

# Journal of Space Law

Volume 40

Number 1-2

2015-2016



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- The Exploitation of Asteroids and The Non-Appropriation Principle:  
Reflections on the nature of property rights in light of the US Space  
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**Vol. 40, No. 1-2**

**Journal of Space Law**

Pages  
1  
to  
261

**2013**

**JOURNAL**

**OF**

**SPACE**

**LAW**

**VOLUME 40, NUMBER 1&2**

**2015-2016**

# JOURNAL OF SPACE LAW

UNIVERSITY OF MISSISSIPPI SCHOOL OF LAW  
A JOURNAL DEVOTED TO SPACE LAW AND THE LEGAL PROBLEMS  
ARISING OUT OF HUMAN ACTIVITIES IN OUTER SPACE.

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VOLUME 40

2015-2016

NUMBER 1&2

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JOURNAL OF SPACE LAW. The subscription rate for 2014 is \$100 U.S. for U.S. domestic/individual; \$120 U.S. for U.S. domestic/organization; \$105 U.S. for non-U.S./individual; \$125 U.S. for non-U.S./organization. Single issues may be ordered at \$70 per issue. For non-U.S. airmail, add \$20 U.S. Please see subscription page at the back of this Volume.

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ISSN: 0095-7577

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# CALL FOR PAPERS

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OUT OF HUMAN ACTIVITIES IN OUTER SPACE.

## Volume 41

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## ARTICLES

# THE EXPLOITATION OF ASTEROIDS AND THE NON-APPROPRIATION PRINCIPLE: REFLECTIONS ON THE NATURE OF PROPERTY RIGHTS IN LIGHT OF THE US SPACE RESOURCE ACT OF 2015

*Philip De Man\**

### I. THE SPACE RESOURCE ACT AND THE INTERNATIONAL OBLIGATIONS OF THE UNITED STATES

A number of recent initiatives revolving around the exploration and utilization of the Moon and asteroids, both public and private, have reintroduced space law doctrine to the pressing issue of natural resource appropriation.<sup>1</sup> In direct response to the budding development of an American space mining industry, the US

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\* Senior Researcher, Leuven Centre for Global Governance Studies, University of Leuven, Belgium; member of the official delegation of Belgium to the 55th Session of the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space, 4-15 April 2016, Vienna. The opinions expressed in this article are the personal views of the author.

<sup>1</sup> The most high-profile of these initiatives are Planetary Resources, [www.planetaryresources.com](http://www.planetaryresources.com) (last visited July 19, 2016), Deep Space industries, [deepspaceindustries.com](http://deepspaceindustries.com) (last visited July 19, 2016), Shackleton Energy, [www.shackletonenergy.com](http://www.shackletonenergy.com) (last visited July 19, 2016), and Kepler Energy and Space Engineering, [www.keselle.com](http://www.keselle.com) (last visited July 19, 2016). See also the “Asteroid Redirect Mission,” NASA, [http://www.nasa.gov/mission\\_pages/asteroids/initiative](http://www.nasa.gov/mission_pages/asteroids/initiative) (last visited July 19, 2016).

adopted, in November 2015, the Commercial Space Launch Competitiveness Act.<sup>2</sup> If primarily occupied with streamlining the US legal regime for commercial space launch activities, the act also includes, at the very end, a brief title on Space Resource Commercial Exploration and Utilization (Space Resource Act).

The historic significance of the Space Resource Act lies in the fact that it is the first legal instrument, at any level of governance, to explicitly grant property rights to private enterprises over resources extracted from asteroids and other celestial bodies. In particular, the act provides that

[a] United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States.<sup>3</sup>

Previous versions of the act included a proposal for resolving civil action for relief from harmful interference, in case a US legal entity engaging in asteroid mining would suffer from such interference caused by another entity subject to American jurisdiction. In that case, it was argued that the court should find in favour of the plaintiff if it finds that the activity is “reasonable for the exploration and utilization of asteroid resources”, the plaintiff was first in time to conduct this activity and “acted in accordance with all existing international obligations of the United States.”<sup>4</sup>

The condition of respect for the existing international obligations of the United States, retained in the aforementioned provision of the final version of the 2015 Act, complicates matters significantly in light of the current state of international space law and the ratification status of the Outer Space Treaty. Counting all major spacefaring actors among its signatories, the US, too, is held by

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<sup>2</sup> Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90 (Nov. 25, 2015).

<sup>3</sup> *Id.* at Title IV, §402, proposed §51303 ‘Asteroid resource and space resource rights.’

<sup>4</sup> Sub (c) and (d) of §51303 of the proposed bill for an ASTEROIDS Act. Space Resource Exploration and Utilization Act of 2015, H.R. 1508, 114th Cong. (2015) [hereinafter CSLCA].

the requirement in Article II of the Outer Space Treaty that “[o]uter space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.” Natural resources are neither explicitly included in, nor expressly excluded from the text of this provision; indeed, they are not even once mentioned in the set of United Nations (UN) space treaties binding upon the United States.<sup>5</sup> International discussions on the regulation of the utilization of natural resources will only be taken up, for the first time ever, at the next session of the Legal Subcommittee of the UN Committee on the Peaceful Uses of Outer Space (COPUOS) in 2017.<sup>6</sup> Hence, during the congressional hearings for the US Space Resource Act, it could rightly be noted that resource extraction represents “a very volatile and contentious issue at the international level.”<sup>7</sup>

In tandem with the above developments, the US Federal Aviation Administration (FAA) dealt with an issue closely related to the regulation of property rights over asteroid and other resources from space. In 2014, Bigelow Aerospace, the company responsible for launching inflatable habitats into space, asked the FAA to “recognize ownership by the company and other US firms of extracted resources” in space, as it is planning to land its modules on the Moon.<sup>8</sup> On 22 December 2014, the FAA responded favourably to the

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<sup>5</sup> Natural resources are included in the text of the 1979 Moon Agreement. Infamously, however, this treaty has not been signed or ratified by the US. Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, *opened for signature* Dec. 18 1979, 1363 U.N.T.S. 21 [hereinafter Moon Agreement].

<sup>6</sup> Proposed by Belgium and supported by a number of other states, including the Russian Federation and the United States, the agenda of the 56th session of the Legal Subcommittee will include a single issue/item on the “General exchange of views on potential legal models for activities in exploration, exploitation and utilization of space resources”. See the UNCOPUOS Leg. Subcomm., *Legal Subcommittee’s Draft Report of 13 April 2016*, UN Doc. A/AC.105/C.2/L.298/Add.4, §20 (Apr. 13, 2016).

<sup>7</sup> Remarks by Prof. Joanne Gabrynowicz quoted in Jeff Foust, *Hearing Raises Questions about Asteroid Mining Bill*, SPACE NEWS (Sept. 10, 2014) <http://space-news.com/41825hearing-raises-questions-about-asteroid-mining-bill/>. See also Michael Listner, *Asteroid Resource Rights Will Require White House Support*, SPACE NEWS (Sept. 22, 2014) <http://spacenews.com/41954letter-asteroid-resource-rights-will-require-white-house-support/>.

<sup>8</sup> Wayne White, *The Space Pioneer Act*, SPACE NEWS, (Nov. 1, 2014) <http://spacenews.com/42436the-space-pioneer-act/>.

company's request.<sup>9</sup> However, the administration stressed that "[w]e're not talking about property rights at this point . . . . What we're talking about is having the US government have a regulatory framework that provides some certainty so they will be free to proceed with their plans and raising of funds."<sup>10</sup> Rather than dealing with property rights, this framework primarily aims to give mining companies solid guarantees that they will not be harmfully interfered with by other companies licensed by the FAA during their extraction activities.

By focusing on the harmful interference angle and making reference to the international obligations of the United States, both the FAA and US Congress appear to acknowledge the legal uncertainty in terms of international law concerning property rights over natural resources extracted from celestial bodies. Nevertheless, the 2015 Space Resource Act is unambiguous in declaring the rights acquired by private enterprises engaging in such activities 'property rights.' To be sure, it explicitly adds the proviso that

It is the sense of Congress that by the enactment of this Act, the United States does not thereby assert sovereignty or sovereign or exclusive rights or jurisdiction over, or the ownership of, any celestial body.<sup>11</sup>

Whether this proviso is sufficient to meet the international obligations of the US is unclear, however, for we already noted that these obligations do not distinguish anywhere between the legal regime applicable to celestial bodies as a whole and their natural resources. We therefore consider it opportune to offer some thoughts on the contentious issue of space resource appropriation by deconstructing the notion of property rights in an international legal context. In so doing, we hope to arrive at an alternative approach for aligning the ambitions of the space mining industry with the apparently intransigent space law framework at the international level.

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<sup>9</sup> See Jeff Foust., *FAA Review a Small Step for Lunar Commercialization Efforts*, SPACE NEWS (Feb. 6, 2015) <http://spacenews.com/faa-review-a-small-step-for-lunar-commercialization-efforts/>.

<sup>10</sup> *Id.*

<sup>11</sup> CSLCA, *supra* note 4, §402 at 'Disclaimer of extraterritorial sovereignty.'

## II. PROPERTY THEORIES

Though the exploitation of resources is generally considered a lawful form of use of outer space,<sup>12</sup> the extraction and destructive use of minerals from asteroids and other celestial bodies is often deemed problematic from a legal point of view to the extent that it presupposes or necessarily entails the creation of property rights over the used resource or celestial body from which it hails.<sup>13</sup> For this particular activity, the freedom to use outer space enshrined in Article I, para. 2 of the Outer Space Treaty thus appears difficult to reconcile with the strict language of the non-appropriation principle in Article II.<sup>14</sup>

Compounding a clear analysis of this issue is the inherently novel nature of the national appropriation concept in international

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<sup>12</sup> See, for example, Ernst Fasan, *Basic Principles Regarding the Celestial Bodies*, 6 PROC. COLLOQUIUM L. OUTER SPACE s.p. (1963); E. Brooks, *Control and Use of Planetary Resources*, 11 PROC. COLLOQUIUM L. OUTER SPACE 344 (1968); O. Fernández-Brital, *Activities on Celestial Bodies, Including Exploitation of Natural Resources*, 12 PROC. COLLOQUIUM L. OUTER SPACE 196 (1969); A. Kiss, *Le régime juridique applicable aux matériaux provenant de la Lune et des autres corps célestes*, 16 ANN. FR. DR. INT'L 765 (1970); E.G. Vassilievskaya, *Notions of "Exploration" and "Use" of Natural Resources of Celestial Bodies*, 20 PROC. COLLOQUIUM L. OUTER SPACE 473, 475-476 (1977); A. BÜCKLING, DER WELTRAUMVERTRAG 41 (1980); S. HOBE, DIE RECHTLICHEN RAHMENBEDINGUNGEN DER WIRTSCHAFTLICHEN NUTZUNG DES WELTRAUMS 66 (1992); Stephan E. Doyle, *Using Extraterrestrial Resources under the Moon Agreement of 1979*, 26 J. SPACE L. 114 (1998); K.N. METCALF, ACTIVITIES IN SPACE: APPROPRIATION OR USE? 163, 221 (1999); and THOMAS GANGALE, THE DEVELOPMENT OF OUTER SPACE: SOVEREIGNTY AND PROPERTY RIGHTS IN INTERNATIONAL SPACE LAW 41-42 (2009). Some authors even consider use and exploitation to be synonymous, see FABIO TRONCHETTI, THE EXPLOITATION OF NATURAL RESOURCES OF THE MOON AND OTHER CELESTIAL BODIES: A PROPOSAL FOR A LEGAL REGIME 233 (2009).

<sup>13</sup> Fernández-Brital, *supra* note 12, at 197; Ernst Fasan, *Celestial Bodies and the Exploitative Use of Outer Space*, 12 ANN. AIR & SPACE L. 232 (1987); K.V. Cook, *The Discovery of Lunar Water: An Opportunity to Develop a Workable Moon Treaty*, 11 GEORGE. INT'L ENVTL. L. REV. 664 (1999); and R.J. LEE, LAW AND REGULATION OF COMMERCIAL MINING OF MINERALS IN OUTER SPACE 13-14 (2012). Kerrest agrees that "[a]uthorising the mining of consumable non-renewable goods is undisputedly a way of appropriation, therefore the [Outer Space Treaty] forbids it." A. Kerrest, *Exploitation of the Resources of the High Sea and Antarctica: Lessons for the Moon?*, 47 PROC. COLL. L. OUTER SPACE 534 (2004), cited in P.M. Sterns and L.I. Tennen, *Private Enterprise and the Resources of Outer Space*, 48 PROC. COLL. L. OUTER SPACE 246 (2005).

<sup>14</sup> Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

law.<sup>15</sup> The notion has sparked numerous discussions, often compounded by muddled accounts mixing private property with national sovereignty.<sup>16</sup> As an international legal concept, property is dealt with only in the context of very specific fields of law, such as intellectual rights<sup>17</sup> and cultural heritage,<sup>18</sup> or as a basic human right against expropriation.<sup>19</sup> Other than that, private international law largely underscores the irreconcilable differences between various conceptions of property rights as notions of purely national origin, whose interactions inevitably result in conflicts that need to be resolved through an overarching set of international rules of mediation.

There is no autonomous international definition of property or appropriation, let alone national appropriation that could be transposed to clarify the use of the term in the treaties on international space law. To understand property as a universal notion, then, one quickly drifts into the realm of legal philosophy, which, like any self-respecting branch of law or philosophy, is burdened with an overlapping and ever-evolving set of conflicting theoretical approaches to the same concept. If anything, the philosophy of property teaches us that the meaning of the notion is anything but universal and immutable, as it strongly depends on the legal system observed and the specific situation, social relation and resource considered.<sup>20</sup>

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<sup>15</sup> See *id.* at Art. II and Moon Agreement, *supra* note 5, Art. 11 (2).

<sup>16</sup> On the relationship between property rights and international law in general, see R. BARNES, PROPERTY RIGHTS AND NATURAL RESOURCES 10-16 (2009).

<sup>17</sup> See the Berne Convention for the Protection of Literary and Artistic Works, Sept. 9 1886, 1161 U.N.T.S. 3 and the instruments developed by the United International Bureau for the Protection of Intellectual Property and the World Intellectual Property Organization.

<sup>18</sup> See the Convention Concerning the Protection of the World Cultural and Natural Heritage, Nov. 16 1972, 1037 U.N.T.S. 151 and other treaties.

<sup>19</sup> See Art. 17 of Universal Declaration of Human Rights, G.A. Res. 217 A (III), Art. 17, U.N. DOC. A/RES/217 A (III) (Dec. 10, 1948 and Art. 1 First Additional Protocol to the European Convention on Human Rights and Fundamental Freedoms, Art. I, Mar. 20, 1952, E.T.S. No. 009.

<sup>20</sup> See in general C.B. Macpherson, *The Meaning of Property*, in PROPERTY: MAINSTREAM AND CRITICAL POSITIONS 1-14 (C.B. Macpherson, ed., 1978). Waldron notes that there are "as many ambiguities in the term 'ownership' as there are legal systems . . . leaving the concept of ownership without any essential content at all." J. WALDRON, THE RIGHT TO PRIVATE PROPERTY 29 (1988). See also J. Waldron, *What is Private Property?*, 5 OXFORD J. LEGAL STUD. 313-316 (1985).

However, even if property, as a concept, is inevitably contaminated by a plethora of socio-political and economic connotations that evolve over time, the very identification and discussion of property as a separate legal notion implies that it is imbued with one or more discernible features that distinguish it from other, comparable concepts.<sup>21</sup> Moreover, this article is one on international space law, not property law. We need not tackle all of the vexing problems that hinder a universal understanding of property rights in order to ascertain the place of the notion within the confines of the present contribution. If the specific meaning of the concept depends on the context, our discussion should be limited to property in the context of international space law.

Therefore, in order to settle whether the rights of states, companies or private individuals in space resources under the currently applicable regime can or should lawfully rise to the level of property rights, we must first isolate those characteristics of property that render it an identifiable legal concept. These features will then be transposed to the existing legal regime in outer space, to assess whether the property notion can be reconciled with the general tenets of said regime, as revealed by the corresponding provisions of free use and non-appropriation. By closely circumscribing the exact meaning of the national appropriation concept in international space law, we will be able to determine to what extent the exploitative use of tangible resources from celestial bodies really entails or requires the creation of property rights. If this approach is necessarily construed on a less than exhaustive account of property, we trust it will not want for accuracy.<sup>22</sup>

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<sup>21</sup> This point is also stressed in A.M. Honoré, *Ownership*, in OXFORD ESSAYS IN JURISPRUDENCE: A COLLABORATIVE WORK 108-109 (A.G. Guest, ed., 1961).

<sup>22</sup> For a more comprehensive discussion of the notion, the reader is referred, in addition to the writings covered in the following pages, to the excellent legal analyses of property in F.S. Cohen, *Dialogue on Private Property*, 9 RUTGERS L. REV. 357-87 (1954); Waldron, *What is Private Property?*, *supra* note 20; and J.E. PENNER, *THE IDEA OF PROPERTY IN LAW* (1997).

*B. Diverging Approaches*

## 1. Property as a Bundle of Rights

The apparent complexity and versatility of the property notion, as described above, has inspired many authors to approach it from a 'legal realist' perspective, characterizing the concept as a composite bundle of rights exercised by the holder with respect to a certain thing, object, commodity, or resource. According to this theory, the combined presence or absence of a number of rights, in varying degrees, determines the existence of ownership with respect to a certain tangible thing or intangible phenomenon, as a set of relations between the owner and non-owners, including prospective users of the thing owned.<sup>23</sup> The approach has been adopted by many scholars, but is most commonly traced back to Hohfeld and Honoré.<sup>24</sup> In direct opposition to the previously articulated intuition that property can only exist as a fixed concept with one or more uniquely determining characteristics, Hohfeld approached the notion, not in direct relation to the owned thing, but as "a complex aggregate of rights . . . , privileges, powers, and immunities" that determine the relationships between the owner and all others with respect to a certain thing.<sup>25</sup> Honoré further concretized this conception of property as a set of societal relations through a comprehensive list of so-called standard incidents of ownership, eleven in total, which "are not individually necessary, though they may be together

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<sup>23</sup> See the thorough discussion of this concept by Penner and the list of authors approaching property rights from such a perspective in J.E. Penner, *The "Bundle of Rights" Picture of Property*, 43 UCLA L. REV. 711, fn. 1 (1996). See also L. Katz, *Exclusion and Exclusivity in Property Law*, 58 U. TORONTO L.J. 275-316, fn. 2 (2008); J. CHRISTMAN, *THE MYTH OF PROPERTY: TOWARD AN EGALITARIAN THEORY OF OWNERSHIP* 19-20 (1994); Barnes, *supra* note 16, at 23; P. Delville, *Reflexions sur le principe de non appropriation de l'espace extra atmosphérique et des corps célestes*, 63 REV. FR. DR. AÉR. & SPATIAL 139 (2009). The conception is also adhered to in philosophical writings on property. See F. Snare, *The Concept of Property*, 9 AM. PHIL. Q. 200 (1972); L.C. BECKER, *PROPERTY RIGHTS - PHILOSOPHIC FOUNDATIONS* 18 (1977).

<sup>24</sup> W.N. Hohfeld, *Some Fundamental Legal Conceptions as Applied in Judicial Reasoning*, 23 YALE L.J. 16-59 (1913); W.N. Hohfeld, *Fundamental Legal Conceptions as Applied in Judicial Reasoning*, 26 YALE L.J. 710-770 (1917); Honoré, *supra* note 21. The pedigree of the approach is discussed in Becker, *supra* note 23, at 7-23; S.R. MUNZER, *A THEORY OF PROPERTY* 23 (1990); Penner, *supra* note 23, 724-738.

<sup>25</sup> W.N. HOHFELD, 1917, *supra* note 25, 746.

sufficient, conditions for the person of inherence to be designated 'owner' of a particular thing in a given system."<sup>26</sup>

The considerable impact of these authors' writings has culminated in the widespread endorsement of what is sometimes also referred to as the 'Blackstonian trilogy' of property rights, after the influential philosopher whose ideas have been claimed by competing schools in property philosophy, among which the legal realist or bundle of rights theorists.<sup>27</sup> The trilogy typically encompasses the rights of "possession, use and disposition,"<sup>28</sup> though it is often translated into a composite right that combines use, enjoy and transfer.<sup>29</sup> There is no single catalogue of property components that is supported by all legal realists, and the bundle is often adapted to the philosophical needs of the particular theory elaborated by the author at hand. As such, the umbrella of ownership has been expanded to cover such diverse rights as the right to possess, use, manage, waive, transfer, exclude, abandon, consume, and destroy, along with the duty not to use harmfully.<sup>30</sup> Similar bundles have been compiled over the years by some of the highest national courts in western jurisprudence. The US Supreme Court has many times insisted on the characterization of property rights as a bundle of rights to "possess, use, transport, sell, donate, exclude, or devise."<sup>31</sup> The same elements can be distilled from the case law of the European Court of Justice,<sup>32</sup> which recognizes property as an integral part of the general principles of Community and Union law, based

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<sup>26</sup> See Honoré, *supra* note 21, 112-113. The list comprises "the right to possess, the right to use, the right to manage, the right to the income of the thing, the right to the capital, the right to security, the rights or incidents of transmissibility and absence of term, the prohibition of harmful use, liability to execution, and the incident of residuarity." *Id.* at 113.

<sup>27</sup> See, however, also *infra*, §II.A.2.

<sup>28</sup> E.g. T.W. Merrill, *Property and the Right to Exclude*, 77 NEB. L. REV. 736 (1998).

<sup>29</sup> Snare, *supra* note 23, 202-204; Becker, *supra* note 23, p. 18; L.S. Underkuffler, *The Idea of Property: Its Meaning and Power* 14, 25 (2003); K.N. Murray, *Of Gardens and Streets: A Differentiated Model of Property in International and National Space Law*, 32 J. SPACE L. 374 (2006); J. PURDY, *THE MEANING OF PROPERTY* 16 (2010). See also Barnes, *supra* note 16, at 22-24.

<sup>30</sup> Munzer, *supra* note 24, at 22 (referring to the landmark analysis of the concept in Honoré, *supra* note 21).

<sup>31</sup> See the case law cited in Underkuffler, *supra* note 29, at 19.

<sup>32</sup> S. PAVAGEAU, *LE DROIT DE PROPRIÉTÉ DANS LES JURISPRUDENCES SUPRÊMES FRANÇAISES, EUROPÉENNES ET INTERNATIONALES* 83-129 (2006).

on the constitutional traditions of the Member States of the European union and Article 1 of the First Protocol to the European Convention on Human Rights.<sup>33</sup>

Many authors writing on international space law single out the bundle of rights theory as the defining theory on property, painting it as the closest to a consensus that can realistically be expected to emerge from polarizing discussions on an elusive, shape-shifting concept.<sup>34</sup> According to Fasan, appropriation refers to property, the establishment of which gives the right “(a) to make use of the owned thing according to one’s own and alone will, including the right of destroying, (b) to exclude every other legal subject, (c) to maintain or to hand over or even to abandon every right regarding the thing in question including property itself.”<sup>35</sup> Baca lists the power to exclude, use and transfer as constitutive elements of property.<sup>36</sup> Pop confirms that property is a bundle of rights that encompasses “the right to use, to enjoy the fruits and to abuse one’s own good insofar as law allows this.”<sup>37</sup> Delville lists as one of the main attributes of property rights that the owner has all prerogatives over the thing, including the right to “l’usus, le fructus et l’abusus,”<sup>38</sup> referencing the famous formulation of the French *Code Civil*.<sup>39</sup> Finally, Lachs notes that, as the legal expression of a basic form of appropriation, property confers “the right to use or dispose of an object and exclude all others from doing so.”<sup>40</sup>

The success of the bundle of rights theory outside the field of legal philosophy can be explained by its malleable nature and easy

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<sup>33</sup> First Protocol to the ECHR, *supra* note 19. See Case 44/79, Hauer v. Rhineland, Case 44/79, 1979 E.C.R. 3727.

