Preventing the Next Global Crisis: Addressing the Urgent Need for Space Debris Removal

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Space debris is an undeniable threat to the future use of orbital space around Earth. Most experts agree that we are reaching the point of maximum capacity in many parts of space and the threat of future collisions is growing more severe. However, little is being done to address the issue. This Note argues that establishing an international space regulatory body is the optimal solution for achieving a sustainable use of Earth's orbit. However, the current structure of international treaties and international norms in space prevent the realization of this solution at present. Unilateral action must be taken to push the global community towards the sustainable use of space. This Note further explains how unilateral action can effectively address the many legal hurdles and changes to international norms that must occur to make the international regulation of space a reality. It then explains what the ideal state of the use of Earth's orbit would look like and discusses the role of an international space regulatory body. This entity would both establish policy regarding the removal of space debris and also fund the removal of space debris through creating a fee system for placing satellites into space. In doing so, the organization can direct the development of the most effective debris-removing technologies while also identifying the most critical debris for removal.

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INTRODUCTION

Shortly after the first satellites were launched into space, people started to worry about how to handle space debris.[1] In the 1980s, the concept of active space debris removal started to formalize as a possible solution.[2] However, until recently, the high cost and limits of technology made active space debris removal impractical. Technological advancements and the escalating demand for active removal have brought us closer to a point where space debris removal is both achievable and economically viable.[3] The threat of space debris is largest in Low Earth Orbit (LEO), where 99 percent of manmade objects are space debris.[4] This risk is rapidly increasing. In 2017, over sixty countries operated satellites, and more than 357 objects were launched into space.[5] This was over 50 percent more than recorded in any prior year.[6] With the rising use of satellite constellations, the amount of satellites could increase by as much as 600 percent in the next three to five years.[7] This surge in satellites will generate more space debris and increase the probability of collisions that may interrupt services, cause millions

1. James E. Dunstan, *Space Trash: Lessons Learned (and Ignored) from Space Law and Government*, 39 J. SPACE L. 23, 24 (2013)

2. J.-C. Liou, N.L. Johnson & N.M. Hill, *Controlling the Growth of Future LEO Debris Populations with Active Debris Removal*, 66 ACTA ASTRONAUTICA 648, 648 (2010).

3. Jeff Foust, *Astroscale Raises $109 Million Series F Round*, SPACENEWS (Nov. 25, 2021), https://spacenews.com/astroscale-raises-109-million-series-f-round/ [https://perma.cc/PX85-ZTR3].

4. Holli Riebeek, *Catalog of Earth Satellite Orbits*, NASA (Sept. 4, 2009), https://earthobservatory.nasa.gov/features/OrbitsCatalog [https://perma.cc/UFP3-LTWX]. Low Earth Orbit is defined as the area of space that is 180 to 2,000 kilometers from Earth.

5. KIRAN KRISHNAN NAIR, SMALL SATELLITES AND SUSTAINABLE DEVELOPMENT – SOLUTIONS IN INTERNATIONAL SPACE LAW 27 (2019).

6. *Id.*

7. Jackson Ryan, *Space Has Become a Junkyard, and It's Getting Worse*, CNET (Nov. 16, 2020), https://www.cnet.com/science/features/space-has-become-a-junkyard-and-its-getting-worse/ [https://perma.cc/8LTT-EWLB].

of dollars of damages, or even lead to a cascading series of collisions that prevents the use of LEO.

Current collision mitigation efforts primarily revolve around tracking space debris and implementing measures to curb its proliferation. This includes the establishment of international best practices for satellite launches and the requirement for satellite deorbiting after a satellite's operational lifespan. These methods, however, have limits. There is no overarching international body that tracks debris and manages the prevention of space collisions.[8] The organization that largely fills this role is the 18th Space Control Squadron (18th SPCS) of the U.S. Space Force.[9] The 18th SPCS provides notifications to companies and governments when their satellites are at risk of collision.[10] For LEO, this is defined as two objects passing within one meter and having a greater than one in ten thousand chance of colliding.[11] With the Space Fence, a new system that was introduced in 2020, objects smaller than ten centimeters can now be tracked, but an increase in space objects and debris will push the capabilities of the system. For example, an increase of four times the tracked objects would require growth of sixteen times the computing capability.[12] This highlights the difficulties in continuously striving to enhance tracking capabilities to keep up with the ever-increasing volume of space debris.

While the 18th SPCS is effective, the long-term viability of the organization serving as the global space debris watchdog is a major issue. The 18th SPCS continuing to fill this role requires both the United States's willingness to provide this global service and the international community's ongoing trust in the United States's ability to effectively execute this responsibility. In one of any number of situations, such as scaled back funding or increased geopolitical tensions, the 18th SPCS may no longer be willing or able to fill this role. Moreover, finding an organization to quickly replace it would be difficult due to the requisite technological and manpower requirements to effectively monitor space debris and coordinate avoidance measures. This situation will only become more difficult and costly as the amount of space objects and space debris increases.

Space is a critical part of the global economy. In 2020, the space industry was valued at nearly $447 billion[13] and today consists of over 10,800 metric tons

8. Keith Kirkpatrick, *A Traffic Cop for Low Earth Orbit*, 64 COMMC'NS OF THE ACM 15, 16 (2021).

9. *Id.*

10. *Id.*

11. *Id.* at 17.

12. *Id.*

13. *Symposium, 2021 TSR – Space Symposium Special Edition: Global Space Economy Climbs Despite Pandemic, Disrupted Government Spending*, THE SPACE REPORT ONLINE (2021), https://www.thespacereport.org/resources/global-space-economy-climbs-despite-pandemic-disrupted-government-spending/ [https://perma.cc/2935-WXWA].

of manmade space objects.[14] Satellites are essential to everyday functions such as GPS, communications, and scientific research. As the likelihood of collision with space debris increases, space objects must be fortified to prevent damage from collisions. This increases the cost to launch a space object due to its heavier weight and limits the payload. Even with increased protection, satellites are still vulnerable to chain reaction collisions.

Recent events highlight the risks to satellites, astronauts, and the continued use of space. In March 2021, a Chinese military satellite was damaged by a piece of debris that was likely only spotted in tracking data after the collision occurred.[15] The collision did not completely disable the satellite, but due to the classified use of the satellite, it is unknown if it remains fully operational.[16] The collision created at least thirty-seven pieces of new debris, each capable of causing subsequent debris and generating collisions.[17] As discussed in greater detail below, each collision further increases the risk of another collision, which can eventually lead to a cascade of impacts that would effectively close outer space for commercial use.[18]

In November 2021, the crew of the International Space Station (ISS) took emergency evacuation precautions due to the risk of a collision with debris after a Russian anti-satellite weapons (ASAT) test.[19] The crew later modified its station maintenance schedule because of the increased risk of harm to the astronauts during space walks.[20] As the amount of debris grows, so does the risk that astronauts will not have time to adjust to incoming space debris. With space programs serving as a point of national pride, any harm to astronauts could elevate international tensions. Despite these incidents, there is a lack of urgency to address the escalating space debris crisis. A key driving factor is the tragedy of the commons.[21] This is due largely to the original international treaties established in the years following the first satellite launches. Overcoming international agreements and the norms those agreements established will likely be an even larger hurdle than developing space debris removal technology.

