

2024: A SPACE JUNK ODYSSEY – APPLYING STRICT LIABILITY TO SOLVE THE PRIVATE SPACE JUNK PROBLEM

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I. INTRODUCTION

Science fiction frequently shows the treachery of space missions, usually in the form of hostile extraterrestrial life, but it rarely portrays a more real and tangible threat—space junk. Space junk, or space debris, is a catchall term describing orbital objects, encompassing anything as small as paint flecks from operational space stations to old, nonfunctioning spacecraft.¹ According to the National Aeronautics and Space Administration (“NASA”), there are currently over 27,000 pieces of space junk in Earth’s orbit, all traveling at speeds approximating 17,500 miles per hour.² Due to this immense speed, even the tiniest fragments can cause severe damage to spacecraft.³ While there are 25,000 objects that are known to exist, a true estimate of total space junk larger than one millimeter is greater than 100 million objects.⁴ A single collision between space objects only creates thousands more particles, as seen in 2009, when the Russian satellite Cosmos 2551 collided with Iridium 33, an American satellite.⁵

While spacefaring countries are the main producers of this debris, the rise in private space flight over the last several years introduced a new player to the space junk conversation.⁶ A decrease in launch costs enables companies, like Elon Musk’s SpaceX, to take advantage of economies of scale by putting more people into space, ultimately “securing 60% of the global commercial launch market.”⁷ Not only is the commercial space flight industry quickly establishing itself as a more

¹ See Charlotte Luke, *What is Space Junk and How Does It Affect the Environment*, EARTH (Sept. 6, 2021), <https://earth.org/space-junk-what-is-it-what-can-we-do-about-it/>.

² See Mark Garcia, *Space Debris and Human Spacecraft*, BREWMINATE: A BOLD BLEND OF NEWS AND IDEAS (Feb. 25, 2024), <https://brewminate.com/space-debris-and-human-spacecraft/>.

³ *Id.*

⁴ See NASA ORBITAL DEBRIS PROGRAM OFFICE, *Frequently Asked Questions*, NASA, <https://orbitaldebris.jsc.nasa.gov/faq/#>.

⁵ See Luke, *supra* note 1.

⁶ See Matt Weinzierl & Mehak Sarang, *The Commercial Space Age Is Here*, HARV. BUS. REV. (Feb. 12, 2021), <https://hbr.org/2021/02/the-commercial-space-age-is-here>.

⁷ *Id.*

than viable market,⁸ but SpaceX, as well as other private endeavors, such as Boeing and Blue Origin, are teaming up with NASA to “put people in space sustainably and at scale.”⁹ This burgeoning private market supports a projected rise in space tourism, which is expected to grow at a compound annual rate of 44.8% from 2024 to 2030, and will add to the space junk orbiting our Earth.¹⁰ As more objects are added to our atmosphere, the percentage chance of a collision will rise.

The dilemma with space debris, however, reaches far beyond our atmosphere and space exploration; the concern stretches back to Earth as threats to human safety. In Australia, for instance, a piece of junk off SpaceX’s Crew Dragon capsule crash-landed into a sheep farm.¹¹ The “10-foot-tall spike” found lodged into farmland in New South Wales, Australia, produced no damage, but the situation could have been worse should it have landed on someone’s house.¹² Additionally, a fuel tank damaged an Indonesian livestock pen, and a piece of a first-stage rocket damaged a house on the Ivory Coast.¹³ Situations like these are likely to increase with the expected rise in private space flight, as billionaires’ personal joyrides through the new frontier produce questions of property law and liability.

Beyond the on-Earth dangers, concern for those in space is well documented, as there are associated risks with each phase,¹⁴ and could become more of a concern as these commercialized, spacefaring companies dip their toes further into the space tourism market. NASA named a few types of hazards astronauts will continually encounter during their expeditions: radiation, isolation and confinement, distance

⁸ See Space Foundation Editorial Team, *Global Space Economy Grows In 2019 To \$423.8 Billion, The Space Report 2020 Q2 Analysis Shows*, SPACE FOUNDATION, <https://www.spacefoundation.org/2020/07/30/global-space-economy-grows-in-2019-to-423-8-billion-the-space-report-2020-q2-analysis-shows/>.

⁹ See Weinzierl, *supra* note 6.

¹⁰ See *Space Tourism Market Size, Share & Trends Analysis Report*, GRAND VIEW RSCH., <https://www.grandviewresearch.com/industry-analysis/space-tourism-market-report>.

¹¹ See Ben Turner, *SpaceX Space Junk Crash Lands in Australian Sheep Farm*, LIVESCIENCE, (Aug. 4, 2022) <https://www.livescience.com/spacex-rocket-hits-sheep-farm#:~:text=The%20space%20junk%2C%20found%20embedded,light%20arc%20across%20the%20sky>.

¹² *Id.*

¹³ See Jesse Emspak, *What Goes Up Must Come Down: Study Looks at Risk of Orbital Debris Casualties*, SPACE (July 18, 2022), <https://www.space.com/space-junk-rocket-debris-reentry-risk>.

¹⁴ See Karl Tate, *Space Travel: Danger at Every Phase (Infographic)*, SPACE (Jan. 28, 2013), <https://www.space.com/10694-human-spaceflight-dangers-infographic.html>.

from Earth, the lack of gravity, and hostile/closed environments.¹⁵ Other hazards include over thirty human health risks ranging from cancer and cardiovascular disease to problems with behavioral health.¹⁶

While there is guidance on the responsibility owed by one country to another in the form of Article VII of the Outer Space Treaty,¹⁷ apportioning liability is difficult when private space junk invades onto the private property of another, especially when crossing international waters.¹⁸ The United Nations (“UN”) discussed government responsibility through a series of treaties, but the discussion on private space junk is in its infancy.¹⁹

To adequately address the issues associated with damaging space junk as space flight becomes more frequent through private companies like SpaceX, Blue Origin, and Virgin Galactic, the international community needs to adequately apportion tort liability for private entities. The current UN framework for allocating liability in space debris cases is easily avoided, primarily because it is difficult for plaintiffs to bring cases against the appropriate defendants. Plaintiffs must prove that the defendant (either the launching state or private actor for whom the launching state is responsible) was negligent or that their act or omission caused the space debris to land where it did.²⁰ It is unlikely that lawyers’ knowledge about space flight is adequate to successfully bring a claim of negligence against a private actor. And even if it were, the costs of litigation would likely be too great for a plaintiff going against a private corporation with numerous lawyers and financial resources.

One possible solution is holding commercial agents strictly liable under an abnormally dangerous activity theory. This paper focuses on abnormally dangerous activities. An abnormally dangerous activity is an activity that involves a high level of danger, but still provides some

¹⁵ See, *5 Hazards of Human Spaceflight*, NASA, <https://www.nasa.gov/hrp/5-hazards-of-human-spaceflight>.

¹⁶ Zarana S. Patel, Et Al., *Red risks for a journey to the red planet: The highest priority human health risks for a mission to Mars*, NATURE (Nov. 5, 2020), at 1, <https://www.nature.com/articles/s41526-020-00124-6>.

¹⁷ See *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, G.A. Res. 34/68, U.N. GAOR, 34th Sess., (Dec. 5, 1980).

¹⁸ See Turner, *supra* note 11.

¹⁹ See *Space Law Treaties and Principles*, U.N. OFF. FOR OUTER SPACE AFFS., <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.html>.

²⁰ See *Convention on International Liability for Damage Caused by Space Objects*, U.N. OFF. FOR OUTER SPACE AFFS., <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introliability-convention.html>.

positive benefit, and thus carries strict liability.²¹ Strict liability holds a defendant liable regardless of intent and can apply to instances involving wild animals or abnormally dangerous activities.²² Strict liability does not require proof that the defendant was negligent or intended to cause harm to the plaintiff as discussed above.²³ Generally, U.S. courts will look towards factors such as the risk and magnitude of harm, location, commonness, value to the community, and whether there would be a serious risk of harm even after the exercise of reasonable care.²⁴ This paper argues that private actors should be held strictly liable under an abnormally dangerous activity theory, which would alleviate the need for proving negligence against a private actor.

