

Fall 2011

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**DEBRIS MITIGATION CERTIFICATION AND THE
COMMERCIAL SPACE INDUSTRY: A NEW WEAPON IN THE
FIGHT AGAINST SPACE POLLUTION**

*Benjamin Jacobs**

I. INTRODUCTION

Orbital debris, or “space junk,” is quickly becoming a serious barrier to the effective use of outer space.¹ As the world increasingly relies on satellite technology, the number of man-made satellites orbiting the Earth has grown and, with it, the amount of debris that endangers the operation of those very satellites.

All space-faring states likely have contributed on some scale to the orbital debris problem, and every state’s orbital debris threatens the entire space ecosystem. The international nature of the orbital debris problem therefore demands an international solution. Although most, if not all, space-faring states have indicated a desire to implement various mitigation strategies, the resulting regulations are inconsistent. This piece will examine the regulatory responses of major space-faring states and identify further significant steps to reduce gaps in the international debris mitigation framework. Part II of this piece provides a broad overview, including basic information on the problem of orbital debris. Part III discusses the foundational international treaties that ultimately may serve as a basis for regulation or liability in the context of orbital debris. Part IV is a survey of debris mitigation processes and methodologies in national and regional space programs around the world. Part V describes mitigation standards and regulations in the United States, with specific attention to federal agencies involved in the mitigation of orbital debris. Part VI discusses existing institutions at the international level, which are involved in analyzing the problem of orbital debris and formulating international policy. Part VII identifies outstanding issues in the global effort to mitigate and regulate the

* J.D. expected, Georgetown University Law Center, 2012. He thanks Professor Jennifer Manner for her invaluable guidance and encouragement, the editors of *Media Law & Policy* for their thoughtful comments, and his family and friends for their love and support.

¹ See generally *Junk Science*, *ECON*, Aug. 19, 2010, available at <http://www.economist.com/node/16843825> (providing background information on the growing problem of orbital debris).

problem of orbital debris. Part VIII analyzes these outstanding issues and suggests remedies that will involve all stakeholders in achieving a clear outer space environment.

II. ORBITAL DEBRIS – AN OVERVIEW

Not all space debris is human-made. At any one time, as much as 200 kilograms of naturally occurring debris, meteoroids, are passing through the area in which human-made satellites orbit.² *Orbital* debris refers to objects that have been left in space as a result of human activity and remain there, often orbiting the planet for years until “friction and gravity combine” to pull the object back into the Earth’s atmosphere.³

Orbital debris can be created in myriad ways. One particularly famous piece of debris, which has since returned to Earth, was the glove of Gemini 4 astronaut Ed White that was released during a spacewalk in 1965.⁴ Large and small pieces of spacecraft may also become debris. For example, entire stages of a launch vehicle may be discarded in orbit, and bolts, small pieces of paint, and other “micro-debris” may be accidentally released from a larger space object.⁵ If not properly disposed of, an entire space station may become debris if it remains in orbit after operators have lost control.

Even very small debris can have devastating consequences. Collision with an object as small as one centimeter in diameter can permanently disable a satellite.⁶ A fleck of paint four one-hundredths of a millimeter in diameter could damage a window of the International Space Station, requiring the window to be replaced.⁷ In addition to the risk of physical damage, orbital debris makes it more difficult and expensive to execute space missions. In order to protect against debris, contemporary spacecraft need to be outfitted with more durable shields (to absorb impacts) and more

² Steven A. Mirmina, *Reducing the Proliferation of Orbital Debris: Alternatives to a Legally Binding Instrument*, 99 AM. J. INT’L L. 649, 649 (2005).

³ *Id.* at 650.

⁴ Richard Crowther, *Space Junk – Protecting Space for Future Generations*, 296 SCI. SIGNAL 1241 (2002).

⁵ Natalie Pusey, *The Case for Preserving Nothing: The Need for Global Response to the Space Debris Problem*, 21 COLO. J. INT’L ENVTL. L. & POL’Y 425, 429 (2010).

⁶ *Id.* at 430.

⁷ Mirmina, *supra* note 2, at 650.

fuel (to dodge impacts that can be anticipated).⁸ Both of these measures increase the weight of a spacecraft, and thus the cost of launch. Furthermore, no existing measures are foolproof; shields can protect only against debris up to a diameter of two centimeters⁹ and operators are only able to dodge debris large enough to be detected from Earth.

III. INTERNATIONAL TREATIES

Several important international conventions predate the recent attempts at space debris mitigation. This section will describe these conventions briefly, highlight their shortcomings in the context of orbital debris, and describe how they may nonetheless form the basis of effective contemporary legal regimes.

A. *Outer Space Treaty*

The foundational legal document dealing with human activity in outer space is the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and other Celestial Bodies (“Outer Space Treaty” or “the Treaty”).¹⁰

Some legal scholars have suggested that several provisions of the Treaty could provide a framework for future debris mitigation law.¹¹ Article I of the Treaty provides that disputes related to outer space will be decided in accordance with international law. However, the most significant provisions for the purposes of orbital debris are Articles VI, VII, and VIII. Article VI provides that each state is responsible for its “non-governmental entities” and all national governmental agencies.¹² Article VII and Article VIII provide that each state is responsible for damage caused “on the Earth,

⁸ Pusey, *supra* note 5, at 430.

⁹ *Id.*

¹⁰ See 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, 610 U.N.T.S. 205 [hereinafter *Outer Space Treaty*].

¹¹ Michael W. Taylor, *Trashing the Solar System One Planet at a Time: Earth's Orbital Debris Problem*, 20 GEO. INT'L ENVTL. L. REV. 1, 25-26 (2007); see also Bin Cheng, *STUDIES IN INTERNATIONAL SPACE L.* 604 (1997).