<sup>34</sup> Apart from the authors cited in the following footnotes, see also A.A. Cocca, *Property Rights on the Moon and Celestial Bodies*, 39 PROC. COLL. L. OUTER SPACE 17 (1996) and D. COLLINS, *Efficient Allocation of Real Property Rights on the Planet Mars*, 14 B.U.J. SCI. & TECH. L. 206 (2008).

<sup>35</sup> Ernst Fasan, *Law and Peace for the Celestial Bodies*, 5 PROC. COLL. L. OUTER SPACE 9 (1962). For an overview of interpretations of the appropriation notion as conveyed to the author in private correspondence by several authoritative space law scholars, see Fasan, *supra* note 13, at 231-233.

<sup>36</sup> K.A. Baca, *Property Rights in Outer Space*, 58 J. AIR L. & COM. 1049-51 (1993).

<sup>37</sup> VIRGILU POP, WHO OWNS THE MOON? EXTRATERRESTRIAL ASPECTS OF LAND AND MINERAL RESOURCES OWNERSHIP 62 (2009).

<sup>38</sup> Delville, *supra* note 23, at 138.

<sup>39</sup> See Pavageau, *supra* note 32, at 83.

<sup>40</sup> M. LACHS, THE LAW OF OUTER SPACE: AN EXPERIENCE IN CONTEMPORARY LAW-MAKING 41 (1972).

adaptability to a host of widely diverging philosophical, economic, and societal undercurrents. For these very same reasons, however, the theory is increasingly being questioned as a valid theory on property *qua* theory as such. If the relativistic approach to property supported by the so-called legal realists accurately reflects the factual divergence of interpersonal relations encompassed by the notion, its conception of property as an empty vessel whose contents cannot be accurately described *in abstracto* fails to satisfy the basic requirements of a workable theory. In this regard, we may refer to the writings of Thomas Grey, for whom the evolution of property from an easily identifiable concept relating to ownership over land and other material things to a fragmented bundle of rights covering innumerable specialized, and at times conflicting, legal, societal, and economic relations, has resulted in nothing less than the disintegration of property. The concept thus “ceases to be an important category in legal and political theory.”<sup>41</sup> A similar radicalization of the relativistic tenets inherent in the bundle of rights theory can be seen in the writings of Kevin Gray, who contends that “the ultimate fact about property is that it does not really exist: it is mere illusion. It is a vacant concept - . . . rather like thin air.”<sup>42</sup>

Though it is nowhere challenged that property is an elusive concept with many different facets, overly broad denunciations of property as an inapproachable notion without proper legal content should be dismissed forthright, for they rely on a level of relativity that can be invoked to render any type of discussion impossible *ab initio*. As such, Merrill correctly derides the bundle of rights approach for incorrectly interpreting property as a “purely conventional concept with no fixed meaning.”<sup>43</sup> Grey in particular is heavily criticized by Smith as being myopic, inflexible, unworkable, and ultimately failing to provide a theory of property at all.<sup>44</sup> Rather than transcending ostensible aporias in the application of property through the formulation of an overarching theory, the bundle of

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<sup>41</sup> T.C. Grey, *The Disintegration of Property* in NOMOS XXII: PROPERTY 81 (J.R. Pennock & J.W. Chapman, eds., 1980). See also H.E. Smith, *Property as the Law of Things*, 125 HARV. L. REV. 1697 (2012).

<sup>42</sup> K. GRAY, *Property in Thin Air*, 50 CAMBRIDGE L.J. 252 (1991). The author goes on to label the notion “rhetorical nonsense” and “an emotive phrase in search of a meaning.” *Id.* at 305. Compare Waldron, THE RIGHT TO PRIVATE PROPERTY, *supra* note 20.

<sup>43</sup> Merrill, *supra* note 28, at 737.

<sup>44</sup> Smith, *supra* note 42, at 1692, 1694-1700.

rights approach descends into largely descriptive enumerations, masquerading its conceptual shortcomings as ‘realism.’ While the bundle of rights theory may be more exhaustive in describing the social relations that flow from property, its descriptive nature ultimately adds little to our understanding of the concept as a legal notion. Worse still, its descriptive approach effectively clouds the conceptual characteristics that distinguish property from other rights.

## 2. Property as the Right to Exclude

In traditional dialectic fashion, the critique on the bundle of rights theory has given rise to a strand at the opposite side of the philosophical spectrum, one populated with authors equating property, not with an ever-changing amalgamate of rights, duties, privileges and other forms of social relationships, but with a single core formed by the right to exclude others from the thing owned.<sup>45</sup> Ironically, this strand, too, is often typified as a modernization of the ancient philosophy of Blackstone, since the author once famously characterized property as “that sole and despotic dominion which one man claims and exercises over the external things of the world, in total exclusion of the right of any other individual in the universe.”<sup>46</sup> The aforementioned trilogy of property rights, also attributed to Blackstone, already reveals that the philosopher adhered to a more nuanced view of property than is implied by the isolated quote on despotic dominion. Nevertheless, it is frequently cited by property lawyers as a rhetorical statement of substantial pedigree, in order to counter the overly amorphous ‘realistic’ conception of property by the bundle of rights theorists, as it earmarks the right to exclude as the single characteristic that distinguishes property from other, similar institutions in law, and stands out as the one feature that binds all social interactions described by the legal realists.

The arguments put forth by the adherents of the right to exclude against the bundle of rights theorists are manifold and need

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<sup>45</sup> For a highly insightful attempt to marry both conceptions of property, see Smith, *Property and Property Rules*, 79 N.Y.U.L. REV. 1791-1793 (2004).

<sup>46</sup> W. BLACKSTONE, COMMENTARIES ON THE LAWS OF ENGLAND: A FACSIMILE OF THE FIRST EDITION OF 1765-1769 (1979).

not be repeated here in full. Rather, they are accurately summarized by what Merrill has termed the ‘logical primacy’ argument.<sup>47</sup> In the words of the author, the logical primacy argument elevates the right to exclude above all other sticks in the property bundle, for,

if one starts with the right to exclude, it is possible to derive most of the other attributes commonly associated with property through the addition of relatively minor clarifications about the domain of the exclusion right. On the other hand, if one starts with any other attribute of property, one cannot derive the right to exclude by extending the domain of that other attribute; rather, one must add the right to exclude as an additional premise.<sup>48</sup>

From this perspective, it becomes clear that the owner’s rights to usufruct, use and transfer, as well as any other characteristic of property rights that may be included in the composite bundle, in essence rely on the right to exclude all others from doing so with respect to the thing owned, and the obligation of all others to withhold from such behaviour.<sup>49</sup>

The exact implications of the right to exclude have been the source of much misunderstanding. To illustrate its content, we may turn to Hohfeld’s famous catalogue of rights as an eight-part scheme of opposites and correlatives.<sup>50</sup> The scheme strongly relies

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<sup>47</sup> Other arguments raised by the author refer to the ubiquity of the right to exclude and the historical primacy of this right. The latter is based on the observation that, in primitive societies, the right to exclude is always the first aspect of property to evolve over time. Merrill, *supra* note 28, at 745-747. It is interesting to note, in this respect, that international space law may be characterized as a legal environment in the early stages of development.

<sup>48</sup> *Id.* at 740. The author then proceeds to analyse the rights to use, transfigure, transfer during life and devise upon death from the angle of the right to exclude. *Id.* at 740-745.

<sup>49</sup> Penner, *supra* note 23, at 754-767. Smith makes a similar argument, noting that the law specifies “an open-ended set of uses implicitly by giving the owner the right to exclude others from the asset.” Smith, *supra* note 46, at 1759 (emphasis omitted). Of all sticks in the property bundle, perhaps the most far-reaching is the right to transfer the owned resource. Difficult though it may initially appear to understand from the vantage point of the right to exclude, the argument is easily made if we accept that the right to exclude also comprises the owner’s right to include others, while excluding himself. Penner, *supra* note 22, at 80-97 and Merrill, *supra* note 28, at 743.

<sup>50</sup> Hohfeld, 1913, *supra* note 24, at 30-32. The theory is further developed in Hohfeld, 1917, *supra* note 24.

on a correlation between rights and duties, the latter of which is defined as the legal opposite of a privilege. The nature of the relation between rights and duties is such that the content of one's right is mirrored in the correlative duty that is thereby imposed on all others. A privilege should be distinguished from a right on the basis that it allows one to do something quite independently from anything that is expected from others.<sup>51</sup> From this categorization, it follows that, if one accepts that the right to exclude all others constitutes the core of property, the correlative duty thereby imposed on all others is one not to interfere with the use of the thing owned. Proponents of the right to exclude theory therefore often define property in terms of the negative duty of non-owners to keep from interference. Balganesch argues that, "[w]hen individuals view themselves as being placed under a duty (or obligation) to stay away from a resource, its owner is said to be vested with the claim-right to exclude."<sup>52</sup> Likewise, Merrill notes that "the core of the property right is the right to exclude others from interfering with or using the right in specified ways."<sup>53</sup> Coval bluntly equates property with a duty of non-interference.<sup>54</sup>

Either on its own or through the mirror image of the duty not to interfere, the right to exclude is commonly recognized as the most

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<sup>51</sup> *Id.* at 31-32. See also S. BALGANESH, *Demystifying the Right to Exclude: of Property, Inviolability, and Automatic Injunctions*, 31 HARV. J.L. & PUB. POL'Y 603 (2008).

<sup>52</sup> Balganesch, *supra* note 52, at 612. The author adds that "[t]he right to exclude becomes a perfectly logical idea if understood entirely in its primary or correlative right conception - through the lens of the duty it imposes on others. The duty in turn derives its normative content from the moral notion of inviolability embodied in the institution of ownership." *Id.* at 19.

<sup>53</sup> Merrill, *supra* note 28, at 749. The author is talking about intellectual property rights, though the sentiment applies to property in general. Detractors of the right-to-exclude approach also conceive of the right in terms of non-interference on the part of non-owners. See, for example A. Dorfman, PRIVATE OWNERSHIP, 16 LEGAL THEORY 5-6 (2010) ("[t]hus the notion that ownership is essentially the exercise of a right to the exclusive use of an object implies that nonowners incur a duty to keep off objects owned by others and thus indirectly to sustain use by owners"). However, the author then proceeds to argue, incorrectly, that "actual possession, rather than ownership, is the ground of the common-law duty of non-interference" *Id.* at 8. This approach to property is the exact opposite of the relationship between possession, use and exclusion that will be developed in the following sections of this article.

<sup>54</sup> "Property rights, or rights of non-interference, may be held in anything which functions as means in an action." S. Coval, J.C. Smith, and S. Coval, *The Foundations of Property and Property Law*, 45 CAMBRIDGE L.J. 461 (1986).

important distinguishing feature of property.<sup>55</sup> As such, Penner's influential approach to property is based entirely on an analysis that takes the perspective of exclusion. The author views property as a "right to exclude others from things which is grounded by the interest we have in the use of things."<sup>56</sup> Another writer sums up a detailed Hohfeldian analysis of property by noting that "[t]he right to exclude, then, remains the defining ideal of property."<sup>57</sup> Even Gray, who equated property with thin air, concedes that the core of the right, if it can be identified, is one of exclusion, by recognizing that "the criterion of 'excludability' gets us much closer to the core of 'property' than does the conventional legal emphasis on the assignability or enforceability of benefits."<sup>58</sup> And though the case law of the US Supreme Court appears to lean toward the bundle of rights theory, its judges have many times insisted on the importance of the right to exclude as one of the most essential sticks in the whole bundle.<sup>59</sup> Noting that, in fact, the Court has never singled out any other aspect of property as being of equal import, Merrill argues that

the right to exclude others is more than just 'one of the most essential constituents of property' - it is the *sine qua non*. Give someone the right to exclude others from a valued resource, *i.e.*, a resource that is scarce relative to the human demand for it, and you give them property. Deny someone the exclusion right and they do not have property.<sup>60</sup>

The author therefore concludes that "property means the right to exclude others from valued resources, no more and no less."<sup>61</sup>

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<sup>55</sup> M.R. Cohen, *Property and Sovereignty*, 13 CORNELL L.Q. 12 (1927) ("the essence of private property is always the right to exclude others"). See also Munzer, *supra* note 24, 22; Gray, *supra* note 42, 252; Penner, *supra* note 22, Chap. 4; W.N. White, *Real Property Rights in Outer Space*, 40 PROC. COLL. L. OUTER SPACE 380 (1997); Barnes, *supra* note 16, 15, 24-29.

<sup>56</sup> Penner, *supra* note 22, 71. On this approach, see further *infra*, II.B.

<sup>57</sup> Balganes, *supra* note 52, 661.

<sup>58</sup> Gray, *supra* note 442, 294. To be sure, the author is mainly talking about the factual possibility of exclusion. Nevertheless, the link between excludability and exclusion as the core of property as a legal concept is clear.

<sup>59</sup> See the analysis of US case law in Merrill, *supra* note 29, 735 and Balganes, *supra* note 51, 596.

<sup>60</sup> Merrill, *supra* note 28, 730.

<sup>61</sup> *Id.* at 754. The paramount importance of the right to exclude to characterize property also surfaces in Purdy, *supra* note 29, 16.

### 3. Property as Authority

The exclusive use theory of property is appealing for its clarity and robust implications, especially when compared to the non-committal strand of legal realism. At the same time, the theory's apparent rigidity has opened it up to scrutiny as well. Among the detractors are those who hastily point out that the right to exclude others, like all other sticks in the bundle of rights of property, is not impervious to restrictions either.<sup>62</sup> The exclusivist approach is assailed for elevating the right to exclude above all others, while failing to account for the fact that an owner's exclusive use of a resource is itself highly relative.<sup>63</sup> The main sentiment behind the argument appears to be that the comparable relativity of the right to exclude and the other sticks in the property bundle somehow deprives the former of its distinguishing characteristics. To illustrate the point, reference is often made to rules on fair housing and fair use of copyrighted works that significantly curb the right of house owners and authors to exclude others from their property.<sup>64</sup> The right to exclude would therefore not deserve the absolutist position allegedly attributed to it by those that equate property with exclusive use.

While grounded in factually correct observations, the arguments of the detractors unfairly misinterpret the position attributed to the right to exclude in an exclusivist conception of property. Nowhere do proponents of the exclusive use theory contend that the right to exclude others is absolute; they merely note that all rights commonly attributed to property can be reduced to the right to exclude others, thereby singling out the distinguishing feature that guides the application of property to a multitude of situations. It is not because the reach of an owner's exclusionary power is curbed in order to blunt its societal impact that exclusivity ceases to be the defining element of property. In other words, "the thesis . . . is not that property requires a certain quantum of exclusion rights. It is simply that to the extent one has the right to exclude, then one has property; conversely, to the extent one does not have

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<sup>62</sup> H. DAGAN, PROPERTY - VALUES AND INSTITUTIONS 37 (2011).

<sup>63</sup> Dorfman, *supra* note 53, 7.

<sup>64</sup> Dagan, *supra* note 62, 50-54.

exclusion rights, one does not have property.”<sup>65</sup> The sentiment is reflected by Cohen, who notes that property “must at least involve a right to exclude others from doing something.”<sup>66</sup>

If anything, the exceptional nature of the measures adopted to soften the exclusive impact of property, such as those on fair use and fair housing, confirm the right to exclude as the defining element of property.<sup>67</sup> For it is clear that these and other supplemental measures exist only in order to soften the exclusionary core of property rights, without which there would be no need for counteracting inclusive measures in the first place. The discussion is aptly summarized by Merrill and Smith, who note that,

starting with the Legal Realists, the dominant assumption has been that the need to refine the exclusionary regime calls everything into question. A better view would be that efforts to supplement exclusion with various devices governing proper use respond to moral considerations that supplement those backing exclusion, but that exclusion retains its presumptive moral and legal force.<sup>68</sup>

It is self-evident that a society can only exist on the condition that all rights enjoyed by its individual members, whether property or other, be exercised with a modicum of respect for the position of others, lest society cease to exist and the rules governing social interactions be rendered empty and utterly meaningless. Arguing

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<sup>65</sup> Merrill, *supra* note 28, 753. The author clarifies that “[m]y claim is simply that in demarcating the line between ‘property’ and ‘nonproperty’ - or ‘unowned things’ - the right to exclude others is a necessary and sufficient condition of identifying the existence of property.” *Id.* at 731. Likewise, Balganesch explains that his objective is not to argue “that the right to exclude is all that there is in property. Although the idea of property most certainly consists of more than just exclusion, to be meaningful it must contain, at a minimum, some element of exclusion.” Balganesch, *supra* note 51, 600. Also compare Gray, *supra* note 42, 295 (“[t]he differentiation of excludable and non-excludable resources points up the irreducible elements which lie at the core of the ‘property’ notion”).

<sup>66</sup> Cohen, *supra* note 22, 371. Dagan concedes to this point but discards it as a trivial truism that does not explain the true nature of property. Dagan, *supra* note 62, 37.

<sup>67</sup> Honoré notes that the existence of limitations to the right to use property at one’s own discretion does not detract from the cardinal importance of this right, “since the standard limitations are, in general, rather precisely defined, while the permissible types of use constitute an open list.” Honoré, *supra* note 21, 116. See further Smith, *supra* note 45, 1759-1760.

<sup>68</sup> T.W. Merrill and H.E. Smith, *The Morality of Property*, 48 WM. & MARY L. REV. 1891 (2007).

that the very restrictions needed to allow these rights to operate effectively in a societal context would deprive them of their content, is nothing short of nihilistic.

If the focus on exclusive use thus remains, in our view, sound from a legal perspective, the morally questionable nature of an approach that ostensibly reduces a pre-eminently social institution to yet another exponent of antisocial individualism with pernicious implications for wealth distribution, continues to raise doubts.<sup>69</sup> However, it is axiomatic that property does not equal wealth.<sup>70</sup> Socially inspired corrections to overly broad claims of exclusive use, the very existence of which prompted the argument that the relativity of the right to exclude somehow invalidates the exclusivist account of property, operate to ensure that the most objectionable moral consequences of exclusionary property rights are remedied.

Moreover, those decrying the antisocial implications of an approach that couches property in terms of the right to exclude all others, appear to confound the discussion on the exclusive content of the right with the exercise thereof. As such, they ignore the possibility of multiple holders of property, or, even worse, wrongly argue that such multiplicity of claimants would invalidate the exclusive nature of property itself. This argument unfairly trades on an ambiguity inherent in 'private' property as referring to the concept as a notion of private or civil law, on the one hand, and property that is enjoyed by one individual, on the other.<sup>71</sup> In the present discussion, as in the general discourse on property rights, 'private property' of course refers to the former.<sup>72</sup> The fact that more than one person has the authority to decide on the use of the thing owned

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<sup>69</sup> Dagan, for one, concedes that his opposition to the exclusivist theory is partly due to a fear that "[e]ntrenching an understanding of property as an exclusive right might misrepresent owners' social responsibility and nonowners' right to entry as suspicious intrusions to property, rather than necessary entailments of property." Dagan, *supra* note 62, 44.

<sup>70</sup> MERRILL, *supra* note 28, 754. On the disconnect between property and wealth, or poverty, see Becker, *supra* note 23, 88-94.

<sup>71</sup> This is evident in the case of Dagan, who contends that marital property invalidates the exclusive view of property. DAGAN, *supra* note 62, 42.

<sup>72</sup> Compare WALDRON, *What is Private Property?*, *supra* note 20, 327 ("[o]wnership, then, . . . is a term peculiar to systems of private property").

does not change the nature of property as being grounded in exclusivity; it merely renders divisible the exercise of the right to exclude.<sup>73</sup>

Even if those who criticize the exclusivist viewpoint appear to mistake, either wilfully or out of neglect, theoretical simplicity for simple-mindedness, they offer an alternative perspective that merits closer inspection, if only to avoid the common misconception that the right to exclude necessarily implies absolute and automatic exclusion of all non-owners. In an apparent refutation of both legal realism and exclusivism, Dorfman argues that private property should be understood as

a three-place relationship between owner, nonowners, and an object that can be described in the following manner. Being an owner involves a special normative power—that is, the power to change (in some nontrivial measure) the rights and duties that nonowners have toward the owner with respect to an object. More precisely, private ownership comes into being when society vests practical authority in an individual (the owner) to fix in some measure the normative standing of others in relation to an object.<sup>74</sup>

Likewise, Katz notes that “[w]hat it means for ownership to be exclusive is just that owners are in a special position to set the agenda for a resource. Ownership’s exclusivity is simply an aspect of its nature as a position of agenda-setting authority, rather than, in itself, the essence of ownership.”<sup>75</sup> Both apparent corrections to the exclusivist perspective go back to Waldron, who noted that “in the case of each object, the individual person whose name is attached to that object is to determine how the object shall be used and by whom. His decision is to be upheld by the society as final.”<sup>76</sup>

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<sup>73</sup> The detractors of the exclusivist theory apparently suppose „that any author who defines property as an exclusionary right is thereby denying the logical possibility of common property.” J.W. HARRIS, *PROPERTY AND JUSTICE* 156 (1996). Or, in the words of Balganesch, “[t]he idea of exclusion, in one form or the other, tends to inform almost any understanding of property, whether private, public, or community. The only variation tends to be the person or group in whom it is vested.” Balganesch, *supra* note 51, 596.

<sup>74</sup> Dorfman, *supra* note 53, 17.

<sup>75</sup> Katz, *supra* note 23, 277-278, 290. *See also* Smith, *supra* note 45, 1754 (“the right to exclude from a thing . . . is the result of second-order delegation to the owner to choose among any uses, known or unknown, of the thing”).

<sup>76</sup> Waldron, *What is Private Property?*, *supra* note 20, 327.

With respect to ownership of a resource in particular, the authority of the owner is clarified as “the option of using the resource in such a way as to exclude others from it”.<sup>77</sup> If such an option does not exist, there is no property, for there can be no exclusion that follows from a discretionary decision of the owner. To be sure, the authority to exclude may temporarily be devolved to others without ownership being transferred, as is the case for tenants and lessees. However, even in those instances, the exclusionary power of the latter would still find its origin in the agenda set by the owner for the use of the thing owned.

The account that emerges from the above ‘critique’ on the exclusivist take on property is one that conceives of property, not so much as an institution automatically implying exclusion of all non-owners, but as an authority to exclusively determine the use of the thing owned, which may or may not result in the actual exclusion of non-owners. The authority perspective is helpful for it focuses our attention on the ‘right’ component of property and its innate link with the utilitarian goal of property rights, whose exclusive impact is, after all, justified with a view of using the owned resource.<sup>78</sup> Both aspects are usually ignored in the entire property debate.<sup>79</sup> Through its apparent criticism of the exclusionary viewpoint, the authority theory completes the property debate, by moving it from the exclusive *impact* of property rights for non-owners to the discretionary exercise of the owner’s right to determine the use of his resource as the *source* of such exclusion. By advertising itself as a correction to the right to exclude theory, however, authoritarians unfairly misrepresent the former account as one that is built on exclusion rather than the right to exclude as justified by the actual use of the object; it wilfully confuses the exclusive means of property with the construct’s goal of actual and undisturbed use.