Section II of this comment dissects the harms created by space debris as well as examines the current, ineffective legal framework established by UN treaties. Section III looks at the risks associated with an increase in private space flight (and consequently, more space junk) for poorer, non-spacefaring countries, as those countries tend to bear the burdens of private excess. Additionally, Section III examines the difficulties of regulating private space flight in our modern era of space exploration. Section IV argues for a strict liability approach to damage caused by private space flight and will discuss why the abnormally dangerous activity theory can and should apply to commercial space debris. In so doing, this section examines the instances in which a strict liability framework applies to other situations between private entities, and applies that framework to instances involving accidents with space debris. Moreover, Section IV argues that the Artemis Accords is an ideal vehicle through which to enforce this strict liability approach to the damage caused by private, orbital space junk. Finally, Section V summarizes the issues and reiterates the need for holding private spacefaring enterprises strictly liable under an abnormally dangerous activity theory.

II. SPACE DEBRIS AND THE UN'S ATTEMPTED SOLUTIONS

A. *The Dangers of Space Junk*

While there is no universal definition for space junk, it is generally understood to mean “all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are

²¹ See RESTATEMENT (SECOND) OF TORTS § 520 (AM. L. INST. 1977).

²² See *infra* note 139.

²³ See *generally Strict Liability*, CORNELL L., https://www.law.cornell.edu/wex/strict_liability (last visited Feb. 24, 2024).

²⁴ See *supra* note 21.

non-functional.”²⁵ This kind of debris originated in 1957 with Sputnik I, the Russian satellite that launched the space race.²⁶

A growing concern is Kessler syndrome, which arises when “once past a critical mass, the total amount of space debris will keep on increasing: collisions give rise to more debris and lead to more collisions, in a chain reaction.”²⁷ This space junk sits in Earth’s orbit, creating a “belt of debris around the Earth.”²⁸ Because of the self-generated debris caused by Kessler syndrome, experts fear that the low-earth orbit could be made inaccessible because the amount of debris acts as a barrier.²⁹ Moreover, a majority of the debris is non-functioning: since the start of the space age in 1957, humans have deployed 12,170 satellites into space.³⁰ Only 4,700 of the remaining 7,630 satellites in space are still functioning.³¹

The nearly 3,000 pieces of inoperative debris are a concern both in space and on Earth, as they travel at speeds of approximately 17,100 miles per hour at the altitude at which the International Space Station (“ISS”) flies.³² In space, the ISS performed twenty-nine “debris-avoiding maneuvers” since 1999 – and that number is expected to climb.³³ On Earth, Kessler syndrome is likely to produce severe socioeconomic impacts.³⁴ Specifically, “[c]ertain geographic areas and social groups would be disproportionately affected, in particular in rural areas with limited existing ground infrastructures and large reliance on space infrastructure.”³⁵ Additionally, “the distribution of rocket body launches and reentries leads to the casualty expectation (that is, risk to

²⁵ Inter-agency Space Debris Coordination Committee, *IADC Space Debris Mitigation Guidelines* (Mar. 2020); U.N. Office for Outer Space Affairs, *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010).

²⁶ See Maris Fessenden, *Jettison Through Nearly 60 Years of Space Junk Accumulation*, SMITHSONIAN MAGAZINE (Dec. 28, 2015), <https://www.smithsonianmag.com/smart-news/jettison-through-nearly-60-years-space-junk-accumulation-180957653/>.

²⁷ *The Kessler Effect and How to Stop It*, THE EUR. SPACE AGENCY, https://www.esa.int/Enabling_Support/Space_Engineering_Technology/The_Kessler_Effect_and_how_to_stop_it.

²⁸ See Mike Wall, *Kessler Syndrome and the space debris problem*, SPACE (Nov. 15, 2021), <https://www.space.com/kessler-syndrome-space-debris>.

²⁹ See Marit Undseth et al., *Space Sustainability: The Economics of Space Debris in Perspective*, OECD SCIENCE, TECHNOLOGY AND INDUSTRY POLICY PAPERS ORG. FOR ECON. COOP. AND DEV., SPACE SUSTAINABILITY 1, 26 (2020), https://www.oecd-ilibrary.org/science-and-technology/space-sustainability_a339de43-en.

³⁰ Wall, *supra* note 28.

³¹ *Id.*

³² *Id.*

³³ *Id.*

³⁴ Undseth, *supra* note 29, at 7.

³⁵ *Id.*

human life) being disproportionately borne by populations in the Global South, with major launching states exporting risk to the rest of the world.”³⁶

The Global South bears this disproportionate risk because the historically wealthiest countries in the Global North appropriated natural resources from the South.³⁷ Over time, this resulted in environmental and economic degradation of the South,³⁸ and because of this degradation, these countries do not have the necessary resources to develop at the same rate as countries in the Global North.³⁹ These countries in the Global South must base their economies on extracting fossil fuels and deforestation in order to avoid the very worst of economic inequalities.⁴⁰ The Global South, with its limited bargaining power, is highly dependent on the North for resources,⁴¹ which could make it more difficult for the South to recover from damage caused by private space debris. In fact, it is only recently that wealthier countries agreed to pay developing nations for climate change damage caused by the Global North’s poaching of natural resources in the South.⁴²

Space debris also poses environmental concerns.⁴³ Larger debris that makes its way back to Earth can contain toxic material from old fuel tanks.⁴⁴ Specifically, a carcinogen called unsymmetrical dimethylhydrazine (“UDMH”), which can harm plants and animals, was at issue in the case of Russia’s proton rockets that peppered eastern Siberia.⁴⁵ These chemicals also harm humans, as locals living in the affected Siberian region pointed towards the UDMH as the catalyst for a number of cancer cases.⁴⁶ Locals suspect UDMH caused acid rain to seep into their water and soil over decades, resulting in “high blood pressure and headaches” as well as a high percentage of cancer cases among the

³⁶ Michael Byers et al., *Unnecessary Risks Created by Uncontrolled Rocket Reentries*, NATURE ASTRONOMY 1093, 1093 (2022).

³⁷ See Carmen G. Gonzalez, *Environmental Justice, Human Rights, and the Global South*, 13 SANTA CLARA J. INT’L L. 151, 154 (2015).

³⁸ See *id.*

³⁹ See Antonia Perez Bravo, *The Global South*, MEDIUM (Mar. 26, 2017), <https://medium.com/@antoniaperezbravo/the-global-south-6d066634e037>.

⁴⁰ See *id.*

⁴¹ See Gonzalez, *supra* note 37, at 177 (2015).

⁴² See Brad Plumer et al., *In A First, Rich Countries Agree to Pay for Climate Damages in Poor Nations*, N.Y. TIMES (Nov. 19, 2022), <https://www.nytimes.com/2022/11/19/climate/un-climate-damage-cop27.html>.

⁴³ See Luke, *supra* note 1.

⁴⁴ *Id.*

⁴⁵ *Id.*

⁴⁶ *Id.*

villagers.⁴⁷ One individual living in the affected region, Mrs. Marina Lyamkina, observed that “[t]here is someone with cancer in every house: either someone with a tumor, or who has had surgery, or already dead.”⁴⁸ Another individual “had 11 siblings, 10 of whom died from cancer.”⁴⁹

Another concern involves debris that explodes while in space,⁵⁰ which only contributes to Kessler syndrome’s replicating nature. Typically, spacecrafts have small traces of fuel leftover after they are no longer in use, and after a piece of debris strikes the fuel tank, the fuel mixes together and explodes.⁵¹ “[T]he worst case on record . . . [was] a European Ariane rocket [that] produced more than 500 pieces of debris big enough to disable a spacecraft.”⁵² In a colossal software disaster, the Ariane 5 rocket flipped ninety degrees, just a mere thirty-seven seconds after lift-off, resulting in the complete destruction of the rocket.⁵³ While this particular explosion was the result of software design errors⁵⁴ of the rocket’s guidance system, it no less contributed to the threat posed by Kessler syndrome.