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14. *Space Debris by the Numbers*, EUR. SPACE AGENCY (Mar. 27, 2023), http://www.esa.int/Our_Activities/Operations/Space_Debris/Space_debris_by_the_numbers [https://perma.cc/3567-32EX].

15. Mike Wall, *Space Collision: Chinese Satellite Got Whacked by Hunk of Russian Rocket in March*, SPACE.COM (Aug. 17, 2021), https://www.space.com/space-junk-collision-chinese-satellite-yunhai-1-02 [https://perma.cc/9BP4-V4].

16. *Id.*

17. *Id.*

18. *See infra* Part II for a more detailed explanation on the risks of cascading space debris collisions.

19. Jeff Foust, *NASA Postpones ISS Spacewalk Because of Debris*, SPACENEWS (Nov. 30, 2021), https://spacenews.com/nasa-postpones-iss-spacewalk-because-of-debris/ [https://perma.cc/P8XL-L9PW].

20. *Id.*

21. Tragedy of the commons reveals that resources will be misused when everyone has access to these resources and each actor solely acts in their best interest in regard to the use of the resources.

As we are on the cusp of developing technologies that can remove space debris,[22] now is the time to address the legal issues of debris removal and begin taking steps towards developing an international system to effectively remove the threat of space debris. This Note covers the current state of the risks involved with the rapid growth of space debris in Earth's orbit, the challenges of creating an effective system of regulating space debris, and the steps the international community has taken so far. From there, this Note examines concepts in other fields that could potentially be applied to combat the threat of space debris. This Note then concludes with imagining what steps could be taken unilaterally and by the international community to build an effective system to regulate space debris. While the creation of an international regulatory organization for space debris is likely far off in the future, unilateral steps taken today could pave the way to making a strong regulatory system a reality, ensuring humanity's continued access to Earth's orbit for generations to come.

I.
THE GROWING THREAT FROM SPACE DEBRIS

Space debris presents a wide range of risks, each with its own distinct nature and level of severity. Space debris endangers astronauts, escalates costs for both manned and unmanned space missions, and carries the potential to trigger international conflicts, particularly in situations involving collisions or loss of life. Most worryingly, the risk from space debris is increasing rapidly. While steps are being taken to mitigate the growth of space debris, these steps are only moderately effective, and the total amount of debris cannot significantly decrease without intervention.

The threat of space debris is already a reality, and it has the potential to transform the world into a place where satellite utilization becomes severely constrained or even impossible.[23] The ISS executes maneuvers to avoid space debris. These maneuvers use fuel, which is a precious commodity in space. Avoiding space debris is a problem for unmanned spacecrafts as well. When satellites avoid space debris, it is estimated that each maneuver costs approximately $10 million due to the loss of fuel that would otherwise be used to maintain the satellite in orbit.[24]

The threat from space debris is constantly rising. Catastrophic collisions between large objects in LEO can create hundreds of thousands of fragments,

22. Foust, *supra* note 3; *see also* Sarah Scoles, *Here Come the Space Tugs, Ready to Tidy Up Earth's Orbits*, WIRED (Aug. 22, 2019), https://www.wired.com/story/here-come-the-space-tugs-ready-to-tidy-up-earths-orbits/ [https://perma.cc/CT2Y-RLVK].

23. Eric Berger, *Space Debris Expert: Orbits Will Be Lost—and People Will Die—Later This Decade*, ARS TECHNICA (Dec. 14, 2022), https://arstechnica.com/science/2022/12/space-debris-expert-orbits-will-be-lost-and-people-will-die-later-this-decade/ [https://perma.cc/H649-T9E9].

24. Stuart Clark, *Space Junk: Hunting Zombies in Outer Space*, NEW SCIENTIST (Sept. 8, 2010), https://www.newscientist.com/article/mg20727772-300-space-junk-hunting-zombies-in-outer-space/ [https://perma.cc/P9LS-PATJ].

each capable of disabling or seriously damaging a satellite.[25] However, the growth of the small satellite industry is particularly problematic to the threat of space debris. Small satellites typically carry little fuel and are on station for only a few years before they become debris.[26] The rapid expansion of commercial satellites not only contributes to the growing number of space objects but also raises a new risk: the potential implications of a company that launches hundreds or even thousands of small satellites, a so-called satellite swarm company, going bankrupt. Bankruptcy is not only a sign that supply outpaced demand, meaning space debris was generated needlessly, but it also increases the chance of collision as a whole system of objects that were once monitored by the company are now no longer being as closely watched. OneWeb, a satellite swarm company, already went bankrupt but then was saved by the U.K. government.[27] In the future, there may not be an entity interested in purchasing a profit-negative swarm network.

The rising danger of space debris is already happening. The number of times the ISS maneuvers to avoid space debris has increased over time. Unanticipated collisions that generate new debris are particularly dangerous to the ISS. In 2009, astronauts in the ISS were forced to take shelter in an escape capsule out of fear that debris would collide with and damage the station.[28] This was due to U.S. commercial satellite Iridium 33 colliding with a derelict Russian satellite that damaged Iridium 33 and generated over 2,500 pieces of trackable debris.[29] It is estimated that this debris will remain in orbit for at least one hundred years, posing a threat to satellites for decades to come while also continuing to collide with other debris.[30]

Mitigation efforts play a key but limited role in addressing the rise of space debris. The United Nations (U.N.) Committee on the Peaceful Use of Outer Space created a system of guidelines in 2007 that was approved by the U.N. General Assembly the same year.[31] While useful in limiting the generation of new debris, these guidelines do not provide any way to remove debris. Additionally, these guidelines do not have any enforcement mechanism,

25. EUGENE M. LEVIN & JOSEPH A. CARROLL, THE COST OF FUTURE COLLISIONS IN LEO 2 (2012).

26. Nair, *supra* note 6, at 62.

27. Tom Pfeiffer & Thomas Seal, *The British Want to Clean Up Space*, BLOOMBERG BUSINESSWEEK (Apr. 16, 2021), https://envoy.east-us.cumulus.bloomberg.com/news/articles/2021-04-16/u-k-space-industry-sees-opportunity-to-remove-debris-from-orbit [https://perma.cc/HVG4-BKY5].

28. Traci Watson, S*tation Crew Has Close Call with Space Junk*, USA TODAY (Mar. 13, 2009), https://abcnews.go.com/Technology/story?id=7076129&page=1 [https://perma.cc/F48U-RZR4].

29. Dunstan, *supra* note 1, at 31.

30. Marc G. Carns, *Consent Not Required: Making the Case that Consent Is Not Required Under Customary International Law for Removal of Outer Space Debris Smaller than 10cm*^{2}, 77 A.F. L. REV. 173, 182 (2017).