¹² *Outer Space Treaty*, *supra* note 10, art. VI.

in air space, or in outer space”¹³ by that state’s space objects “and their component parts.”¹⁴

Because there was significantly less space activity when the Outer Space Treaty was concluded, the agreement was not intended to cover today’s outer space environmental problems. Applying the Outer Space Treaty to orbital debris would be problematic for other reasons as well. First, the Treaty lacks a specific definition of the phrase “component parts,”¹⁵ and the extent to which unintended debris could fall within this category is unclear. This is a significant problem, because not all debris would necessarily be described as a component part. Larger pieces of space debris, such as discarded fuel canisters, could be uncontroversially classified as components. The classification of smaller debris, such as flecks of paint, is more ambiguous. Second, the Treaty does not establish a legal standard for liability.¹⁶

B. *Liability Convention*

The 1972 Convention on International Liability for Damage Caused by Space Objects (“Liability Convention”), like the Outer Space Treaty, was not created for the purpose of dealing with orbital debris.¹⁷ The Liability Convention was created in response to international concern about potential damage caused by space objects re-entering the Earth’s atmosphere.¹⁸ However, it does provide insight into how an international orbital debris regime might be framed. Article II states that a “launching state shall be absolutely liable” for damage caused on the surface of the Earth or to flying aircraft.¹⁹ On the other hand, for damage caused in space, liability is to be

¹³ Outer Space Treaty, *supra* note 10, art. VII.

¹⁴ Outer Space Treaty, *supra* note 10, art. VIII.

¹⁵ *Id.*

¹⁶ *See generally* Outer Space Treaty, *supra* note 10.

¹⁷ *See generally* Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 961 U.N.T.S. 187, *available at* <http://www.oosa.unvienna.org/pdf/publications/STSPACE11E.pdf> [hereinafter *Liability Convention*].

¹⁸ Pusey, *supra* note 5, at 438-39.

¹⁹ Liability Convention, *supra* note 17, art. II.

determined based on fault, although the level is not specified in traditional tort terms.²⁰

Like the Outer Space Treaty, the Liability Convention is unlikely to effectively counter the current space debris problem. First, the Liability Convention relies on the ambiguous phrase *space object*, defined as “component parts of a space object as well as its launch vehicle and parts thereof.”²¹ This language does not clearly apply to all forms of orbital debris, particularly micro-debris, because such small fragments may be too small to qualify as “components.” Furthermore, it may be impossible to determine the origin of such small fragments with precision. Second, although the Liability Convention establishes a fault standard for damage occurring in outer space, it fails to establish a mechanism or standard for establishing fault, and so provides insufficient detail for a workable international regime.²²

IV. GLOBAL DEBRIS MITIGATION

Although the community of space-faring states is relatively small, many of its members have taken steps to address the issue of orbital debris. The following is a brief survey of orbital debris mitigation practices in a number of states and regional organizations; it is not an exhaustive list of foreign practices.

A. *European Space Agency*

The European Space Agency (“ESA”) is an intergovernmental network of space agencies connecting Europe and Canada. In 2004, after several years of discussion, the organization released the European Code of Conduct for Debris Mitigation (“the Code”), which was to be implemented at the national level by member states.²³ The document is largely based on a draft submitted by the French government, which in turn is largely based on the mitigation standards of the United States.²⁴ The guidelines fall into four

²⁰ Liability Convention, *supra* note 17, art. III.

²¹ Liability Convention, *supra* note 17, art. I.

²² David Tan, *Towards a New Regime for the Protection of Outer Space as the “Province of All Mankind,”* 25 Yale J. Int’l L. 145, 169 (2000).

²³ Taylor, *supra* note 11, at 38.

categories: “[debris] prevention, [spacecraft] end-of-life, impact protection, and reentry safety measures.”²⁵ These categories will be explored further in Part V.

B. *United Kingdom*

The 1986 Outer Space Act (“OOSA”) grants the British Secretary of State, acting through the British National Space Centre (“BNSC”), the authority to regulate the outer space activities of any person or organization “connected with the United Kingdom.”²⁶ Although space debris was not considered when the OOSA was first promulgated, the Act has proven sufficiently flexible to address these new issues.²⁷ During the licensing process required for any outer space activity by either the British government or its nationals, each application is subjected to rigorous quantitative and qualitative analyses. The quantitative analyses focus on, *inter alia*, the risks that a project’s hardware will pose to other orbiting spacecraft.²⁸ The qualitative analyses focus on the project’s “procedures . . . qualifications of key individuals, and critical internal and external interfaces.”²⁹

C. *France*

France’s Centre National d’Études Spatiales (“CNES”) began working on a national space debris mitigation standards in 1997.³⁰ This work culminated in a draft, which was submitted to the CNES’ partners at the European Space Agency two years later.³¹ After several years and rounds of discussion, the ESA converted the French draft into the European Code of Conduct, which was then signed by the President of CNES and incorporated

²⁴ See Claudio Portelli et al., *Space Debris Mitigation in France, Germany, Italy and United Kingdom*, 45 *ADVANCES IN SPACE RES.* 1035, 1038 (2010).

²⁵ Taylor, *supra* note 11, at 33.

²⁶ Portelli, *supra* note 24, at 1036.

²⁷ *Id.* at 1038.

²⁸ *Id.* at 1037.

²⁹ *Id.*

³⁰ *Id.* at 1038.

³¹ *Id.*

into French development procedures.³² A major shortcoming of the French regime is that CNES' debris mitigation regime applies only to projects of the agency itself, and "has no bearing on projects led by other French manufacturers or operators."³³ This creates a noteworthy gap, since private French operators are not subject to orbital mitigation regulations.