B. *The Current Ineffective Legal Landscape*

Before any treaty was signed, the UN established the Committee on the Peaceful Uses of Outer Space (“COPUOS”).⁵⁵ COPUOS evaluated international cooperation between nations within their uses of states, which eventually led to COPUOS establishing the five treaties governing the peaceful use of outer space.⁵⁶ The first UN treaty, the Treaty on Principles Governing the Activities of States in the Exploration of Outer Space, including the Moon and Other Celestial Bodies (“Outer Space Treaty”), established the foundation of what we now know colloquially

⁴⁷ Maria Vassilieva, *Russians say space rocket debris is health hazard*, BBC NEWS (Aug. 7, 2012), <https://www.bbc.com/news/world-europe-19127713>.

⁴⁸ *Id.*

⁴⁹ *Id.*

⁵⁰ See Steve Olson, *The Danger of Space Junk*, THE ATLANTIC (July 1998), <https://www.theatlantic.com/magazine/archive/1998/07/the-danger-of-space-junk/306691/>.

⁵¹ *Id.*

⁵² *Id.*

⁵³ Jamie Lynch, *The Worst Computer Bugs in History: The Ariane 5 Disaster*, BUGSNAG (Sept. 7, 2017), <https://www.bugsnag.com/blog/bug-day-ariane-5-disaster>.

⁵⁴ See No. 33 – 1996: *Ariane 501 – Presentation of Inquiry Board report*, THE EUR. SPACE AGENCY, (July 23, 1996) https://www.esa.int/Newsroom/Press_Releases/Ariane_501_-_Presentation_of_Inquiry_Board_report.

⁵⁵ See *Committee on the Peaceful Uses of Outer Space*, U.N. OFFICE FOR OUTER SPACE AFFAIRS, <https://www.unoosa.org/oosa/en/ourwork/copuos/index.html>.

⁵⁶ *Id.*

as “space law.”⁵⁷ With the space race well underway, the UN ratified this treaty in 1967 to prevent the potential damage generated by space junk⁵⁸ – both in space and on Earth – and apportion liability to offending nations.⁵⁹ While adequate for its time, the Outer Space Treaty could not have predicted the potential damage of Kessler syndrome.⁶⁰ Additionally, the Outer Space Treaty did not account for the rise in private space flight and an exponential rise in space tourism,⁶¹ both of which will only exacerbate the threat associated with uncontrolled rocket reentries.⁶²

i. The Historical Ineffectiveness of U.N. Treaties

The Outer Space Treaty holds each State Party to the Treaty liable to other State Parties to the Treaty for damage caused by launching an object into outer space.⁶³ While it mentions that liability is found for damage to a State Party’s “natural or judicial persons,”⁶⁴ the specific duty owed by one country to another is unclear. Four years later, the UN sought to define that burden by ratifying the Liability Convention, which stated that “[a] launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to the aircraft in flight.”⁶⁵ While shoring up some ambiguity, the Outer Space Treaty does not include anything regarding liability of private actors, most likely due to the fact that the UN could not have predicted private space flight would mature into such a viable industry. With the amount of space junk in orbit likely to rise due to a burgeoning

⁵⁷ See G.A. Res. 2222 (XXI), 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).

⁵⁸ See Loren Grush, *How an International Treaty Signed 50 Years Ago Became the Backbone for Space Law*, THE VERGE (Jan. 27, 2017), <https://www.theverge.com/2017/1/27/14398492/outer-space-treaty-50-anniversary-exploration-guidelines>.

⁵⁹ See Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *supra* note 57.

⁶⁰ See The Kessler Effect and How to Stop It, *supra* note 27.

⁶¹ See *Space Tourism Market Size, Share & Trends Analysis Report*, *supra* note 10.

⁶² See Byers et al., *supra* note 36 (stating that “[a]ssuming . . . that each [uncontrolled rocket] reentry spreads lethal debris over a 10m² area, we conclude that current practices have on order a 10% chance of one or more casualties over a decade.”).

⁶³ See Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *supra* note 57, at 14.

⁶⁴ *Id.*

⁶⁵ See G.A. Res. 2777 (XXVI), *Convention on International Liability for Damage Caused by Space Objects*, at 25 (Nov. 29, 1971).

new space tourism market,⁶⁶ the expectation is that the Liability Convention controls potential liability disputes.⁶⁷ Despite the Liability Convention recently celebrating its fiftieth birthday, it has rarely been used,⁶⁸ with the exception being one case between the USSR and Canada, discussed in the next section.⁶⁹

Enforcement of UN treaties and international law is not a new issue.⁷⁰ Mandatory arbitration clauses help facilitate enforcement of private transactions,⁷¹ but holding states accountable of international law remains difficult. While the UN Charter established an International Court of Justice through which Member States can settle disputes,⁷² the lack of a blanket judicial or penal system makes enforcing treaties difficult.⁷³ Additionally, the UN Charter provides the International Court of Justice the ability to grant advisory opinions on legal issues referred to it by other international entities,⁷⁴ but these are merely opinions that hold little enforcement power.⁷⁵

Critics of the current UN framework argue that the veto power of the five permanent members that make up the Security Council – the United States, the United Kingdom, Russia, France, and China – “gives undue deference to the[ir] political interests . . . leading to inaction in the face of mass atrocities.”⁷⁶ The criticism against the UN is warranted, but it paints a clear picture as to why the Liability Convention has only been

⁶⁶ See *Space Tourism Market Size, Share & Trends Analysis Report*, *supra* note 10.

⁶⁷ See Andrew Brearley, *Reflections upon the Notion of Liability: The Instances of Kosmos 954 and Space Debris*, 34 J. SPACE L. 291, 292 (2008).

⁶⁸ *Id.*

⁶⁹ *Id.*

⁷⁰ See generally *More Than 4000 Attacks Against Health Workers, Facilities, and Transports Since 2016 Underscore Need for Action to Protect Health Care in Conflict*, PHYSICIANS FOR HUMAN RIGHTS (May 5, 2021), <https://phr.org/news/more-than-4000-attacks-against-health-workers-facilities-and-transport-since-2016-underscore-need-for-action-to-protect-health-care-in-conflict/> (statement of Leonard Rubenstein) (“The absence of follow-through commitments made by [U.N.] Member States shows that to date they have offered only rhetorical support for Resolution 2286 and the obligation to protect health care.”).

⁷¹ See *Int’l Chamber of Com., Arbitration Clause Rules and Procedures*, <https://icwbo.org/dispute-resolution-services/arbitration/rules-procedure/arbitration-clause/>.

⁷² U.N. Charter art. 33, ¶ 1.

⁷³ See U.N. 2010 Treaty Event, *Towards Universal Participation and Implementation* (2010), https://treaties.un.org/doc/source/events/2010/press_kit/fact_sheet_5_english.pdf.

⁷⁴ U.N. Charter art. 96, ¶ 1.

⁷⁵ See U.N. 2010 Treaty Event, *supra* note 73.

⁷⁶ The Council on Foreign Relations Staff, *The UN Security Council*, COUNCIL ON FOREIGN RELS. (Aug. 12, 2021), <https://www.cfr.org/background/un-security-council>.

invoked once during its lifetime.⁷⁷ The crash of Soviet satellite Kosmos 954 illustrates the difficulty with enforcing the Liability Convention.

C. The Liability Convention's Limited Use: The Case of Kosmos 954

In 1978, the Soviet satellite Kosmos 954 crashed into northern Canada.⁷⁸ This crash provided a perfect backdrop to enforce the Liability Convention; however, the case was settled out of court, leaving no case law involving the Liability Convention.⁷⁹ Even if the case of Kosmos 954 was adjudicated using the Liability Convention, it would not have necessarily produced a slam-dunk decision.⁸⁰ This section looks at a few of the treaty's shortcomings.