The relevance of the distinction can be illustrated with reference to the writings of Katz.<sup>80</sup> Though the author is by no means the only one to misrepresent the assumptions of the exclusivist

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<sup>77</sup> Balganes, *supra* note 51, 613.

<sup>78</sup> For an excellent overview of the various social, philosophic, and legal justifications of (private) property, see Becker, *supra* note 23.

<sup>79</sup> Balganes, *supra* note 51, 597.

<sup>80</sup> Katz, *supra* note 23.

property theory to facilitate her own approach by contrast, the author's arguments are singled out for the welcome opportunity they offer to further clarify the exact contours of the right to exclude in property. The author argues, first, that exclusivists trade on an ambiguity in the meaning of the word 'exclusive' by "conflating the concept of an exclusive right with that of the right to exclude."<sup>81</sup> It should be clear, however, that, if an error has crept into the discussion, it is on the part of the authoritarians. No proponent of property as exclusion has ever argued that the holder of the right to exclude must actually and continually exercise it so as to be considered the rightful owner. Though thrust into focus by the authoritarians, the normative element of ownership is already present in the *right to exclude* component of the exclusive use theory. As such, Penner, one of the most influential proponents of property *qua* right to exclude, has commonly characterized the right to exclude as 'the right to exclusively determine how particular things will be used.'<sup>82</sup>

A second problem arises with Katz's typification of the exclusivist account as contending that "the ability of the owner to use and dispose of her thing is simply the effect of her right to exclude others generally. It does not, on this view, represent any additional power or require any separate justification."<sup>83</sup> This is a wilfully myopic take on exclusivism as property, and one that unjustly represents the theory as propagating exclusion as the ultimate goal and justification of property, rather than a means to the end of actual use by the owner. Again, it should be pointed out that proponents of the right to exclude theory, too, recognize that the exclusive powers of the owner are justified by the interest in the use of the thing owned, which is simply facilitated by the exclusivity of said powers.<sup>84</sup> Indeed, even those authors that criticize the exclusivist strand in property writings acknowledge the intrinsic link between the right to exclude and the right to use as inherent in this approach.<sup>85</sup>

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<sup>81</sup> *Id.* at 277.

<sup>82</sup> *See, for example*, Penner, *supra* note 22, 71, 79.

<sup>83</sup> Katz, *supra* note 23, 283.

<sup>84</sup> Smith, *supra* note 41, 1693.

<sup>85</sup> Dorfman, *supra* note 53, 5-6 ("the right to use a thing requires the right to exclude others from the thing, and the right to exclude presupposes a right to use. Or perhaps it would be more accurate to say that private property is not just about excluding others and about the right to use, taken severally, but rather about the right to exclusive use").

Finally, by subverting the meaning of the right to exclude as attributed to property by exclusivists, Katz also misrepresents the corresponding duty on the part of non-owners not to interfere in the relationship between the owner and the owned thing. In line with the agenda-setting authority of the owner, the author contends that non-owners are required not so much to ‘keep out,’ as they are to “fall in line with the agenda the owner has set. The law preserves the exclusivity of ownership not by excluding others but by harmonizing their interests in the object with the owner’s position of agenda-setting authority.”<sup>86</sup> The duty of non-interference is thus fundamentally reinterpreted from a duty substantially coinciding with the exclusive core of property to *a measure of enforceability* in case the owner has decided that others should refrain from any interference with the owned resource.<sup>87</sup> Again, the distinction between both conceptions of property is only skin-deep. For non-interference as a measure to enforce the agenda set by the owner is merely incidental to the duty of non-owners not to interfere with the agenda-setting authority itself, which remains, as in the case of the right to exclude conception of property, the core duty corresponding to the exclusive rights of the owner.<sup>88</sup>

A critical analysis of the exclusive use and agenda-setting authority accounts of property ultimately reveals nothing more than a proper understanding of the fundamental principle that underpins both. The largely semantic nature of the differences between exclusivism and authoritarianism is perfectly encapsulated by the fact that authors of both schools of thought frequently cite the same typification of property by Cohen, as the definition that most pointedly captures the meaning of the notion, both legal and ordinary. Fittingly, it is construed as a note attached to the resource of an owner, whose content reads as follows:

To the world:

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<sup>86</sup> Katz, *supra* note 23, 278.

<sup>87</sup> *Id.* at 284-285 (“[t]he most basic criticism we can make of a boundary approach is that we cannot look to the right/duty of exclusion to define the contours of an owner’s position”).

<sup>88</sup> The difference between non-interference as a correlative duty and as a measure of enforceability is revealing, for it will re-enter the discussion when distinguishing property rights from use privileges. *See infra*, III.B.

Keep off X unless you have my permission, which I may grant or withhold.

Signed: Private citizen

Endorsed: The state.<sup>89</sup>

In the end, it is but a small step from the right to exclude as constituting the core means through which property ensures the use of a resource, to a qualification that represents property as the exclusive right to determine the use of a thing. Though small, the step is invaluable; not for any correction it may bring to the exclusivist account, but for the shift in perspective by which it is accompanied. For it brings into clear focus the specific relationship between the right to exclude and the use of the owned resource as the primary means of distinguishing property from other legal institutions.

### *B. Unifying Foundations: Use and Exclusion*

The fundamental nature of the relationship between the right to exclude and the right to use for defining property is elucidated nowhere with more clarity than in the writings of Penner<sup>90</sup> - though the link is blatantly ignored by nearly all of his detractors. Recognized as “one of the best accounts one can find of the kinds of rights that property - as legally understood - involves,”<sup>91</sup> Penner’s approach to the idea of ownership is founded on the basic contention that property rights are typified by the specific interaction between the related rights of exclusion and use as determinants of the social relations between the owner and non-owners, including prospective users. In general, relations between a user and others with respect to the thing that is used may take on any of three following forms, with differing degrees of exclusive impact:

[t]he right to use something so long as no one else was using it or wanted to use it is equivalent to having no right of exclusion whatsoever. The right to use something so long as one got there first is a right to exclude others while one is using something,

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<sup>89</sup> Cohen, *supra* note 22, 374. *See also* Smith, *supra* note 45, 1759.

<sup>90</sup> In particular, Penner, *supra* note 22.

<sup>91</sup> Underkuffler, *supra* note 29, 32. Penner is also acknowledged as one of the most influential writers on property in recent times in Katz, *supra* note 23, 279.

and the right to use whenever one wants amounts to a right to exclude others whenever one decides to use something.<sup>92</sup>

Of these, only the latter relationship accurately describes property, for it is only when the user can exclude others at will, depending on his discretionary exercise of the right to use, that he is verily endowed with property rights. The discretionary element of the *right to exclude* non-owners implies that the owner is not bound by strict considerations to allow use by others whenever such use is possible, because the owner is not using the thing owned himself. Conversely, if the authority to exclude others from using a thing is merely incidental to the actual use thereof, there is no property, for the *exclusion does not derive from any right to exclude at all* but is merely a factual consequence of the actual use of an object. Again we may cite Penner:

[w]e actually conceive of property in terms of a right which permits an owner to do anything or nothing with his property; the disaggregative bundle of rights thesis insists that an owner may do everything with his property. The former view accords with the fact that the law of property takes no interest in the particular use one makes of one's property (which is not to say that criminal law or the law of taxation does not); the latter holds that the essence of property is an infinite number of rights to use a thing, in the same way that the Hohfeldian idea of a right *in rem* entails having millions of rights against all other people.<sup>93</sup>

If there is a core right that characterizes property, it cannot be found in the positive right to use a thing and thereby exclude all others, but in the negative implication of the authority to decide to use a thing as a right not to use it at all, without losing the rights associated with the owned object.<sup>94</sup> For if the permission to use the

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<sup>92</sup> Penner, *supra* note 22, 70.

<sup>93</sup> Penner, *supra* note 23, 758.

<sup>94</sup> Once more, "the law of property is driven by an analysis which takes the perspective of exclusion, rather than one which elaborates a right to use. In other words, in order to understand property, we must look to the way that the law contours the duties it imposes on people to exclude themselves from the property of others, rather than regarding the law as instituting a series of positive liberties or powers to use particular things. . . . The duty *in rem* that correlates with the right to property is the negative duty not to interfere with the property of others, *i.e.* the duty to exclude oneself from the property of

thing owned may be granted according to the discretion of the owner, the right to use inherent in property also implies the right not to use, as the decision to grant permission to others to use the thing owned may be withheld even if the owner is not using the resource himself. For example, one does not have to justify a decision to disallow others to wear one's clothes simply because they are not being used for their intended purpose at the moment; it is not because I cannot wear all of my clothes at the same time that others may take them from my closet without violating my rights as an owner. It is this disconnection between exclusion, by the owner, and use, both by the owner and by all non-owners, that is as the very core of the property concept. The right to exclude others precedes the right to use, or the actual use of, a thing. This is exactly what is implied by the logical primacy argument: "the feature that makes nonpossessory property rights property is the right to exclude others, and the right to exclude cannot be derived from the right to use".<sup>95</sup>

Some authors even expressly typify the right not to use as constituting the main distinguishing feature of property. Pagaveau notes that,

[d]isposant d'une plénitude de pouvoirs sur son bien, le propriétaire peut en faire ce qu'il veut, y compris ne pas l'utiliser. Le caractère perpétuel du droit de propriété se justifie facilement dans la mesure où «ne pas se servir de sa propriété, c'est encore exercer son droit de propriété». Si aujourd'hui la finalité sociale

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others. The concept of exclusion, not use, dominates the legal analysis." Penner, *supra* note 22, 71-73. He continues, "[t]he driving analysis underlying legal property norms defines these contours in terms of the general duties *in rem* that people have not to interfere in the property of others; it does not specify rights to use or dispose of property. . . . The right to property is thus a right to a liberty, the liberty to dispose of the things one owns as one wishes within a general sphere of protection. It is not the right to any particular use, benefit, or result from the use of property. . . . The general injunction to 'keep off' or 'leave alone' the property that is not one's own defines the practice of property much better than a series of specific duties which work to facilitate particular uses of others' property. The law does not enquire whether, or to what extent, the trespasser or the thief impinged upon the owner's dispositions in respect of the property in question." *Id.* at 73.

<sup>95</sup> Merrill, *supra* note 28, 744.

de la propriété assortit le non-usage d'un certain nombre d'exceptions, le fait pour un propriétaire de ne pas user de son bien n'entraîne pas la perte de son droit.<sup>96</sup>

The right to exclude others thus persists even in the case of perpetual abandonment, for “[i]t is surely part of a right to determine how a thing is to be used that one may make no use of it at all, for evermore.”<sup>97</sup> Interpreted broadly as the right to dispose of one’s own property in the manner of one’s choosing, the *abusus* component of the classic trilogy of property rights thus comes to the fore as best characterizing the exclusive powers of the owner.<sup>98</sup> To be sure, the right not to use a thing may appear a peculiar means of distinguishing property from other legal institutions, especially since the justification of property ultimately remains grounded in the use of the thing owned. It has already been stressed, however, that the utilitarian justification of property should be divorced from its means of realization, as “use justifies the right, while exclusion frames the practical essence of the right.”<sup>99</sup>

The present section has shown that the bundle of rights theory is relevant for highlighting the social intricacies of property rights. However, it suffers from an overly ‘realist’ approach that is devoid of theoretical merit and ultimately appears unworkable. This pitfall is dodged by exclusivists, by reducing the many intricacies of property to a single core characterized by the right to exclude others. Though this right is subject to exceptions much as any other stick in the traditional bundle of property rights, this finding does not,

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<sup>96</sup> Pavageau, *supra* note 32, 107 (footnote omitted).

<sup>97</sup> Penner, *supra* note 22, 79.

<sup>98</sup> See the detailed assessment of the case law of the European courts on the subject and conclusions in Pavageau, *supra* note 32, 85-93.

<sup>99</sup> Penner, *supra* note 23, 743. As eloquently put by Hohfeld, “[e]ven though the land be entirely vacant and A have no intention whatever of personally using the land, his rights or claims that others shall not use it even temporarily in such ways as would not alter its physical character are, generally, of great economic significance as tending to make others compensate A in exchange for the extinguishment of his rights, or claims, or in other words, the creation of privileges of user and enjoyment. . . . But with respect to the suggested absence of value of the land in its present situation, it is enough to say that the very fact that no interference of this kind can lawfully take place without his consent, and without a bargain with him, gives his interest in this land, even in a pecuniary point of view, precisely the value which that power of veto upon its use creates, when such use is to any other person desirable and an object sought to be obtained.” Hohfeld, 1917, *supra* note 24, 747-748.

as such, deprive the right to exclude from its distinguishing relevance. Our understanding of the right to exclude has been facilitated by the authority approach, even if it partially rests on a misinterpretation of the former account. It has revealed that property does not consist of exclusion *per se* but is based on a *right* to exclude that is derived from an original authority over the thing owned.

To be sure, exclusion can follow from use that is not accompanied by property rights, and even non-owners may exclude others without making any actual use of the owned thing themselves. However, it is only when the rights of the user to exclude others flow from the non-derivative authority the user himself has over said object, that he is verily endowed with property rights. If the right of the user to exclude others is derived from a source extraneous to himself, or is dependent on the actual use of the object, and extinguishes upon cessation of said use, the user has no property rights. This fundamental observation holds true for all approaches to property rights, whether characterized by an adaptive bundle of rights approach, a rigid exclusivity account or a theory dwelling the middle ground by stressing the authority element to decide on the use of the thing owned.

### III. APPLICATION: NATIONAL APPROPRIATION

The main finding to arise from the select overview of property theories in the previous section concerns the pivotal place of the right to exclude in determining the legal nature of the use that can be made of an owned resource. A proper understanding of the meaning of the right to exclude in terms of property requires that both the exclusive use and the authority of the owner to determine such use be taken into account. The specific relationship between the right to exclude and the use of an owned resource is represented by the right not to use one's property, while retaining the right to exclude others. It is further elucidated by the corresponding duty on the part of all others not to interfere with the owner's agenda-setting authority. Absent any concrete indications to the contrary, there is little reason to argue that these findings should not be transposed to the national appropriation notion in the Outer Space Treaty and the Moon Agreement. Indeed, the negotiations on the non-appropriation provisions in these treaties were characterized by a notorious pithiness that failed to elaborate on the content of

their wording, let alone indicate a wish to deviate from their generally accepted meaning.<sup>100</sup> The present section will further substantiate this preliminary contention by looking at the history and wording of Article II of the Outer Space Treaty, and its relationship with the other provisions that outline the basic contours of the space resource regime, *i.e.* Articles I and IX of the Outer Space Treaty, as well as the regime of the International Telecommunication Union (ITU), as regards the use of orbits by satellites as a limited natural resource.<sup>101</sup>

### *A. Exclusion: Outer Space Treaty, Article II*

The interpretation of the proscription of national appropriation as entailing a ban on exclusion without use is supported by the precursors of the current formulation of the binding principle in Articles II of the Outer Space Treaty and 11 (2) of the Moon Agreement, even if these provisions do not elaborate on their rationale themselves. The national appropriation formulation first appeared in United Nations General Assembly (UNGA) Resolution 1721 of 20 December 1961.<sup>102</sup> It was subsequently expanded by UNGA Resolution 1962 into the language that currently persists in the Outer Space Treaty and the Moon Agreement.<sup>103</sup> The relevant provisions have never elaborated on the nature of the rights that were considered to make up ‘appropriation,’ but merely summed up the means through which such proscribed rights could be attained. This pithy formulation of the national appropriation concept has sparked many a controversy, *inter alia* on whether all forms of appropriation had been outlawed, or merely those by governmental actors. To clarify that private property rights in outer space were proscribed alongside public variants, Fitzmaurice proposed to include in the text of the first section of the Institute of International Law’s (IIL)

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<sup>100</sup> See Ram S. Jakhu, *The Principle of Non-appropriation of Outer Space and the Geostationary Orbit*, 26 PROC. COLL. L. OUTER SPACE 22 (1983).

<sup>101</sup> See the qualification as such of the radiofrequencies and any associated orbits, including but not limited to, the geostationary satellite orbit, in ITU Constitution, Art. 44(2).

<sup>102</sup> International Co-operation in the Peaceful Uses of Outer Space, G.A. Res. 1721 (XVI), ¶1 (b), U.N. Doc. A/RES/1721 (XVI) (Dec. 20 1961).

<sup>103</sup> Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space, G.A. Res. 1962 (XVIII), U.N. Doc. A/RES/1962 (XVIII) (Dec. 13, 1963).

resolution on outer space a second phrase, which unequivocally extended the prohibition to 'all forms of use of an exclusive nature.'<sup>104</sup> The proposal was rejected, however, and the relevant provision ultimately simply stated that "[o]uter space and the celestial bodies are not subject to any kind of appropriation."<sup>105</sup> The phrase foregoes any explicit link between appropriation and exclusive rights yet is clearly less ambiguous than Article II of the Outer Space Treaty in that it expands the proscription to any kind of property rights, rather than national appropriation only.

Other proposals did explicitly retain the link with exclusive rights as providing the basis for a proscription of property rights in space. The August 1960 resolution of the International Law Association (ILA) recommended "the conclusion of an international agreement whereby States would agree not to make *claims to sovereignty or other exclusive rights* over celestial bodies, and affirm the principles of law stated in paragraph 3(a) and (b) of this resolution."<sup>106</sup> Paragraph 3, sub b of the ILA resolution reiterates that "[o]uter space may not be subject to the sovereignty or other exclusive rights of any State." The Draft Code of the David Davies Memorial Institute of International Studies (DDMIIS) stipulates that "neither outer space nor the celestial bodies in it are capable of appropriation or exclusive use by any state."<sup>107</sup> The importance of the exclusionary aspect of property as the rationale for its prohibition is sometimes stressed by the addition of the somewhat superfluous epithet 'exclusive.' As such, in 1959, the American Bar Association passed a resolution declaring "that in the common interest of mankind . . . celestial bodies should not be subject to exclusive appropriation."<sup>108</sup> Finally, the Tentative Provisions of the New York Bar Association provided that national sovereignty cannot be acquired in

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<sup>104</sup> Discussed in M.G. MARKOFF, *TRAITÉ DE DROIT INTERNATIONAL PUBLIC DE L'ESPACE* 646 (1973).

<sup>105</sup> *Id.* at Art. 1 of the IIL Resolution.

<sup>106</sup> Para. 4 of the Resolution on Air Sovereignty and the Legal Status of Outer Space, published in the Report of the Forty-Ninth Conference of the International Law Association, Hamburg, 1960, p. IX (emphasis added).

<sup>107</sup> Draft Code of the David Davies Memorial Institute of International Studies, Rule 2.1, in 5 *PROC COLL. L. OUTER SPACE* (1962).

<sup>108</sup> American Bar Association, *Report of the Committee on the Law of Outer Space*, 1959 A.B.A. SEC. INT'L & COMP. L. PROC. 210-234 (1959). See also L. LIPSON AND N. KATZENBACH, *REPORT TO THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION ON*

outer space.<sup>109</sup> They further detailed the specific implications of this general proscription with respect to the use of celestial bodies in a provision entitled ‘Territorial claims to celestial bodies,’ which offers a useful and uncharacteristically clear starting point for the description of the legal regime on the use of natural resources, extending to outer space in general:

[c]elestial bodies (other than stations, craft, vehicles, or other objects launched from the earth) shall not be subject to exclusive appropriation by any person, organisation, or State on the earth. Any exploration, occupation, development, use, and exploitation of the resources of such celestial bodies shall be conducted so as not to endanger such activities conducted by others.<sup>110</sup>

The relevance of the above proposals is decidedly diminished by the fact that they could not determine the formulation of the legally binding principle in the Outer Space Treaty. Nevertheless, their common insistence on highlighting the exclusive implications of appropriation retains a particular relevance for the current interpretation of the fundamental principles of international space law, as it mirrors the generally accepted interpretation of property as a legal institution characterized by exclusion and non-interference. Indeed, in light of the characterization of property as the right to exclusively determine the use of the thing owned, we may refer to a number of authors that, in line with the precursors of the non-appropriation principle expanding the proscription to include all forms of exclusive rights, have parsed the legal regime of natural resources in space from the perspective of inclusive v. exclusive use of the entire outer space environment, rather than in terms of property rights over its component resources *per se*. The move is inspired by a desire to reconnect the discussion on property rights over space resources with the general discussion on the status of the outer space environment as *res communis* or a global commons. For example, in an essay suffused with references to the *res communis* character of outer space, Christol concludes that “there has

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THE LAW OF OUTER SPACE 24 (1960) cited in P.G. Dembling and D.M. Arons, *The Evolution of the Outer Space Treaty*, 33 J. AIR L. & COM. 421 (1967).

<sup>109</sup> C.W. JENKS, SPACE LAW, 440-445, Tentative provision B (1) (1965).

<sup>110</sup> *Id.* at Provision U.

come - over time - the view that lawful activities in the space environment include the non-exclusive exploitation of both the area and its resources.”<sup>111</sup> Likewise, Delville’s interpretation of Article II is guided by the general assertion that no single state can acquire or claim ‘exclusive rights’ over celestial bodies.<sup>112</sup>

### *B. Authority? Outer Space Treaty, Article I*

Again, however, it is unclear whether to interpret these and other references to exclusivity in the use of resources from outer space as defining the boundary between lawful use and unlawful appropriation in terms of Article II of the Outer Space Treaty, or as a criterion highlighting the requirement that all states have the possibility to exercise their freedom to use outer space, as guaranteed by Article I OST. Not unlike the debate on property rights in general, the tale of property over resources as exclusive activities v. inclusive use is hence incomplete, as it tends to focus solely on the aspect of exclusion through use, while neglecting the exclusive impact of claims absent their actual exercise.<sup>113</sup> If the focus on *exclusivity* dovetails with the view that the right to exclude is an essential aspect of property rights, it fails to fully account for the fact that property is based on an *authority* to exclude rather than the factual use of the resource. For property does not merely amount to a right not to be excluded, it is the presence of a positive authority to exclusively determine the use of the thing owned that characterizes property. This is, after all, the difference between a property right and a privilege to use.<sup>114</sup>

Before developing this argument any further, we should elaborate on the exact qualification of a ‘right’ as a crucial component of the right to exclusive use. In Hohfeldian nomenclature, as we have

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<sup>111</sup> C.Q. Christol, *Article 2 of the 1967 Principles Treaty Revisited*, 9 ANN. AIR & SPACE L. 261-62 (1984).

<sup>112</sup> Delville, *supra* note 23, 143.

<sup>113</sup> See *supra* II.A.3.

