will be able to operate without “harmful interference.”¹⁹⁸ First, as of now, this company could only be allocated a frequency for either “research” or “operational purposes of spacecraft.”¹⁹⁹ In fact, no commercial category for frequencies on the Moon exists.²⁰⁰ This is not an acceptable solution for a commercial entity seeking financing, especially with the looming future challenges posed by non-traditional types of communication, such as quantum communications.²⁰¹

A space company with lunar mining plans is in an even worse position because the ITU has not designated specific frequency bands for space resource activities yet. Thus far, bands for long-distance space flights have been available for use.²⁰² In addition, “New space” players, based on their activities, will necessitate access to diverse frequency types, such as the X Band frequency utilized by the NASA Deep Space Network, which are not available.²⁰³ International documents have recognized the importance of frequencies for new space; for example, the Building Blocks

¹⁹⁴ Jannat C. Thompson, *Space for Rent: The International Telecommunications Union, Space Law, and Orbit/Spectrum Leasing*, 62 J. AIR L. & COM. 279, 283 (1996) (with a radius of around 42,164 kilometers, geostationary orbits (GSO) are positioned at an approximate altitude of 35,786 kilometers above the Earth’s equator).

¹⁹⁵ See ITU NEWS, *supra* note 188 (arguing that In addition to human spaceflight, the decreasing technology and launch expenses are evident in the rapid expansion of non-geostationary mega-constellations and small satellites, which serve various purposes including low-latency broadband communication, Earth observation, and IOT applications).

¹⁹⁶ See Martin, *supra* note 194, at 103.

¹⁹⁷ ITU, *Reducing Harmful Interference to Satellites Near Earth, The Moon and Beyond*, available at <https://www.itu.int/hub/2020/09/reducing-harmful-interference-satellites-earth-moon-beyond/>.

¹⁹⁸ See Martin, *supra* note 194, at 103.

¹⁹⁹ *Id.* at 88–89.

²⁰⁰ *Id.* (contending that “[m]ember states have developed a practice of assigning lunar frequencies for ‘research purposes’ to commercial entities”).

²⁰¹ *Id.* at 100.

²⁰² *Id.* at 99.

²⁰³ See *id.* at 100.

mention frequency assignment for space resource activities in § 14 of the framework.²⁰⁴

In conclusion, the expanding range of space activities requires a change to the ITU rules; in fact, several scholars have already advocated to this effect, inviting states to make it a “priority.”²⁰⁵ The ITU recognized that new space is coming,²⁰⁶ but this acknowledgment has not caused a change in the rules yet. The ITU rules must evolve as soon as possible, including an additional commercial category for new space activities beyond Earth orbits.²⁰⁷ The ITU Plenipotentiary and World Telecommunications Development Conferences are the proper place for dealing with changes.²⁰⁸ Also, it is necessary to coordinate domestic frequency regulation and the ITU rules. Changing only domestic regulations is not enough.

Scholars have advanced common-sense proposals about the actions that the ITU should take. First, because current regulations require frequencies for deep space missions be allocated for either “research” or “operational purposes of spacecraft,”²⁰⁹ the ITU regulations must evolve and provide a commercial category for new space activities beyond Earth orbits.²¹⁰ Second, the ITU needs to grant specific frequency bands to space resource utilization.²¹¹ Third, the ITU should consider space companies’ need to access different types of frequencies depending on the activities,²¹²

²⁰⁴ See UNIV. OF LEIDEN, *supra* note 164, § 14.

²⁰⁵ Martin, *supra* note 194, at 87.

²⁰⁶ ITU NEWS, *supra* note 181 (“Partnerships between . . . governments’ space agencies and private space companies” want to establish “crewed stations orbiting the Moon and landed on the lunar surface. Other human habitation concepts are in the works to enable people to live in low-Earth orbit or on a crew transport vehicle to Mars or elsewhere.”).

²⁰⁷ Martin, *supra* note 194, at 89 (arguing that the use of “research” frequencies is mostly due to absence of a commercial ones).