First, the Liability Convention attempts to apportion liability to the launching state by explaining that the state “shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to the aircraft in flight.”⁸¹ In contrast, the Outer Space Treaty asserts that “[s]tate [p]arties to the [t]reaty shall bear international responsibility for . . . activities in outer space . . . whether such activities are carried on by governmental agencies or by non-governmental entities.”⁸² The inconsistency between these treaties' use of the terms “liability” and “responsibility,” despite their parallel definitions, is ambiguous. In this instance, liability refers to the guilt that attributed to a state whose launched satellite crashed back on Earth, causing damage to another state that is a party to the Liability Convention.⁸³ Responsibility refers to a state's broader duty it owes to its citizens and other states for its space activities.⁸⁴

⁷⁷ See Richard L. Hermer-Fried, Comment, *Kessler Syndrome: A United States' Statutory Solution for Satellite Debris Removal and the Mitigation of Orbital Collisions*, 18 HOFSTRA U. J. OF INT'L BUS. AND L. 259, 270 (2019).

⁷⁸ See Government of Canada, *Previous nuclear incidents and accidents: COSMOS 954*, <https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/radiological-nuclear-emergencies/previous-incident-accidents/cosmos-954.html> (last visited, Nov. 5, 2022).

⁷⁹ See Hermer-Fried, *supra* note 77.

⁸⁰ See generally Trevor Kehrer, *Closing the Liability Loophole: The Liability Convention and the Future of Conflict in Space*, 20 U. CHI. J. OF INT'L L. 178, 214 (2019) (discussing the Liability Convention's unlikely use between unfriendly countries).

⁸¹ See G.A. Res. 2777 (XXVI), *supra* note 65.

⁸² See G.A. Res. 2222 (XXI), *supra* note 57, at 5.

⁸³ See Brearley, *supra* note 67, at 308.

⁸⁴ *Id.*

However, a state’s onus is more difficult because it is unclear whether foreign, domestic, or international law should apply.⁸⁵ With Kosmos 954, arguments could be made for the use of Canadian or Soviet law.⁸⁶ This is why the use of a blanket, strict liability approach holding the launching state liable would remove any potential ambiguity regarding applicable law.

Second, Article XIV of the Liability Convention has a weak mechanism for establishing a Claims Commission should the involved states not reach a settlement agreement.⁸⁷ The Claims Commission, which is not a standing committee, consists of three members: “one appointed by the claimant State, one appointed by the launching State[,] and the third member, the Chairman, to be chosen by both parties jointly.”⁸⁸ However, the Liability Convention does not grant binding authority to the Claims Commission.⁸⁹ Article XIX only requires the Commission to provide a recommendatory award and is only binding should the parties involved choose to be bound.⁹⁰ A mechanism based on a strict liability theory would remove these enforcement gymnastics plaguing the current framework.

Third, the Liability Convention provides the launching state a procedure for avoiding liability altogether. Under Article VI, “exoneration from absolute liability shall be granted to the extent that a launching State establishes that the damage has resulted . . . from gross negligence or from an act or omission done with intent to cause damage on the part of a claimant State.”⁹¹ While proving gross negligence—the “lack of even slight diligence or care”⁹²—on the part of the claimant state is a high threshold to achieve, it is hard to imagine a scenario where a claimant state is so negligent that the state’s actions would activate this provision. With gross negligence being a lack of any care by the defendant, it is contrasted with contributory negligence. Contributory negligence occurs when a “plaintiff’s own negligence . . . play[s] a part in causing the plaintiff’s injury and that is significant enough . . . to bar the plaintiff from recovering damages.”⁹³ It is unlikely that contributory negligence would apply in situations involving space debris, seeing as it

⁸⁵ *Id.*

⁸⁶ *Id.*

⁸⁷ See G.A. Res. 2777 (XXVI), *supra* note 65, at 26.

⁸⁸ *Id.* at 26-27.

⁸⁹ See Brearley, *supra* note 67, at 310–11.

⁹⁰ See G.A. Res. 2777 (XXVI), *supra* note 65 at 27.

⁹¹ *Id.* at 26.

⁹² *Gross Negligence*, BLACK’S LAW DICTIONARY (11th ed. 2019).

⁹³ *Contributory Negligence*, BLACK’S LAW DICTIONARY (11th ed. 2019).

only exists in a limited number of jurisdictions.⁹⁴ It is also hard to imagine a scenario in which an individual could contribute to the destruction of their property caused by falling space debris. Article VI distracts from the issue of finding an adequate mechanism to hold a state and its private entities liable for damage caused by their spacefaring endeavors.

Moreover, the Liability Convention only allows claimant states the ability to impose liability on a launching state should it be successful in identifying that state.⁹⁵ Unfortunately, identifying the launching state responsible for the damage is difficult because “tracking technology can only detect debris of a certain size.”⁹⁶ Therefore, should a piece of debris cause severe damage but have no markings identifying the state from which it originated, the claimant state might be unable to obtain adequate relief.

Even if a claimant state could identify the state from which the debris originated, they would have to show that the damage was a result of the fault of the state or a person for whom the state is responsible, and also requires an intentional act or omission.⁹⁷ Causation alone is not enough, and even if the claimant state could show an intentional act or omission, “it isn’t entirely clear whether a private corporation’s intent can or should be imputed to a State that may have no involvement in the relevant decision other than its mere hosting of the launch site.”⁹⁸ In this instance, how a claimant state or private citizen obtains adequate recourse is unclear, and to whom that state or citizen directs its lawsuit is ambiguous. And finally, coming to an “international consensus” on how to handle uncontrollable space objects returning to Earth is a tall order “given current geopolitical tensions.”⁹⁹ This only shines a brighter light on the failures of the UN Liability Convention.

III. THE COMMERCIALIZATION OF OUTER SPACE AND ITS ASSOCIATED RISKS

Basic math indicates that with more private spacecraft circling our atmosphere, the amount of space junk is only going to increase, along

⁹⁴ *Id.*

⁹⁵ See Hermer-Fried, *supra* note 77 at 260.

⁹⁶ *Id.*

⁹⁷ *Id.* at 271.

⁹⁸ *Id.*

⁹⁹ See Ben Turner, *A 25-ton Chinese Rocket Booster Will Crash to Earth Saturday. What’s the Risk?*, LIVESCIENCE (July 29, 2022), <https://www.livescience.com/chinese-rocket-booster-third-uncontrolled-reentry>.

with the risk of harm from that space junk.¹⁰⁰ The rapid commercialization of outer space by companies like SpaceX, Blue Origin, and Virgin Galactic is likely to expedite Kessler syndrome, as all three companies made various strides in sending rockets into outer space.¹⁰¹ Not only are they sending rockets, but SpaceX also sends satellites, called Starlink, into low Earth orbit to provide internet access across the world.¹⁰² The private investment into space flight has lowered the costs of launching satellites into orbit,¹⁰³ which will likely encourage both public and private entities to send satellites into orbit, contributing more to the cyclical nature of Kessler syndrome.

The commercialization of outer space is contributing to the “space-for-space economy,” which is a market of goods and services produced in space for use in space.¹⁰⁴ Private firms like SpaceX will make this space-for-space market more viable, encouraging private citizens to embark on space expeditions as tourists and passengers,¹⁰⁵ ultimately adding to the collection of space junk in Earth’s orbit. However, Blue Origin is working towards reusable rockets,¹⁰⁶ which could lower the amount of space debris added by private corporations.

On its face, private space innovation is not inherently wrong, but its contribution to exporting risk to uninvolved third parties is troubling.¹⁰⁷ This burden has predominantly fallen on the Global South – countries south of the equator in parts of Latin America, Asia, Africa, and Oceania.¹⁰⁸ By exposing these countries to unwanted space debris, private space flight contributes to the plight these countries already face due to the excesses of developed countries – like greenhouse gas

¹⁰⁰ See Douglas Broom, *As private satellites increase in number, what are the risks of the commercialization of space?*, WORLD ECON. FORUM (Jan. 12, 2022), <https://www.weforum.org/agenda/2022/01/what-are-risks-commercial-exploitation-space/>.

¹⁰¹ See Svetla Ben-Itzhak, *Companies are commercializing outer space. Do government programs still matter?*, WASH. POST (Jan. 11, 2022), <https://www.washingtonpost.com/politics/2022/01/11/companies-are-commercializing-outer-space-do-government-programs-still-matter/>.

¹⁰² See STARLINK, <https://www.starlink.com/technology>.

¹⁰³ World Econ. F., *The Global Risks Report* (17th ed.) 1, 71 (2022).

¹⁰⁴ See Weinzierl, *supra* note 6.