D. *Italy*

Italy's space authority is the Italian Space Agency ("ASI"). Since the organization's General Director signed the European Code of Conduct in 2003, ASI has applied the Code's requirements to all space projects of the national government.³⁴ Because, like France, Italy does not apply the standards to entirely commercial space projects, the government has not enacted any market or licensing regulations. Instead, the agency self-implements the Code during the technical review and development stages of its own projects.³⁵

E. *Russia*

The Russian Federation has taken a hard line against the intentional creation of orbital debris, likely because of its enormous presence in outer space.³⁶ The national legislature has promulgated a law forbidding "harmful contamination of outer space which leads to unfavorable changes of the environment, including deliberate elimination [destruction?] of space objects in outer space."³⁷ To further protect against unintended orbital debris, the Russian Federal Space Agency adopted a formal orbital debris mitigation standard in 2000.³⁸

³² *Id.*

³³ *Id.* at 1039.

³⁴ *Id.* at 1040.

³⁵ *Id.*

³⁶ See Union of Concerned Scientists, UCS SATELLITE DATABASE, available at http://www.ucsusa.org/assets/documents/nwgs/UCS_Satellite_Database_7-1-10.xls [hereinafter UCS Satellite Database].

³⁷ *Law of the Russian Federation "About Space Activity,"* Decree No. 5663-1 of the Russian House of Soviets, sec. 1, art. 4, available at http://www.unoosa.org/oosa/en/SpaceLaw/national/russian_federation/decreed_5663-1_E.html.

³⁸ Taylor, *supra* note 11, at 36.

F. *Japan*

In 1996, Japan was among the first states to establish a standard for orbital debris mitigation.³⁹ The standard was promulgated by Japan's National Space Development Agency ("NASDA") and applies to both the development and operational phases of NASDA space projects.⁴⁰ In addition to promulgating the NASDA standard, Japan formed the Space Debris Committee in 2000, which links "experts from space agencies, research institutes, universities and related organizations" for the purpose of coordinating debris mitigation both nationally and with the United Nations.⁴¹

The mitigation regimes discussed above illustrate the serious commitments made by space-faring states to address the problem of orbital debris. By enacting domestic mitigation policies, these states – and others – have imported non-binding international guidelines (discussed in Part VI, below) and implicitly recognized the necessity of orbital debris mitigation. However, a common shortcoming is their failure to extend debris mitigation requirements to private operators. This failure and potential solutions will be addressed in Part VII.

V. MITIGATION IN THE UNITED STATES

With more satellites than any other nation,⁴² the United States has perhaps the greatest interest in a safe outer space environment. To that end, the United States has been a leader in establishing effective anti-debris regulations.⁴³ This section will begin by examining the U.S. government's

³⁹ *Id.*

⁴⁰ United Nations, Committee on the Peaceful Use of Outer Space, *National Research on Space Debris, Safety of Space Objects with Nuclear Power Sources on Board and Problems Relating to Their Collision with Space Debris*, 2, U.N. Doc. A/AC.105/770/Add.1 (Feb. 18, 2002), available at http://www.oosa.unvienna.org/pdf/reports/ac105/AC105_770Add1E.pdf.

⁴¹ *Id.*

⁴² See UCS Satellite Database, *supra* note 36. The database, which is maintained by the Union of Concerned Scientists, lists over 400 satellites currently operating under the control of the United States government and United States nationals. Because many of those satellites are controlled by the United States government, and because an unknowable number of these satellites are kept secret for national security purposes, it is impossible to precisely determine the number of satellites controlled by the United States and its nationals.

⁴³ Taylor, *supra* note 11, at 33-36 (discussing the policies of various U.S. agencies); see also Taylor, *supra* note 11, at 32 (the United States has been at the center of a push for international

overarching Orbital Debris Mitigation Standard Practices, as well as the implementation of these guidelines by individual government agencies. Finally, this section will analyze the Obama administration's 2010 National Space Policy paper, and the U.S. government's comprehensive policy towards the mitigation of orbital debris.

A. U.S. Government Orbital Debris Mitigation Standard Practices

In 2001, the U.S. government formally approved the Orbital Debris Mitigation Standard Practices ("Standard Practices").⁴⁴ These guidelines, which later informed similar guidelines in countries, govern four areas.⁴⁵ First, the Standard Practices restrict the creation of debris during normal operations, including the launch phase, and any debris that may result from discarded launch stages.⁴⁶ Any anticipated debris larger than 5 millimeters must be "evaluated and justified on the basis of cost effectiveness and mission requirements."⁴⁷ Second, operations must be planned to minimize the risk of explosions in orbit.⁴⁸ This includes measures such as depleting unnecessary stores of energy. Third, operators must provide a safe flight plan and "operational configuration" to minimize the risk of collision with other objects in the space environment.⁴⁹ In this context, space objects are not limited to other operational satellites, but also includes any debris that could be expected to affect operational control in the event of a collision.⁵⁰ Finally, the Standard Practices call for effective disposal plans following a spacecraft's operational lifetime.⁵¹ These plans rely primarily on three basic

regimes and participated in the creation of the Interagency Space Debris Coordination Committee ("IADC").

⁴⁴ See Natl. Aeronautics and Space Admin., *Orbital Debris Mitigation Standard Practices* (2001), available at http://orbitaldebris.jsc.nasa.gov/library/USG_OD_Standard_Practices.pdf [hereinafter *Standard Practices*].

⁴⁵ See Portelli, *supra* note 24, at 1038.

⁴⁶ *Standard Practices*, *supra* note 44 at 1.

⁴⁷ *Id.*

⁴⁸ *Id.*

⁴⁹ *Id.* at 2.