²⁰⁸ *World Radiocommunication Conference*, U.S. DEP’T OF STATE, <https://www.state.gov/world-radiocommunication-conference/> [https://perma.cc/KKE3-U3H2] (“The World Radiocommunication Conference (WRC) is a global, inter-governmental treaty conference held every four years by the [ITU].”); see *World Telecommunication Development Conferences*, ITU, <https://www.itu.int/en/ITU-D/Conferences/WTDC/Pages/default.aspx> [https://perma.cc/3ERN-A35Q].

²⁰⁹ Martin, *supra* note 187, at 88–89.

²¹⁰ *Id.* at 89 (arguing that the practice of using the “research” category is “primarily because of the absence of a commercial category”).

²¹¹ *Id.* at 99.

²¹² *Id.* at 99–100 (arguing that space firms undertaking lunar and deep space missions need access to three types of frequencies: S Band for strong wireless connections between landers and rovers, K Band for navigation, and X Band for deep space communications).

including X Band frequency.²¹³ Fourth, the ITU should develop a framework to deal with frequency assignment in relation to future technologies, including quantum communication systems.²¹⁴ Without these changes, financing could be challenging for new space.

3. *Lack of a Clear Licensing Framework at the Domestic Level*

Consider a scenario similar to the one above: a space company plans to robotically mine the Moon. When it seeks financing, the financier may have another legitimate concern: is the company properly licensed?

Article VI of the OST requires states to implement authorization procedures for commercial space companies and to perform continuing supervision.²¹⁵ However, at the moment—at least in the United States—new space activities (e.g., space resource utilization) cannot obtain a license because a license procedure is simply not available.²¹⁶ More broadly, the United States does not have a licensing procedure to perform any activity beyond Earth orbit, except to a limited extent (e.g., frequency assignment), nor does any agency have clear authority to regulate activities beyond Earth orbit.²¹⁷

Some years ago, a former FAA executive testified in Congress that “regulatory agencies may not prohibit a U.S. national from conducting an activity in space unless Congress required federal oversight”²¹⁸ and that Article VI (which is not self-executing) would not require regulation of any particular activities of U.S. citizens in outer space.²¹⁹ This position is contrary to several decades of interpretation of Article VI of the OST and to the concept

²¹³ *Id.* at 100.

²¹⁴ *Id.*

²¹⁵ OST, *supra* note 45, art. VI.

²¹⁶ Marcia Smith, *President Signs Law Protecting Lunar Heritage Sites*, SPACE POLICY ONLINE (Jan. 1, 2021, 2:36 PM), <https://spacepolicyonline.com/news/president-signs-law-protecting-lunar-heritage-sites/> [<https://perma.cc/DS6V-ASHQ>]/.

²¹⁷ *Id.*

[N]o U.S. agency currently has clear-cut authority to license activities on the Moon or, indeed, anywhere in space Companies including Moon Express (for a lunar lander mission that has not taken place) and SpaceLogistics (for the MEV-1 satellite servicing mission) have obtained authorization through ad hoc processes, but the question of what agency should be in charge of licensing in-space activities is unresolved.

Id.

²¹⁸ *Reopening the American Frontier: Exploring How the Outer Space Treaty Will Impact American Commerce and Settlement in Space: Hearing Before the S. Subcomm. on Space, Science and Competitiveness*, 115th Cong. (2017) (testimony of Laura Montgomery, Ground Based Space Matters) [hereinafter *Testimony of Laura Montgomery*].

²¹⁹ *Id.*

of non-self-executing treaty provisions.²²⁰ It has been sharply criticized by scholars,²²¹ and seems unlikely that the Government itself could accept it.

The reality is that a license procedure is required, and the absence of it creates uncertainty. Further, a space company could indeed be prohibited from operating even if no licensing procedure exists. Brian Egan pointed out in 2016 that the current payload review might not be sufficient to authorize certain lunar missions.²²² There are precedents of activities that were prevented from being performed. For example, in 2014, a U.S. company filed for a payload review determination for a lunar habitat that once operational, was expected to fulfill various functions throughout an estimated twenty-year period;²²³ the request, however, was denied.²²⁴ Moreover, in the same period, another company filed for a payload review determination for a compact, privately-owned lunar lander whose mission had a narrow scope and short duration (the lander's batteries would not last more than two weeks) and it was approved.²²⁵ Egan's opinion is that the OST does not "categorically prohibit[] any of the proposed activities," but the Government the government needs a mechanism to provide authorization subject to conditions that would ensure conformity