31. Dunstan, *supra* note 1, at 60. These guidelines were based largely on the Orbital Debris Mitigation Standard Practices established by the United States in 2001 and guidelines developed by the Inter-Agency Space Debris Coordination Committee.

allowing for them to be ignored at will. For example, China's destruction of its Fengyun-1C weather satellite in 2007 violated key provisions in these guidelines even though China was a cosigner.[32] While the Fengyun destruction is a particularly egregious example of the guidelines being ignored, the guidelines are frequently broken in more mundane but also dangerous ways. One of the most common cases is failing to deorbit satellites. While deorbiting a satellite at the end of its life is part of the guidelines, countries and companies alike frequently fail to do so. For example, in 2008, only seven out of twelve failing satellites were boosted out of orbit in accordance with the guidelines.[33] This is likely because users are forced to give up valuable functional satellite time to properly deorbit.[34]

A 2009 U.N. study estimated that only five objects larger than ten squared centimeters naturally decay back into the Earth's atmosphere each year.[35] Over the same period, seven times that amount of material was launched into space.[36] Since then, the amount of material launched into space has continued to increase dramatically. Even if no new space debris were introduced, there is still a high risk of damage possible just from the space debris that is currently in orbit. This ever-growing risk is called the Kessler Syndrome, and it could cause significant long-term disruption to humanity's use of LEO. The Kessler Syndrome, named after NASA engineer Donald Kessler, established that collisions between space debris would create more debris and collisions, resulting in a cascading effect that over time would make LEO unserviceable, even without the introduction of new satellites.[37] According to Jonathan McDowell, an astrophysicist at the Harvard-Smithsonian Center for Astrophysics, we may reach the point in just a few years where there are one hundred times as many collisions as there are today.[38] A 2011 NASA study concluded that even if all mitigation procedures were followed and the orbital lifetime of future debris was contained to twenty-five years, the amount of space debris would still continue to grow.[39] Given the escalating rate at which satellites are being launched each year, the urgency to address space debris through its removal has never been more critical.

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32. *Id.* at 61.
33. Clark, *supra* note 24, at 48.
34. Dunstan, *supra* note 1, at 62.
35. Carns, *supra* note 30, at 184.
36. *Id.*
37. *Kessler Syndrome*, SPACE SAFETY MAG. (Aug. 31, 2022), https://www.spacesafetymagazine.com/space-debris/kessler-syndrome/ [https://perma.cc/2QDZ-K7DM]; *see also* Donald J. Kessler & Burton G. Cour-Palais, *Collisional Frequency of Artificial Satellites: The Creation of a Debris Belt*, 83 J. GEOPHYSICAL RSCH. 2637, 2637 (1978); Donald J. Kessler, *Collisional Cascading: The Limits of Population Growth in Low Earth Orbit*, 11 ADVANCES IN SPACE RES. 63, 63–66 (1991); James Rendleman, *Space Traffic Management - Private Regulation?*, *in* AIAA SPACE 2012 CONF. & EXPO., 2, 2 n.6 (2012), https://arc.aiaa.org/doi/10.2514/6.2012-5124.
38. Wall, *supra* note 15.
39. Carns, *supra* note 30, at 196.

In addition to the devastating economic impacts, there are likely to be political ramifications of a major collision or chain reaction. While there were no major political ramifications after the collision between a defunct Russia satellite and an operational Iridium satellite, this was a relatively minor collision. Since only the Iridium satellite was operational, the total cost of the incident was about $30 million.[40] More costly future incidents could result in massive reparations to the injured nation(s), the consequences of which should not be taken lightly. For example, if an ASAT test were to damage an operational satellite that then causes a chain reaction, the testing nation could be responsible for hundreds of millions of dollars of damages. A worst-case scenario, a major incident creating a Kessler Syndrome scenario, would result in billions of dollars in damages to multiple countries. Other scholars believe that an inopportune collision could spark a global conflict even without a worst-case scenario occurring.[41]

While some scholars claim that the risk of liability for countries that cause a crash are low, this view is focused primarily on liability under the Liability Convention.[42] In the case of unattributable debris, it is likely that the original launching nation will not be liable due to not being identifiable. In a situation such as the Chinese ASAT test on Fengyun-1C, which received widespread international condemnation,[43] other countries may be more likely to hold the launching nation responsible for damages. Moreover, in the event that a country is identified as the cause of a chain reaction rendering LEO unusable, this would pose a unique challenge as it would not fall within the scope of the Liability Convention. Instead of pursuing compensation for specific damages, the affected nations would seek reparation for the denial of access to space, an unprecedented circumstance. Countries are also likely to point blame at each other in the event of a collision. After the Iridium 33 crash, both the United States and Russia claimed the other was at fault for the incident.[44]

II.
THE CHALLENGES OF SPACE DIPLOMACY

The web of international treaties that shapes the use of space is arguably the biggest hurdle to addressing the threat of space debris. Even if we had the technology to remove space debris today, the international laws regulating space would make removal legally complex and expose the remover to liability.

40. Levin & Carroll, *supra* note 25, at 13.

41. F. Kenneth Schwetje, *Current U.S. Initiatives to Control Space Debris*, 30 PROC. COLLOQUIUM L. OUTER SPACE 163, 166 (1988) (fearing that "the Archduke Francis Ferdinand of World War III may well be a critical U.S. or [Russian] satellite hit by a piece of space junk during a crisis").

42. Carns, *supra* note 30, at 198.

43. Dunstan, *supra* note 1, at 61.

44. Michael Listner, *Iridium 33 and Cosmos 2251 Three Years Later: Where Are We Now?*, SPACE REV. (Feb. 13, 2012), https://thespacereview.com/article/2023/1 [https://perma.cc/SFG5-38U3].

Countries have often relied on diplomatic negotiations to address incidents that should invoke space law, highlighting the current ineffectiveness of space law in such cases.

The main document of concern is the 1967 Outer Space Treaty, in particular Articles VII, VIII, and IX.[45] Article VII focuses on liability, making launching nations liable for any damage caused by their "space object" or "component parts."[46] However, neither "space object" nor "component parts" were ever defined, and scholarly definitions range widely. Some consider "space objects" as only objects that are controllable. Others view it as any material launched into space.[47] Similarly, "component parts" is interpreted by some to only be rocket boosters and other discarded parts used during launch, while others interpret it to include space debris.[48] Article IX is relevant as it establishes that states will avoid "harmful contamination" and "adopt appropriate measures for this purpose."[49] While harmful contamination was never defined, most believe it to only be focused on contamination from extraterrestrial matter that enters Earth due to space operations.[50] The issue of limited or nonexistent definitions is widespread in space law; even space debris itself does not have a single unified definition.[51] Without shared definitions, it is harder for countries to reach and enforce agreements. The inability to come to a single definition of key terms highlights the unfortunate state of the regulation of space debris.

The 1972 Liability Convention did little to clarify the ambiguous terms used in Article VII and Article IX of the Outer Space Treaty. Of note, however, is that for space objects, a nation would only be found liable for a collision if they were at fault.[52] This further reinforced the incentive for nations to refrain from attempting debris removal, as any such effort could be interpreted as an acknowledgment of responsibility for the debris. Additionally, if an accident were to occur during the removal of the debris, this would likely expose the party that attempted to remove the debris to liability.