<sup>114</sup> See also the distinction between both legal notions as raised in J.A. Heilbock, *Rights or Privileges in Frequency Spectrum*, 43 PROC. COLL. L. OUTER SPACE 196 (2000). We therefore side with Harris’ rejection of MacPherson’s definition of a property right as an “enforceable claim to the use or benefit of something, of which the paradigm is a right not to be excluded whilst the right to exclude others is merely a special case.” Harris, *supra* note 73, 155 (referring to MacPherson, *supra* note 21).

seen, a 'right' can either refer, broadly, to a composite notion encompassing the related concepts of rights *sensu stricto*, privileges, powers and immunities, or, narrowly, to a 'claim.' A claim is defined as the legal correlative of a duty and the legal opposite of a no-right. The term is suggested by Hohfeld to distinguish the narrow connotation of a 'right' from the other three related concepts that make up the composite counterpart of the term.<sup>115</sup> In the present section, when stressing the relevance of the *right* to exclude as constituting the essence of property, we are, of course, referring to the second, narrow connotation of the notion as a claim. Considering the prevailing interpretation of property as outlined in the previous section, the *right* to exclude can hence usefully be interpreted as indicating the authority from which the decision to exclude others follows, in order to distinguish it from exclusion that may accompany any form of factual use not backed up by comparable authority.<sup>116</sup>

If the claim component of property has ever been acknowledged in the discussions on Article II, these instances are very rare indeed. When discussing the possibility of laying claim to the territory surrounding a station on the Moon, Mankiewicz, the Canadian representative at the Working Group (WG) III of the International Institute of Space Law (IISL), objected on grounds that the 'claim' notion could, in his opinion, only refer to rights or title to ownership in space. It followed that "nothing could be 'claimed' because in the [Outer] Space Treaty it is explicitly said that there is no possible appropriation."<sup>117</sup> While we agree with the sentiment of the statement, the argument appears to unnecessarily constrain the claim concept by limiting it to specific rights only. Moreover, the interpretation offered by Mankiewicz would render the notion wholly superfluous in the context of a legal framework that, as noted by the author himself, does not recognize national appropriation in any case. In reaction to the statement, Bartos and Sztucki therefore rightly

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<sup>115</sup> Hohfeld, 1917, *supra* note 24, 717.

<sup>116</sup> This terminological clarification will hopefully help to understand the criticism of the detractors of the exclusivist account of property rights.

<sup>117</sup> Mankiewicz in M.S. Smirnoff, *Report of the Working Group on Legal Status of Celestial Bodies*, 10 PROC. COLL. L. OUTER SPACE 24 (1967). The author adds, somewhat confusingly, perhaps humorously, that the term 'claim' in the context of the question under discussion of the WG III was therefore "not appropriate."

rejected the explanation and reinterpreted the claim notion as referring to a general recognition of title to *certain* rights and aspects of jurisdiction in space only.<sup>118</sup>

The difficulty in interpreting the language of Article II and the persisting inclination by some to discuss the regime of space resources in terms of *res communis*, beg the question whether we can usefully ignore the rights component of property in the exclusive v. inclusive use discourse. Phrased differently, the question arises whether we can solve the issue of property rights over particular amounts of resources by reference to the general qualification of the outer space environment as one of inclusive use. To illustrate this point, we may refer to the writings of McDougal, Lasswell, and Vlasic on law and public order in space. The 1963 exposé of these authors on the enjoyment and acquisition of natural resources in space still stands as one of the most complete analyses of rights over space resources to date.<sup>119</sup> However, the years that have elapsed since the formulation of the authors' theory and the legal developments that have taken place in that timeframe require us to put the account into perspective.

Let us thus start by outlining the context of the debate. When determining whether property rights can be vested in particular types of resources, theorists often revert to the test of excludability. The test posits that resources cannot become someone's property if it is impossible for a legal person to exercise regulatory control over the access to the resource by others, be it for reasons of physical, moral or legal non-excludability.<sup>120</sup> There can be no doubt that all natural resources in outer space, even those that are immaterial and infinitely renewable, are perfectly excludable from a physical and moral perspective. In the early space age, the international community was therefore faced with the task of deciding whether or not to confirm this excludability on the legal plane. To inform the imminent choice of the international community in this respect, McDougal, Lasswell, and Vlasic offered a detailed policy analysis on the interests and stakes at play in the regulation of outer space.

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<sup>118</sup> See the contribution of both authors to the discussion. *Id.*

<sup>119</sup> M.S. McDougal et al., *The Enjoyment and Acquisition of Resources in Outer Space*, 111 U. PA. L. REV. 521-636 (1963) and M.S. MCDUGAL, H.D. LASSWELL, AND I.A. VLASIC, *LAW AND PUBLIC ORDER IN SPACE* chap. 7 (1964).

<sup>120</sup> See, in general, Gray, *supra* note 42, 268-292 and Barnes, *supra* note 16, 26-29.

In the case of natural resource exploitation, as in most other instances, the analysis ultimately boiled down to a choice between inclusive and exclusive use. In the words of the authors, inclusive use refers to

the *claim, made on behalf of all*, that the resource is not in any degree subject to exclusive appropriation but must be maintained as open for inclusive use by all, with complete equality in shared competence. The diametrically opposing claim will of course be that the resource may be exclusively appropriated by a single participant, with all interests in access and enjoyment being subjected to the comprehensive, continuing, unilateral competence of the participant.<sup>121</sup>

Whether the international community should opt for inclusive or exclusive use of particular types of natural resources in space should be decided against the background of the overarching goal of value maximization: how can the greatest production and widest distribution of values be achieved? If through inclusive use, the resources are deemed sharable; otherwise they are non-sharable.<sup>122</sup>

The set-up of the analysis by McDougal, Lasswell, and Vlasic mixes references to inclusive use with implications of exclusive appropriation, suggesting that a decision on one aspect will have unambiguous results for the other. Disregarding for a moment whether it is prudent to make such an assumption, the authors' analysis on inclusive and exclusive use rightly starts from the perspective of claims over types of resources instead of the actual use of particular amounts thereof, as follows from the incorporation of the claim notion in the definition of both policy options. It is clear that a narrative focusing on exclusive use yet omitting the authority angle cannot usefully settle the argument of national appropriation in Article II, for it overlooks the obvious fact that every form of use by one state of a resource in space, whether permanent or momentary, is necessarily exclusive to all others for the duration of the use, for otherwise the freedom to use outer space could not be exercised.<sup>123</sup> The physical excludability of space resources, whether

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<sup>121</sup> McDougal et al., *supra* note 119, 771 (emphasis added).

<sup>122</sup> *Id.* at 774-775.

<sup>123</sup> G.B. Krause-Ablas, *The Need for International Community Systems of Satellite Telecommunications*, 15 PROC. COLL. L. OUTER SPACE 81 (1972); R. Wolfrum, *Einzelne Formen der Nutzung des Weltraums - Geostationäre Umlaufbahn* in HANDBUCH DES

tangible or intangible, implies that the use of a specific segment by a certain participant at a given moment *ipso facto* excludes a similar activity by all other competing users over the same segment at the same time. In this regard, Metcalf rightly notes that, “[i]f any use, which for some time excludes identical use of the same segment by somebody else, amounts to appropriation, it is difficult to see how there can be any content left in the principle of freedom of use.”<sup>124</sup>

Our interpretation of property gives solid legal footing to this intuition.<sup>125</sup> For, as we have seen, mere exclusion *through use* does not, by any means, imply the existence of property rights, and the mere use of a resource is not an unlawful activity in and of itself. Quite the opposite: it is positively protected by the freedom to use outer space. Just as the general principle on the freedom to use outer space should not be defined with reference to each particular

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WELTRAUMRECHTS 354 (K.-H. Böckstiegel, ed., 1991). Specifically with respect to the exploitation of mineral resources in outer space, see M.L. Smith, *The Commercial Exploitation of Mineral Resources in Outer Space* in SPACE LAW: VIEWS OF THE FUTURE (T.L. Zwaan, ed., 48-49 (1988). Compare Lee, *supra* note 13, 164-165. The author notes that the strict application of the reciprocal freedom to use outer space would imply that the placement of a satellite in any orbital position would be unlawful, for it precludes other states from using that same point in space at the same time. The issue is exacerbated when we approach orbits as circular entities rather than a series of points in space, as evidenced by Goedhuis’ argument that, strictly speaking, the free use of outer space can only support one satellite in the GSO, for a second one may interfere with the route of the first: see INTERNATIONAL LAW ASSOCIATION, REPORT OF THE FIFTY-SIXTH CONFERENCE 454 (1975).

<sup>124</sup> K.N. Metcalf, *supra* footnote 13, p. 241. But see C.R. Buxton, *Property in Outer Space: The Common Heritage of Mankind Principle vs. the “First in Time, First in Right” Rule of Property Law*, 69 J. AIR L. & COM. 705 (2004) (arguing that “despite the label, when a satellite fills an orbit slot, the party occupies that space and effectively asserts sovereignty. This concept seems no different than an unmanned station on the moon; the space being used becomes inaccessible to others”). See also W. von Kries, *The Legal Status of the Geostationary Orbit: Introductory Report*, 18 PROC. COLL. L. OUTER SPACE 29-30 (1975) (“[s]ince the stationing of a geostationary satellite precludes the use of the position by other states, this fact could already as such be construed as national appropriation”). Compare with Jakhu, *supra* note 100, 22 (contending that “the use of the geostationary orbit is allowed as long as it does not amount to appropriation, i.e. it does not exclude others from using the orbit”).

<sup>125</sup> Even if Metcalf herself ostensibly disagrees with this assessment, as she argues that permanent use may “with the normal interpretation of the word amount to appropriation.” Metcalf, *supra* note 12, 246. The author also deems it necessary to take into account the type and scale of use in order to judge whether the exclusion of others amounts to appropriation. It is argued here that such considerations relate to Art. I OST rather than Art. II OST.

segment or piece of outer space, a similar interpretation of the exclusive use criterion would result in too broad a restriction of the freedom to exploit natural resources. Additionally, since every use is exclusive for its entire duration and property is defined as exclusion that is not grounded in use, the length of time of resource exploitation is definitively removed from the equation applied to determine the legality of an activity, whether it concerns the instantaneous exhaustion of matter or the prolonged use of immaterial orbits. Finally, it should be pointed out that, in line with the caveat on mixing property with wealth,<sup>126</sup> exclusivity of use should be separated from the divisibility of the benefits that follow from such use, as the fruits of exclusive use by one can obviously be shared among multiple stakeholders.

To be sure, the inevitability of exclusivity through use does not apply to all types of resources in all fields of human activity. As such, it has been noted that the use of intellectual resources is by its nature non-exclusive.<sup>127</sup> The sharable use of data, for example, is a good reminder of the importance to take into account the physical characteristics of resources when defining the applicable property institution. Though factually accurate, the observation is of little relevance for space resources. All resources under consideration here are natural rather than intellectual, and, for all their diversity, by definition correspond to a physical, if not always material, set of phenomena, whose use by one is necessarily exclusive of all others. Moreover, it is not because the use of some resources is not by its nature exclusive that the legal implications of property over such resources are any different than for resources that are physically excludable. Intellectual resources remain legally excludable and hence susceptible to property, regardless of the physical possibilities of simultaneous exploitation. If everyone is free to use a piece of information, there is no property over the relevant data simply because there is no legal exclusion, regardless of physical excludability or inclusivity. As such, the counterargument can only underscore the importance of properly understanding the authority element in the right to exclude others as constitutive of property. This is, after all, what separates physical excludability from legal

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<sup>126</sup> See *supra* note 70 and accompanying text.

<sup>127</sup> Dagan, *supra* note 62, 42.

excludability. And, in these pages, we are only concerned with the latter.

If the dichotomy of exclusive and inclusive use can only be understood with reference to claims instead of actual use, claims for exclusive use should be interpreted, as per our analysis in the previous section, as property rights. However, in this regard, the actual property implications of McDougal, Lasswell, and Vlasic' analysis for concrete activities of natural resource exploitation are equivocal at best. For nearly every type of space resource considered, whether spatial-extension, flow or stock,<sup>128</sup> the authors conclude that value maximization occurs when the international community opts for inclusive use over exclusive appropriation by a single participant.<sup>129</sup> Specifically, the authors assert that "inclusive use is always the best, even when there is great inequality among participants, in that there are only a few participants having potential capabilities."<sup>130</sup> The outcome is understandable in light of the goal of value maximization for the international community.<sup>131</sup> At the same time, however, it is unmistakably influenced by this finality as well, for there is scarcely a type of natural resource conceivable of which the value for the entire international community would be maximized by allowing only one participant to appropriate it.

The only type of resource that is deemed non-sharable by the authors are scarce stock resources, though only if the "context of interaction is such that exclusive use encourages development without injury to the interests of other participants."<sup>132</sup> It is decidedly unnecessary, however, to allow a single participant to *a priori* lay claim on a resource that is only of use to him, for exclusion through property is only useful when there are competing interests.

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<sup>128</sup> According to the authors, spatial-extension resources are "those whose most distinctive characteristic is their utility as media of transportation and communication." Conversely, stock resources are those whose total supply does not significantly increase in time. See McDougal, *et al.*, *supra* note 119, 777, 779.

<sup>129</sup> *Id.* at 776-781.

<sup>130</sup> *Id.* at 782.

<sup>131</sup> The same finality guides the analysis in A.S. De Vany, *et al.*, *A Property System for Market Allocation of The Electromagnetic Spectrum: A Legal-Economic-Engineering Study*, 21 STAN. L. REV. 1512 (1969) ("our working rule is that the social value of production from the use of electromagnetic spectrum should be maximized") and M.A. Rothblatt, *The Impact of International Satellite Communications Law Upon Access to the Geostationary Orbit and the Electromagnetic Spectrum*, 16 TEX. INT'L L.J. 224 (1981).

<sup>132</sup> McDougal, Lasswell, & Vlasic *et al.*, *supra* note 119, 781.

Moreover, it is wholly unclear why this exception for exclusive use *qua* appropriation should be limited to the category of scarce, non-renewable resources, for there seems to be little point in banning private appropriation of any type of resource that is merely of interest to one user. Indeed, the qualification of scarce stock resource as exclusive use resources is accompanied by an entire set of procedural and substantive limitations whose pertinence extends far beyond this category alone. Consider, for example, the requirement that the exploiting state take into account the amount of resources claimed and the time within which its planned exploitation must be undertaken.<sup>133</sup> Clearly these limits should apply to the exploitation of all types of resources, regardless of the policy on claims of exclusive or inclusive use, thus further questioning the relevance of such distinction for determining property rights over specific resources. Moreover, they obviously relate, in terms of the Outer Space Treaty, to matters of reciprocity in Article I rather than the absolute ban of Article II.

If the issue with a regime based on claims for exclusive use is one of equivocal application, the problems with a suggested regime based on 'claims for inclusive use' are of a more fundamental nature, for the concept as such resists a translation into property rights terminology that could usefully determine the lawfulness of property through exploitation activities in space. At best, it suggests an outcome that is decidedly at odds with the current provisions of international space law. Separated from the claim component, the notion of inclusive use merely reflects the requirement that no prospective user can be excluded from the freedom to use a resource. As such, it mirrors the provision in Article I, para. 2 of the Outer Space Treaty on the freedom to use outer space by all states on the basis of equality. It does not answer the question, however, of whether the freedom to use entails the freedom to appropriate, as the right not to be excluded differs from the right to exclude for want of the authority element. It merely negates the existence of such authority in others to the extent that it would preclude actual use by all; if such inclusiveness is not threatened by property rights in specific resources, however, there is no compelling argument against appropriation.

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<sup>133</sup> McDougal *et al.*, *supra* note 119, 636.

This is confirmed by the interpretation of inclusive use by McDougal, Lasswell, and Vlasic as inherently being a requirement of equal access. However, the addition of the claims component changes matters on a fundamental level, as it adds the positive connotation of property to the notion of inclusive use, thereby transforming it from a mere guarantee against being excluded to the negation of the right to exclude qua property. In other words, property by the community amounts to a negation of property by the constituent individuals that make up said community. As indicated previously, much of the critique on the interpretation of property as determined by the right to exclude is based on the allegation that such an approach unfairly disregards the social component of property rights in favour of a myopic conception of property as an enabling tool of individualist freedom. Detractors of the exclusivist approach have therefore pointed to such institutions as communitarian property for downplaying the distinguishing element of the right to exclude.<sup>134</sup> However, it would be wrong to characterize communitarian institutions of property as a form of ownership lacking the authority to exclude. As argued by one of the characters in Cohen's dialogue on private property, "the essential factor that we are reaching for [in property] is the power to exclude, whether that power is exclusive or shared with others."<sup>135</sup> Hence, even in the case of common property, the right to determine the use of a thing remains exclusive to the holders of the right, though it is simply shared by all states. Property includes the right to determine that non-owners may use the thing owned, though not to the effect that property rights are acquired, for this would turn the system of common property in one of individual ownership. Hence, a system governed by claims of inclusive use over resources, as opposed to one of inclusive use, period, has the positive implication of disallowing any and all type of individual property rights, regardless of whether it would threaten actual inclusiveness in the use of these resources.

In theory, it would be possible to conceive of the hypotheses proclaiming the outer space environment as *res communis* and a global commons as accurately encompassing connotations of free and equal use of outer space, as well as deciding on the lawfulness of property rights. For one could incorporate the authority angle in

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<sup>134</sup> See *supra* note 73 and accompanying text.

<sup>135</sup> Cohen, *supra* note 22, 370.

the inclusive use discourse by arguing that, in space law, the international community has retained the highest authority to decide, through the mechanism of treaties, how space resources shall be used by its constituent states, which are free to exploit these resources yet can never obtain property over them. Such a literal interpretation of inclusive use *qua* common property conflicts with the present formulation of Article II, however, which precludes not only appropriation by states *qua* states but also as members of the international organizations through which the international community acts. For this reason, it appears incorrect to label the current regime of outer space as one guided by *res communis*.<sup>136</sup> If the international community is not vested with ownership authority over resources in space, the regulation in the UN treaties merely represents the exercise of the law-making powers of an international organization with regard to an environment that as a whole has been removed from the sphere of appropriation. This dovetails with the general attitude of many property law theorists to common property, who fail to see the added value of qualifying rights obtained through the exercise of a universal freedom as a form of property.<sup>137</sup> Indeed, even those authors that suppress the importance of the right to exclude in property recognize the inherent contradiction in concepts of inclusive property. As remarked by one author, “exclusion and inclusion are not symmetric in property; in the limiting

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<sup>136</sup> The only alternative would be to assert that ownership is retained by humanity. However, the view according to which the UN space law treaties have elevated mankind to the level of actionable subject of international law is unsupported at best by the majority of space law doctrine. See R.V. Dekanozov, *The “Common Heritage of Mankind” in the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, 24 PROC. COLL. L. OUTER SPACE 182 (1981); A. Bückling, *Die Freiheiten des Weltraumrechts und ihre Schranken*, in HANDBUCH DES WELTRAUMRECHTS 97 (K.-H. Böckstiegel, ed., 1991); and Metcalf, *supra* note 13, 194.

<sup>137</sup> Harris on the right to clean air and water as property rights: “[w]hat is added by terming such rights ‘property’ rights? Nothing - it seems - except the negative point that, because the atmosphere and open stretches of water are owned by nobody and for that reason can be described as ‘common property’, no-one can counter the demand for these measures by asserting ownership of the air and the water.” Harris, *supra* note 73, 57. This simply amounts to a right not to be excluded, however, without justifying the need for a supreme body vested with the authority to exclude.

case of inclusion, namely universal equal access, there is no owner.”<sup>138</sup>

Hence, what is most troubling about a discussion on space resources in terms of inclusive v. exclusive use is not that it would be incorrect - it is not - but that it does not unequivocally address the fundamental issues raised by the concept of property rights. In particular, the qualification of outer space as guided by inclusive use does not settle whether the exercise of the universal freedom to use space includes the possibility of private property over specific natural resources as a form of use by one participant. For a decision on the *status* of the outer space environment or a particular *type* of resources therein in terms of inclusive use does not determine whether property rights can be obtained through specific exploitation activities if these activities do not preclude inclusive exploitation for the type of resource that is being consumed. Conversely, if the legality of appropriative exploitation is to be determined by its effects on the inclusivity of the use that the international community can make of the type of resource concerned, appropriation thereof should be allowed up to the point where it would preclude comparable activities by all other users. This conflicts with the implications of a regime guided by claims of inclusive use, for if claims for exclusive use are tantamount to property, inclusive use as common property simply does not allow for individual appropriation without changing the nature of the regime. Finally, claims of inclusive use, whatever form they may take, imply the existence and recognition of a body that is endowed with the supreme authority to exclude, which is contrary to the existing formulation of the non-appropriation principle.

Ultimately, the inclusive use narrative simply rehashes the old *res communis v. res nullius* discussion. It suffers from the same fundamental defects, only aggravated by the flagrant neglect of the actual language of the provisions of the UN space treaties that have since come into effect.<sup>139</sup> Reducing the space resource regime to one

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<sup>138</sup> Dagan, *supra* note 63, 44. Even though the author argues that property is both about exclusion and inclusion, he concedes that there can be no symmetry between both. *Id.* at 55, 44.

<sup>139</sup> This critique applies to the writings of McDougal, Lasswell and Vlasic as well, for they claim that the theory of inclusive use had been accepted at the time of writing by the international community in Resolution 1721, *supra* note 102, OP 1, sub b, the ascendant of current Arts. I and II OST. McDougal *et al.*, *supra* note 119, 589-590.

guided by inclusive use, without considering the claim component of property rights, merely accounts for the provisions of Article I of the Outer Space Treaty. To the extent that it leaves unresolved the matter of resource appropriation, the theory is therefore incomplete. To the extent that it pretends to settle the property rights issue as well, it is flawed. For free access to segments of outer space and celestial bodies is hindered, not only through acts of appropriation, but from the moment a state uses the relevant segment, even if only temporarily and non-exhaustively. An argument alleging that the inclusive use theory implicit in Article I also proscribes isolated acts of appropriation would thus have to recognize that mere acts of use violate Article I as well, even though the provision is intended to encourage actual use of outer space.

Worse still, such an expansive reading of Article I would reduce the non-appropriation provision to an empty vessel that only enters the discussion in the case of extreme violations of Article I of the Outer Space Treaty, when sovereignty is explicitly claimed over entire areas in space, as was the case with the Bogotá Declaration.<sup>140</sup> The recognition of the claim component helps to expose the distinction between inclusive use and exclusive appropriation as a false dichotomy whose respective meanings do not correspond to the negation of each other's content. The inclusive v. exclusive use discourse is incongruous with the fundamental issues of property rights over resources and sparks confusion when connected with the claim notion of authority to exclusively decide over their use. Its use as a theoretical framework should hence be discarded in favour of an account that is guided by the prevailing language of rights, claims, use and appropriation as adopted in the existing treaties. What matters is whether *claims* can be made for exclusive use - and what else are such claims than assertions of rights of exclusion over resources when they are not being used by the claimant, *i.e.* property?

### *C. Non-interference: Outer Space Treaty, Article IX*

If the exact legal implications of the right to exclude remain elusive under direct scrutiny, it may help to look at the right from

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<sup>140</sup> Declaration of the First Meeting of Equatorial Countries, ITU Doc. WARC-BS (1977) 81-E (Dec. 3 1976).

the viewpoint of the corresponding duty of non-interference on the part of non-owners. The exact implications of the legal nature of the relationship between both should be properly understood. It is not because users have a right not to be interfered with in the use of a certain segment or area of outer space or celestial body, that the rights thus acquired amount to property rights. This is nonetheless implied by some authors who present property as the protection of means applied to achieve a certain goal through the general duty on the part of others not to interfere with the means deployed to this end.<sup>141</sup> This particular interpretation of property rights is inspired by the vantage point of a legal justification for property, which lies in the facilitation of the use of the thing owned.