¹⁰⁵ *Id.*

¹⁰⁶ See About Blue, *Increase Access to Space Through Reusable Rockets*, BLUE ORIGIN, <https://www.blueorigin.com/about-blue/>

¹⁰⁷ See Chase DiBenedetto, *Space junk is unregulated, harmful, and putting people at risk*, MASHABLE (Aug. 14, 2022), <https://mashable.com/article/space-junk-unregulated-global-south>.

¹⁰⁸ *Id.*

emissions.¹⁰⁹ Specifically, a *Nature Astronomy* study found that “Jakarta, Indonesia; Dhaka, Bangladesh; Mexico City, Mexico; Bogotá, Colombia; and Lagos, Nigeria, are at least three times as likely than Washington, D.C., New York, Beijing, and Moscow to have a rocket body reenter over them.”¹¹⁰ These cities in the Global South are hit more frequently because the study inferred that these rockets with “uncontrolled reentries . . . [are] associated with launches to geosynchronous orbits, located near the equator.”¹¹¹ While the brunt is already being felt by these countries due to government-driven space exploration, private space companies will have little incentive to limit their involvement, as the space industry is expected to see revenue soar to the tune of \$1 trillion dollars.¹¹²

A. *Regulating Private Space Flight*

While the space industry booms financially, a more puzzling concern is the weak regulation private space flight currently experiences.¹¹³ In the United States, the Federal Aviation Administration (“FAA”) regulates private space flight,¹¹⁴ albeit in a limited and relatively weak manner. Because satellite technology powered by commercial space flight must pass through United States airspace to provide U.S. citizens with services like radio, television, and weather forecasts, the FAA was given the role of space regulation of commercial space flight.¹¹⁵ Primarily, the FAA “issues commercial space licenses, verifies launch or reentry vehicles meant to carry humans . . . and provides regulation of flight crew qualifications and training.”¹¹⁶ While Congress has not granted the FAA complete authority in all aspects of

¹⁰⁹ See Feargus O’Sullivan, *The World’s Fastest-Growing Cities Are Facing the Most Climate Risk*, BLOOMBERG (Feb. 28, 2022), <https://www.bloomberg.com/news/articles/2022-02-28/global-south-cities-face-dire-climate-impacts-un-report>; see also Byers et al., *supra* note 36, at 1095.

¹¹⁰ See Byers et al., *supra* note 36, at 1095.

¹¹¹ *Id.*

¹¹² See Michael Sheetz, *The Space Industry is on Its Way to Reach \$1 Trillion in Revenue by 2040, Citi Says*, CNBC (May 21, 2022), <https://www.cnbc.com/2022/05/21/space-industry-is-on-its-way-to-1-trillion-in-revenue-by-2040-citi.html>.

¹¹³ See Rebecca Heilweil, *How bad is space tourism for the environment? And other space travel questions, answered*, VOX (July 25, 2021), <https://www.vox.com/recode/22589197/space-travel-tourism-bezos-branson-rockets-blue-origin-virgin-galactic-spacex>.

¹¹⁴ Fed. Aviation Admin., *Human Space Flight* (May 17, 2022), https://www.faa.gov/space/human_spaceflight.

¹¹⁵ Fed. Aviation Admin., *Additional Information* (Sept. 9, 2022), https://www.faa.gov/space/additional_information.

¹¹⁶ See Fed. Aviation Admin., *supra* note 114.

private space flight (most notably, the FAA cannot regulate the safety of individuals on board the spacecraft), this hold expired on March 8, 2024.¹¹⁷ With this moratorium now expired, “the human spaceflight industry will be opened to new regulations to protect the safety of people carried to space on their [private] rockets.”¹¹⁸

In Europe, the European Space Agency (“ESA”) is headquartered in Paris, France, and has twenty-two member states that engage with other spacefaring countries for the advancement of space exploration and research, and to produce “satellite-based technologies and services.”¹¹⁹ The ESA sent rockets to space, teamed up with NASA to launch the now-famous James Webb Space Telescope, and also sought improvement in space engineering, which includes areas like “thermal control, structures and mechanisms, propulsion, and mechanical engineering.”¹²⁰ Some of the notable member states of the ESA include France, Germany, Italy, and the United Kingdom.¹²¹ Forty-two countries throughout the world have their own independent space program, some of which are member-states to the ESA.¹²²

This worldwide assortment of space programs makes it difficult for a unified, international coordination to apportion liability to private space companies (whether by UN treaty or international cooperation). For example, Arianespace, a French company, which describes itself as a “commercial space transportation company,” is headquartered in Evry, France with locations in Washington, D.C., Tokyo, and Singapore, while also launching spacecraft from Kourou, French Guiana.¹²³ Arianespace’s international footprint makes it difficult for any one country to properly regulate its activity in space. Moreover, appropriating liability is more difficult when state governments collaborate with private endeavors.¹²⁴

¹¹⁷ *Id.*

¹¹⁸ Miriam Kramer, *Private human spaceflight’s future hangs on looming regulation*, AXIOS (Jan., 3, 2023), <https://www.axios.com/2023/01/03/private-human-spaceflight-regulations>.

¹¹⁹ See European Space Agency, *ESA facts*, https://www.esa.int/About_Us/Corporate_news/ESA_facts (last visited Jan. 4, 2023).

¹²⁰ Elizabeth Howell, *European Space Agency: Facts & Information*, SPACE (May 24, 2016), <https://www.space.com/22562-european-space-agency.html>.

¹²¹ See European Space Agency, *supra* note 119.

¹²² See U.N. Office for Outer Space Affairs, *Worldwide Space Agencies*, <https://www.unoosa.org/oosa/en/ourwork/space-agencies.html>.

¹²³ *About Us*, ARIANESPACE, <https://www.arianespace.com/about-us/>.

¹²⁴ See Katherine Brown, *NASA’s SpaceX Crew-1 Astronauts Headed to International Space Station*, NASA (Feb. 27, 2021), <https://www.nasa.gov/press-release/nasa-s-spacex-crew-1-astronauts-headed-to-international-space-station>; Peter B. de Selding, *France Giving up Arianespace Ownership, but not Oversight*, SPACENEWS (June 19, 2015), <https://spaceneews.com/france-giving-up-arianespace-ownership-but-not-oversight/>.

B. *Suggested Interpretations*

On first glance, the Outer Space Treaty solves the issue of liability, stating that "State Parties to the Treaty shall bear international responsibility for national activities in outer space . . . whether such activities are carried on by governmental agencies or by non-governmental entities."¹²⁵ While the Outer Space Treaty states that private space activities are under the purview of the state from which the private spacecraft launched, by the Treaty using the language, "non-governmental,"¹²⁶ it says nothing else about private space flight and fails to acknowledge which state, specifically, shall retain liability over the private actor. Moreover, the Outer Space Treaty struggled to enforce liability, which ushered in the Liability Convention with hopes that it would solve its shortcomings (as discussed above). Some have proffered that a state's employment of its criminal and civil laws can shore up the inadequacies of the Liability Convention because the states to which the private actor belongs owe a responsibility to ensure international law in space.¹²⁷ Others have found that "[i]f a genuine link exists between a State and individuals deemed to be its nationals, it is settled that the jurisdiction of the state of nationality will follow all such persons into outer space."¹²⁸

Moreover, Article II of the Liability Convention states that "[a] launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to aircraft in flight."¹²⁹ One view is that this "absolute liability" holds the launching state liable, not the state's citizens or private corporations, and that these "states will transfer the absolute liability . . . to private enterprises participating in commercial space activities."¹³⁰ And while in theory the Liability Convention is sufficient on its face, in practice it proves futile, as the lack of case law surrounding the Liability Convention¹³¹ suggests that the mechanisms through which states may bring claims (i.e., the

¹²⁵ See G.A. Res. 2222 (XXI), *supra* note 57, at 5.

¹²⁶ See Bruce Brumberg, *Regulating Private Space Transportation*, 36 ADMIN. L. REV. 363, 369-70 (1984).

¹²⁷ See James J. Trimble, *International Law of Outer Space and its Effect on Commercial Space Activity*, 11 PEPP. L. REV. 521, 545 (1984).