The U.N.'s Registration Convention was established in 1975, but it too is a flawed system.[53] The Registration Convention aimed to cover multiple issues through requiring the registration of space objects. In addition to assisting with

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.

46. Joseph S. Imburgia, *Space Debris and Its Threat to National Security: A Proposal for a Binding International Agreement to Clean Up the Junk*, 44 VAND. J. OF TRANSNAT'L L. 589, 615 (2011).

47. *Id.*

48. *Id.*

49. *Id.* at 614.

50. *Id.* at 615.

51. *Id.* at 616.

52. *Id.* at 617.

53. Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, T.I.A.S. 8480.

determining liability, the convention aimed to specifically register objects used for "Moon and Other Celestial Bodies" exploration as well as "the Return of Objects Launched into Outer Space."[54] To do so, the convention requires that space objects are registered "as soon as practicable," but there are no enforcement mechanisms.[55] Sometimes this means objects are never registered. Over 225 objects are not registered, and no satellites are registered as "military satellites," despite the recognized existence of military satellites.[56] Enforcing the registration requirement is the first step in addressing space debris through an international organization.[57] Registration establishes that there is no complete sovereignty in space and that nations must operate within the bounds of international laws.

Nations often do not register their satellites even though the requirements for registration are very minimal. The information required for registration is listed under Article IV of the convention. These requirements include "(a) Name of launching State or States; (b) An appropriate designator of the space object or its registration number; (c) Date and territory or location of launch; (d) Basic orbital parameters, including: (i) Nodal period, (ii) Inclination, (iii) Apogee, (iv) Perigee; (e) General function of the space object."[58] These requirements are not so extensive that a nation could reasonably justify not registering their satellites for national security concerns. The vague wording of the requirements leaves open that for requirement (c), instead of listing, for example, "Vandenberg Air Force Base, California," a country could instead list "California" or even just "United States." Similarly, the requirements for (e) could be an issue of national security if specifics were required. However, due to the vague wording, a country could simply list "data collection" or "government use" for the satellite's function. To prevent countries from using national security reasons as an excuse to abstain from registration, it is important to normalize the practice of providing minimal information for sections (c) and (e), which are not vital for preventing future collisions. For the other points regarding the orbit of the satellite, this information is collectible once the object is in orbit. If a satellite could be operated in stealth, providing the orbital parameters would certainly be a national security issue. At this time, though, orbits of satellites can be tracked and identified.[59] The aforementioned March 2021 collision between a Chinese satellite and a piece of space debris is an apt example.[60] It was publicly known

54. *Id.*

55. *Id.*

56. Imburgia, *supra* note 47, at 618–19.

57. See *infra* Part VI for discussion on methods to enforce registration.

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

59. Geoff Manaugh, *Tracking Earth's Secret Spy Satellites*, THE ATL. (June 10, 2016), https://www.theatlantic.com/technology/archive/2016/06/mapping-clandestine-moons/485915/ [https://perma.cc/X8BQ-HTMZ].

60. *See supra* text accompanying note 18.

that the satellite was a Chinese military satellite, and its orbit was already being tracked.

As shown above, the state of international space law exists more as guidelines than binding rules. Other than serving as general guidelines, the value of this combination of treaties and conventions is questionable. In one of the few instances where international space law would apply—the crash landing of a Soviet satellite in Canada that caused nuclear contamination—the two sides came to a diplomatic settlement rather than pursuing damages.[61] This brings into question whether there is any value in pursuing binding liability when differences are more likely to be resolved diplomatically. Similarly, the Iridium 33 crash—discussed in Part II above—highlights the issues of the current international space law system. While the Russian satellite was non-operational, there is no recognized classification for when a space object becomes space junk. As such, Russia asserted that Iridium, or alternatively the United States since Iridium is a U.S. corporation, should have taken precautions to avoid the Russian satellite as the Iridium satellite possessed a self-propulsion system, unlike the Russian satellite.[62] This matter was further complicated since Kazakhstan was technically the launching state and Russia performed the launch, even though the satellite was owned by Iridium, a U.S. company.[63] In the end, both the United States and Russia elected to not bring any claims against the other, further highlighting the trend of using diplomatic negotiations over pursuing legal action.[64] Without improvements to international space law, countries are left to negotiate conflicts through regular diplomatic channels rather than through the methods that were originally envisioned with the creation of treaties surrounding the proper use of space.

III.
THE FAILURES OF SPACE DIPLOMACY

The threat of space debris originally was not widely appreciated, and the response to the risks of space debris has only recently begun. Any attempts at addressing space debris have been further complicated by a variety of issues, each significant enough on its own to prevent meaningful progress. These issues include the tragedy of the commons, norms regarding the unregulated use of space, and distrust between space-faring nations over the militarization of space. Early indications show progress in creating international agreements that actively address the threat of space debris, despite the challenges faced. To address the expanding issue of space debris, it is essential to first identify the

61. Olga A. Volynskaya, *Landmark Space-Related Accidents and the Progress of Space Law*, 62 ZEITSCHRIFT FUR LUFT-UND WELTRAUMRECHT 220, 226 (2013).

62. *Id.* at 229.

63. *Id.* at 230.

64. *Id.* at 229.

successes and failures of various efforts along the way and understand the underlying reasons behind them.

Governments have only recently begun to address the issue of space debris, despite its recognition for decades. This response is largely driven by the tragedy of the commons phenomenon, analogous to the global response to climate change. The limited response to space debris is further complicated by human nature and our general inability to comprehend high-risk, low-probability events.[65] This can be seen through the limited global preparations to handle a widespread pandemic such as COVID-19.[66] Despite decades of knowing the consequences of a global pandemic, the low probability of one happening led to minimal preparation. However, after a long enough period of time, such an event occurring is a near certainty. Similarly, at any given time, the risk of a catastrophic collision in space is low, so few resources are devoted to preventing one. Over an extended period, especially with the rapidly increasing risks of a collision, such an event is a near certainty without mitigation efforts.

In the first decades of human space activity, many scientists and policy-makers believed in the "Big Sky Theory." This theory suggests that space has enough room for everyone, negating the need for coordination or mitigation efforts. The world slowly realized that while space is infinite, the space around Earth was finite. In the mid-1990s, the global community began to recognize that LEO was a limited resource.[67] However, by then, norms regarding national independence on launching objects into space were already established. Space-faring governments are addressing the issue of removing space debris but in a haphazard way that brings up questions of long-term sustainability. For example, the United States, the United Kingdom, the European Union, and China have all funded programs that research the removal of space debris.[68] The U.S. Vice Chief of Space Operations, General David Thompson, said he would "pay by the ton if [companies] can remove debris." However, this begs the question: how much would the United States pay, and what would the United States pay to

65. *See generally* BERNICE LEE & GEMMA GREEN, CHATHAM HOUSE REP., PREPARING FOR HIGH-IMPACT, LOW-PROBABILITY EVENTS: LESSONS FROM EYJAFJALLAJOKULL (2012), https://www.chathamhouse.org/2012/01/preparing-high-impact-low-probability-events-lessons-eyjafjallajokull [https://perma.cc/6RET-9A45].