⁵⁰ *Id.*

⁵¹ *Id.* at 3.

strategies: placing a spacecraft into a decaying orbit where it will burn up in the Earth's atmosphere, placing a spacecraft into an unused orbit where it will not interfere with operational spacecraft, or retrieving a spacecraft after the completion of its mission.⁵²

B. U.S. Government Policies

The above Standard Practices structure the policies throughout the U.S. government. In addition, individual agencies have adopted their own specific measures to minimize orbital debris.⁵³

1. Department of Defense

The Department of Defense ("DoD") has implemented rules that track closely with U.S. Standard Practices.⁵⁴ However, DoD also has policies and programs that distinguish it from other U.S. agencies involved in the mitigation of orbital debris. In the event of military hostilities, for example, DoD's Standing Rules of Engagement provide that "space defense operations will be conducted, insofar as practicable . . . [to] minimize the creation of space debris."⁵⁵ Furthermore, DoD administers the U.S. Space Surveillance Network ("SSN") through the U.S. Strategic Command. SSN continuously tracks space objects via an array of optical and radar sensors and helps to prevent collisions by providing its data to both governmental and commercial operators.⁵⁶ Unfortunately, the SSN program relies on technology built in the 1960s and 1980s, and is unable to track space objects smaller than 10 centimeters in diameter.⁵⁷ Because much smaller debris can still wreak havoc on spacecraft windows and electrical systems,⁵⁸ the U.S. Air Force has proposed supplementing the existing SSN infrastructure with a network of satellites dedicated to tracking orbital debris.⁵⁹

⁵² *Id.*

⁵³ Taylor, *supra* note 11, at 33-36.

⁵⁴ *Id.* at 34.

⁵⁵ Chairman of the Joint Chiefs of Staff Instruction 3121.01B, *Standing Rules of Engagement/Standing Rules for the Use of Force of US Forces* (2005).

⁵⁶ Pusey, *supra* note 5, at 433.

⁵⁷ *Id.*

⁵⁸ *Id.* at 430-31.

Media Law & Policy

2. National Aeronautics and Space Administration

In addition to adhering to the national Standard Practices, the National Aeronautics and Space Administration (“NASA”) has established the NASA Safety Standard.⁶⁰ This document overlaps considerably with the Standard Practices by providing for debris assessments covering normal operations, accidental explosions and collisions, and spacecraft disposal.⁶¹

3. National Oceanic and Atmospheric Administration

Under the Land Remote Sensing Policy Act of 1992, the National Oceanic and Atmospheric Administration (“NOAA”) requires commercial remote sensing satellite operators to dispose of satellites in “a manner approved by the U.S. government.”⁶² However, NOAA has not promulgated formal debris mitigation standards of its own.

4. Federal Communications Commission

Although the Federal Communications Commission (“FCC”) is primarily responsible for licensing commercial communications satellites, the agency also plays a significant role in the licensing of commercial remote-sensing satellites.⁶³ As part of the FCC licensing process, all commercial operators are required to provide a detailed plan for minimizing the potential for orbital debris.⁶⁴ The plan must describe debris mitigation measures relating to each of the four categories established in the Standard Practices: normal operations, explosions, collisions, and post-operations disposal.⁶⁵ These requirements were passed in 2004.⁶⁶

⁵⁹ *Id.* at 433.

⁶⁰ *Standard Practices*, *supra* note 44.

⁶¹ *Id.* at 33-34.

⁶² *Id.* at 35.

⁶³ *Id.*

⁶⁴ 47 C.F.R. § 25.114(d)(14) (2010).

⁶⁵ *Id.*

⁶⁶ *See* Mitigation of Orbital Debris, 69 Fed. Reg. 54581-01 (Sept. 9, 2004) (amending the FCC’s “informational collection requirements” to include orbital debris mitigation).

5. Department of Transportation

Historically, the Department of Transportation (“DOT”) has had the most limited role in the mitigation of space debris among U.S. agencies. DOT licenses space launch vehicles, which are typically discarded after reaching orbit.⁶⁷ Current DOT regulations require “the depletion of all onboard propellant sources in order to prevent accidental debris-generating explosions.”⁶⁸ However, DOT’s role may increase in the future as its subsidiary agency, the Federal Aviation Administration (“FAA”), takes a leading role in regulating the commercial spaceflight industry. The FAA has demonstrated intent to incorporate orbital debris mitigation into its policy framework, and has recently established the Center of Excellence for Commercial Space Transportation, in New Mexico, which will, *inter alia*, research orbital debris mitigation technology and policy.⁶⁹

C. 2010 National Space Policy

On June 28, 2010, the Obama administration released the National Space Policy of the United States of America (“Space Policy Paper”), outlining the goals of American space policy.⁷⁰ One of the highest priorities is debris mitigation, and the Administration announced its intent to pursue the issue in a number of ways.⁷¹ Although the Bush administration’s 2006 Space Policy Paper was the first executive policy paper that established overall debris mitigation goals of the U.S. government,⁷² the Obama administration’s policy offers a more specific plan.⁷³ In addition to recognizing the United States’ leading role in the management and mitigation of space debris, the Administration has dedicated itself to further

⁶⁷ Taylor, *supra* note 11, at 36.

⁶⁸ *Id.*

⁶⁹ Press Release, Fed. Aviation Admin., FAA Creates Center of Excellence for Commercial Space Transportation (Aug. 18, 2010), *available at* http://www.faa.gov/news/press_releases/news_story.cfm?newsId=11737.

⁷⁰ See generally President of the U.S., *National Space Policy of the United States of America* (June 28, 2010), *available at* www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf [hereinafter *National Space Policy*].

⁷¹ *Id.* at 3, 4, 6-8, 13-14.

⁷² Taylor, *supra* note 11, at 32-33.