¹²⁸ J. Henry Glazer, *Domicile and Industry in Outer Space*, 17 COLUM. J. TRANSNAT'L L. 67, 104 (1978).

¹²⁹ See G.A. Res. 2777 (XXVI), *supra* note 65.

¹³⁰ Brumberg, *supra* note 126, at 371-72.

¹³¹ See Brearley, *supra* note 67.

Claims Commission) against other states is too difficult to be practical.¹³²

The U.S. government also provides insurance for users of a spacecraft to compensate third parties for injuries sustained from the spacecraft.¹³³ While this is useful for domestic issues and protecting the United States from international liability, it did not have the foresight to see the scale at which private space flight would prosper, and in turn, raise the level of potential damage that could be caused from space flight on the international scene.¹³⁴ In an article explaining private space travel, Bruce Brumberg, a lawyer and member of the American Institute of Aeronautics & Astronautics, provides a hypothetical scenario:

If damage is caused by a United States company’s spacecraft to a United States national, domestic law and not the Liability Convention applies. In a suit against a private spacecraft operator for domestic damage, the tort standard would logically be strict liability, as the space launch business is an ultra-hazardous activity.¹³⁵

While a strict liability approach through civil tort law is satisfactory in protecting the United States for instances like the one Brumberg presents, it is necessary to take this strict liability theory to the international stage to establish a more comprehensive safeguard for at-risk populations.

The overcomplicated, intertwined web of public and private involvement in modern space exploration caused the international system to become defunct and confusing. The growth of the commercial space market led to a domestic approach to space law, slowly deteriorating the presence and effectiveness of international law.¹³⁶ While the United States and Russia have robust domestic space policies, the lack of cooperation with the other twenty-eight spacefaring nations creates more headaches than benefits. For example, satellite servicing operations and space traffic management only function when there is coherent cooperation, like how civil aviation is only effective when

¹³² See G.A. Res. 2777 (XXVI), *supra* note 65, at 26.

¹³³ See National Aeronautics and Space Act of 1958 § 203(b)(13)(A).

¹³⁴ See Byers et al., *supra* note 36.

¹³⁵ Brumberg, *supra* note 126, at 372.

¹³⁶ See Sophie Goguichvili et al., *The Global Legal Landscape of Space: Who Writes the Rules on the Final Frontier?*, WILSON CENTER (Oct. 1, 2021), <https://www.wilsoncenter.org/article/global-legal-landscape-space-who-writes-rules-final-frontier>.

every state in a country agrees to the same practices and norms involving things like air traffic control and flight safety.¹³⁷

A new, simplified approach, one based on strict liability, is a necessary next step as the world transitions into the next phase of space exploration.

IV. A STRICT LIABILITY APPROACH TO THE MODERN SPACE DEBRIS PROBLEM

A. *Tort Liability and the Abnormally Dangerous Theory*

Any individual who commits “[a]n unjustified, intentional infliction of harm on another person, resulting in damages” is a tort.¹³⁸ However, under the umbrella of tort law exists two adjacent concepts: negligence and strict liability.¹³⁹ This paper will focus on strict liability, which holds an individual liable for committing harm to another individual regardless of their intent.¹⁴⁰ One theory through which an individual can be liable under strict liability is engaging in abnormally dangerous activities.¹⁴¹ An abnormally dangerous activity is any activity that carries serious risk, even in the presence of reasonable care.¹⁴² Under an abnormally dangerous activity theory of strict liability, courts can more easily attribute liability to private actors who are responsible for damage caused by their space debris. Those who perform abnormally dangerous activities are held strictly liable because “the activity (1) involves the risk of serious harm to persons or property, (2) cannot be performed without this risk, regardless of the precautions taken, and (3) does not ordinarily occur in the community.”¹⁴³ A common example of an abnormally dangerous activity is the activity of blasting with dynamite – a necessary activity that has inherent and foreseeable dangers.¹⁴⁴

B. *Applying Strict Liability to the Space Debris Problem*

In 1967, a plaintiff brought a strict liability claim against Lockheed Martin, an aerospace and defense company, for damages to their

¹³⁷ *Id.*

¹³⁸ *Tort*, BLACK’S LAW DICTIONARY (11th ed. 2019).

¹³⁹ *See generally Tort*, CORNELL LAW, <https://www.law.cornell.edu/wex/tort>.

¹⁴⁰ *See generally Strict Liability*, CORNELL LAW, https://www.law.cornell.edu/wex/strict_liability.

¹⁴¹ *Id.*

¹⁴² *Abnormally Dangerous Activity*, BLACK’S LAW DICTIONARY (11th ed. 2019).

¹⁴³ *Id.*

¹⁴⁴ *See Foster v. Preston Mill Co.*, 268 P.2d 645, 647 (Wash. 1954).

property caused by vibrations from a rocket motor testing.¹⁴⁵ The rocket motor testing did not create any structural damage to their property, but resulted in the muddying of a water well that produced high-quality water before Lockheed Martin’s rocket motor testing.¹⁴⁶ The California Court of Appeals determined that test firing the rocket was an abnormally dangerous activity because it is not a “matter of common occurrence.”¹⁴⁷ Moreover, the Court held that the defendant (the privately owned corporation, Lockheed Martin) “who is engaged in the enterprise for profit, is in a position best able to administer the loss so that it will ultimately be borne by the public.”¹⁴⁸

Michael Mineiro, the Boeing Fellow in Air and Space Law at McGill University, argues that “[c]ourts should rule in favor of imposing strict liability against licensed vehicle operators for ground damage caused by [commercial human space flight] vehicles.”¹⁴⁹ This is so because “[t]he imposition of strict liability for abnormally dangerous activities is ‘designed largely to protect innocent third parties’ . . . and uninvolved parties on the ground that have no control over the [commercial human space flight] vehicle and no means to prevent or mitigate the harm.”¹⁵⁰ While the need for domestic accountability is important, taking Mineiro’s proposal one step further and applying it to the international stage is vital, and NASA’s Artemis Accords is the ideal vehicle through which to adopt this strategy.

C. *The Artemis Accords*

Based on the principles set forth in the original UN Outer Space Treaty, the Artemis Accords are a NASA-led operation that seek to send the first woman and the first person of color to the moon through international cooperation.¹⁵¹ Established in 2020,¹⁵² the Accords look to develop a unified framework that outlines a sustainable approach to

¹⁴⁵ See *Smith v. Lockheed Propulsion Co.*, 56 Cal. Rptr. 128, 137 (Cal. Ct. App. 1967).

¹⁴⁶ See *Id.* at 132.

¹⁴⁷ See *Id.* at 137.

¹⁴⁸ *Id.*

¹⁴⁹ Michael C. Mineiro, *Assessing the Risks: Tort Liability and Risk Management in the Event of a Commercial Human Space Flight Vehicle Accident*, 74 J. AIR L. & COM. 371, 387 (2009) (quoting RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL HARM § 20 CMT. K (Proposed Final Draft No. 1, 2005)).

¹⁵⁰ *Id.*

¹⁵¹ See generally *The Artemis Accords*, NASA, <https://www.nasa.gov/specials/artemis-accords/index.html>.

¹⁵² *Id.*

space exploration amongst its signatories.¹⁵³ Currently, there are twenty-one nations signed on to the Artemis Accords, with the Kingdom of Saudi Arabia being the most recent.¹⁵⁴ As more countries are pursuing public space programs due to the rapid growth of private space exploration, the Artemis Accords seek to establish an internationally cooperative coalition that pursues peaceful space exploration.¹⁵⁵ While the Accords discuss the mitigation of orbital debris, the language is weak and merely invokes the Outer Space Treaty as its basis for liability, which is unwise.¹⁵⁶

The Accords maintain the status quo regarding liability and miss an opportunity to invoke a stronger approach, specifically one centered around an abnormally dangerous theory of strict liability. Given the current global-political climate, any chance at UN treaty reform is unlikely, and in turn, unlikely to extend to private entities in any serious manner. Therefore, the United States should embark on pursuing agreements with allies and forming other partnerships to circumvent the difficulties of UN treaty reform, with hopes that “bilateral agreements between leading countries [will] [influence] broader global governance behavior” as in the past.¹⁵⁷

Because each signatory voluntarily signs on to the Accords and ensures that all spacefaring actors, including private corporations, will take appropriate measures to comply with the Artemis Accords,¹⁵⁸ they are an appropriate vehicle through which to adopt a strict liability approach. The Accords are new and the signatories are free to develop and mold the document in a way that is distinctly different from past UN treaties. Since it is difficult to modify an existing treaty unless there is consent from all contracting parties to that treaty, the Artemis Accords act as a method to circumvent the Outer Space Treaty without rewriting the treaty.¹⁵⁹ To avoid confrontation with those signed to the Outer Space

¹⁵³ See *First Meeting of Artemis Accords Signatories*, DEPT. OF STATE (Sept. 19, 2022), <https://www.state.gov/first-meeting-of-artemis-accords-signatories/>.