66. *See generally* Aaron S. Bernstein, Amy W. Ando, Ted Loch-Temzelide, Mariana M. Vale, Binbin V. Li, Hongying Li, Jonah Busch, Colin A. Chapman, Margaret Kinnaird, Katarzyna Nowak, Marcia C. Castro, Carlos Zambrana-Torrelio, Jorge A. Ahumada, Lingyun Xiao, Patrick Roehrdanz, Les Kaufman, Lee Hannah, Peter Daszak, Stuart L. Pimm & Andrew P. Dobson, *The Costs and Benefits of Primary Prevention of Zoonotic Pandemics*, 8 SCI. ADVANCES 1 (2022), https://doi.org/10.1126/sciadv.abl4183 [https://perma.cc/5WUC-UNM4].

67. Carns, *supra* note 30, at 193.

68. Press Release, UK Space Agency, Government Fund Will Support New Ideas for Cleaning up Space (June 3, 2021), https://www.gov.uk/government/news/government-fund-will-support-new-ideas-for-cleaning-up-space [https://perma.cc/M9F8-HJRN]; Foust, *supra* note 3.

remove?[69] Seeing the potential opportunity, the private sector is taking small steps towards developing space debris removal technology.[70] However, General Thompson's words are more aspirational than realistic without dedicated funding from Congress. Without additional government support, the technological gap between where we are now and where we would have to be to have commercially viable space debris removal remains too wide for private industry to surmount on its own.[71]

Additionally, these efforts are undermined by the distrust that exists over space debris removal technology. Nearly all space debris removal technology has dual use, meaning it can be used for civilian purposes, such as removing space debris, but also military purposes, such as removing an adversary's active satellite.[72] For this reason, countries are skeptical about the unilateral development of space debris removal technology, especially when done in secret. For example, China recently launched a satellite that was allegedly for testing space debris removal technology.[73] However, the secretive nature of the launch suggests it is more likely for military than civilian purposes.[74]

Recent efforts in the United Nations could serve as the groundwork for updating and expanding international agreements on the use of space. However, a lack of key support from China and Russia weakens its credibility.[75] In November 2021, the United Kingdom led a resolution that included part of the Preventing an Arms Race in Outer Space (PAROS) proposal and established a new U.N. working group; this resolution was supported by 163 states, excluding Russia and China.[76] China and Russia have previously proposed their own resolution, the Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force Against Outer Space Objects (PPWT), but it met resistance from other nations, including the United States.[77] The PPWT would have created a legally binding ban on weapons in space; however, multiple

69. Sandra Erwin, *U.S. Space Force Would Support Commercial Services to Remove Orbital Debris*, SPACENEWS (Mar. 16, 2021), https://spacenews.com/u-s-space-force-would-support-commercial-services-to-remove-orbital-debris/ [https://perma.cc/864H-85R9].

70. Foust, *supra* note 3.

71. *See, e.g.*, *infra* Part V.A.

72. Mark Harris, *Enter the Hunter Satellites Preparing for Space War*, ARS TECHNICA (Feb. 2, 2023), https://arstechnica.com/science/2023/02/enter-the-hunter-satellites-preparing-for-space-war/ [https://perma.cc/FDA8-7QPM].

73. Elizabeth Howell, *China Launches Military Satellite that Will Take Aim at Space Junk*, SPACE.COM (Oct. 27, 2021), https://www.space.com/china-launches-military-space-junk-satellite [https://perma.cc/PRV2-KLYC].

74. *Id.*

75. Ramin Skibba, *The United Nations Could Finally Create New Rules for Space*, WIRED (Nov. 3, 2021), https://www.wired.com/story/the-united-nations-could-finally-create-new-rules-for-space/ [https://perma.cc/8E5H-R8WM].

76. Rajeswari Pillai Rajagopalan, *Space Security Governance: Could a New Working Group Narrow the Divide?*, DIPLOMAT (Nov. 4, 2021), https://thediplomat.com/2021/11/space-security-governance-could-a-new-working-group-narrow-the-divide/ [https://perma.cc/7H8J-FMQN].

77. *Id.*

nations took issue with unaddressed flaws in the treaty, including the lack of a provision for verification of compliance and allowing for ASAT testing.[78]

IV.
INCORPORATING CONCEPTS FROM OTHER FIELDS

One of the many difficulties of addressing space debris problems is that no legal framework serves as a model to address the issue. For this reason, other global crises and their international responses must be analyzed to determine what has and has not worked in order to glean some lessons on how to address space debris. The following examples highlight concepts that can be incorporated into space debris regulation.

A. Cap and Trade

Cap-and-trade programs have proven successful in decreasing greenhouse gases by encouraging the development and implementation of cost-effective methods to eliminate pollutants.[79] A similar model could be incorporated to fuel space debris removal technology development and then to eventually encourage space debris removal. For a space debris cap-and-trade program, launch permits could be issued to all nations based upon the average number of satellites launched per country. This would have the benefit of providing a means of income for nascent space programs that are able to sell their excess permits to larger countries. To avoid a hard limit on satellite launches, buying additional permits from the international regulatory body at a significantly higher price could be allowed. Additionally, the international regulatory body could provide supplementary permits to nations when their space debris is removed or when they are compliant with debris mitigation policies. This would encourage nations to remove their own space debris and mitigate many of the legal issues surrounding countries removing space debris that belongs to another nation. Over time, the money generated from this program could be used to fund the bounty system mentioned below. In the interim, it could be used to fund further research to support the growth of space debris technologies that may be beneficial but are not currently under development. This would ensure funding

78. Michael Listner & Rajeswari Pillai Rajagopalan, *The 2014 PPWT: A New Draft but with the Same and Different Problems*, SPACE REV. (Aug. 11, 2014), https://thespacereview.com/article/2575/1 [https://perma.cc/6Q97-872U]. Both Russia and China have previously taken advantage of loopholes in international law or ineffective compliance methods to shirk international responsibilities, leading to skepticism about the motives behind Russia and China backing the PPWT when it would both create loopholes to their advantage and have limited methods to enforce compliance. See *infra* Parts V.C and VI.C for examples of Russia and China's methods for previously avoiding international commitments.

79. Government cap-and-trade programs establish a limit for harmful activity (typically the release of pollutants) and then provide permits to industry members that can be used or "traded" to others in the industry if they can find alternative ways to mitigate their pollution. *See generally* Meredith Fowlie & Jeffrey M. Perloff, *Distributing Pollution Rights in Cap-and-Trade Programs: Are Outcomes Independent of Allocation?*, 95 THE REV. OF ECON. AND STAT. 1640 (2013).

to develop the technology to remove smaller debris, which may be less valuable due to its limited dual-use capabilities.

B. International Seabed Authority

International oceans and space share many common factors. First, both areas are global commons shared by everyone. Second, there are limited resources available to all nations in both deep-sea mining and the limited space in orbit around Earth. These resources are both incredibly valuable but also capital intensive. Third, in both the sea and in space there is conflict between balancing commercial use and environmental preservation. While there is no "environment" in space in the traditional sense of the word, balancing the preservation of outer space for future use with present commercial use takes on the same cost-benefit analysis.