⁷³ See generally *National Space Policy*, *supra* note 69.

developing space situational awareness (“SSA”) systems, strictly adhering to the Orbital Debris Mitigation Standard Practices, investing in the research and development of new technologies that could facilitate the removal of orbital debris, and cooperating with other space-faring nations to establish international and industrial standards of debris mitigation.⁷⁴

VI. INTERNATIONAL EFFORTS TOWARDS DEBRIS MITIGATION

Because of the inherently international nature of outer space, domestic policy on debris mitigation has been coordinated closely with international efforts. The primary international organizations involved in the mitigation of orbital debris are the Interagency Space Debris Coordination Committee (“IADC”) and the United Nations Committee on the Peaceful Uses of Outer Space (“COPUOS”).

A. *Space Debris Coordination Committee*

IADC was formed by eleven space-faring states in 1993 for the purpose of “exchanging information on orbital debris research, facilitating cooperation..., reviewing the progress of cooperative activities, and identifying debris mitigation options.”⁷⁵ Although IADC does not promulgate binding rules,⁷⁶ in 2002 the organization published the non-binding IADC Space Debris Mitigation Guidelines.⁷⁷ The IADC guidelines fall into four basic categories: (1) minimizing the release of debris during normal operations, (2) minimizing the risk of unexpected “break-ups” during operations, (3) preventing collisions while spacecraft are in orbit, and (4) effective disposal of spacecraft following operations.⁷⁸

B. *United Nations Committee on the Peaceful Uses of Outer Space*

The IADC’s publication of guidelines for orbital debris mitigation in 2002 prompted COPUOS’ Scientific and Technical Subcommittee to undertake a similar project one year later. In 2007, COPUOS approved its

⁷⁴ *Id.* at 7.

⁷⁵ Taylor, *supra* note 11, at 38-39.

⁷⁶ *Id.* at 39.

⁷⁷ Inter-Agency Debris Coordination Comm., *IADC Space Debris Mitigation Guidelines* (2002) [hereinafter IADC Guidelines].

⁷⁸ *Id.*

own guidelines based largely on the template provided by IADC. Unfortunately, the COUPOS document lacks the technical specificity of the IADC guidelines, and declares the United Nations guidelines to be non-binding under international law.⁷⁹

VII. OUTSTANDING GAPS IN CONTEMPORARY REGULATION OF ORBITAL DEBRIS

Surveying the field of debris mitigation more than thirty years after the problem was first identified,⁸⁰ two deficiencies are immediately apparent. The first is the lack of a binding international agreement establishing mitigation requirements or a definitive liability regime.⁸¹ The second – and potentially the most dangerous – is the reluctance of some space-faring states to extend domestic mitigation regulations to the private sector.⁸² This section will closely examine each of these problems before discussing a potential solution in Part VIII.

A. *The Lack of a Comprehensive International Treaty*

The absence of a binding international framework for space debris mitigation can be traced to the inability of space-faring states to form a consensus on an appropriate structure of a regime, for several reasons.⁸³ First, some parties believe that an international agreement requires a greater understanding of the technical issues surrounding space debris than is currently possible.⁸⁴ The second issue is the general difficulty of establishing a consensus in an area as strategic as outer space.

⁷⁹ *Id.* at 41.

⁸⁰ In 1978, Don Kessler and Burton G. Cour-Palais first described the possibility of what has been since termed “Kessler Syndrome.” They theorized that, as the number of satellites increases, orbital debris poses an increasing risk of future collisions. Eventually, any single collision could generate sufficient debris to cause another collision, and then another, creating a snowball effect with the potential to devastate and render useless entire swaths of the Earth’s atmosphere. Don Kessler & Burton G. Cour-Palais, *Collision Frequency of Artificial Satellites: The Creatino of a Debris Belt*, 83 J. GEOPHYSICAL RES. 2637 (1978), available at <http://webpages.charter.net/dkessler/files/Collision%20Frequency.pdf>.

⁸¹ See generally Outer Space Treaty, *supra* note 10; Liability Convention, *supra* note 17.

⁸² See Portelli, *supra* note 24, at 1039-41.

⁸³ Mirmina, *supra* note 2, at 652.

⁸⁴ *Id.* at 653.

The strategic significance of outer space cannot be overstated. Although Article III of the Outer Space Treaty calls for outer space to be used only in the interest of “maintaining international peace,”⁸⁵ increasing military reliance on satellite technology has led states to cautiously protect their sovereignty in the outer space environment.⁸⁶ Since 2007, both China and the United States have tested anti-satellite weapons. While the United States conducted its 2008 test at a sufficiently low altitude – 210 kilometers – to avoid creating debris,⁸⁷ China’s test in 2007 “created over 2,000 pieces of junk bigger than 10 cm, and an estimated 35,000 pieces more than 1 cm across.”⁸⁸ The Chinese experience illustrates the high costs of the militarization of space technology. These costs could further escalate as new countries seek to develop anti-satellite technology.⁸⁹ Ultimately, the necessity of a functioning outer space environment will almost certainly push states toward a reliable and cooperative orbital debris framework, but, in the short term, it has been difficult to construct any agreement that could curtail national sovereignty.

B. Inconsistent Standards in the Private Sector

In the absence of a binding international instrument, space-faring states have taken different approaches to implementing the debris mitigation procedures.⁹⁰ As discussed above, the greatest inconsistency is the degree to which mitigation standards are applied to private sector operators. This variation may be less relevant than it first appears, at least for the present. For example, the United States applies similar, relatively strict debris mitigation standards to both governmental and non-governmental entities.⁹¹ France, on the other hand, is an example of a state that has yet to apply its

⁸⁵ Outer Space Treaty, *supra* note 10, at art. III.

⁸⁶ See Li Juqian, *Legality and Legitimacy: China’s ASAT Test*, 5 CHINA SECURITY 43, 48 (2009), available at <http://www.chinasecurity.us/pdfs/LiJuqian.pdf>.