¹⁵⁴ See *Kingdom of Saudi Arabia Signs the Artemis Accords*, DEPT. OF STATE (July 16, 2022), <https://www.state.gov/kingdom-of-saudi-arabia-signs-the-artemis-accords/>.

¹⁵⁵ See *The Artemis Accords*, NASA, <https://www.nasa.gov/specials/artemis-accords/index.html>.

¹⁵⁶ *Id.* at 1–7.

¹⁵⁷ Adam Routh, *Near-Earth Space Governance Is All About the Money*, THE SPACE REVIEW (Nov. 11, 2019), <https://thespacereview.com/article/3830/1>.

¹⁵⁸ See *Gateway MoU and Artemis Accords – FAQs*, EUR. SPACE AGENCY, https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Gateway_MoU_and_Artemis_Accords_FAQs (last visited Jan. 7, 2023).

¹⁵⁹ See Sa'īd Mosteshar, *Artemis: The Discordant Accords*, 44 J. SPACE L. 591, 597 (2020).

Treaty, the U.S.-led Artemis Accords can act as a solution to the private space debris problem if the strict liability approach is adopted.

The Artemis Accords may solve some of the issues that have plagued UN treaties in the past. The first shortcoming of a UN treaty is that the United States infrequently signs on to treaties in myriad policy areas that the rest of the world supports.¹⁶⁰ From treaties involving issues such as climate change to others attempting to protect the rights of women and children, the United States shies away from signing on to treaties that tend to “subordinate its governing authority to that of an international body like the United Nations.”¹⁶¹ By losing the United States’ support, international perception of these treaties may be weakened, and show to the international stage that these issues and treaties are not issues worth addressing.¹⁶²

In addition, a study reviewing the effectiveness of international treaties revealed that, outside of a few policy areas, these treaties are generally weak avenues through which to create sustainable and effective international policy.¹⁶³ The study explained that long-term treaties, rather than immediately effective short-term treaties, are also less effective, while treaties that employ enforcement mechanisms “may not be enough to overcome compliance challenges in some policy domains.”¹⁶⁴

Strict liability is not foreign to international law, as it is prevalent through several treaties concerning environmental law. For instance, the 1972 Stockholm Declaration writes that “[s]tates have . . . the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.”¹⁶⁵ Additionally, several international treaties address the liability of private individuals to other non-state actors for environmental harms, primarily concerning nuclear and oil pollution.¹⁶⁶ Strict liability exists in international law, but the

¹⁶⁰ See Anya Wahal, *On International Treaties, the United States Refuses to Play Ball*, COUNCIL ON FOREIGN RELS. (Jan. 7, 2022), <https://www.cfr.org/blog/international-treaties-united-states-refuses-play-ball>.

¹⁶¹ *Id.*

¹⁶² *Id.*

¹⁶³ See Steven J. Hoffman et al., *International treaties have mostly failed to produce their intended effects*, 119 PROC. OF THE NAT’L ACAD. OF SCI. 1, 1 (2022).

¹⁶⁴ *Id.*, at 5–6.

¹⁶⁵ See Dinah L. Shelton, *Strict Liability in International Environmental Law*, GW L. FAC. PUBL’NS. & OTHER WORKS 1131, 1132 (2007) (quoting U.N. Conference on the Human Environment, *Declaration of the United Nations Conference on the Human Environment*, Principal 21, U.N. Doc. A/CONF.48/14/Rev.1 (June 16, 1972)).

¹⁶⁶ See Shelton, *supra* note 165, at 1140.

main issue is enforcement. The UN has the International Court of Justice and other courts and tribunals,¹⁶⁷ but these enforcement bodies are generally weak, and require cooperation of the states in conflict to provide an adequate remedy.¹⁶⁸ If international law cannot successfully govern states when space debris causes harmful damage, then the likelihood of states holding private actors liable for similar harms is unlikely. The Artemis Accords, therefore, remain the best vehicle for attributing strict liability because it recognizes the need for public and private cooperation among international players as the spacefaring industry continues expanding.

D. *Moving Forward*

While the Outer Space Treaty and the Liability Convention apportion liability to state actors (but are relatively weak in response to private action), the Artemis Accords are the best opportunity to implement strict liability onto private actors because of the explicit recognition that international cooperation amongst both public and private actors is necessary for successful and safe space exploration.¹⁶⁹ The Accords acknowledge that private corporations are necessary actors in the space industry that must be covered under civil activities, primarily because these companies are working on behalf of NASA.¹⁷⁰ “Historically, 85 to 90 percent of NASA’s budget went to private contractors.”¹⁷¹ For example, “NASA’s Commercial Lunar Payload Services missions encourage private companies to deliver science, hardware, and other essential items to the moon,”¹⁷² and aim to send Draper’s SERIES-2 lander to the moon by 2025.¹⁷³ This mixture of private and public is blurring the line that previously distinguished the two and is the main reason why strict liability must be extended towards

¹⁶⁷ See *Uphold International Law*, UNITED NATIONS, <https://www.un.org/en/our-work/uphold-international-law> (last visited Feb. 27, 2024).

¹⁶⁸ See, e.g., See G.A. Res. 2777 (XXVI), *supra* note 65.

¹⁶⁹ See generally *The Artemis Accords*, *supra* note 155.

¹⁷⁰ See Elizabeth Howell, *Artemis Accords: Why the International Moon Exploration Framework Matters*, SPACE (Aug. 25, 2022), <https://www.space.com/artemis-accords-moon-space-exploration-importance>.

¹⁷¹ Andrew Chatzky, Et Al., *Space Exploration and U.S. Competitiveness*, COUNCIL ON FOREIGN RELS. (Sept. 23, 2021), <https://www.cfr.org/backgrounder/space-exploration-and-us-competitiveness>.

¹⁷² See Howell, *supra* note 170.

¹⁷³ Elizabeth Howell, *NASA Moon Program Aims for a Daring Commercial Landing on the Far Side in 2025*, SPACE (July 22, 2022), <https://www.space.com/nasa-moon-far-side-commercial-landing-2025>.

private corporations more explicitly.¹⁷⁴ It should not be enforced through a weak mechanism where the onus is on the injured state to jump through the hoops necessary for compensation,¹⁷⁵ especially when the injured plaintiff is a third party citizen of another country who had no involvement whatsoever.¹⁷⁶

Since public and private sectors are working together, the issue of liability can lead to miscommunication and unnecessarily escalate into conflicts with other nations assigned to the Accords.¹⁷⁷ Space lawyer Michael Gold asserted that in order to avoid these international conflicts caused by miscommunication “national security programs and commercial space programs could . . . align on global norms of behavior.”¹⁷⁸ Additionally, conflicts between nations could become more frequent because private corporations are sending up spacecraft alongside the state programs, which might lead to an increase in potential collisions, and ultimately more space junk back on Earth.¹⁷⁹ And finally, Gold urged for the UN’s COPUOS to include private companies to engage with one another in these shared endeavors.¹⁸⁰ Due to the ineffectiveness of UN treaties,¹⁸¹ the Artemis Accords provide the space industry a fresh opportunity to enhance communication between all interested parties in order to minimize the threat associated with space debris.