Non-objectionable though the utilitarian goal of property rights may be, it skews the perspective to the extent that it considers all rights that are protected from interference as property rights. The argument is flawed, however, for it is clear that, without protection from interference, no use of space resources is possible whatsoever, regardless of the relationship between the right to use and the right to exclude. The approach reduces property to the right to use without interference, though such right also accrues to somebody who, for example, rents an apartment or leases a car. Property rights cannot be equated with rights of non-interference without taking into account the origin of these rights. To the extent that it flows from the actual use of a resource, the right of non-interference is a necessary attribute of the freedom to use said resource; if it precedes the actual use and is retained after the completion of the use, it is an attribute of property.

The duty of non-interference in property immediately calls to mind the provisions in the UN space treaties and ITU instruments requiring states to engage in consultations in case of potentially harmful interference with the experiments or activities of other states exploring or using outer space. The corresponding nature of the duty of non-interference in property parlance appears to imply that, in space law too, it should be linked with property rights over outer space. The space treaties expressly link the duty not to interfere with experiments or activities of states in space, however, not

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<sup>141</sup> See Coval *et al.*, *supra* note 54.

with the area covered by these ventures, even if both will often coincide. For it is self-evident that

[w]e cannot [...] protect action without protecting those events which are means to its success. If we have a right of non-interference with respect to action then that entails that we have a right of non-interference with respect to that part of the world which is used to satisfy the reason for the action.<sup>142</sup>

This is not to say that property is acquired in the part of the world covered by our actions, even if some theories wilfully blur this line.<sup>143</sup>

The definition of harmful interference as provided by the ITU Radio Regulations confirms this view, for it describes the notion as a form of interference that endangers the functioning of a radio navigation service or of other safety services, or otherwise seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the ITU RR.<sup>144</sup> Likewise, Article IX of the Outer Space Treaty obliges states to engage in consultations with those states whose activities would likely be harmfully interfered with by its own planned or existing activities. Article 8 (3) of the Moon Agreement drops the qualifier ‘harmful’ and requires that consultations be had as soon as ‘interference’ with the activities of other states may occur. This provision is sometimes interpreted as broader than Article IX of the Outer Space Treaty, as there appears to be no requirement of harm in the implementation of the former, but merely an issue of “physical intrusion of the activities of other States Parties.”<sup>145</sup> As the intrusion is still interpreted in relation to the activities of others, however, it is doubtful

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<sup>142</sup> *Id.* at 460 (emphasis omitted).

<sup>143</sup> See the authors that adhere to the so-called functional property theory: I. CSABAFI, *THE CONCEPT OF STATE JURISDICTION IN INTERNATIONAL SPACE LAW: A STUDY IN THE PROGRESSIVE DEVELOPMENT OF SPACE LAW IN THE UNITED NATIONS* 136 (1971); Coval *et al. supra* note 54, p. 460; White, *supra* note 55; Cook, *supra* note 14, 694; and H.R. Hertzfeld and F.G. Von der Dunk, *Bringing Space Law into the Commercial World: Property Rights without Sovereignty*, 6 *CHI. J. INT'L L.* 83 (2005).

<sup>144</sup> ITU Radio Regulations, No. 1.169.

<sup>145</sup> S. Freeland, [*Moon Agreement:*] *Article 8 (exploration and use/consultations)*, in *COLOGNE COMMENTRY, VOL. II: RESCUE AGREEMENT, LIABILITY CONVENTION, REGISTRATION CONVENTION, MOON AGREEMENT NO. 154* (S. Hobe, B. Schmidt-Tedd and K.-U. Schrogl, eds., 2013) (referring to A.A. Cocca *et al.*, *Autonomous Settlements and*

whether there is any actual difference between both notions in practice, especially since the assessment must be made before the interference actually occurs.<sup>146</sup>

The duty of non-interference, through its inherent link with experiments and activities of states in space, rather than space itself, does not act as a corresponding obligation to the property right of an owner, but as a measure enforcing the exercise of the freedom to use, without changing the qualification of such freedom into an actual right. The previous section recalled the Hohfeldian theory that a duty is to be considered the jural correlative of a right in the strict sense of the word but the jural opposite of a privilege. In clarifying this relationship, Hohfeld emphasized that “[a] ‘liberty’ considered as a legal relation (or ‘right’ in the loose and generic sense of that term) must mean, if it have any definite content at all, precisely the same thing as privilege.”<sup>147</sup> Hence, the freedom to use outer space should legally be considered a privilege, though not a right on its own terms, since the negation of the freedom to use a particular segment of outer space, for reason that it is being, or has been, used or consumed by another user having the same privilege, does not give rise to a violation that can be remedied through legal process. To be sure, the effective exercise of said freedom may well require a right not to be interfered with by others for the duration of the use, which are thus under a duty not to do so. This does not alter the legal character of the freedom to use outer space, however. As argued by Balganesch,

[a]lthough a right and a privilege [...] no doubt remain distinct, it is important to note that in a vast majority of situations a privilege comes to be protected by a right. In other words, a privilege becomes capable of being exercised because of the existence of an overarching right that shadows it and requires others to abstain from interfering with the privileged area of

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*Environmental Protection in the Law of Outer Space*, 44 PROC. COLL. L. OUTER SPACE 342 (2001).

<sup>146</sup> The regulation of consultations in Art. 15 (2) of the Moon Agreement omits the link with state activities: COLOGNE COMMENTRY, VOL. II: RESCUE AGREEMENT, LIABILITY CONVENTION, REGISTRATION CONVENTION, MOON AGREEMENT NO. 242 (S. Hobe, B. Schmidt-Tedd and K.-U. Schrogl, eds., 2013). However, the specific nature of this provision as pertaining to the installation of an inspection mechanism renders it irrelevant for the present discussion.

<sup>147</sup> Hohfeld, 1913, *supra* note 24, 36.

action. This is often referred to as the «shielding» thesis. This thesis helps explain why rights and privileges are often conflated and why in a vast majority of situations privileges continue to derive at least indirect protection from the law.<sup>148</sup>

The author clarifies that the act of shielding a privilege by a claim-right is a critical condition for such a privilege to exist.<sup>149</sup> It is easy to see how this applies to the regulation of resource exploitation in space law, for without a duty of non-interference on the part of others, there can be no actual use of resources by one. To be sure, the legal situation relating to space resources is complicated by the fact that all states have the same freedom to use outer space. Again, this does not warrant a change in legal nomenclature, however, and there is no need to resort to theories of common property to explain the relations between users, non-users and physical space. Hohfeld already clarified that, “whenever the privilege does exist, it is not special in the sense of arising from a special law, or of being conferred as a special favour on a particular individual. The same privilege would exist, by virtue of general rules, for any person whatever under similar circumstances.”<sup>150</sup> This is confirmed by Harris, who notes that, “if a resource is set aside as common property, the rights of use thereby reserved are strictly Hohfeldian privileges [ . . . ] rather than ‘claim rights’. Such privileges are enforceable only in the sense that no other person has a correlative right that they be not exercised.”<sup>151</sup> This supports our conclusion in the previous section that little would be gained by rephrasing the universal freedom to use outer space as a property right. And regardless of whether the outer space environment *in toto* should be considered a global commons determined by common property rights, we are only concerned with the question of whether national appro-

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<sup>148</sup> Balganes, *supra* note 51, 604-605. See also Hohfeld, 1913, *supra* note 24, 36 (“such a privilege or liberty to deal with others at will might very conceivably exist without any peculiar concomitant rights against ‘third parties’ as regards certain kinds of interference. Whether there should be such concomitant rights (or claims) is ultimately a question of justice and policy; and it should be considered, as such, on its merits. The only correlative logically implied by the privileges or liberties in question are the ‘no-rights’ of ‘third parties’”).

<sup>149</sup> *Id.* at 617-618.

<sup>150</sup> Hohfeld, 1913, *supra* note 24, 40.

<sup>151</sup> HARRIS, *supra* note 73, 155-156.

priation can be vested by single users of space in the natural resources thereof, and whether this is indeed necessary for an effective and economic exploitation of the space environment.

Since all parties in international space law have the same privileges or freedoms with regard to outer space, the enforcement of the exercise of the freedom to use outer space with a concomitant duty on the part of others not to interfere morphs from an optional measure into a necessity, without altering the implications of the rights of the user from privilege to property.<sup>152</sup> The exercise of the freedom to use space resources is strengthened by a right not to be interfered with, which sparks a duty not to interfere with the actions of the user, though not, it is stressed, on the basis of a property right over the thing used. In other words, the duty not to interfere is the correlative of the right of the user not to be interfered with, rather than an indication of any type of property right in the thing used. In this respect, Balganesch explicitly excludes the privilege-right to exclude others as the basis of a right of property *qua* right to exclude, even in a situation where the privilege would be 'shielded' by a claim-right: "[b]ecause the remedial alternatives remain premised on the primary one, courts would be restricted to reaffirming or enforcing the privilege alone, in turn delegating much of its application to the holders' abilities."<sup>153</sup> This is exactly what we see in the environment of space resources: even if the maligned first-come, first-served slogan were an accurate representation of the regime on the exploitation of space resources, it would not imply but rather disprove the existence of a property system.

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<sup>152</sup> Rothblatt, when discussing the use of the GSO, shares this view, even if the author mistakenly reclassifies the inclusive freedom to use outer space as an inclusive *right*. See Rothblatt, *supra* note 131, 225 ("an inclusive right to use the geostationary orbit would be meaningless without a protected right (or the satellite's life) to enjoy one's share - an orbital position and frequency band within the orbit-spectrum resource"). Or, in the words of Stull and Alexander, "[a] system . . . which purports to divide rights . . . among competing individuals for the public benefit but fails to prevent these individuals from interfering with each other is nothing more than a sham." M.A. Stull and G. Alexander, *Passive Use of the Radio Spectrum for Scientific Purposes and the Frequency Allocation Process*, 43 J. AIR L. & COM. 476 (1977) .

<sup>153</sup> Balganesch, *supra* note 51, 617.

#### IV. PRINCIPLE OF EXCLUSIVE EXPLOITATION FOR FUNCTIONAL DURATION

The agenda-setting approach to property makes explicit the implied link between property and sovereignty as corresponding concepts in the private and public law spheres guided by undivided authority over others.<sup>154</sup> We may illustrate this link by calling to mind the characterization of sovereignty in the Palmas arbitration case by Max Huber, who famously noted that “[s]overeignty in the relations between states signifies independence. Independence in regard of a portion of the globe is the right to exercise therein to the exclusion of any other state the functions of a state.”<sup>155</sup> The analogy between both concepts is interesting for it adds further substance to the argument that property by private individuals is implicitly proscribed by the prohibition of national appropriation, as both are rooted in the same rationale. The parallel between sovereignty and appropriation is so strong that many authors writing in international space law use both concepts almost synonymously. As such, Fawcett writes that

[t]he only way in which any part of outer space could be appropriated by a State would be by its effectively denying access to it of spacecraft of other States; and free exploration and use entail that every part of outer space shall be open under international law to all spacecraft without interference. It follows that the principles of free use and non-appropriation must [imply that] no State can exercise exclusive jurisdiction or control, so as to deny or interfere with the access of any spacecraft to any part of outer space.<sup>156</sup>

The equation of appropriation with sovereignty is made most commonly in order to justify the limitation of Article II of the Outer Space Treaty to territorial sovereignty. It is axiomatic, however,

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<sup>154</sup> See Cohen, *supra* note 55, 29 (“[t]here can be no doubt that our property laws do confer sovereign power on our captains of industry and even more so on our captains of finance”). See also Katz, *supra* note 23, 278 (“[a]n exclusivity-based approach to ownership revives the old analogy of ownership to sovereignty. Ownership, like sovereignty, relies on a kind of notional hierarchy, in which the owner’s authority to set the agenda is supreme, if not absolute, in relation to other private individuals”).

<sup>155</sup> Island of Palmas (or Miangas) (United States of America v. Netherlands), Award, Permanent Court of Arbitration, REPORTS INT’L ARBITRAL AWARDS Vol. XI, 838.

<sup>156</sup> J.E.S. FAWCETT, INTERNATIONAL LAW AND THE USES OF OUTER SPACE 22 (1968).

that sovereignty and property should not be regarded as synonyms.<sup>157</sup> In the context of space law, in particular, the distinction between both should be respected, no matter how closely their content may resemble each other. For Article II, it is recalled, proscribes national appropriation in general, while sovereignty is merely listed as one of several means through which property rights may be established. Hence, the provision's language reveals a connotation of the property notion that is far broader than mere sovereignty. If the latter is necessarily aligned with the territorial competences of a state, the other modalities of Article II point to a broader scope of application that would be wholly negated by the arbitrary exclusion of natural resources. Rather than reinterpreting the reference to national appropriation and sovereignty as a duplicitous proscription of the latter only, the specific formulation of Article II thus underscores the need for a proper understanding of property rights in the context of international space law as broadly outlawing any form of exclusion from segments of outer space that is not accompanied by actual use, regardless of their qualification as areas or resources.

While property rights distinguish themselves through exclusion in order to use, the essence of rights over space resources is exclusion through use, and the former only exists by virtue of the latter. States' rights over space resources arise only through their lawful use of these resources; they are rights to use, though not to use unrestrictedly, and the proscription of others to interfere is not absolute but exists only to the extent that such interference would prevent the use of the area or resource for the goal that originally justified the exclusion. If property entails the disconnection of exclusion from actual use and international space law proscribes the national appropriation of outer space by states, a violation of Article II occurs when rights are claimed over resources in space that do not arise from and during actual use. If they can only be acquired *through* actual use, they can only be exercised *during* this use. As noted by Goedhuis:

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<sup>157</sup> Stressed, in the context of international space law, in M.G. Markoff, *Moon Landing and International Law*, 3 IL DIRITTO AEREO 31 (1964), and for property law, in Katz, *supra* note 23, 295.

[i]t is suggested that [...] any earmarking, any efforts to reserve areas of outer space for exclusive use would be contrary to the aim and purpose of the Treaty; that it is only when the exploration and use takes place in effect that States should be allowed to exercise certain rights over such areas.<sup>158</sup>

Far from being a matter of conjecture that is vaguely implied by the aim and purpose of the space treaties, our understanding of property as distinguished by exclusion, even without use, reveals that 'earmarking' is, in a very literal way, what is proscribed by Article II of the Outer Space Treaty. If this entails that no claims can be made with respect to resources that have never been used, it also implies that, no matter how extensive and lengthy instances of actual use may be, they cannot result in property rights that remain after use. This is exactly what is meant by the 'by means of use' modality in Article II of the Outer Space Treaty and Article 11 (2) of the Moon Agreement.<sup>159</sup>

To be sure, some form of 'preferential rights' may be acquired by a state on the basis of its previous efforts and activities. Just as the Moon Agreement recognizes that the efforts made by the first one to exploit certain resources may be reflected in the distribution of benefits from this exploitation,<sup>160</sup> space law doctrine generally recognizes that a state actually using a resource may be granted some form of preferential treatment, in addition to the rights of non-interfered use that are secured through the exercise of its freedom to use.<sup>161</sup> These rights are invariably limited by the duration of the actual use, however, and in particular should not be mistaken

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<sup>158</sup> D. Goedhuis, *Some Legal Problems Arising From the Utilization of Outer Space*, in REPORT OF THE FIFTY-FORTH CONFERENCE, FROM 23-29 AUGUST 1970 IN THE HAGUE, NETHERLANDS 430 fn. 40 & 38 (ILA 1970). The suggestion can be traced back to F. Vallat, *The Outer Space Treaty*, 1969 AERONAUTICAL J. 754 (1969).

<sup>159</sup> S. Freeland and R.S. Jakhu, [*Outer Space Treaty:*] *Article II*, in COLOGNE COMMENTARY, VOL. I: OUTER SPACE TREATY 44-63 (S. Hobe, B. Schmidt-Tedd and K.-U. Schrogl, eds., 2009). See also the interpretation offered by the representative of Belgium to the UNCOPUOS at the time of adoption of the Outer Space Treaty, who construed it as meaning that use would not produce a condition of sovereignty, nor would it lead to the creation of titles to property in private law. UNCOPUOS Leg. Subcomm., *Summary Record of the Seventy-first Meeting*, U.N. Doc. A/AC.105/C.2/SR.71 (Aug. 4, 1966) and Addendum 1, at 7 U.N. Doc. U.N. Doc. A/AC.105/C.2/SR.71 add. 1 (Oct. 21, 1966).

<sup>160</sup> Moon Agreement, Art. 11 (7), sub d.

<sup>161</sup> Zhukov agrees that states arriving first on a celestial body should have some minimal greater rights with respect thereto than others. See comments in Smirnoff, *supra* note 117, 22.

for watered-down property rights. In his discussion of the regulation of activities on celestial bodies, Markoff concedes that the legitimate interests of the state exploiting a resource should be translated into certain preferential rights. However:

[l]es droits préférentiels de nature exclusive ne peuvent pas se transformer en droits acquis. Ils ne peuvent exister que durant la période de fonctionnement de la station planétaire. Une fois que l'objet spatial s'est envolé vers la Terre, ou la station démontée, déplacée à un autre endroit ou simplement supprimée, soit par l'achèvement des travaux, soit par l'abandon des activités et le transfert des installations ailleurs, l'Etat compétent ne peut plus revendiquer aucun droit d'établissement sur le même site. Celui-ci peut légitimement être engagé, par l'objet spatial appartenant à un autre Etat.<sup>162</sup>

Valters discerns between lawful use and unlawful appropriation on a similar basis, by noting that "certainly a state cannot legally claim a particular orbital 'parking slot' merely by virtue of having had a satellite in that 'parking slot.'"<sup>163</sup> Lachs' views on the regime of space resources, too, closely resemble a recognition of the right to use without resulting in a future title to exclusive rights:

[n]either priority in discovery nor the mastery of technical facilities could constitute a title to exclusive rights in this field [of the use and exploitation of natural wealth and resources on celestial bodies]. Those who command these special possibilities may no doubt be entitled to claim that their efforts leading to the discovery and use of the facilities or resources should duly be taken into account. This could not, however, affect the basic principles: that the Moon and celestial bodies are 'not subject to national appropriation,' and that the exploration and use of outer space and celestial bodies 'shall be carried out for the benefit and in the interest of all countries.'<sup>164</sup>

The author adds that, while the fact that the actual use of space is still the privilege of a minority of states cannot be altered

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<sup>162</sup> Markoff, *supra* note 104, 657.

<sup>163</sup> Valters, *Perspectives in the Emerging Law of Satellite Communication*, 5 STAN. J. INT'L STUD. 66 (1970).

<sup>164</sup> Lachs, *supra* note 40, 45.

by space law, “what the latter can do, however, is to refuse to sanction situations which may close the door to equal rights and benefits for all States in the future.”<sup>165</sup> As such, the proscription of appropriation remains as a guarantee for inclusive use without, however, limiting the freedom to use outer space. Or, in the words of Doyle: “[t]he fact that the use of a celestial body may not justify a declaration of national sovereignty over that body is not the same as saying ‘because one cannot declare sovereignty one cannot use.’ The OST says the opposite.”<sup>166</sup> Whatever rights are acquired through use, they remain limited to the duration of the use. And while the duration of this use may be indefinite, this does not pose a problem in light of Article II as such, for the use cannot, legally, result in property rights.<sup>167</sup>

Hence, it is clear that the exploitation of space resources does not involve, *nor does it require*, a *right* to exclude others, for exclusion in space does not follow from an exercise of authority other than the authority inherent in the universal freedom to use outer space. There is no *option* to exclude others when exploiting resources, for the enforceability of the right not to be interfered with exists only when the resource is actually and lawfully in use, in which case the exclusion of others derives from the actuality of the use itself.

## V. CONCLUSION

Our renewed understanding of the concept of property rights allows us to reconcile the practice of tangible resource exploitation as conceived by private space enterprises with the language of the existing international treaties on the subject. Any allegations of unlawfulness of the exploitation of material resources on celestial bodies for reason of their exclusivity through consumption fail to take into account the link with the right to use outer space and the au-

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<sup>165</sup> *Id.* at 43.

<sup>166</sup> Doyle, *supra* note 12, 114. See also S.E. Doyle, *Issues of Sovereignty and Private Property* in LUFT- UND WELTRAUMRECHT IM 21. JAHRHUNDERT: LIBER AMICORUM KARL-HEINZ BÖCKSTIEGEL 315 (M. Benkö and W. Kröll, eds., 2001).

<sup>167</sup> See C.Q. CHRISTOL, SPACE LAW: PAST, PRESENT, AND FUTURE 113 (1991) (“Article 2 of the 1967 Principles Treaty [*sic*] means that the early and continuing use by the United States of the orbit/spectrum resource does not convert the ‘first-come, first-served’ doctrine into a base upon which exclusive, *i.e.* sovereign, rights may be asserted”).

thority component of property. Hence, Fasan's contention that "destruction of an object [...] is the ultimate appropriation,"<sup>168</sup> though intuitively sensible, proves utterly misleading. For consumption *through the exercise of a universal freedom to use* is not the same as destruction emanating from a *right to destroy*, without realization of the resource's economic potential. The latter is legally speaking an exponent of the right not to use, in that it only mirrors the exclusivist consequences of consumption, without the utilitarian justification therefor. It can be explained, not as an exercise of the freedom to use, but only with reference to the right not to use as the defining emanation of the particular relationship between exclusion and use so characteristic of property.

Which brings us back to the property implications of permanent exclusion following the consumptive use of tangible resources. Indefinite exclusion of others through instantaneous use of resources by one is particularly problematic in a legal regime characterized by the absence of property, for the consumption appears to sever the link between exclusion and use. When discussing the regime on the use of orbital positions, limitations in time are sometimes offered as a safeguard to restrict the impact on others of the continued use of limited resources by some. An isolated focus on the duration of the exclusion, without contemplating its original link with actual use, as a ground for raising suspicions of *de facto* appropriation, both in the context of orbital positions and the use of consumable resources, is thoroughly misplaced, however, as it rests on the *a contrario* assumption that property necessarily entails an element of longevity or permanence. This of course is dubious at best, as is demonstrated, for example, by the regime of intellectual property rights. Though always limited in time, there is no doubt that these rights retain their qualification as property.<sup>169</sup>

If the above shows that property rights can exist even when limited in time, it also implies that the permanent nature of exclusion does not provide an insurmountable hurdle for dispelling the

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<sup>168</sup> E. Fasan, *Asteroids and Other Celestial Bodies - Some Legal Differences*, 26 J. SPACE L. 39 (1998) (reiterated in Lee, *supra* note 13, 188. See also L. VIHKARI, FROM MANGANESE NODULES TO LUNAR REGOLITH: A COMPARATIVE LEGAL STUDY OF THE UTILIZATION OF NATURAL RESOURCES IN THE DEEP SEABED AND OUTER SPACE 109 (2002).