⁸⁷ Pusey, *supra* note 5, at 431-32.

⁸⁸ *Junk Science*, *supra* note 1.

⁸⁹ See Jeff Kueter, *China’s Space Ambitions – And Ours*, THE NEW ATLANTIS, Spring 2007, at 14, available at <http://www.thenewatlantis.com/docLib/TNA16-Kueter.pdf>.

⁹⁰ Compare Taylor, *supra* note 11, at 32-36 (discussing U.S. Debris Mitigation), with Portelli, *supra* note 24.

⁹¹ See Taylor, *supra* note 11, at 32-36.

debris mitigation standards to the commercial sector.⁹² This variation may be largely explained by the relative size of the outer space activity of the states' private sectors. As of 2010, the United States had licensed at least 184 commercial satellites, while France operated only two commercial satellites, both in conjunction with Swedish and Belgian entities.⁹³ Italy, which also was cited as having failed to apply its debris mitigation policies against private operators, has no commercial operators.⁹⁴

Another possible explanation for the United States' relatively strict debris mitigation regime is the number of advantages it may have had in implementing regulations. First, the United States' vibrant commercial market provides a greater wealth of expertise to draw upon when drafting and establishing mitigation standards. The United States' administrative rulemaking procedures provide concerned parties ample opportunities to participate actively in the process of crafting agency regulations.⁹⁵ In this sense, the intense concentration of commercial satellite operators in the United States may have proven to be a valuable resource in hastening the creation of an American commercial regulatory regime. The second U.S. advantage is derived from game theory. Because of the size of the U.S. commercial satellite industry, each American operator receives a relatively great benefit for its investments from domestic debris mitigation regulations. When the costs of adherence can be spread proportionally among the large community of U.S. operators, each operator shares in the overall benefit of cooperating to create a safer outer space environment. This potential payoff may have encouraged commercial operators to encourage the U.S. government to form commercial debris mitigation policies.

If the United States' vibrant commercial space industry was a contributing factor to the country's sophisticated orbital mitigation regime, how do emerging space powers effectively mitigate debris in a developing or not-yet-existent commercial sector? For the reasons already discussed *supra*, international treaty obligations are unlikely to provide the answer for the short or medium term. Guidelines produced by intergovernmental organizations, such as the United Nations and the IADC, may also be

⁹² Portelli, *supra* note 24, at 1038.

⁹³ UCS Satellite Database, *supra* note 36.

⁹⁴ *Id.*

⁹⁵ *See generally* 5 U.S.C.A. § 553(c) (2010).

suboptimal if they rely on states independently to regulate commercial industries that may be too small to be considered a high regulatory priority. States with small commercial sectors also might consciously choose not to regulate strictly, in order to generate a competitive advantage for their own domestic industries.

VIII. ANALYSIS AND POLICY

This Article proposes that a unified international body of private operators establish a new standard of debris mitigation guidelines for privately-owned space projects, to supplement the existing patchwork of international and national standards. These standards should be incorporated into a certification system, which could, in turn, form the basis for substantial market incentives to mitigate orbital debris. Additionally, such a system could serve as a backstop when private operators are unregulated by national governments and as a resource for private operators seeking to benefit from the expertise of the larger international community. This system would have the further benefit of directly involving commercial space operators in the establishment of orbital debris mitigation standards, at a time when the space industry is poised to transition into a more market-oriented model.⁹⁶

A. Organizing Private Operators

In the orbital debris literature, some scholars have called for the creation of a unifying International Space Agency, under the auspices of the United Nations.⁹⁷ In recent years, however, these proposals have been disregarded, partly because of the difficulty of achieving consensus at the international level.⁹⁸ Arguably, it would be easier to reach consensus in a voluntary organization of private operators, as opposed to an intergovernmental body, because the membership would be composed of more similar entities with similar interests. Governments representing diverse military, civil, and private interests have a unique interest in preserving national sovereignty and guarding potential areas of national security.⁹⁹ A more cooperative body, with a more limited mission, would

⁹⁶ See *National Space Policy*, *supra* note 69, at 4, 10.

⁹⁷ Tan, *supra* note 22, at 190.

⁹⁸ Mirmina, *supra* note 2, at 652-53.

have the flexibility necessary to adapt to developments in mitigation technologies and policy more quickly than a governmental body. The organization also would find it less difficult to reach agreement because of the voluntary nature of both membership in the organization and adherence to the mitigation standards promulgated by the organization.

B. Private Sector Guidelines

The first step is for commercial operators from around the world to pool expertise and develop technical standards for orbital debris mitigation. These new standards would likely draw on the existing guidelines discussed above, including those of the IADC and the U.S. government, but they also could be uniquely tailored to the specific interests of private operators. In addition to the United States, several countries have significant commercial satellite and other space operators.¹⁰⁰ Therefore, these proposed guidelines should strive to create a broad, international consensus. An inclusive approach would enhance the new standards' legitimacy and encourage commercial operators in newly emerging space-faring states to participate.

C. Certification

These new technical standards would be most effective if they were used as the basis for a system of certification. Certification, conditioned on satisfying the mitigation standards, could be granted either on a corporation-by-corporation basis, or at the level of individual projects. Certifying individual projects would be the most thorough, but also the most expensive option. However, the burden of individual project certification ultimately may not be so onerous, because private operators licensed in countries such as the United States may be able to rely on the same documentation used to satisfy existing domestic regulatory standards.¹⁰¹ As a less expensive option, corporate certification may be more attractive to a new organization; however, it would also provide a less rigorous standard.

A third option – a compromise between the extremes presented above – could resemble the aviation certification methodology of the FAA.¹⁰² To

⁹⁹ See Juqian, *supra* note 85, at 47-49.