One useful carryover from the International Seabed Authority (ISA) is the management of deep-sea data. The ISA is an autonomous international organization established by the U.N. Convention on the Laws of the Sea in 1982 and the 1994 Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea. The ISA's role is to regulate deep-sea mining in international waters.[80] A similar model would be beneficial for regulating space activity and decreasing the risk of collisions. The ISA maintains a database of geological data and baseline seafloor assessment data.[81] However, only the seafloor assessment data is available to the public. Requiring countries to submit their satellite data to an international body—but only releasing some data to the public for research purposes—would reduce the risk of collision while still maintaining the secrecy that some countries desire.

One issue with applying the concept of the ISA to space is that the ISA was established before deep-sea mining became profitable. With many norms already established and multiple nations operating in space, getting the global community to change the status quo and reimagine the use of space makes incorporating the model of the ISA more difficult. To address this issue, we could start by requiring permits for satellite swarms. This industry is still nascent and poses significant risks in space and harm to Earth-based science research.[82] Regulating satellite swarms would create a foothold from which an international group could hopefully expand and regulate all space objects in the future.

C. World Trade Organization

The World Trade Organization (WTO) is another useful example of how an international regulatory body for space could work. Under the WTO,

80. *About ISA*, INT'L SEABED AUTH., https://www.isa.org.jm/about-isa/ [https://perma.cc/A58A-D4SR].

81. *About DeepData*, INT'L SEABED AUTH., https://www.isa.org.jm/deepdata/about#block-seabed-page-title [https://perma.cc/WYB9-ZQY6].

82. *See generally* Joshua Sokol, *The Fault in Our Stars*, 374 SCIENCE 142 (2021).

participating countries commit to global standards on trade covering a wide body of issues, such as intellectual property protections and tariffs. Additionally, countries commit to resolve trade disputes through the WTO and accept the findings from the WTO's panels. A similar system applied to activity in space, including the regulation of space debris, would be instrumental to solving the threat from space debris.

However, the WTO has flaws that hinder its effectiveness in regulating global trade, and the nature of space would make creating a WTO-like organization very difficult. Large-scale noncompliance by China, and to a lesser extent Russia, consistently causes tension among WTO nations. The 2020 annual reports from the U.S. Trade Representative to Congress on China and Russia's compliance with the WTO both highlight a litany of failures to comply with the requirements of membership.[83] The Trade Representative explained the difficulty in gaining China's compliance: "[e]ven though the United States has routinely prevailed in these WTO disputes . . . they take years to litigate, consume significant resources, and often require further efforts when China fails to comply with WTO rules."[84]

In addition to the inability to force compliance even with a system of enforcement built into the organization, the WTO model would be difficult in space due to China and Russia's ability to operate outside such a system. In the case of the WTO, gaining access was critical for both countries to unlock global trade that is immensely beneficial to them. In the case of a space regulatory organization like the WTO, China and Russia would have little to gain by participating as they do not need international partners like they do when conducting trade. Creating incentives, such as access to funding or technology, would increase the likelihood of both nations participating in a regulatory body. Combining concepts, such as requiring compliance to space regulation rules in order to access funds from the aforementioned cap-and-trade or bounty programs, could be used to compel countries like Russia and China to participate in an international space regulatory group.

V.
THE NEXT STEPS FORWARD

This section will examine the various ideas for the ideal state of international affairs regarding the use of Earth's orbit, identify the issues getting from where we are today to this ideal, and then address the possible solutions to these problems.

83. *See generally* U.S. TRADE REP., 2020 REPORT ON THE IMPLEMENTATION AND ENFORCEMENT OF RUSSIA'S WTO COMMITMENTS (2020); U.S. TRADE REP., 2020 REPORT TO CONGRESS ON CHINA'S WTO COMPLIANCE (2021) [hereinafter U.S. TRADE REP., CHINA REPORT].

84. U.S. TRADE REP., CHINA REPORT, *supra* note 83, at 7.

A. What Does the "Ideal World" Look Like?

The initial challenge in charting a path forward is the myriad variations on the ideal solution. Adding to the complexity, various scholars have proposed numerous pathways to reach these ideal states. Before deciding what steps should be taken today, there must first be an examination of what the ideal solution is and how to best get there.

Early space law scholars understood the complexity of regulating space debris. They suggested a multistep process over time, beginning with mandatory satellite registration by countries with an international body.[85] The registration process would not need to be incredibly detailed and could arguably ask for less information than the current registration system. One aim of such a system would be to gather crucial information for tracking ownership and preventing collisions. Equally important, it would promote the norm of countries ceding some sovereignty to an international authority in space affairs. The next logical step would be for this organization to license satellites and other space vehicles.[86] From the beginning, it was recognized that simply having an international body that requires countries to register their space activity with it would not limit bad behavior or control the generation of space debris.[87] This prediction was unfortunately correct.

With the lack of success in regulating space debris, some argue that the United States should unilaterally create a system where space objects launched from the United States are required to pay a tax to fund the removal of space debris.[88] Political difficulties would likely make enacting such a tax infeasible. In addition to corporate pushback, such a tax would put the United States at a disadvantage for the growth of its launch sector and could encourage companies to outsource their launching to other countries without such a tax.[89]

A focus on developing a United States-focused system for debris removal could have other unintended international consequences. A U.S. unilateral focus on space debris removal technology, which would almost inevitably have dual-use purposes, could cause another space race and further militarize space. Additionally, U.S. development could potentially deter future investment in debris removal if other countries could freeload off the United States's debris removal program. Aiming for a free-for-all system of retrieval could also result in a system where states act in their own interests. For example, a state could deorbit a non-functional satellite—without warning or prior consultation—and declare that the object needed to be deorbited because it was a threat to space navigation.[90] Without international regulation, states could end up removing

85. Dunstan, *supra* note 1, at 42.
86. *Id.* at 41.
87. *Id.* at 42.
88. Carns, *supra* note 30, at 230.
89. *Id.*
90. *See* Dunstan, *supra* note 1, at 73.

satellites or other space objects that the launching state still claimed use or ownership of. This would be especially risky with satellites where even if a nation believed it was removing a commercial satellite, it could in fact be removing one that also had military purposes.[91] Additionally, a non-functional satellite could still hold valuable technology or materials. As technology advances, the ability to service satellites in orbit is likely to develop. Unilateral removal of space debris could become more complicated due to the possibility of repairing satellites or collecting and repurposing materials in space.[92] While risks could be mitigated through developing lines of communication between countries, unilateral removal of large space debris would still increase the chance of destabilizing the already weakening peaceful use of space without an international body that could regulate the removal of space debris.