<sup>169</sup> See Penner, *supra* note 23, 761.

existence of property rights in material resources. Again, what matters is the nature of the relation between the exclusion and use of the resource at hand to discern whether the exploitation in question rises to the level of property. Just as the material or immaterial nature of the thing owned does not alter the legal requirements for ownership, the fact that consumptive destruction entails indefinite exclusion does not change the legal nature of the relationship between the user and non-users. For while the exclusion is not limited to the period of actual use - which is, after all, only momentary - there remains a definite link between the actual use and the exclusion, in that the latter is tolerated only as a precondition for, and consequence of, the exercise of the freedom to use outer space. Hence, if we accept that the exploitation of resources is allowed, in general, under current space law provisions, there is no reason to bar the consumption of resources from celestial bodies in particular, for objections thereto appear to rest on an incorrect understanding of the national appropriation proscription as barring destructive use of resources rather than destruction without use.

Returning to the recent legal developments that inspired this article, our approach to property rights means that the friction created between US space commercial legislation and international space law, through the adoption of the Space Resource Act, appears to be largely theoretical, if our concern is one of violating the non-appropriation provision through the act of resource extraction. To the extent that legal certainty for attracting commercial investments in a high-risk endeavour was the driver for the 2015 Act, the introduction of property rights over removed resources seems less decisive than the, ultimately abandoned, regime of civil action for relief from harmful interference in case of competing activities relating to the same resource. Indeed, granting property rights after extraction would still leave unaddressed the crucial period leading up to the actual point of resource exploitation, as well as the issue of exclusivity over the mining site as such during this activity.

Hence, what is needed is a clear, simple and predictable regime dealing with competing claims over mining sites on celestial bodies both before and during the excavation of valuable resources. Previous versions of the Space Resource Act already contained some indications as to how we should proceed in setting up this regime, though it understandably only dealt with competition between US

citizens. The plans already announced by Luxembourg and, possibly, the United Arab Emirates, to promulgate legislation covering the exploitation of resources from celestial bodies indicates that we will also need international initiatives in this respect sooner rather than later. The general exchange of views expected to take place on the occasion of the 2017 session of the Legal Subcommittee of the UN COPUOS may be a first step in this direction, though the road ahead remains long and perilous.

# GREEN FOR LIFTOFF: STRUCTURAL CHANGES FOR ENVIRONMENTAL AND ECONOMIC SUSTAINABILITY IN SPACE LAUNCHING

*Justin Fisch\**

## I. INTRODUCTION

### *A. Rationale of research*

Space has never been a particularly “green” industry, whether on Earth or in outer space. On our home planet, the space sector has damaged waterways, littered debris, caused nuclear pollution, and released countless harmful chemicals into every layer of the atmosphere.<sup>1</sup> In outer space, the industry has left thousands of dangerous pieces of debris, impacted celestial bodies, and contaminated a previously unblemished natural environment, all within a span of six decades.

Environmental damage in the space sector is often analogized to harms occurring in the air, the high seas, the deep seas, or even, Antarctica.<sup>2</sup> Garrett Hardin’s Tragedy of the Commons helps explain this phenomenon, wherein individual activities account for

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<sup>1</sup> Executive Summary, Final Report, *ecoSpace: Initiatives for Environmentally Sustainable Launch Activities*, International Space University: Strasbourg, 2010.

<sup>2</sup> LOTTA VIHARI, THE ENVIRONMENTAL ELEMENT IN SPACE LAW: ASSESSING THE PRESENT AND CHARTING THE FUTURE 206 (2008).

little gross environmental impact, but accumulated damage renders a common space environmentally distraught.<sup>3</sup> As such, the history of space exploration has seen individual missions derive benefits from environmentally-harmful activity, while causing an overall detriment to future space exploitation.<sup>4</sup> For this reason, the international community has agreed on common rules to safeguard the future of human activities in the space environment, broadly encapsulated in Article IX of the 1967 Outer Space Treaty, banning contamination that had the potential to cause harmful interference with human space activities or life on Earth.<sup>5</sup>

Yet where international regulation has made a modicum of difference in the sphere of outer space,<sup>6</sup> the terrestrial impacts of space activity have been largely ignored.<sup>7</sup> Oversight of the Earth's biosphere is thus left to national and local jurisdiction, with some international oversight in the form of bilateral treaties, settlement agreements, and the broad provisions of the Liability Convention.<sup>8</sup>

This lacuna in international environmental space law presents vulnerability in environmental protection on a global scale. Due to the highly competitive and expensive nature of the space sector, customers—commercial and governmental—seek out the most remunerative launch opportunities in an international industry.<sup>9</sup> The lack of space launch regulation has the potential to lead to a “race to the bottom”<sup>10</sup> in the industry, enticing entrepreneurs to take

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<sup>3</sup> Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

<sup>4</sup> Viikari, *supra* note 2, at 4.

<sup>5</sup> Although scholars will argue that the considerations brought about by international regulation on the law of space are exclusively meant to safeguard future human activity, and have little concern for the natural space environment. *See generally*, Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

<sup>6</sup> Many publicists would argue that international space law is not at all environmental. *See, e.g.*, Viikari, *supra* note 2.

<sup>7</sup> *Id.* at 52.

<sup>8</sup> Convention on International Liability for Damage Caused by Space Objects, *opened for signature* Mar. 29 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention]. These provisions find their base in the Outer Space Treaty, *supra* note 5.

<sup>9</sup> Viikari, *supra* note 2 at 323.

<sup>10</sup> For further insight on the socio-economical “race to the bottom” phenomenon, *see* Michael Ashby, Zach Goldstein, & Carly Van Dort, *A Race to the Bottom: The Adverse Effects of Globalization on Environmental Standard*, University of Michigan Global

their launch business to the most economical and least regulated launch sites,<sup>11</sup> essentially creating a “flag of convenience” in the global space industry.<sup>12</sup>

In accordance with the precautionary principle in environmental law,<sup>13</sup> policy and regulatory research is needed in order to prevent a race to the bottom in the space sector. The research proposed is current and topical, in that ten countries (and counting) now possess space launch capabilities with indigenous rockets.<sup>14</sup> Yet only five of these states have been properly surveyed for adequate environmental protection in the launch sector.<sup>15</sup> In accordance with the scientific uncertainty, as well as technical and political challenges that underlie the space sector, the rationale of this paper is to briefly canvass the existing policy and legal framework at a crucial time for the industry.

### *B. Objective of Research*

The research will focus on the environmental impacts of space launches, drawing on the historically diverse uses of space, from its military beginnings to its current commercial reality. The paper strives to offer a brief comparative approach to national and local environmental laws with regard to space launches, in order to properly situate them within the appropriate international legal framework.

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Change, <http://www.globalchange.umich.edu/globalchange2/current/work-space/Sect007/s7g3/index.htm>.

<sup>11</sup> Armel Kerrest, Space Debris, *Remarks on Current Legal Issues*, 2 Proc. of the Third European Conf. on Space Debris 869 (2001).

<sup>12</sup> Flags of convenience are an issue that the domains of air and space law have been largely able to avoid. Contrastingly, the maritime industry has wholly suffered from flags of convenience: *See, e.g.*, GBENGA ODUNTAN, SOVEREIGNTY AND JURISDICTION IN THE AIRSPACE AND OUTER SPACE 75 (2012).

<sup>13</sup> Stephan Hobe, Book Review, 26 Space Policy 128 (2010) (reviewing LOTTA VIKARI, *THE ENVIRONMENTAL ELEMENT IN SPACE LAW: ASSESSING THE PRESENT AND CHARTING THE FUTURE* (2008)).

<sup>14</sup> Jonathan O’Callaghan, Space Answers, How many countries have rockets capable of reaching space? (Mar. 21, 2013), <http://www.spaceanswers.com/space-exploration/how-many-countries-have-rockets-capable-of-reaching-space/>.

<sup>15</sup> ISU Final Report, *supra* note 1.

Following, the paper's objective is to present a broad survey of international environmental protections and regulation, both binding and not, while suggesting room for improvement on international protocol. The paper concludes with an outlook to the future of impact assessments and regulation for space launches, while highlighting best practices and room for improvement.

It is important to note that this article is limited to policy regarding protection of the terrestrial environment in launch settings. Whereas environmental problems in outer space are also vital to the sustainability of the industry, they have been well surveyed by various authors.<sup>16</sup> Moreover, the paper's objective is to offer a critical analysis of regulation as a precondition for launch site selection. Therefore, the piece will not address issues of space debris, nuclear contamination, and exobiological contamination not directly associated with launch settings.<sup>17</sup> In limiting the scope of the article, particular focus will be paid in local site affect, terrestrial impact assessment, ocean contamination, hazardous exhaust, and impact contamination from return to Earth.

## II. LITERATURE REVIEW

### *A. Background*

Literature on environmental aspects of space law is growing at a fast rate. Interest in the field comes from a variety of stakeholders, including academics, students, industry professionals, governments, and potential launch customers. Environmental analysis of space law comes from a various points of view, including scientific, engineering, technological, practical, political, legal, and business. The most common material in the field includes books, journal articles, public reports, commercial press pieces, and journalistic investigations. These second-hand analyses are complemented with a range of official documents, from acts and regulations to case law.

In order to specifically analyze the launch industry, a cross-disciplinary literature review was undertaken. Diverse scientific reports and industry publications were studied to understand the

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<sup>16</sup> Including, but not limited to Viikari, *supra* note 2; MATTHEW J KLEIMAN, THE LITTLE BOOK OF SPACE LAW (2013); and ISU Final Report, *supra* note 1.

<sup>17</sup> For further reading on these subjects, a fine reference is: Viikari, *supra* note 2.

technical challenges to green launching.<sup>18</sup> Following, a general read on international environmental law was done, so as to comprehend the place of space in this broad field.<sup>19</sup> Lastly, specific investigation on space law and its environmental applications was performed.<sup>20</sup>

The last portion of the review proved most challenging, as little has been written regarding the “environmental element” in space law.<sup>21</sup> Even more difficult proved to be narrowing the ambit of research to specific application of environmental considerations in space launches. As discussed in the Introduction, environmental application of space law is a large area, focused generally on outer space itself. Few authors have addressed the terrestrial impacts of space launches, to which this article seeks to add a modicum of detail.

### *B. Technical Challenges to Green Launches*

Space launching is an inherently polluting industrial activity. From rocket manufacturing to attaining orbit, numerous environmental harms are committed. The concept of “green launching” seeks to minimize these harms so as best to protect the surrounding environment and pave the way (so to speak) for a sustainable industrial model in an era of growing space needs and activity.<sup>22</sup> In this section, we study three of the greatest environmental challenges affected the space launch industry: payload separation, fuel use, and failed launches.

#### 1. Payload Separation

Planned environmental harm is that which is foreseen in the concept of the launch. The most common example in modern-day rocketry is payload separation, wherein stages gradually detach

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<sup>18</sup> *E.g.*, Kleiman, *supra* note 16.

<sup>19</sup> DANIEL BODANSKY, JUTTA BRUNNÉE, & ELLEN HEY, *THE OXFORD HANDBOOK OF INTERNATIONAL ENVIRONMENTAL LAW* (2007).

<sup>20</sup> Viikari, *supra* note 2.

<sup>21</sup> To borrow the term from Viikari, *id.*

<sup>22</sup> Kleiman, *supra* note 16.

from the intended orbit vehicle on its way to space.<sup>23</sup> Although research and development is underway to develop new rocket-less launch technologies, such as space elevators and mass drivers,<sup>24</sup> most current launch methods require payload separation. The sole exception is Virgin Galactic's stratolaunch system.<sup>25</sup> However, this launch method is currently under development, and recently suffered a major drawback due to a failed launch in November 2014.<sup>26</sup>

Although dropped rocket stages are generally not considered a significant environmental contaminant by the launch industry, public opinion regarding perception of environmental responsibility is increasing.<sup>27</sup> Scientifically, payload separation is detrimental to the environment as a result of its impact back on Earth, following a split from the orbiting vehicle. Dropped payload can impact sea or land, depending on launch trajectory and launch site.<sup>28</sup> Currently, Russia and China have the most notable operations involved planned payload drops over land, from the Baikonur Cosmodome and Xichang Spaceport, respectively.<sup>29</sup> Whether coming down on land or in the sea, rocket stages can have a considerable environmental impact on the terrestrial ecosystem they affect. Upon crashing into the ocean, for instance, stages can break up into many small pieces, floating to the surface or sinking to the bottom.<sup>30</sup> Animals may be killed by the impact or consumption of the former rocket pieces.

More concerning, however is the dispersion of large amounts of unburned fuel on the surface of land or sea. Rocket tanks retain

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<sup>23</sup> Donna Lawler & Anthony Lloyd, ITechLaw, Legal Aspects of Launches and Satellite Operations, <http://asia.itechlaw.org/assets/ITECHLAW/2-Anthony-Lloyd-and-Donna-Lawler.pdf>.

<sup>24</sup> ISU Final Report, *supra* note 1, at 47.

<sup>25</sup> Ram Jakhu, General Principles of Space Law: Legal Status of Outer Space and Celestial Bodies, course lecture presentation at the McGill Institute of Air and Space Law (Oct. 6 2014).

<sup>26</sup> Virgin Galactic, [www.virgingalactic.com](http://www.virgingalactic.com) (last visited Aug. 28, 2016).

<sup>27</sup> ISU Final Report, *supra* note 1 at 26.

<sup>28</sup> FRANCIS LYALL AND PAUL B LARSEN, SPACE LAW: A TREATISE 116 (2009).

<sup>29</sup> ISU Final Report, *supra* note 1, at 23.

<sup>30</sup> ICF Kaiser Consulting Group, FINAL ENVIRONMENTAL ASSESSMENT FOR THE SEA 31 (1999), available at [https://fas.org/spp/guide/ukraine/launch/2\\_99Bslea.pdf](https://fas.org/spp/guide/ukraine/launch/2_99Bslea.pdf) (last visited Aug. 28, 2016).

approximately 9% of their propellant following detachment,<sup>31</sup> endangering both people and wildlife.<sup>32</sup> When this highly fuel comes back to Earth, it has the potential to spread over several kilometers, causing serious health problems for the local population and ecosystem.<sup>33</sup> Mitigation of payload separation harm currently takes the form of planned drop trajectories, but even these can deviate.<sup>34</sup>

## 2. Fuel Use

Another significant technical challenge to green launches is propellant input. Fuel use in today's industry is often synonymous with rocket choice and launch venue, as each particular rocket generally accepts its own mix of propellants, which vary greatly in environmental impact.<sup>35</sup> Whereas fuel choice is vital to future green launches, it is important to note that all current fuels are greatly detrimental to the local and atmospheric environments with which they interact.<sup>36</sup> Modern rocket propellants utilize highly toxic chemical compositions and contribute harmful gases into the atmospheric layers with which they interact.<sup>37</sup>

Although small on a global scale, a rise in rocket launch emissions could have deleterious consequences on the world's atmosphere.<sup>38</sup> In a recent study, climate scientists theorized that as few as one thousand yearly launches could lead to worldwide climate change.<sup>39</sup> Current negative effects of launch fuel include increasing levels of acid rain<sup>40</sup> and entrapment of black carbon in the upper reaches of the stratosphere.<sup>41</sup> Moreover, rockets deposit particulate matter directly into all layers of the Earth's atmosphere, from the

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<sup>31</sup> ISU Final Report, *supra* note 1.

<sup>32</sup> *Id.* at 3.

<sup>33</sup> Viikari, *supra* note 2, at 14.

<sup>34</sup> ISU Final Report, *supra* note 1, at 28.

<sup>35</sup> *Id.* at 31.

<sup>36</sup> A Sergeeva, "Analysis of the impact of rocket and space activities on the environment" (2004).

<sup>37</sup> Viikari, *supra* note 2, at 14.

<sup>38</sup> Kleiman, *supra* note 16, at 39.

<sup>39</sup> Adam Mann, Space Tourism to Accelerate Climate Change (Oct. 22, 2010), <http://www.nature.com/news/2010/101022/full/news.2010.558.html> (last visited Aug. 28, 2016).

<sup>40</sup> Viikari, *supra* note 2, at 14, 30.

<sup>41</sup> Jon Krois, *Onwards and Upwards: Space Tourism's Climate Costs and Solutions*, 37 COLUM. J. ENVTL. L. 40 (2011).

troposphere to the stratosphere.<sup>42</sup> The release of even trace amounts of ozone depleting and global warming inducing particulates has the potential to significantly modify global ozone levels in the coming years.<sup>43</sup>

Modern technology does not allow for harmless fuel use.<sup>44</sup> As such, “green propellants” are a general category of fuels that earn industry-leading scores in low toxicity, low pollution impact, and sustainable materials.<sup>45</sup> The most eco-friendly propellant in use today is a liquid-hydrogen/liquid-oxygen combination used by the US’s Delta UV rockets and the European Ariane 5.<sup>46</sup> In contrast, the most polluting fuels in the industry is unsymmetrical dimethylhydrazine/nitrogen tetroxide, currently in use by Russia’s Proton and China’s Long March rockets.

The technical challenges underlying green fuel development are just as real as the economic and commercial challenges in the space industry, due to the high cost of rocket conversion. The greenest fuels can be retrofitted into current rocket models, but at a significant cost.<sup>47</sup> Moreover, new rocket designs and fuel combinations come with restrictively high insurance rates in their first launches, inhibiting proper technological development in a now private space industry.<sup>48</sup>

### 3. Launch Failure

Finally, the last significant technical challenge inhibiting environmentally-friendly space launches is launch success rate, and the environmental consequences that come about in a failed launch. Although launch success has greatly improved in the last decades, there still remains approximately a one in twenty risk<sup>49</sup> of launch

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<sup>42</sup> Kleiman, *supra* note 16, at 39.

<sup>43</sup> *Id.* at 41.

<sup>44</sup> However, there is research being done in the realm of alternate propulsion, in the form of solar-electric, magnetic levitation, and laser propulsion. ISU Final Report, *supra* note 1, at 16.

<sup>45</sup> *Id.*

<sup>46</sup> *Id.* at 9.

<sup>47</sup> ISU Final Report, *supra* note 1.

<sup>48</sup> *Id.*

<sup>49</sup> Launch success rates have improved steadily since the 1990s. The years between 1990-1999 saw a success rate of 92.8%, and 2000-2009 was 94.1% successful. *See*, SPACE LAUNCH REPORT, WORLDWIDE SPACE LAUNCH BOX SCORE (Dec. 4, 2014), <http://www.spacelaunchreport.com/logyear.html>.

failure, an average of over two failures per year. Upon failure, large quantities of unburned fuel are dispersed on the surface of the Earth and in the ocean, often in close proximity to the launch site.<sup>50</sup> Unlike in payload separation or regular propellant use, launch failures feature an extreme concentration of fuel in one specific ecosystem, exacerbating the injury and further prolonging Earth's natural recovery processes.

Launch failures are an inherent reality in the still nascent phase of human space exploration. What is more, launch failures have the potential to increase as further "green" technological developments are pushed on the industry.<sup>51</sup> The scientific uncertainty and risk accompanied with spaceflight are poignantly visible in launch failures, ranking among the most serious public concerns about space agencies, worldwide.<sup>52</sup>

In attempting to lessen the environment impact of space launches, there is the potential of making it (albeit hopefully temporarily) worse, a difficult political decision for space agencies and launch operators.

### *C. Space in General Environmental Law*

General international environmental law is primarily governed by international treaties and principles of customary law. The underlying principles of sustainable development and environmental protection are said to have been first introduced at the 1972 UN Conference on the Human Environment (Stockholm Conference), where states recognized the importance of protecting the environment as the "desire of the peoples of the whole world and the duty of all governments."<sup>53</sup> It is important to note that the Stockholm Declaration was signed after the negotiations and deliberations leading to the 1967 Outer Space Treaty and the 1972 Liability

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<sup>50</sup> ISU Executive Summary, *supra* note 1.

<sup>51</sup> Viikari, *supra* note 2, at 44.

<sup>52</sup> ISU Final Report, *supra* note 1, at 61.

<sup>53</sup> UN Declaration of the United Nations Conference on the Human Environment, UN Doc A/CONF 48/14/Rev 1 (June 5-16, 1972) [hereinafter Stockholm Declaration]. See also Oscar Schachter, *The Emergence of International Environmental Law*, 44 J. Int'l Affairs 457 (1991).

Convention, thus underlining the lack of terrestrial environmental considerations in the latter treaties.<sup>54</sup>

The environmental movement as a whole has largely ignored space utilization.<sup>55</sup> No international agreements have specific space provisions, despite the increasing importance of the industry. However, three particular treaties are applicable and important to space launches, as presently formulated: (1) the 1979 Geneva Convention on Long-Range Transboundary Air Pollution (Air Pollution Convention), (2) the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol), and (3) the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change (Kyoto Protocol).<sup>56</sup> Moreover, soft and customary international law have an acknowledgeable effect on space in international law.

### 1. International Legislation

The Air Pollution Convention aims to reduce air pollution across international borders, with specific substances being of particular interest.<sup>57</sup> It is not yet clear if this agreement is applicable to space, as no formal complaint has been lodged with respect to transboundary air pollution caused by rocket launches.<sup>58</sup> However, the informative, collaborative, and consultative management of the treaty body has the potential to inform discussions on reduction of rocket pollution in a cross-boundary context. Yet, not all of the major space-faring nations have ratified the Convention. China, Japan, North Korea, South Korea, India, Israel, and Brazil are notably absent.

The Montreal Protocol calls for the reduction and eventual phasing-out of ozone-harmful substances.<sup>59</sup> Following up on the 1985 Vienna Convention for the Protection of the Ozone Layer, the two agreements call on states to “take appropriate measure... to

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<sup>54</sup> It has been argued that the environmental considerations in these treaties are strictly to safeguard human activity, and not for genuine environmental concerns: Viikari, *supra* note 2, at 285.

<sup>55</sup> *Id.* at 13.

<sup>56</sup> ISU Final Report, *supra* note 1, at 43.

<sup>57</sup> Some of these include aldrin, chlordane, and dieldrin, for instance.

<sup>58</sup> ISU Final Report, *supra* note 1.

<sup>59</sup> Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, 1522 UNTS 3 [hereinafter Montreal Protocol].

protect human health and the environment against adverse effects resulting ... from human activities which modify... the ozone layer.”<sup>60</sup> It is the most successful international environmental agreement ever, with all UN member states signing and ratifying the treaty.<sup>61</sup> Despite its successes, it has little practical effect on the space launch industry. Its definition of ozone depleting chemicals is currently too narrow to include halogenated ozone depleting chemicals, of which launch fuels form a part.<sup>62</sup> As such, the space launch sector is one of the only remaining industries that actively depletes the ozone layer, without commercial or regulatory incentives to change its behavior.<sup>63</sup>

The Kyoto Protocol’s goal is to reduce greenhouse gas emissions by developed countries set percentage reduction targets and strong national implementation programs.<sup>64</sup> Kyoto has had mixed implementation results, with various countries making concerted efforts to reach their stated targets, others never signing (such as the United States), and still more withdrawing (notably, Canada). However, Kyoto was written to exclude international aviation and space activity.<sup>65</sup> As such, there is little incentive for launch operators to reduce their carbon emissions, given the lack of regulatory incentive, even in Kyoto-abiding states. With current climate change estimates proving worse than anticipated,<sup>66</sup> the lack of regulation in this area is worrisome, stated lightly.

## 2. Soft Law

The precautionary principle is an evolving principle of international environmental law. It encourages states to act in order to

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<sup>60</sup> Vienna Convention for the Protection of the Ozone Layer, Mar. 22 1985, 1513 UNTS 293 [entered into force 22 Sep 1988].