²²⁰ The US would be in breach of its international obligation of "authorization" and "supervision" even if Article VI is not self-executing. See Carlos Manuel Vázquez, *Treaties as Law of the Land: The Supremacy Clause and the Judicial Enforcement of Treaties*, 122 HARV. L. REV. 599, 624–25 (2008) (arguing that even a non-self-executing treaty can be the basis of international responsibility (citing *The Head Money Cases*, 112 U.S. 580, 598 (1884) (holding that "[a] treaty is primarily a compact between independent nations," and "depends for the enforcement of its provisions on the honor and the interest of the governments which are parties to it. If these fail, its infraction becomes the subject of international negotiations and reclamations . . . which may in the end be enforced by actual war."))).

²²¹ See Major John S. Goehring, *Properly Speaking, The United States Does Have an International Obligation to Authorize and Supervise Commercial Space Activity*, 78 A.F. L. REV. 101, 119–21 (2018) (arguing that Montgomery's position raises doubts, especially regarding its potential negative impact on U.S. national security, while acknowledging that it may yield short-term benefits for commercial space industries, the contention is that it could have significant long-term consequences).

²²² Egan, *supra* note 174.

²²³ *Id.*

²²⁴ *Id.* The Federal Aviation Administration (FAA) asked the State Department to ascertain that the proposed payload would not raise any issues of foreign policy or Article VI OST obligation. See *id.* The absence of licensing and monitoring mechanism recommended the denial of the payload authorization. See *id.*

²²⁵ *Id.* (arguing that the State Department's evaluation indicated that the limited scale and short duration of the proposed activities did not raise issues regarding certain provisions of the OST, which could be relevant in the context of broader lunar endeavors).

with US obligations under the OST, and this requires the implementation of a licensing procedure.²²⁶

Because of the absence of a licensing procedure, new space projects might not be in a position to receive financing because of uncertainty of whether the activity could actually start. The company could be prevented from operating either at the time of the payload review determination or at launch. Indeed, under 51 U.S.C. § 50904, even if “no license, authorization, or permit is required,” the Government could prevent the launch for several reasons, including national security and foreign policy interests.²²⁷

This paper argues that the lack of a specific authorization procedure could constitute a serious hurdle to asset-based financing, even if there is disagreement among space actors on the details of a new procedure.²²⁸ The current framework for authorizing commercial activities beyond Earth’s orbit is deficient²²⁹ and the uncertainty should be solved by the adoption of a specific framework, which has come to be known as “mission authorization,” and which should “address the ‘gap’ that currently exists between new commercial space activities and the three existing licensing processes.”²³⁰ The Biden Administration is making progress in this direction.²³¹ Establishing rulemaking and licensing authority for in-orbit activities is vital to financing because the uncertainty

²²⁶ See *id.*

²²⁷ 51 U.S. Code § 50904 (c) (PREVENTING LAUNCHES AND REENTRIES).

²²⁸ Space companies disagree on the details of this unified procedure, and whether this unified procedure should exist at all. On November 21, 2022, space companies articulated their suggestions on the oversight of new space at the National Space Council, offering solutions ranging from a “clearing-house” to a “one stop shop.” Theresa Hitchens, *Space Firms want White House Fix for Regulatory Tangle, but Disagree on how*, BREAKING DEFENSE (Nov. 22, 2022, 4:07 PM), https://breakingdefense.com/2022/11/space-firms-want-white-house-fix-for-regulatory-tangle-but-disagree-on-how/?utm_campaign=Newsletters&utm_medium=email&_hsmi=235725191&_hsenc=p2ANqtz-8mHW6ADL9OWy5BXihqmQB_0Qt1Ej3f7LX3swc0GgzPDvoL7srA6sgfK-ngBG_JqHSCUx1Gb44XFzi0isdN3AuO7uSyqOy2HSKlnWo1cf_L6ngJw&utm_content=235725191&utm_source=hs_email [https://perma.cc/9TXU-FY4L]. The majority indicated the Commerce Department’s Office of Space Commerce is the authority that should be responsible for licensing, or at least the “point of contact.” *Id.* Only a few suggested a “permission-less” period. *Id.*

²²⁹ Egan, *supra* note 174 (arguing for approval of a “Mission Authorization” framework or similar legislation).