For this reason, an ideal solution would be an international one. However, what this international system would look like remains a point of contention. An effective international system must weigh the costs and benefits of the inclusion of multiple different elements and will require more than a one-size-fits-all solution. First, countries with emerging space programs might disapprove of having to pay to clean up the mess for countries that have been generating space debris for decades with little to no concern for the future use of space. A cynical view would also interpret such a tax as a way to weaken developing space programs and serve as a barrier to entry for any new programs. On the other end of the spectrum, countries with long-established space programs might not support being forced to underwrite the removal of space debris while latecomers contribute very little. Much like the issue of climate change mentioned previously, an effective international solution will need to consider the interests of both established and nascent space-faring nations.[93]

In order to prevent escalation of conflict over the use of space, an international system must be able to discourage a state from acting in its own interests. The first step would be to create international standards to identify what space debris is acceptable to be deorbited. This would need to be managed by an international body, ideally one that requires registration of all space objects before they launch. With time, such a group could collect registration fees and begin to use the income the fees generate to fund experiments and test concepts for space debris removal. Creating this organization is critical to begin shaping international norms. International norms can quickly become established when covering a new field.[94] For this reason, it is important to create an international regulatory group with at least some power now so that this norm of accepting an international regulatory body is established before we become even further cemented into the "Big Sky" system that currently governs space.

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91. *Id.*
92. Carns, *supra* note 30, at 179.
93. *See supra* Part V.A.
94. *See generally* ANDREW G. HALEY, SPACE LAW AND GOVERNMENT (1963).

With a list of removable space debris already established, nations could begin to remove the identified debris once the removal technology exists.[95] To incentivize removal, the funds that were collected to fund experiments and test concepts could then be used as a bounty system to remove space debris. Such a system could be used to prioritize the most dangerous space debris based on models that can identify the debris that crosses paths with the most satellites.[96]

With such a system in place, the goal would be to remove a certain number of debris every year to create a sustainable level of space debris. It has been predicted that five or more large objects will need to be removed each year to maintain a sustainable level of space debris.[97] However, this prediction does not account for the growing number of space objects that are launched every year.[98] It also assumed that there would be no further breakups of new launches and that active debris removal would begin in 2020.[99] Based on these assumptions, it is almost certain that there will need to be more than five objects removed per year to stabilize the amount of space debris, but the exact number is unknown.

Under this system, as space debris reaches a sustainable level, the program could be modified to encourage the development of technology that could remove smaller but just as dangerous pieces of debris. Most current research and development focuses on removing large pieces of debris. Large debris removal technology has dual-use capabilities that could be used to disable adversarial nations' active satellites. Once the immediate threat of space debris is diminished, creating systems designed specifically to handle only space debris would decrease the risk of the militarization of space.

B. Interim Unilateral Steps

Decades of inaction show that despite numerous scholarly articles recommending the establishment of an international space regulatory body, it will be very difficult to create such a body. In the interim, there are unilateral steps that nations could take to either set the stage for new international agreements or advance international norms. Ideally, the United States, as a leading space-faring nation and also a major creator of space debris, would lead these actions. This would not be unprecedented since the United States has

95. James Dunstan & Bob Werb, *Legal and Economic Implications of Orbital Debris Removal: Comments of the Space Frontier Foundation*, SPACE FRONTIER FOUND. (Oct. 30, 2009), https://www.scribd.com/document/23379988/Legal-and-Economics-Implications-of-Orbital-Debris-Removal [https://perma.cc/N92X-RCUF].

96. Clark, *supra* note 24, at 48.

97. V.V. Mironov & I.V. Usovik, *Retrospective of the Space Debris Problem. Part 1. Technogenic Clogging of Space and Means of Its Control*, 58 COSMIC RSCH. 92, 98 (2020).

98. Liou et al., *supra* note 2, at 649.

99. *Id.* at 650.

already taken steps to regulate its own activity and limit the risks of collision and debris creation.[100]

First, the United States could create a list of satellites and other debris that it owns but that it would allow other countries to remove with its consent and coordination. This would be a token of goodwill to help remove the restrictions that current space treaties have placed on removing space debris. At the same time, however, by requiring that deorbiting be done with U.S. coordination, it would protect the United States from potentially losing proprietary technology and ensure that the removal is done safely. U.S. leadership could encourage other nations to come forward and do the same, advancing norms regarding the coordinated removal of space debris. The United States could also offer to partner with allies and growing space-faring nations in the removal of their own debris. This would further strengthen international cooperation in space, making it easier to advance the goal of an international space debris regulation organization, while also improving information sharing on space debris technology and ensuring developing space-faring nations do not take on the "Big Sky" mentality.

This United States-led effort might not be enough to spark the urgent need to address space debris. The United States could go a step further and declare that it considers any space object that is no longer under the control of its operator to be abandoned and thus eligible for removal. This declaration would not be baseless. Prior scholarly works have suggested that the Outer Space Treaty could be interpreted in such a way that if a nation loses control of an object, the nation is in violation of the treaty.[101] Such a declaration would be valuable in creating an internationally accepted definition of space debris while also establishing a basis for countries to remove debris of other countries.

Another similar declaration could assert that any unregistered object lacks an owner and, as such, could be removed. This would encourage compliance with the registration convention. However, either one of these declarations could cause a rush to capture space debris, especially if a nation found a way to return a satellite to Earth that maintained the satellite's functionality. To counter this, countries should be given a grace period to register any space objects currently in orbit. For derelict satellites and other space debris, countries could similarly register them but be required to provide a plan to remove the debris in order to prevent another nation from deorbiting it. Noncompliance with such a plan could then be grounds for again declaring debris abandoned and open to removal by another nation. Doing so would give nations adequate time to declare which

100. Memorandum from the Sec'y of Def. to the Dep't of Def., Tenets of Responsible Behavior in Space (Jul. 7, 2021), https://media.defense.gov/2021/Jul/23/2002809598/-1/-1/0/TENETS-OF-RESPONSIBLE-BEHAVIOR-IN-SPACE.PDF [https://perma.cc/V8HK-N2LZ].

101. *See* Dunstan, *supra* note 1, at 48; *see generally* Melissa Kemper Force, *Active Space Debris Removal: When Consent Is Not an Option*, 29 AIR & SPACE L. 9 (2016).

objects belong to which nations and sort out any disagreements, while also serving as a major incentive to develop space debris-removing technologies.

While these declarations would not have any backing by international treaty or any established international norms, the immediate establishment of international norms is not unheard of. The idea of instant customary law has existed in academia since the 1950s.[102] In space, key norms have been established instantaneously through unilateral action. For example, a nation's right to its airspace was long established, but the upper limit to this right was never defined. With the first satellite launch and the lack of protest to satellites orbiting over a country, it became an established norm that states did not maintain their airspace rights into LEO.[103] Another method to quickly establish international norms is known as the "articulation and act" test.[104] Under this method, a state announces its intended norm-defining action, from which the acting state can then weigh the potential outcome or modify its action depending on the resulting responses.[105] It is also not without precedent that such instant customary law goes against prior international norms.[106]

Alternatively, the United States could build on prior international agreements to better align them with the realities of today. One example could be the United States declaring it will view any country that has not taken action to remove its space debris as a negligent operator. As such, the United States would sanction any negligent operator that causes a collision with an American satellite. This would in effect be an expansion and update to the Liability Convention in order to address the realities of modern satellite operation while also addressing the threat of space debris. With the weak state of current space treaties, this would likely be viable as an instant norm, especially if it were first discussed with other key space-faring nations. This would incentivize all nations to at least participate in the global coordination on removing space debris so that a nation would be less likely to be liable in the case of a collision. While an international court might not uphold a finding of liability, the fact that the major collisions so far have been handled diplomatically indicates that such a finding would probably not matter in this context.[107]

The United States could also apply the Law of Finds to help define limits to the Outer Space Treaty and allow for the removal of large pieces or amounts of debris while still relying on legal precedent.[108] The Law of Finds would

102. Michael P. Scharf, *Accelerated Formation of Customary International Law*, 20 ILSA J. INT'L & COMP. L. 305, 314, 318–29 (2014).