¹⁰⁰ See UCS Satellite Database, *supra* note 36.

¹⁰¹ See 47 C.F.R. § 25.114(d)(14) (2010) (detailing the requirements by the FCC to describe mitigation strategies in applications for space station authorizations).

¹⁰² See 14 C.F.R. §§ 21.33, 21.35 (2010).

conserve resources, the FAA relies on a system combining manufacturer self-regulation and agency spot-checking. Although the FAA loosely monitors all manufacturers and maintains the authority to review any documents or test results, a manufacturer with a reliable commitment to adherence is supervised less closely than new entrants or manufacturers with a history of regulatory difficulties.¹⁰³ Any of these or other certification methodologies could be used, and each entails different costs and benefits to the organization and to the certification process more generally.

D. *Incentives*

Certification could be combined with incentives to private operators to strongly encourage them to adhere to new voluntary mitigation standards. Any number of incentive structures is possible, and the following list is not exhaustive.

1. National Government Incentives

National governments could incentivize participation in an independent certification program in a number of ways. First, national governments could establish a preference for certified bidders when awarding government contracts. Second, national governments could provide rebates for certified projects, or could pay domestic companies to incentivize or defray the costs of bringing a project into compliance with the requirements of certification.

The U.S. government explicitly reserved the right to consider non-cost factors in awarding government contracts,¹⁰⁴ and incorporating industry-administered certifications into government contracting is not novel – particularly in areas of environmental concern. Perhaps the highest profile example is Leadership in Energy and Environmental Design (“LEED”) certification, developed by the U.S. Green Building Council.¹⁰⁵ LEED certification is frequently incorporated into the bidding process for government construction contracts,¹⁰⁶ and in some instances an agency will

¹⁰³ *United States v. S.A. Empresa de Viacao Aerea Rio Grandense*, 467 U.S. 797, 819-20 (1984).

¹⁰⁴ 48 C.F.R. § 15.101-1 (2010).

¹⁰⁵ *What LEED Is*, U.S. GREEN BLDG. COUNCIL, <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988>, (last visited Oct. 21, 2011).

¹⁰⁶ *See, e.g.*, N.J. ADMIN. CODE § 19:4-6.6 (2009).

refund licensing or contracting fees when an applicant achieves certification.¹⁰⁷

2. Standardized International Regulatory Approval

Governments also can incentivize observance of private operator mitigation standards by streamlining regulatory approval for certified foreign applicants. Under this system, States A, B, and C would formally recognize certification as sufficient adherence to mitigation requirements. Then, a certified private operator can apply more efficiently for regulatory approval in other states. This system would foster regulatory uniformity and decrease transaction costs for both regulators and operators. Such a system would not require states to grant regulatory approval automatically to be effective. Even if states merely *reduced* regulatory hurdles for certified applicants, economies of scale ultimately could create incentives for international private operators to achieve certification before dealing with government regulators.

Professor Jennifer Manner has observed a similar transition in the telecommunications industry.¹⁰⁸ As telecommunications markets around the world have opened to competition, industry regulators have moved cautiously toward “regulatory policies that can cut across national borders and . . . be applied in most global markets.”¹⁰⁹ The trend toward a more standardized telecommunications regulatory policy has provided a number of benefits, including decreasing international operators’ cost of compliance and simplifying the process of competing internationally.

Standardizing global telecommunications regulation also has created space for international organizations to “step in as policy setters.”¹¹⁰ Within the telecommunications industry, there are a number of inter-governmental organizations (most notably the International Telecommunications Union) that facilitate the involvement of private operators in the formulation of policy. The space industry currently lacks a major organization of commercial stakeholders, but the proposed certification body potentially could fill this role.

¹⁰⁷ *Id.*

¹⁰⁸ See Jennifer Manner, GLOBAL TELECOMMUNICATIONS MARKET ACCESS, 125 (Artech House ed. 2002).

¹⁰⁹ *Id.*

¹¹⁰ *Id.*

3. Limited Liability

Another possible benefit of certification could be as a defense to liability in the event of an orbital debris collision. Currently, there is great debate on the future of liability in the event of orbital debris collisions. If the international community ultimately determines that a negligence standard should be implemented in litigation over damage caused by orbital debris,¹¹¹ certification could be used as evidence of reasonable care. In U.S. tort law, adherence to or disregard of industry standards is probative, but not dispositive evidence of a defendant's reasonable care.¹¹² If private operators believe that certification will protect them against future liability, they may be encouraged to participate. Similarly, if the Liability Convention continues to be interpreted to provide *governmental* liability for the orbital debris of national private operators,¹¹³ governments may encourage their nationals to achieve certification in order to reduce the possibility of negligence damages.

4. Incentives for Government Endorsement of Certification

Several additional benefits that would flow to national governments may incentivize them to endorse an international certification regime. By cooperating with a competent, independent certifying body, regulatory agencies could leverage the financial and technical expertise of private operators and reduce the amount of government resources required during the licensing process. A private certifying body could serve as a preliminary review, ultimately decreasing the burden on regulators. Furthermore, if an international certification system fully developed, governments may seek to assist their domestic operators in obtaining certification in order to make these operators more competitive in the international market.

As an example, a Notice of Inquiry (“NOI”) published by the FCC in April of 2010 suggests the agency is willing to incorporate privately operated certification programs into its overarching regulatory framework.¹¹⁴ The NOI proposes a certification program for cyber security, and suggests

¹¹¹ See Taylor, *supra* note 11, at 57.

¹¹² See, e.g., 79 N.Y. Jur 2d Negligence § 167 (2010).

¹¹³ See Liability Convention, *supra* note 17.