²³⁰ Hitchens, *supra* note 221.

²³¹ Currently, two competing bills for mission authorization and supervision are pending in Congress: One bill proposes to designate the Department of Commerce (DoC) as the sole regulatory authority for private sector space endeavors, streamlining licensing with a more efficient certification process (H.R. 6131, the Commercial Space Act of 2023).

about the authorization of future missions is likely to make financing difficult.

IV. ACTIONS BY THE SPACE INDUSTRY

The industry could do much to overcome impediments to asset-based financing and to improve its access to traditional asset-based financing. First, the industry should lobby on several fronts (e.g., for domestic regulation on licensing new space, ratification of the Space Protocol, amendments to the ITU regulations, actions by the WIPO for IP protection, and other useful actions).²³² Even if it seems counterintuitive, space companies should advocate for more regulation; indeed, the absence of a clear path for licensing constitutes a hurdle to financing.²³³ Second, space companies could help shape the law through industry practice.²³⁴ Third, creative space companies should cooperate in finding solutions that are acceptable to lenders and meet the space companies' needs, such as the use of new technology (e.g., blockchain).²³⁵

A. INDUSTRY PRACTICE TO SHAPE THE LAW

It is well-known how important industry practice is in shaping domestic law.²³⁶ In the space field, this can also be true for

The other bill, proposed by the White House National Space Council, divides regulatory control between the DoC and the Department of Transportation (DoT), expanding DoT oversight to include safety in orbit, on commercial space stations, and around celestial bodies. Additionally, it broadens DoT licensing to cover in-space transportation and extends DoC licensing for remote sensing satellites to include new activities like assembly and debris removal. *See, e.g.,* Theresa Hitchens, *White House asks Congress to split 'new space' authority between Commerce, Transportation* (Nov. 15, 2023), <https://breakingdefense.com/2023/11/white-house-asks-congress-to-split-new-space-authority-between-commerce-transportation/>.

²³² For example, lobbying for the adoption by the *Committee on the Peaceful Uses of Outer Space* (COPUOS) of non-binding guidelines applicable to new space. *See* Committee on the Peaceful Uses of Outer Space, UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS, <https://www.unoosa.org/oosa/en/ourwork/copuos/index.html> [<https://perma.cc/2GW2-HQGA>].

²³³ OECD (2015-03-01), *Industry Self-Regulation: Role and Use in Supporting Consumer Interests*, *OECD Digital Economy Papers*, No. 247, OECD Publishing, Paris. <http://dx.doi.org/10.1787/5js4k1fjqkwh-en> (arguing that regulation often serves to mitigate risks within industries. Without adequate regulation in the borrower industry, there may be higher levels of risk associated with lending. This increased risk can make lenders more cautious about providing financing, potentially leading to reduced access to funding for borrowers).

²³⁴ Part IV.A.

²³⁵ Part IV.B.

²³⁶ For example, in the contracts field. *See* U.C.C. § 1-303; Restatement (Second) of Contracts §§ 219–22 (1981).

international law; in an era in which treaty lawmaking seems to be in a deep crisis, industry can contribute to the evolution of space law through what a scholar has defined as “attributed lawmaking.”²³⁷ Attributed lawmaking is the idea that private conduct can be attributed to the state, and therefore count as state subsequent practice for treaty interpretation, and/or contribute to the formation of customary international law as state practice.²³⁸ While the process could occur in other areas of international law, space is a prime example of a field in which the private sector can help develop international law by advocating their selected legal principles to legislators, investors, and the media, along with their actual rocket launches. These companies’ own actions constitute the “subsequent practice” shaping the interpretation of the treaties.²³⁹

The rationale of this approach is in Article VI of the OST, which deems “private missions” to be state missions (at least in terms of state responsibility); therefore, the conduct of private actors becomes the state’s conduct.²⁴⁰ In the inertia of the state, private practice can be considered as a “subsequent practice” per Article 31 of the Vienna Convention and even be a significant factor in the formation of customary international law.²⁴¹ As an example, the space industry should maintain practices consistent with the interpretation that the non-appropriation principle of Article II of the OST does not extend to extracted space resources and that property rights in such resources exist. Under this concept of “attributed lawmaking,” private actors may drive the establishment of an international legal standard that allows for the appropriation of space resources.²⁴²

²³⁷ See Durkee, *supra* note 84, at 427 (arguing that international custom may be experiencing a resurgence in an era of nationalist retraction, where significant multilateral treaty regimes are confronting existential challenges).