<sup>61</sup> United Nations Environmental Programme, Key Achievements of the Montreal Protocol to Date, [http://www.unep.ch/ozone/Publications/MP\\_Key\\_Achievements-E.pdf](http://www.unep.ch/ozone/Publications/MP_Key_Achievements-E.pdf) (last visited Aug. 28, 2016).

<sup>62</sup> ISU Final Report, *supra* note 1, at 43.

<sup>63</sup> ID PH DIEDERIKS-VERSCHOOR & V KOPAL, AN INTRODUCTION TO SPACE LAW 131 (3d ed. 2008).

<sup>64</sup> Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10 1997, UN Doc FCCC/CP/1997/7/Add 1, 37 I.L.M. 22 (1998) (entered into force 16 Feb 2005) [hereinafter Kyoto Protocol].

<sup>65</sup> ISU Final Report, *supra* note 1, at 43.

<sup>66</sup> Krois, *supra* note 41, at 41.

prevent environmental damage, even if there is still lingering scientific uncertainty on an issue.<sup>67</sup> The precautionary principle has been argued to be a principle of customary international law,<sup>68</sup> and forms an important part of numerous international environmental agreements and domestic environmental law frameworks.<sup>69</sup> It underlies the rationale for environmental assessments and impact statements, a common practice among launch states. The precautionary principle is ideally suited as a basis for environmental space legislation, due to its accord with the scientific uncertainties and risks that accompany space exploration.

Intergenerational equity is the implication that our legal framework should not work solely for the present, but should also take into account the interests of future generations.<sup>70</sup> The concept is common in global environmental regulation, as well as national environmental law, particularly in natural resource extraction, where trust funds are set up to account for the depletion of access to environmental goods for future generations.<sup>71</sup> Of notable example is Argentina's constitutional requirement that national space activities not "compromise the needs of future generations."<sup>72</sup> In space, the greed of the present generation risks compromising future opportunities for space exploration, which is as true in terrestrial space application as outer space regulation. The lacuna in this area is a notable void in regulation.

### 3. Domestic Environmental Law

Note: This topic is further discussed in the following subsection "Environmental Protection of Space Law." Due to the diversity of legal regimes governing space in domestic environmental law, the subject cuts across both topics, and as such, is discussed briefly in each instance, in an effort to offer a cogent whole.

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<sup>67</sup> European Union, *The Precautionary Principle* (2005).

<sup>68</sup> Hobe, *supra* note 13.

<sup>69</sup> ISU Final Report, *supra* note 1, at 50.

<sup>70</sup> Edith B. Weiss, *Intergenerational Equity: A Legal Framework for Global Environmental Change*, in ENVIRONMENTAL CHANGE AND ENVIRONMENTAL LAW: NEW CHALLENGE AND DIMENSIONS 395 (Edith B. Weiss ed., 1992).

<sup>71</sup> *Id.* at 155-156.

<sup>72</sup> JULIAN HERMIDA, LEGAL BASIS FOR A NATIONAL SPACE LEGISLATION 193 (2004).

National environmental policy takes different forms across the world. From constitutional protections,<sup>73</sup> to legislative requirements, to regulatory frameworks, states implement environmental protection in distinct ways. However, one common theme cuts across the spectrum: the domestic requirement for environmental impact assessments and statements (EIAs) for space launch activities.<sup>74</sup>

EIAs are not required in international environmental law.<sup>75</sup> However, when implemented, they rest on the ideology of sustainable development<sup>76</sup> and the precautionary principle,<sup>77</sup> common themes in international environmental legislation. EIAs, broadly, are a procedure to evaluate the likely impact of a proposed activity on the environment. In the case of space launches, particular elements are taken into consideration, such as pollution control, environmental protection measures, reporting, post-project analysis, and site rehabilitation.<sup>78</sup> EIAs require public participation, which can be complicated, expensive, and slow.<sup>79</sup>

Across jurisdictions, EIAs can be mandated in a variety of fashions. US-based space launches must perform EIAs through the Federal Aviation Administration in compliance with the National Environmental Protection Act.<sup>80</sup> Russian space launches, both in Russia and Kazakhstan, must perform EIAs in compliance with the Russian Statute on Licensing Space Operations.<sup>81</sup> European space launches must accept inspections from the European Space Agency's (ESA) Coordinating Office on Sustainable Development.<sup>82</sup> Chinese launches must conform to the People's Republic of China Environmental Protection Law.<sup>83</sup>

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<sup>73</sup> *Id.*

<sup>74</sup> Viikari, *supra* note 2, at 261.

<sup>75</sup> ISU Final Report, *supra* note 1, at 43.

<sup>76</sup> Stockholm Declaration, *supra* note 53.

<sup>77</sup> PATRICIA W BIRNIE & ALAN E BOYLE, INTERNATIONAL LAW & THE ENVIRONMENT (2002).

<sup>78</sup> Viikari, *supra* note 2, at 269.

<sup>79</sup> *Id.* at 271.

<sup>80</sup> National Environmental Policy Act of 1969, Pub. L. 91-190, 83 Stat. 852 (1970).

<sup>81</sup> Viikari, *supra* note 2, at 275.

<sup>82</sup> ISU Final Report, *supra* note 1.

<sup>83</sup> *Id.* at note 1 at 51.

The difficulty in regulating EIAs comes back to the concept of a “race to the bottom”, as presented in the research rationale.<sup>84</sup> As the core of national environmental legislation varies from state to state, the rigor and efficacy by which EIAs are implemented varies widely.<sup>85</sup> Given this disparity, the launch industry may be inclined to do business where regulation is least stringent, and thus, most attractive.<sup>86</sup>

#### *D. Environmental Protection in Space Law*

Current international space law is a patchwork of international treaties, bilateral agreements, customary international law, and sometimes, official resolutions and declarations. International space law is often completed with national and local space legislation and regulations.

For concision, this paper’s analysis will focus on the provisions affecting green launching existent in the most notable and influential international space law treaties, notably the Outer Space Treaty, the Liability Convention, and the Registration Convention.

### 1. International Treaties

International space law has historically has little to say about environmental issues.<sup>87</sup> Where international agreements include environmental provisions, the goal has been to assign state responsibility<sup>88</sup> and mitigate harm from human or mechanical failure.<sup>89</sup> International space law has taken few proactive steps to prevent terrestrial environmental degradation resulting from space launches.

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<sup>84</sup> See “Research Rationale,” above.

<sup>85</sup> Hermida, *supra* note 72, at 173.

<sup>86</sup> Cologne University, *Project 2001 Working Group on National Space Legislation*, Institute of Air and Space Law.

<sup>87</sup> ML Chen, *Development of Environmentally Acceptable Propellants*, PROCEEDING OF THE 84TH SYMPOSIUM OF THE PROPULSION AND ENERGETIC PANEL ON THE ENVIRONMENTAL ASPECTS OF ROCKET AND GUN PROPULSION 305 (1994).

<sup>88</sup> Liability Convention, *supra* note 8.

<sup>89</sup> *Id.*; See also Krois, *supra* note 41, at 41.

*Outer Space Treaty*

Where space law has succeeded is the imposition of continuous supervision on states for their actions in space.<sup>90</sup> The framework of international space law in this regard—holding all states accountable for injuries to others in space exploration—has proven to be a groundbreaking development in environmental responsibility, which other common protection regimes, such as fishing or air pollution, cannot match. However, the Outer Space Treaty, and its accompanying Liability and Registration Conventions, lack comprehensive plans for terrestrial environmental preservation and control of externalities in the exploitation of space.<sup>91</sup>

Even the Outer Space Treaty's infamous Article IX, mandating "due regard" for other state parties and calling for "cooperation and mutual assistance" in space exploration, has little practical terrestrial use.<sup>92</sup> The requirement to avoid "harmful interference" has never been applied in the context of environmental preservation from launching, as the harmful interference envisaged is that of human activity in space, and not human and environmental well being on Earth.<sup>93</sup> Resulting, the Outer Space Treaty has little practical application for safeguarding green launching provisions into the future.

Article X of the Outer Space Treaty allows third party states to observe the launch and flight of a state object.<sup>94</sup> This provision is generally a positive development for environmental protection, as it allows third party states to be ready to respond in case of a failed launch or unexpected payload separation. Working in concert with Article 5 of the Rescue & Return Agreement, third party states are under a duty to notify the launching state of any harm to their territory<sup>95</sup> and resulting, the launching authority must eliminate any possible danger of harm.<sup>96</sup> Combining the aspects of the Outer

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<sup>90</sup> Outer Space Treaty, *supra* note 5, at arts VI & VII.

<sup>91</sup> Krois, *supra* note 41, at 45.

<sup>92</sup> Outer Space Treaty, *supra* note 5, at art IX.

<sup>93</sup> Viikari, *supra* note 2, at 285.

<sup>94</sup> Outer Space Treaty, *supra* note 5, at art X.

<sup>95</sup> Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, *opened for signature* Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119 [hereinafter Rescue and Return Agreement].

<sup>96</sup> *Id.*, at art V(4).

Space Treaty and Rescue & Return Agreement in this regard, environmental protection during space launches is bettered as a result.

Moreover, Article III of the Outer Space Treaty calls for parties to carry on “activities in the exploration and use of outer space... in accordance with international law.<sup>97</sup> Whereas on its face this provision seems well worded to protect against environmental launch harms, one will remember that space activities are exempt from nearly all successful formal international environmental legal mechanisms, such as the Air Pollution Convention, the Montreal Protocol, and the Kyoto Protocol.<sup>98</sup> Whereas Art III of the OST has the potential to hold states accountable for launch activities, it loses its effectiveness in the legal carve-outs designed for space activities.

### *Liability Convention*

Of international space laws, the Liability Convention (LC) is the most appropriate mechanism through which to mitigate and control environmental damage resulting from space launches. Art II of the Liability Convention imposes absolute liability to damage caused by space objects on the surface of the Earth. Its provisions have been activated twice, but never in claims against launch activities.<sup>99</sup> However, this provision, and the Convention as a whole, are positive developments in international space law, significant improvements from the early days of launching, when spent boosters, cones, and explosive bolts were simply abandoned.<sup>100</sup>

Article V of the Liability Convention calls for joint and several liability between launching states.<sup>101</sup> This legislative requirement has been important to assure reparation in the case of environmental harm from launch failure or payload damage. However, its environmental efficacy is consistently undermined through the signing of cross waivers of liability and exclusion of liability contracts, wherein one state shoulders all the blame for environmental damage that may occur following a launch.<sup>102</sup> Although politically and

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<sup>97</sup> Outer Space Treaty, *supra* note 5, at art III.

<sup>98</sup> Montreal Protocol, *supra* note 59.

<sup>99</sup> LYALL & LARSEN, *supra* note 28 at 118.

<sup>100</sup> *Id.* at 303.

<sup>101</sup> Liability Convention, *supra* note 8, at art V.

<sup>102</sup> LYALL & LARSEN, *supra* note 28, at 284.

legally efficient, these agreements remove environmental burdens from states, thereby reducing precaution in launch activities.<sup>103</sup>

Article XII of the Liability Convention calls for payment to be made according to “international law and the principles of justice and equity” in order to provide reparation for damage.<sup>104</sup> This provision, along with the methods established for proceeding with a claim in Article VIII,<sup>105</sup> are generally good practices in environmental law, establishing clear guidelines for compensation in cases of harm. As a counter argument, the provision lacks penal enforcement. States can thus put a “price” on their environmental costs, as has been done by Russia in the case of the Baikonur Cosmodome, located in Kazakh territory.<sup>106</sup>

Lastly, Article VII of the Liability Convention provides one of space law’s most controversial environmental provisions, clearing a state of international liability towards its own citizens.<sup>107</sup> Although not surprising,<sup>108</sup> Article VII shows the inability of space law—thus far—to incorporate fundamental notions of environmental human rights into its legal framework. These lack of domestic legal protections have the potential to produce launch sites of convenience in a growing industry, given lower regulatory and launch costs associated with loose domestic protectionist frameworks.<sup>109</sup>

## 2. Environment in National Space Law

Space is regulated in a variety in variety of different manners on a domestic level. Certain countries, such as the US, Russia, Australia, the UK, Ukraine, Sweden, South Africa, and Japan have comprehensive space-specific laws.<sup>110</sup> Other states employ executive policy to implement their space programs.<sup>111</sup> Still more regulate space as part of their general legal framework, notably France

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<sup>103</sup> Viikari, *supra* note 2, at 169.

<sup>104</sup> Liability Convention, *supra* note 8, at art XII.

<sup>105</sup> *Id.*, at art VIII

<sup>106</sup> LYALL & LARSEN, *supra* note 28, at 46 (a secret settlement was reached between Russia and Kazakhstan).

<sup>107</sup> Liability Convention, *supra* note 8, at art VII.

<sup>108</sup> ODUNTAN, *supra* note 12 (establishing domestic liability would violate state sovereignty).

<sup>109</sup> *Id.* at 75.

<sup>110</sup> Hermida, *supra* note 72, at 73.

<sup>111</sup> *Id.* (Norway, Brazil, and Italy are among these).

and Canada.<sup>112</sup> One common denominator remains, however: all space-faring states have implemented authorization systems to ensure that no activities entail significant safety perils, as required in international space law.<sup>113</sup>

Yet there exist no international requirements for shaping domestic space law with regards to environmental protections during space launches. Whereas international environmental law helps shape domestic systems in the areas of safety and liability for harmful contamination of Earth,<sup>114</sup> these concerns—as previously expressed—are primarily protections against tortious damage designed to safeguard human and national interests, leaving environmental protection as solely a side benefit.

Of notable example are launch failures or payload separation that occur on one's one territory.<sup>115</sup> Under international space law, the state is under no duty to compensate its citizens for damage suffered as a result. Had this damage occurred over an international broader, however, the state would be liable for damage.<sup>116</sup>

Although there exists a relative wealth of jurisprudence related to space launches,<sup>117</sup> little case law deals practically with environmental damage. Of notable exception is the dual cases *Florida Coalition for Peace & Justice v George HW Bush*.<sup>118</sup> These two cases, heard in 1989 and 1990, involved two separate launches from Florida's Cape Canaveral. It was alleged that NASA had failed to satisfy all of the requirements of the National Environmental Policy Act (NEPA) in assessing the risk of launching nuclear power into space. The court found in Bush's favor, granting discretion to NASA's "reasoned evaluation of relevant factors" in deciding that it had met all necessary NEPA requirements.<sup>119</sup> *Florida Coalition* is crucial domestic case law in the US context for granting discretion to federal

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<sup>112</sup> *Id.* at 74.

<sup>113</sup> *Id.* at 75.

<sup>114</sup> *Id.*

<sup>115</sup> Liability Convention, *supra* note 8, at art VII.

<sup>116</sup> *Id.*, at art II.

<sup>117</sup> *See, e.g.*, European Center for Space Law, Feature: Space Law Cases, [http://www.esa.int/SPECIALS/ECSL/SEMT9MMKPZD\\_0.html](http://www.esa.int/SPECIALS/ECSL/SEMT9MMKPZD_0.html) (last visited Aug. 28, 2016).

<sup>118</sup> *Florida Coalition for Peace and Justice v. George Herbert Walker Bush*, Civil Action No 89-2682-OG DDC (1989); *Florida Coalition for Peace and Justice v. George Herbert Walker Bush*, Civil Action No 89-2682-Og DDC (1990).

<sup>119</sup> DIEDERIKS-VERSCHOOR & KOPAL, *supra* note 63, at 154.

agencies in overseeing and supervising the domestic space industry. However, it poses challenges for enforcement of environmental legislation, giving broad leeway to governmental agencies in conducting environmental impacts assessments based on uncertain science.<sup>120</sup>

### III. DISCUSSION

The preceding literature review canvassed regimes of space technology, environmental law, and space law while attempting to point the reader towards structural weaknesses inhibiting the growth of the green space launch sector in today's industry. In this Discussion, the author outlines current economic and environmental challenges to space launch sustainability given market trends and emerging space actors. The analysis will focus on the most important elements for achieving green launches, those being payload separation, fuel use, and launch failure.

#### *A. Economic and Environmental Sustainability*

##### 1. Payload Separation

Jettisoning payload is an important planning element of any launch. Recent research, as well as current industry best practices, suggests that separating payload over open ocean is the least environmentally harmful practice available.<sup>121</sup> Abandonment over open water lessens risks to populated regions,<sup>122</sup> due to the inherent and inevitable deviations that will result from launch trajectories. The ocean is better poised to remediate environmental harm from pollutants, whereas land areas can be severely affected by hydrochloric acid contamination into ground water sources.<sup>123</sup> Of active space launch sites, the USA, Europe, Japan, and India are most notable for using open ocean launch trajectories. Russia and China, on the other hand, launch over land.

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<sup>120</sup> Space law, after all, is entirely uncertain.

<sup>121</sup> ISU Final Report, *supra* note 1 at 27.

<sup>122</sup> *Id.*

<sup>123</sup> *Id.* at 26. Nevertheless, launching over water is essentially using the commons (space) to pollute another commons (oceans). For more on this, see LYALL & LARSEN, *supra* note 28, at 45.

Of further consideration are the legal liabilities entailed with payload separation. Most notable are Articles II and VII of the Liability Convention,<sup>124</sup> wherein states must compensate for harm suffered from launch damage. However, injured parties cannot claim against their own states.<sup>125</sup> As a result, land-based launches over considerable stretches of one's own territory offer considerably less motive for environmental protection. This launch pattern is currently employed by Russia and China, with the former employing a trajectory overflying Kazakhstan and Russia, and the latter launching and dropping payload in its territorial boundaries. Whereas China does not have any disclosed reparation measures for environmental damage from payload separation, Russia "compensates all regions affected," but does not disclose exact sums.<sup>126</sup>

Given these considerations, green launches are best practiced from coastal spaceports, with ocean-based trajectories providing for adequate remediation abilities and low risk to national populations.

## 2. Fuel Use

Spaceports are large infrastructural investments. Hence, it is difficult to imagine a significant change in physical launch venues in the near future. Altering fuel use, however, is a strictly economic choice. As previously discussed, the most environmentally friendly propellants in the industry are liquid-hydrogen/liquid-oxygen combinations, primarily employed by US Delta IV and European Ariane 5 rockets.

Until technological development produces truly green propellants, liquid-hydrogen/liquid-oxygen combinations should be incentivized as the most environmentally sustainable choice for space launches. Two technological changes are available to allow for liquid-hydrogen/liquid-oxygen fuel use on a worldwide scale: (1) retrofitting current rockets to accept liquid-hydrogen/liquid-oxygen,<sup>127</sup> or (2) retrofitting launch sites to accept liquid-hydrogen/liquid-oxygen rockets, such as the Delta IV and Ariane 5. Given the current

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<sup>124</sup> Liability Convention, *supra* note 8, at arts II & VII.

<sup>125</sup> *Id.*, at art VII.

<sup>126</sup> Viikari, *supra* note 2, at 14. Kazakhstan suspended Russian use of the site until compensation was agreed upon: M Hošková, *The 1994 Baikonour Agreements in Operation*, 42 PROC. IISL 263 (1999).

<sup>127</sup> ISU Final Report, Executive Summary, *supra* note 1.

launch industry practice of using Soyuz and Long March rockets,<sup>128</sup> the first option is preferable, as retrofitting a rocket entails a significantly lower capital cost than adapting a launch platform to accommodate a new rocket type.<sup>129</sup>

Given these considerations, green launches are best performed with fuels dependent on liquid-hydrogen/liquid-oxygen combinations, so as to minimize environmental impact of dropped stages, local chemical pollution, and atmospheric depletion. Fuel procurement is a relatively achievable change to the *status quo*, involving changes in agency procurement strategies and commercial launch choices.

### 3. Launch Failure

The challenge of reducing launch failure is among the most difficult choices to make in green launching. Although launch failures account for less than 10% of all launches,<sup>130</sup> their environmental effects are dramatic: dispersing rocket parts and propellant in the local region, threatening human life, and increasing toxicity in the ecosystem.<sup>131</sup> What is more, launch failures may increase in the coming years, with the development of nascent space launch technologies and experimental launch practices.<sup>132</sup> As such, launch failures are an endemic reality of space exploration that cannot be prevented, solely mitigated.

To mitigate the environmental risk of launch failures, careful launch site selection should focus on unpopulated regions close to water,<sup>133</sup> while employing the greenest fuels available.<sup>134</sup>

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<sup>128</sup> Viikari, *supra* note 2, at 270.

<sup>129</sup> Anatoly Zak, Russian Space Web: ELS, [http://www.russianspaceweb.com/kourou\\_els.html](http://www.russianspaceweb.com/kourou_els.html) (last visited Aug. 28, 2016).

<sup>130</sup> ISU Final Report, *supra* note 1, at 5.

<sup>131</sup> *Id.* at 1.

<sup>132</sup> Krois, *supra* note 41, at 44.

<sup>133</sup> Environmental impact is less deleterious in water than on land.

<sup>134</sup> ISU Final Report, *supra* note 1, at 9.

## IV. CONCLUSION

A. *Structural Changes*

As public and private space exploration increases, so will demand for space launch capabilities. With increasing space launches comes increasing terrestrial environmental degradation. In order to mitigate such inevitable damage, the industry has a moral duty to make concerted efforts to implement sustainable practices into an already heavily polluting sector.

This challenge will come at the level of international political and legal frameworks. With its inexpensive Soyuz rockets,<sup>135</sup> Russia is completing almost half of the world's launches.<sup>136</sup> Chinese launches offer a nearly 50% price advantage as compared to US and European services.<sup>137</sup> The industry's current commercial penchant is clear: a desire for inexpensive launches, regardless of detrimental environmental impact.<sup>138</sup>

As such, a national environmental regime for space launches would have little effect on international practice. In a globalized industry, strict national regulation presents the danger of impeding the development of a young industry, preventing it from competing with other states.<sup>139</sup>

Yet, despite the fierce competition between the four primary launch providers,<sup>140</sup> an international solution is not out of the question. What is more, an international solution for green launching is necessary. With a sharp rise in spaceport construction across the globe,<sup>141</sup> the risk of a race to the bottom in environmental standards is resurrected. Virtually all states have direct access to outer space<sup>142</sup> and have the potential to compete in the launch services sector.

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<sup>135</sup> Relatively inexpensive: see Federal Aviation Administration, SEMI-ANNUAL LAUNCH REPORT 2009-2010, available at [https://www.faa.gov/about/office\\_org/headquarters\\_offices/ast/media/10998.pdf](https://www.faa.gov/about/office_org/headquarters_offices/ast/media/10998.pdf).

<sup>136</sup> Viikari, *supra* note 2, at 270.

<sup>137</sup> DIEDERIKS-VERSCHOOR & KOPAL, *supra* note 63, at 107.

<sup>138</sup> Remember that Russia and China use a combination of the most environmentally harmful location and launch trajectories, as well as the most contamination fuels. See "Literature Review," above.

<sup>139</sup> Krois, *supra* note 41, at 46.

<sup>140</sup> Russia, China, the US, and Europe.

<sup>141</sup> Space Launch Report, *supra* note 49.

<sup>142</sup> Depending on the trajectory of rockets: ODUNTAN, *supra* note 12, at 13.