103. HALEY, *supra* note 96, at 60–61; *see* Dunstan, *supra* note 2, at 8–9.

104. Scharf, *supra* note 104, at 318–29.

105. *Id.*

106. Carns, *supra* note 30, at 212–15.

107. *See supra* text accompanying note 18.

108. The Law of Finds is essentially the well-known idea of "finders keepers." To acquire property, or in this case space debris, the party would need to show the object has been abandoned. The Law of Finds has previously been used in maritime law, which can be applied to space law when

support the argument that when a nation no longer controls a satellite, the satellite is considered abandoned; as such, another country could claim ownership over these nonfunctional satellites. In this case, the vague definitions used in the Outer Space Treaty could in fact be used to support the removal of debris and encourage countries to not abandon their satellites in LEO. One drawback to the Law of Finds is that in the maritime environment, it is assumed that states never give up searching for their ships and so they retain ownership in perpetuity. However, the reasoning for this is not completely transferable to space and the ownership of satellites. One key reason is that unlike with missing ships, satellites are unmanned and so there is no justification to continue searching for crew.

The greatest risk from these unilateral actions would be sparking another space race. While the technological developments from a space race would be beneficial to limiting space debris, the risks of accidental military escalation in a new battlespace would be greatly elevated. The continued use of ASAT testing and the development of other anti-satellite technology indicates that a new space race is already brewing. If this is the case, unilateral action would in fact be critical to get in front of unrestrained testing conducted by Russia and China, which might—as mentioned above—attempt to stymie any international agreements. Despite widespread condemnation of China's 2007 ASAT test, Russia conducted its own test in November 2021 that resulted in over 1,500 pieces of debris.[109] While this test was conducted at a lower altitude than the Chinese test, the satellite was destroyed at an altitude where the debris will be in orbit for years to come.[110] Additionally, the destroyed satellite weighed approximately 3,860 pounds, making it one of the larger targets ever shot down.

In addition to cleaning up LEO, taking unilateral steps to develop stronger international norms around space debris would be beneficial towards creating the previously mentioned "ideal state" for international cooperation in space. Most importantly, these steps would emphasize operating in space in a responsible manner. With those norms loosely established, it would then become easier to create a more solidified international agreement based upon those norms that could incorporate the ideas discussed in this Note.[111]

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applying rules regarding the abandonment of ships to satellites. *See* Adams v. Unione Mediterranea Di Sicurta, 220 F.3d 659, 670 (5th Cir. 2000); Fairport Int'l Expl. v. Shipwrecked Vessel Known as the Captain Lawrence, 105 F.3d 1078, 1084 (6th Cir. 1997).

109. Kylie Atwood, Jim Sciutto, Kristin Fisher & Nicole Gaouette, *US Says It 'Won't Tolerate' Russia's 'Reckless and Dangerous' Anti-Satellite Missile Test*, CNN (Nov. 16, 2021), https://www.cnn.com/2021/11/15/politics/russia-anti-satellite-weapon-test-scn/index.html [https://perma.cc/YG3J-CNBC].

110. Chelsea Gohd, *Russian Anti-Satellite Missile Test Was the First of Its Kind*, SPACE.COM (Aug. 10, 2022), https://www.space.com/russia-anti-satellite-missile-test-first-of-its-kind [https://perma.cc/P9DX-66RA].

111. *See supra* Part VI.A.

C. Herding the Elephants in the Room

The unwillingness of China and Russia to participate in or follow international conventions in general will also be an issue for getting international agreement on the use of space.[112] China and Russia will be important for any international space agreement due to their significant activity in space. Also, not having the support of two of the largest space actors would weaken the chance of other nations participating in an international space regulatory group. As noted in the examples of prior successful international agreements, such as the WTO, an incentive must be provided to these countries to get their participation.[113]

Incremental steps, starting with commitments surrounding the use of weapons and weapons testing in space, will likely be the key to eventually getting Russia and China to support an international regulatory body for space debris. Agreeing to follow the Registration Convention would be one method of achieving both transparency and building confidence. Another step towards getting Russia and China's participation in regulating space debris could be limiting ASAT testing to altitudes where any debris that is generated is burnt up within a year. This would be an effective incremental step, as it would still allow ASAT testing but would begin the process of regulating the generation of space debris and ensure that any testing does not cause long-term risk. An additional step could also require notification prior to testing so that nations could further limit the risk of collision with any debris that is generated. ASAT testing at altitudes where debris deorbited in under a year is still useful and has previously been conducted.[114] Finding common ground, such as the steps mentioned above, and creating written commitments towards preventing the growth of space debris are key first steps. While these incremental steps would likely not have a method of enforcement, in order to get Russia and China to agree to any incremental steps, the public recognition and commitment to these steps would help develop international customs regarding a sustainable use of space.

CONCLUSION

The risks from space debris continue to increase every day as debris breaks apart. On top of that, we are now entering a new era in space where the sharp

112. While all nations fail to follow all international rules at all times, China and Russia are both recognized for their frequent noncompliance, manipulation of loopholes, or selective compliance when convenient. *See* Robert D. Williams, *International Law with Chinese Characteristics: Beijing and the "Rules-Based" Global Order*, BROOKINGS (Oct. 2022), https://www.brookings.edu/research/international-law-with-chinese-characteristics-beijing-and-the-rules-based-global-order/ [https://perma.cc/9PSC-RHZY]; *see generally* Pamela A. Jordan, *Diminishing Returns: Russia's Participation in the World Trade Organization*, 33 POST-SOVIET AFF. 452 (2017).

113. *See supra* Part V.

114. Daniel Oberhaus, *India's Anti-Satellite Test Wasn't Really About Satellites*, WIRED (Mar. 27, 2019), https://www.wired.com/story/india-anti-satellite-test-space-debris/ [https://perma.cc/GN6E-W7MU].

increase in commercial viability of satellites, especially satellite swarms, will further increase the amount of space debris. At the same time, we continue to see ASAT testing without regard for the risk of generating additional space debris. However, if action is taken to change the norms in international space law and create a new international system to regulate space debris, the growing crisis in Earth's orbit can be reversed. This would ideally be done through an international space debris organization, but this is not currently politically feasible. To set the stage for such an organization to come into existence, unilateral action is required to create new norms and push the boundaries of the current set of treaties that shape space law. From there, an organization could be created based on lessons learned from other global agreements to create a permanent solution to the space debris problem.