²³⁸ *Id.* at 427–28 (arguing that when “the conduct of a private actor becomes attributed . . . to the state . . . [it] contribute[s] to the formation of customary international law[.]”).

²³⁹ *Id.* at 428.

²⁴⁰ See *id.*

²⁴¹ See *id.* (arguing that private missions can be treated as national missions for a variety of issues including formation of customary law and treaty interpretation because national inaction amounts to virtual acceptance of the private action) (citing Vienna Convention on the Law of Treaties art. 31 ¶ 3(b), May 23, 1969, 1155 U.N.T.S. 331 (entered into force Jan. 27, 1980)).

²⁴² *Id.* at 429. Attributed law making does not undermine national authority because nations can register timely objections, enact law to deal with unacceptable private practice, or negotiate new agreements. See *id.*

B. USE OF TECHNOLOGY: BLOCKCHAIN

The space industry could use technology to solve some of the issues discussed above.²⁴³ One interesting application of technology to financing is the use of blockchain.

“A blockchain is a decentralized ledger of all transactions across a peer-to-peer network.”²⁴⁴ In other words, a blockchain is “a shared, public database” that stores all transactions of a certain type that are verified through a chained cryptographical record of the transactions.²⁴⁵ The key aspects of blockchain are the public nature of the data and the cryptographic verification that prevents altering of the record except for legitimate transactions.²⁴⁶

Blockchain can be used as a method of financing for many ventures, including space.²⁴⁷ Because both blockchain and commercial space activities are in their early stages of development, the exact way in which blockchain could be used for space is still unclear,²⁴⁸ but many ideas exist.²⁴⁹ However, this Article focuses on one possible use of blockchain for asset financing in the space industry: blockchain smart contracts.

A fundamental aspect of smart contracts is that transactions are self-executing without the need for human intervention.²⁵⁰ This characteristic can be used by prospective lenders to give them the equivalent of the kind of security they would have in an Article 9 secured transaction.²⁵¹ For example, in an Article 9 transaction, if the debtor defaults, the lender can resort to various remedies, including self-help.²⁵² Many of these will require

²⁴³ See *supra* Part III.A.2.

²⁴⁴ *Making Sense of Bitcoin, Cryptocurrency, and Blockchain*, PwC, <https://www.pwc.com/us/en/industries/financial-services/fintech/bitcoin-blockchain-cryptocurrency.html> [<https://perma.cc/X2PY-S8T7>].

²⁴⁵ Dylan Taylor, *Blockchain's Application for the Space Industry*, FORBES (Feb. 10, 2022, 7:30 AM), <https://www.forbes.com/sites/forbesbusinesscouncil/2022/02/10/blockchains-applications-for-the-space-industry/?sh=69bfe5d2721f> [<https://perma.cc/4E9G-GMXB>].

²⁴⁶ See *id.*

²⁴⁷ *Id.*

²⁴⁸ Some space companies have already used blockchain. For example, SpaceChain offers blockchain-based services to companies involved in space activities. *Id.*

²⁴⁹ *Id.* (arguing that one possibility among many is to monetize particular space ventures by issuance of initial coin offerings and to monetize and distribute through utility coins data gathered on missions).

²⁵⁰ See Heather Hughes, *Blockchain and the Future of Secured Transactions Law*, 3.1 STANFORD J. BLOCKCHAIN L. & POL'Y 1, 29 (2020).

²⁵¹ See *id.* at 1.