¹¹⁴ See generally *Cyber Security Certification Program*, Notice of Inquiry, 25 FCC Red. 4345 (Rel. Apr. 21, 2010).

the possibility of an organization composed of industry stakeholders in both establishing standards for certification and conducting network inspections.¹¹⁵ The FCC suggests that, although the body could have a limited role, an organization led by industry stakeholders may have greater access to the financial resources and “up-to-date knowledge” that is essential in such a highly technical area.¹¹⁶ The FCC’s concerns regarding its relative familiarity with the latest technologies in the area of cyber security vis-à-vis the private sector’s could easily describe the space industry. If the proposed cyber security certification program is successful, it could ultimately serve as a model for a future orbital debris certification program.

E. Long-Term Benefits

1. Corporate Responsibility and the Rise of Private Space Operators

Perhaps the most important justification for encouraging responsibility among private space operators is the likelihood – perhaps already a reality – that the role of government operators will give way to an era of private operator dominance in space activities.¹¹⁷ The Obama administration explicitly recognizes and encourages the trend toward a market-oriented space industry. The first goal of the National Space Policy is to “energize competitive domestic industr[y] to ... advance development of: satellite manufacturing; satellite-based services; space launch; terrestrial applications; and increased entrepreneurship.”¹¹⁸ The Space Policy Paper further states the new U.S. government policy is “purchas[ing] and us[ing] commercial space capabilities and services to the maximum practical extent.”¹¹⁹ As a leader among space-faring states, the United States’ transition toward a market-driven space industry may mark the beginning of an international trend. In this context, it is especially important to encourage private operators to participate in the formation of orbital debris mitigation standards.

¹¹⁵ *Id.* at 4352.

¹¹⁶ *Id.*

¹¹⁷ See *Starship Enterprise: The Next Generation*, THE ECONOMIST, Jan. 24, 2008, available at <http://www.economist.com/node/10566293>.

¹¹⁸ *National Space Policy*, *supra* note 69, at 4.

¹¹⁹ *Id.* at 10.

2. Reliance by Non- and Newly-Space-Faring States

Another important long-term benefit of a coordinated system for private operators is that it could serve as a source of either expertise or model regulations in the many states that do not currently regulate commercial operators. A certification system could be used to assist inexperienced state regulators when analyzing mitigation procedures in a proposed space project. Many states do not currently regulate private operators at all;¹²⁰ this group includes non-space-faring states, as well as some states that are engaged in outer space activities. As satellite and other space technologies become increasingly necessary to modern society, and as private operators enter new markets,¹²¹ it will be necessary for these “non-regulating” states to implement orbital debris mitigation policies.

Under the system described here, states could either rely entirely on the standards required for certification, or could merely consult the certification standards for assistance in crafting their own mitigation regulations. Either of these methods would reduce the costs associated with regulating orbital debris.

Finally, by creating standards tailored specifically to commercial operators, states might be more amenable to adhere to mitigation requirements. Narrowing the scope of the regulations may make it easier to involve states that have been historically reluctant to regulate because of sovereignty or national security concerns.¹²²

3. Groundwork for Binding Legal Obligations

Although this organization – at least initially – would be entirely voluntary, the criteria for certification ultimately could be converted into private legal obligations imposed on members of the organization.¹²³ The organization eventually might condition certification upon a contractual obligation to adhere to its mitigation standards. In the context of lingering uncertainty over the future liability of space-farers and their governments for

¹²⁰ See Portelli, *supra* note 24, at 1039-41; see also UCS Satellite Database, *supra* note 36.

¹²¹ See *National Space Policy*, *supra* note 69, at 10.

¹²² See generally Juqian, *supra* note 85; Kueter, *supra* note 88.

¹²³ See Mirmina, *supra* note 2, at 660 (discussing the creation of binding legal obligations in a state-sponsored code of conduct).

damage caused by orbital debris,¹²⁴ these private contractual obligations could ultimately provide a basis for liability or a mechanism for litigation. Private operators likely would agree to these obligations only if a threshold number of other operators assumed reciprocal obligations, or if there were adequate incentives in place to maintain the attractiveness of certification.

IX. CONCLUSIONS

The international community of space-faring states is slowly moving to address the issue of orbital debris. Thus far, efforts to mitigate this growing problem involve international treaties, non-binding international guidelines, and domestic regulations. Because of the sensitive nature of space operations, however, states have been reluctant to agree upon a unified, binding international legal framework. This piece proposes supplementing the existing tools of debris mitigation with a certification regime, to be designed and implemented by a voluntary organization of private space operators. This proposal has a number of merits. First, an organization of private operators with a limited mission could act more quickly and respond more flexibly than many governments to changes in the industry. Second, a credible international certification system would support a more streamlined and efficient process of regulatory approval for private operators seeking to serve foreign or domestic markets. Third, an international certifying body could provide expertise or model debris regulations for newly space-faring states and for existing space-faring states that are developing commercial markets for space services. Fourth, with a liability regime for governing damages caused by orbital debris, certification could help to establish industry standards for responsible and non-negligent behavior. Finally, and most important, it would place private operators at the forefront of efforts to mitigate orbital debris. As the United States – and possibly the world – moves towards a market-driven model of space services, the involvement of private operators in the formation of mitigation standards will be critical.

The results achieved by traditional international institutions have been slow and uneven. As the hazards of orbital debris increase, along with our reliance on outer space technologies, it will be necessary for all stakeholders to pursue mitigation aggressively. While states continue to negotiate international obligations, commercial operators best can serve the interests

¹²⁴ See generally Taylor, *supra* note 11; Pusey, *supra* note 5.

Media Law & Policy

of all stakeholders by organizing, leveraging resources and expertise, and creating aggressive standards for debris mitigation in the commercial sector.

MEDIA LAW & POLICY

Spring 2013 | Volume 20 | Number II

185 West Broadway
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