The case involving Lockheed Martin illustrates the framework through which to assert strict liability upon private entities when working with the federal government.¹⁸² This approach should be utilized through the Artemis Accords towards private space corporations in the international scene. Just as in *Smith v. Lockheed Martin Propulsion Co.*, where Lockheed Martin was held strictly liable after testing a rocket motor pursuant to a contract with the U.S. government,¹⁸³ corporations

¹⁷⁴ See Michael Sheetz, *Investing in Space: NASA and SpaceX Need Each Other*, CNBC (Nov. 3, 2022), <https://www.cnbc.com/2022/11/03/investing-in-space-nasa-and-spacex-need-each-other.html>.

¹⁷⁵ See generally Convention on International Liability for Damage Caused by Space Objects, *supra* note 65, art. XV.

¹⁷⁶ See Turner, *supra* note 11.

¹⁷⁷ See Howell, *supra* note 170.

¹⁷⁸ *Id.*

¹⁷⁹ *Id.*

¹⁸⁰ *Id.*

¹⁸¹ The Council on Foreign Relations Staff, *The UN Security Council* (last updated Feb. 26, 2024), <https://www.cfr.org/background/un-security-council>.

¹⁸² *Smith v. Lockheed Propulsion Co.*, 56 Cal. Rptr. at 137–38.

¹⁸³ *Id.* at 131.

like SpaceX and Blue Origin should be strictly liable for any damage caused by space debris when working with the U.S. government.

The frequency with which space debris crashes back to Earth is known,¹⁸⁴ and the extent of the damage is well documented.¹⁸⁵ Since we generally view space exploration as an important endeavor,¹⁸⁶ the liability must be strict to protect those most vulnerable.¹⁸⁷ In *Chavez v. Southern Pacific Transportation Co.*, the United States District Court for the Eastern District of California explained that:

Where one, in the conduct and maintenance of an enterprise lawful and proper . . . deliberately does an act under known conditions, and, with knowledge that injury may result to another, proceeds, and injury is done to the other as the direct and proximate consequence of the act, however carefully done, the one who does the act and causes the injury should, in all fairness, be required to compensate the other for the damage done.¹⁸⁸

Moreover, strict liability will be the necessary standard as private corporations eat away at the federal government's grip on the space sector, and entities like NASA become beholden to working with companies like SpaceX.¹⁸⁹ For example, a SpaceX flight at the end of 2021 flew private citizens, not NASA trained astronauts,¹⁹⁰ leading SpaceX to be liable towards not only those on the ground, but the private citizens it sends into space. Due to its profitability,¹⁹¹ this private-centric shift could entice those who would normally work at NASA to work at

¹⁸⁴ See Dep't of Com., *Does Space Junk Fall from the Sky?*, NAT'L ENV'T SATELLITE DATA AND INFO. SERV. (Jan. 19, 2018), <https://www.nesdis.noaa.gov/news/does-space-junk-fall-the-sky/>.

¹⁸⁵ See generally Supantha Mukherjee, *Q+A What is Space Debris and How Dangerous Is It?*, REUTERS (Nov. 16, 2021), <https://www.reuters.com/lifestyle/science/qa-what-is-space-debris-how-dangerous-is-it-2021-11-16/>.

¹⁸⁶ See Weinzierl, *supra* note 6.

¹⁸⁷ See DiBenedetto, *supra* note 107.

¹⁸⁸ *Chavez v. Southern Pac. Transp. Co.*, 413 F.Supp. 1203, 1207 (E.D. Cal. 1976) (quoting *Green v. Gen. Petroleum Corp.*, 270 P. 952, 955 (Ca. 1928)).

¹⁸⁹ See Christian Davenport, *As Private Companies Erode Government's Hold on Space Travel, NASA Looks to Open a New Frontier*, WASH. POST (Feb. 25, 2021), <https://www.washingtonpost.com/technology/2021/02/25/nasa-space-future-private/>.

¹⁹⁰ *Id.*

¹⁹¹ See Space Foundation Editorial Team, *Global Space Economy Grows In 2019 To \$423.8 Billion, The Space Report 2020 Q2 Analysis Shows*, SPACE FOUNDATION (July 30, 2020), <https://www.spacefoundation.org/2020/07/30/global-space-economy-grows-in-2019-to-423-8-billion-the-space-report-2020-q2-analysis-shows/> (last visited Nov. 5, 2022).

a private firm.¹⁹² Some view this as a good thing, however, because it allows NASA to focus on “blazing the trail and opening new frontiers, and then allowing private industry to take over in the way homesteaders expanded into the West.”¹⁹³ In contrast, world-renowned astrophysicist Neil deGrasse Tyson asserts that private corporations “are unable to bear the large and unknown risks of advancing the space frontier.”¹⁹⁴ While the long-term benefits of private industry in space are not yet known, the need for stricter liability enforcement for private firms is known. Therefore, the Artemis Accords, not a traditional UN treaty, must be the appropriate vessel through which to implement this strict liability approach to private entities.

V. CONCLUSION

Falling space debris is an underdiscussed threat that is only going to grow more serious in the coming decades.¹⁹⁵ Past attempts to remedy the situation have only proven ineffective or weak. The current framework under the UN’s Outer Space Treaty and Liability Convention is inadequate at holding state parties liable due to its requirement for a claims commission should the two parties fail to settle.¹⁹⁶ This resulted in a scarce body of case law consisting of only one instance between Canada and the Soviet Union.¹⁹⁷ Liability is thus unlikely to be appropriately extended towards private corporations.

Due to its limited use, the Liability Convention must be retired in favor of a strict liability approach as it is used in other instances between private entities.¹⁹⁸ Strict liability should be implemented internationally through the Artemis Accords because it allows the United States and other signatories to circumvent the weak Outer Space Treaty.¹⁹⁹ The Artemis Accords also provide an opportunity to implement modern standards and governance to twenty-first century space exploration – something the Outer Space Treaty surely was unable to predict. The domestic use of strict liability makes it a candidate for international

¹⁹² See Davenport, *supra* note 189.

¹⁹³ *Id.*

¹⁹⁴ Chatzky, et al., *supra* note 171.

¹⁹⁵ See *The Kessler Effect and How to Stop It*, *supra* note 27.

¹⁹⁶ See G.A. Res. 2777 (XXVI), *supra* note 65, at 26.

¹⁹⁷ See Government of Canada, *Previous nuclear incidents and accidents: COSMOS 954*, <https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/radiological-nuclear-emergencies/previous-incidents-accidents/cosmos-954.html> (last visited, Nov. 5, 2022).

¹⁹⁸ See *Smith v. Lockheed Propulsion Co.*, 56 Cal. Rptr. at 132.

¹⁹⁹ See Howell, *supra* note 170.

implementation,²⁰⁰ as those who bear the burden of western excess are typically without the means to repair the damage.²⁰¹

Additionally, the case involving Lockheed Martin, a private corporation, paves a roadmap for how to apply strict liability to private entities.²⁰² The court in that case determined that because Lockheed Martin was for-profit, they were the party best able to remedy the damage, regardless of their intent.²⁰³ And therefore, courts should apply this same standard of strict liability to other companies, like SpaceX and Blue Origin.

As private corporations push into the space industry with new markets like space tourism,²⁰⁴ the threat of space debris is only going to increase as more spacecraft are sent into space. While a discussion must be had on how to remove space debris,²⁰⁵ ensuring private corporations are held liable should their space debris fall back to Earth and hurt someone is a change that can be made right now to protect those most vulnerable.

²⁰⁰ See generally Mineiro, *supra* note 149.

²⁰¹ See DiBenedetto, *supra* note 107; O'Sullivan, *supra* note 109; Byers Et AL, *supra* note 36, at 1095.

²⁰² See generally Smith v. Lockheed Propulsion Co., 56 Cal. Rptr. at 137.

²⁰³ *Id.*

²⁰⁴ See *Space Tourism Market Size, Share & Trends Analysis Report*, *supra* note 10.

²⁰⁵ See generally Chelsea Muñoz-Patchen, *Regulating the Space Commons: Treating Space Debris as Abandoned Property in Violation of the Outer Space Treaty*, 19 CHI. J. OF INT'L L. 233 (2018).