²⁵² See *id.* at 31.

judicial intervention, although contractual provisions can be drafted to minimize the need for judicial intervention (e.g., confession of judgment clauses).²⁵³ Blockchain contracts can provide many of the same remedies more efficiently than under Article 9.²⁵⁴ For example, if the debtor defaults, the blockchain contract can automatically disable the debtor's use of the collateral (e.g., a satellite), it can automatically assign revenues from the debtor to the secured party with notification to the affected vendors, and it can provide for a sale of the asset.²⁵⁵

However, the use of blockchain as security entails a risk, i.e., that the blockchain transaction could be recharacterized as an Article 9 security interest, in which case the debtor or any affected third party could claim that the blockchain transaction is unperfected because of the lender's failure to comply with Article 9.²⁵⁶ In fact, the blockchain contract can be interpreted as an Article 9 security interest because the assets allocated to the contract are, in a way, automatically and potentially set aside for the performance of that contract.²⁵⁷ In other words, because "[b]lockchain-based smart contracts are a device or platform . . . [which] dedicates assets to specific transactional counterparties . . . it is possible to interpret all blockchain-based smart contracts as meeting the statutory requirements for a security interest."²⁵⁸

This risk of recharacterization of a blockchain transaction as an Article 9 security interest creates a business decision for lenders, who need to evaluate the risk of loss of their collateral protections through a blockchain transaction against the benefits of the transaction as a whole, including the efficiency savings from using blockchain.²⁵⁹ Like any risk, it can be priced into the transaction. Lenders must be aware of the possibility that a court could interpret provisions of the smart contract as creating an Article 9 security interest (which would be unperfected—because unfiled—and therefore ineffective against creditors with superior rights on the space asset.).

²⁵³ See Will Kenton, *Confession of Judgment: What it is, How it Works*, INVESTOPEDIA (Jan. 16, 2021), <https://www.investopedia.com/terms/c/confession-judgment.asp> [<https://perma.cc/5AP4-39GA>].

²⁵⁴ See generally Hughes, *supra* note 240, at 3–4 (discussing the implications of using blockchain to express transactions).

²⁵⁵ *Id.* at 4.

²⁵⁶ *Id.* at 3–4.

²⁵⁷ See *id.* at 1.

²⁵⁸ *Id.*

²⁵⁹ See *id.* at 4.

Could the parties try and clarify the issue by language that either exempts the blockchain transaction from Article 9 or, conversely, expressly makes the transaction subject to Article 9? A simple agreement that states that “Article 9 of the U.C.C. applies [or does not apply] to this transaction” is unlikely to be successful because Article 9 has quite complex scope and exclusion sections.²⁶⁰ Another possibility is to make a “protective” Article 9 filing, with a notation that the filer does not think that the smart contract transaction is subject to Article 9, but is nonetheless doing so to protect the filer’s interest against such a claim. However, this approach has numerous problems: the filing authority might not accept such a filing; it undermines to some extent the claim that Article 9 does not apply; and it requires a determination of where to file the financing statement, which is a problem with Article 9.²⁶¹

In short, while blockchain has potential, space companies and lenders seeking to use a smart contract for financing purposes must be aware of the uncertainties and risks. To solve these uncertainties, Article 9 could be revised to define whether blockchain transactions are subject to Article 9, are not subject to Article 9, or—like the distinction between true leases and security leases—sometimes are subject to Article 9 depending on certain characteristics of the transaction. This amendment to Article 9 would benefit many industries and not only space, but it could be part of a comprehensive revision of Article 9 to take into account space activities, as discussed above.²⁶²

V. CONCLUSION

The space industry—whose numbers are already substantial—has undeniable potential for further growth. However, because it does not consist anymore of only multibillion-dollar companies, it needs to avail itself of traditional financing. Venture capital alone is insufficient. As this Article has shown, some difficulties exist for the space industry’s access to traditional (and especially asset-based) financing. Some are common to all space activities,

²⁶⁰ See, e.g., U.C.C. § 9-109(a)–(c). (These sections do not have language like “unless otherwise agreed” or similar language. In fact, section (b) points against contractual power to characterize a transaction as subject to Article 9 by agreement: “The application of this article to a security interest in a secured obligation is not affected by the fact the obligation is itself secured by transaction or interest to which this article does not apply.”).

²⁶¹ See *supra* Part III.A.2.

²⁶² *Id.*

while some exist only for new space activities. These difficulties cover a broad range of legal, regulatory, and factual issues (e.g., insurance). While the problems are difficult, ideas to solve them are plentiful, a number of which have been examined. As this Article discusses, the industry can do much to advance its interests, including lobbying governments for specific actions, both at the domestic and international level, and use available technology