Inevitably, flags of convenience for space launching will develop.<sup>143</sup> Particular states will require minimal environmental safeguards, putting their people and wildlife at risk, in exchange for the profit entailed with space launching.<sup>144</sup> With the ability to sign away state liability<sup>145</sup> and bypass important international space law,<sup>146</sup> “launch sites of convenience” will inevitably come to be a reality in the space launch industry.<sup>147</sup> These sites will threaten the economic viability of all current industry powers.

With control of 90% of the industry,<sup>148</sup> Russia, the US, France, and China have the opportunity to pre-empt this trend through a comprehensive bilateral treaty to promote the development of Green Launching. Such an agreement could potentially include a cap-and-trade program<sup>149</sup> for emissions released on launch, while establishing a board to promote best practices in the industry, including: promotion of payload separation over ocean, retrofitting facilities and equipment for sustainable fuel use, and mitigating launch failures.

A comprehensive bilateral treaty between these states would serve their national economic interests while establishing customary international law in the sector<sup>150</sup> through prompt establishment of norms years before competition sets in.<sup>151</sup> Moreover, space clients have expressed a willingness to pay up to 25% more for eco-friendly space launches.<sup>152</sup> As such, the economic impact of green launching would be very minimal on current industry practice.

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<sup>143</sup> *Id.* at 75.

<sup>144</sup> To the tune of \$25 million USD per launch: Viikari, *supra* note 2 at 13.

<sup>145</sup> LYALL & LARSEN, *supra* note 28, at 284.

<sup>146</sup> Liability Convention, *supra* note 8, art XI.

<sup>147</sup> If it happened in the maritime sector, why not in space? ODUNTAN, *supra* note 12, at 75.

<sup>148</sup> ISU Final Report, *supra* note 1, at 2.

<sup>149</sup> Krois, *supra* note 41, at 47.

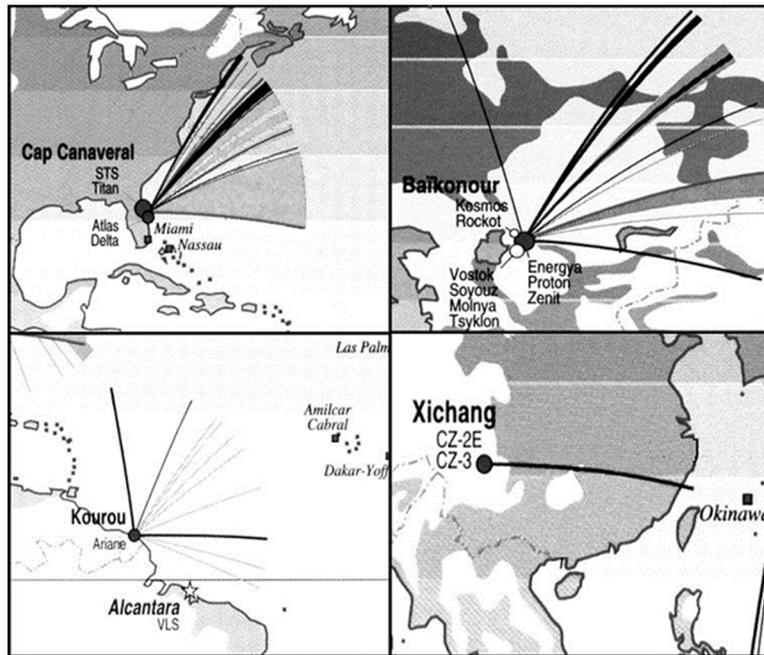
<sup>150</sup> LYALL & LARSEN, *supra* note 28, at 5.

<sup>151</sup> Many new spaceports will not be ready for the next few years to come: SPACE LAUNCH REPORT, *supra* note 49.

<sup>152</sup> ISU Final Report, *supra* note 1, at 62.

APPENDIX

A. Launch trajectories



# ASTEROID MINING AND ITS LEGAL IMPLICATIONS

*Devanshu Ganatra\* & Neil Modi\*\**

*“There is a tide in the affairs of men. Which, taken at the flood, leads on to fortune. But omitted, and the voyage of their life is bound in shallows and miseries. On such a full sea are we now afloat, and we must take the current when it serves—or lose the ventures before us.”*

In the aforementioned scene Brutus tells Cassius that their enemy increases in number every day and they must meet the enemy in battle while they still have a chance of victory. So also, NASA has already predicted that it will send astronauts to Near Earth Asteroids by 2025, and several other private corporations like Planetary Resources and Deep Space Industries are also taking part in the new space race- the race to mine asteroids. Several space agencies and private companies have started raising funds for the same but the framework of international space law regimes, such as the Moon Agreement and the Outer Space Treaty are archaic in this sense. This is because they were created in a time when near-Earth asteroid mining was unfathomable. Accordingly, these laws must be amended prior to commencing mining exploits in space, in order to prevent foreseeable conflict.

This paper, while explaining the concept of asteroid mining, explores the viability of mining Near Earth Asteroids and highlights the lacunas in the existing legal framework. Moreover, it also

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suggests reforms or an overhaul in the said legal regime. The reforms proposed aim to deal not only with dispute resolution but also prevention of disputes in the first instance.

### I. WHAT ASTEROIDS ARE

Asteroids are defined as any of many thousands of small bodies, made of rock and minerals that orbit the Sun. Most lie in a region called the asteroid belt between the orbits of Mars and Jupiter, and are thought to be fragments left over from the formation of the Solar System.<sup>1</sup> Asteroids are those small, rocky and airless worlds in space that are too small to be classified as planets.<sup>2</sup> They are those minor planets that were leftover when our Solar System was created-4.6 billion years ago. Most asteroids were those bodies in the Sun's nebula that never grew big enough to become planets. They come in various shapes and sizes and each asteroid has its own different composition. Some may be piles of rubble, with gravity the only thing holding them together, while others can be solid bodies composed of rich metals.

Though there are a countless number of asteroids in our solar system, with most of them yet to be discovered, a vast majority of them- about a hundred thousand, lie in what is known as the 'Asteroid Belt'. The asteroid belt is the vast ring of asteroids between the orbits of Mars and Jupiter that is home to more than 200 asteroids larger than 100 kilometers in diameter, and 750,000 asteroids that are larger than 1 kilometer in size.<sup>3</sup>

However, many groups of asteroids orbit outside the main belt. In fact, three groups in particular-Amors, Apollos and Atens orbit in the inner solar system and have been known to cross paths with Earth and Mars. These are known as Near Earth Asteroids (hereinafter NEA) and these are the asteroids that are occasionally a cause for concern when they come too close to Earth. On the rare

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<sup>1</sup> JULIUS DASCH, A DICTIONARY OF SPACE EXPLORATION (Oxford University Press, 2d ed. 2016).

<sup>2</sup> Charles Q. Choi, *Asteroids: Fun Facts and Information about Asteroids*, Space.com, Nov. 21, 2014, <http://www.space.com/51-asteroids-formation-discovery-and-exploration.html>.

<sup>3</sup> *Id.*

occasion that an asteroid does crash into Earth, it is called a meteorite. Scientists are constantly keeping track of smaller asteroids that may be on collision course with earth, where asteroids are classified according to the hazard they pose. Scientists estimate that with the advancement of technology possibilities for avoiding an earthbound impact include exploding or diverting the asteroid in its path in the future.

Asteroids are classified into 3 types based on their shape, colour and composition. The classification of asteroids is a crucial factor while conducting probes and deciding which asteroids are worth mining.

### *A. The Three Types Of Asteroids*

#### *C-Type Asteroid*

These are asteroids, which are mostly made up of carbon ('C'-carbonaceous). They are the most common, with 75% or more of total asteroids found belonging to this category<sup>4</sup>. Due to the high carbon content they are mostly dark grey or black masses. C-Type asteroids contain water, organic carbon and other trace amounts like phosphorus.<sup>56</sup> Despite being the most common C-Type asteroids may very well contain the most valuable substance of all- Water. As will be explained later, water found on these asteroids can be used as space propellant for any further exploration efforts to other planets or bodies, far into space. If utilized correctly, the use of water as rocket fuel can totally transform the way rockets and space travel works.

#### *S-Type Asteroid*

Found mostly as NEA, they are attractive targets for mining as they are made up of mostly silicate metals and rock ('S'-Siliceous or Stony). They contain rare metals like gold, platinum, rhodium;

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<sup>4</sup> ASTEROIDS II (SPACE SCIENCE SERIES) 316 (Richard P. Binzel et al., eds., University of Arizona Press, 1989).

<sup>5</sup> Planetary Resources, *Asteroids: Composition*, <http://www.planetaryresources.com/asteroids/#asteroids-overview-composition> (last visited Jul. 24, 2016).

<sup>6</sup> NASA, '*New NASA Mission to Help Us Learn How to Mine Asteroid's*', <http://www.nasa.gov/content/goddard/new-nasa-mission-to-help-us-learn-how-to-mine-asteroids> (last visited Jul. 24, 2016).

nickel, cobalt etc. are making up about 17% of total asteroids<sup>7</sup>. With their reddish to greenish hue colours, they appear more attractive than C- Type Asteroids.<sup>8</sup>

### *M-Type Asteroid*

These are those asteroids where the composition is only partially known and are 10 times rarer than S-Type Asteroids. Found only in the middle region of the Asteroid Belt, they seem to be made up of nickel-iron.<sup>9</sup> They are unlike any other metallic ores found on earth today, and are extremely dense.<sup>10</sup> Scientists estimate that a single M-Type asteroid may have more platinum that has ever been mined on earth till date.

## II. REASONS TO MINE ASTEROIDS

Human thinking has seen a radical shift with the progress made in technology. While earlier, asteroids were seen more as a threat to all life on earth, today with the huge steps the human race is taking in space, we are looking at the potential in space instead. In particular we are looking at the potential of asteroid mining- a concept that envisages using the vast resources we know that exist on asteroids for the benefit of all. Asteroid mining will become necessary not only for the furtherance of science, but for meeting the needs of the Earth's 7.1 billion strong population.

Asteroid mining would solve the world's energy crisis faster than any other solution we currently have. Fossil fuels like coal, oil and natural gas currently account for 81% of the world's primary energy. While we look for sources of renewable energy, slow progress is being made as only 2% of the world's consumption of energy was provided non-hydroelectric renewables in 2010.<sup>11</sup> The problem is essentially of risk and cost. The process of renewable energy production is unable to compete head to head with fossil fuels because

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<sup>7</sup> DASCH, *supra* note 1, at 1.

<sup>8</sup> *Id.*

<sup>9</sup> *Id.*

<sup>10</sup> RICKY J. LEE, LAW AND REGULATION OF COMMERCIAL MINING OF MINERALS IN OUTER SPACE 59 (Springer, 2012).

<sup>11</sup> Dana G. Andrews et.al, *Defining a Successful Commercial Asteroid Mining Program*, 108 ACTA ASTRONAUTICA 106, 106-07 (2015).

many of the methods are either too expensive or unproven. Primarily, they are too expensive because they rely on metals that are in short supply.<sup>12</sup> Technology development is also becoming harder for the same reason. As key rare earth elements become scarcer, manufacturing costs are skyrocketing. For all the computers ever made, computer chips were required, and all chips are made with a small amount of a particular rare earth metal. Many other industries like the automobile and television industries are beginning to face the same problem. Platinum, for instance, is used in 1 of 4 industrial goods on earth, despite its high cost. Mining one 500 metre asteroid can produce more platinum than has been mined in the history of humankind.<sup>13</sup>

Many of the critical metals used today were deposited in the Earth's crust by meteorite impacts, thousands of years in the past and their supply was always limited. These metals include gold, cobalt, iron, manganese, molybdenum, nickel, osmium, palladium, platinum, rhenium, rhodium, ruthenium, and tungsten.

To get an idea about the potential value involved we can take the study of John Lewis, who co-directs the Space Engineering Research Center at the University of Arizona at Tucson. He studied one C-type asteroid, a 2-km-wide Near-Earth Object (NEO) called Amun and came to the conclusion that the monetary value of Amun's platinum group metals (PMGS) including palladium, platinum etc. is more than US \$6 trillion.<sup>14</sup> Platinum group metals include some of the rarest and most valuable metals on earth. Further, the study said that if the value of cobalt and nickel deposits were added the total value would be an astounding \$20 trillion.

Though these figures are only an approximation of the deposits at the current market value at this point in time, there is consensus among different studies that asteroid mining ventures could become a huge economy all on its own.

#### A. *The Use of Water*

As stated earlier, water may quite simply become the main target of asteroid mining because of its many uses. Despite being

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<sup>12</sup> *Id.* at 106.

<sup>13</sup> Planetary Resources, *Mining & Delivery*, <http://www.planetaryresources.com/asteroids/#mining-delivery> (last visited July 28, 2016).

<sup>14</sup> Mark Ingerbresten, *Asteroid Mining*, IEEE SPECTRUM, 34-36, (2001).

such a simple compound composed of hydrogen and oxygen, the importance of water in space travel cannot be overstated. Today, billions of dollars are spent on rocket fuel each year to send rockets into space and keep them in their orbit. As rocket propellant is hydrogen and oxygen based, the majority of the weight of a rocket is taken up by its fuel. Since a rocket has to carry huge quantities of fuel to cover millions of miles, a majority of the money in space missions is spent only on this avenue. Water is also the oil of space. In space, it is vital for hydrating astronauts, providing oxygen for life support and blocking out harmful radiation. The sourcing of water from Earth is the single largest constraint to expansion in space. If humans wish to expand their growth into space, local resources will have to be used and the start will be using water from asteroids. If water is taken from asteroids and broken down into space fuel, rockets will become lighter and missions will become cheaper. Moreover, asteroids can serve as strategically placed orbital refueling stations or depots, which will enable rockets to restock and make interplanetary journeys that, have always been out of our reach.<sup>15</sup>

### III. FEASIBILITY OF ASTEROID MINING

First and foremost, though asteroid mining is a seemingly expensive venture-and it is an extremely costly project, it is estimated that the benefits of resources derived from asteroids should reasonably compensate and beyond anyone willing to make the investment. In fact, if the resources are mined properly, not only will asteroid mining be a rich source of supplies, it will be an immensely profitable venture. Earlier, asteroid mining was not feasible primarily because of two reasons. The first reason was that very few governments could afford a project like this and there were no private players as space ventures were run only by the State space agencies. However in today's world private companies and space experts have the ability to raise funds and finance this project either with the cooperation of State governments/countries or independently. The second factor that limited asteroid mining was the lack of cutting edge technology and know-how. Today, in the 21<sup>st</sup>

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<sup>15</sup> J.P. Sanchez & C.R.McInnes, *Assessment on the Feasibility of Future Shepherding of Asteroid Resources*, 73 ACTA ASTRONAUTICA 49, 50-51 (2012).

century we finally have the technical knowledge and the equipment to make asteroid mining a reality. Supremely knowledgeable individuals in the field of astronautics can be brought on board to ensure the benefits of technology are maximized. Due to space telescopes, satellite imaging and unmanned probes, we finally understand asteroids and their composition better than we ever have.

Our interest in asteroid mining has everything to do with gravity. Asteroids are attractive targets because of the negligible gravity of NEO's, which means that the energy expended on sending a probe there is even smaller than the energy taken to reach the Moon.<sup>16</sup> When moving between bodies in space, the primary measure of how hard it is to get from point A to B is calculated not in distance but a quantity called delta-V ( $\Delta V$ ). All movements in space—from launching and escaping gravity to landing on another body require considerable changes in velocity or  $\Delta V$ .<sup>17</sup>

Therefore, a trip from an asteroid would require an  $\Delta V$  of just 1km/s or less because many NEO's possess negligible gravity which would translate to very little energy being expended in lifting objects (for mining) off the surface. Moreover, any reduction in velocity would translate directly to rocket fuel saved. For the sake of a comparison, a velocity of  $\Delta V$  of 3 km/s would be the minimum required to make a trip back to the Earth from the Moon.

#### *A. Process Of Asteroid Mining*

If and when humans do get to asteroids, the question of actually extracting the resources they went looking for is of paramount importance. Since, till date, asteroid mining projects continue to be deliberated with various complex calculations being made, successful completion of this exercise is at the least a few years, if not decades away. However, it would be foolish and indeed extremely expensive to launch a mission without actually considering the actual process of extraction. Hence, the following are theories of mining consideration that have been propounded and have been tested to an extent.

The negligible surface gravity of asteroids is what makes them such attractive targets for future mining activities as the materials

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<sup>16</sup> Ingerbresten, *supra* note 14, at 34.

<sup>17</sup> *Id.*

mined from their surface need not be lifted back out of a deep gravity well in order to be delivered to the places where the resources are needed.

Mining operations require special equipment to handle the extraction and processing of ore in outer space.

Planetary Resources, who call themselves the Asteroid Mining Company, have taken the biggest steps yet in theorizing how this process would actually work. Three possible methods have been laid down, all with their own unique advantages and disadvantages.

**1. On Site Extraction.** This method envisages a robot prospector that drills out precious materials, which will be sent back to earth in capsules. The machinery will need to be anchored to the body, but once in place, the ore can be moved about more readily due to the lack of gravity.

Experts are in general agreement that processing *in situ* for the purpose of extracting high-value minerals will reduce the energy requirements for transporting the materials, although the processing facilities must first be transported to the mining site

Cons Affixing or docking to the surface of a small asteroid in order to actually dig into its regolith or drill into its bedrock, may be easier said than done. And the methods that work for one object may not work at all for another.<sup>18</sup>

**2. Tow-Truck Extraction.** As the same suggests, this method requires the asteroid to be hauled into Earth's orbit through the use of rocket power, where it will be mined. Basically, a satellite or a rocket would tow the asteroid before it is docked for processing. Docking with an asteroid can be performed using a harpoon-like process, where a projectile penetrates the surface to serve as an anchor then an attached cable is used to winch the vehicle to the surface, if the asteroid is rigid enough for a harpoon to be effective. Harpoons or penetrators may be a tractable option for objects with porous but cohesive surfaces. Electromagnet pads might just work on the iron-rich asteroids.

Cons- The energy levels required for transport will obviously be much higher than simply processing the asteroid in site, which will greatly increase total expenditure. If we pick very small asteroids, our mining facility may not even "land" on the object at all—

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<sup>18</sup> Daniel D. Durda, *The Solar System Beckons with Resources Unimaginable on Earth*, 18 AD ASTRA, (2006), <http://www.nss.org/adastra/volume18/durda.html>.

the rock could be swallowed whole by the spacecraft itself and mechanically and chemically digested for its resources

**3. Bag-It Procedure.** In what is effectively a retrieval mission an asteroid of up to 23 feet in diameter (where the appropriate size for each mission has been worked out by astrophysicists) is bagged or enclosed for transport to Earth's orbit.<sup>19</sup>

Planetary Resources have created 3 different types of satellites i.e. the Arkyd Space Telescope Series, with each satellite contributing at a different stage in the process.

Through the Arkyd Series, Planetary Resources, have launches scheduled from 2013-2020 with the hope of identifying asteroids in Near Earth Orbit fit for mining. The satellites, which will orbit Earth and picture target asteroids consist of very basic, easy to assemble equipment like solar panels to generate power, communication systems for guidance, on board screens to replay images and a camera for photography.<sup>20</sup>

The next big target for the Arkyd is the 2014 EK24 asteroid, which has an earth like orbit and is fairly close to earth.<sup>21</sup> A relatively large asteroid at about a 130m, the travel time is about 9 months. The main purpose of the mission is to determine if the asteroid has high concentrations of valuable resources. As this paper is being written, the schedule for launch is less than 6 months away.

Due to the distance of an asteroid to be mined to Earth, the round-trip time for communications will be several minutes or more, except during occasional close approaches to Earth by NEA's. As a result, any mining equipment will either need to be highly automated, or a human presence will be needed nearby. Humans would also be useful for troubleshooting problems and for maintaining the equipment. On the other hand, multi-minute communications delays have not prevented the success of robotic exploration

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<sup>19</sup> Karl Tate, *How Asteroid Mining could Work-Infographic*, Space.com, Jan. 22, 2013, <http://www.space.com/15391-asteroid-mining-space-planetary-resources-infographic.html>.

<sup>20</sup> *Arkyd: A Space Telescope for Everyone*, Kickstarter.com, <https://www.kickstarter.com/projects/arkydforeveryone/arkyd-a-space-telescope-for-everyone-0>.

<sup>21</sup> Planetary Resources: The Asteroid Mining Company, *Asteroids: Composition*, <http://www.planetaryresources.com/asteroids/#asteroids-targets>, (last visited Jul. 27, 2016).

of Mars, and automated systems would be much less expensive to build and deploy.<sup>22</sup>

#### IV. EXISTING LEGAL FRAMEWORK

Asteroids among other celestial bodies of our solar system contain a vast amount of natural resources, as mentioned earlier. The potential that exists as far as exploring and exploiting these natural resources is massive. The exploitation of these resources may generate a large amount of benefits and improve the quality of life on earth.

Therefore, there is a clear need for an appropriate legal regime organizing this exploitation in an orderly and safe way.

One of the major reasons why we need a concrete legal regime is that of all the major space law treaties signed till date, not one of them contains any specific rule dealing with the use of extraterrestrial resources, with this reason contributing to the slow progress being made in space exploration in general and asteroid mining in particular.

We now deal with the Outer Space Treaty, which is the foundation of existing space law today.

##### *A. Outer Space Treaty*

The Outer Space Treaty, formally the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies is one of the treaties that form the basis of international space law. Originating in 1967, to be signed originally by the USA, United Kingdom and the Soviet Union, today it has more than 104 parties who have signed and ratified the treaty.

Incidentally, India happens to be one of the parties to the treaty, having ratified it soon after it was signed in 1967. The Outer Space Treaty, though nearly 50 years old, is still at the forefront of all legislation and principles of international space law. Despite rapid technological innovations that constantly change the way we

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<sup>22</sup> Stephen Harris, *Your questions answered: Asteroid Mining*, The Engineer, April 8, 2013, <http://www.theengineer.co.uk/aerospace/in-depth/your-questions-answered-asteroid-mining/1015966.article>.

see space, the Outer Space Treaty is still considered to be that fountain of legal know-how that establishes principles applicable to all activities that are to be carried out in the space environment. Even though newer treaties or laws in the international arena will revolutionize the way things work in space, the core of those treaties will rest firmly on the foundations originally laid down by this treaty.

Ever since the Outer Space Treaty and the first mission to the moon in 1969 (*Apollo 11* Moon Landing), space law has taken small but important strides<sup>23</sup>. While some of those strides were successful, others were not as much. An outstanding example of an international treaty that could never achieve its objective was the Moon Treaty signed in 1979.<sup>24</sup> Drafted to establish a legal regime for the use of the Moon, it was signed by only 16 nations till date. What condemns it is the fact that from the 16 nations that have signed it, not one is a nation that has actually achieved manned space exploration to date. (eg. UK, USA, Russia)

Other examples include the 'Liability Convention',<sup>25</sup> a treaty from 1972 that expands on the liabilities nations face for objects that cause damage in outer space, and the Registration Convention<sup>26</sup>, a treaty from 1974 that promotes disclosure of details of objects States launch into space. Compared to the Moon Treaty both these treaties have been ratified by a majority of the countries in the world that hold an interest in space. All three aforementioned treaties have been adopted by the United Nations General Assembly Resolutions in the past and now fall under the umbrella of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS).

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<sup>23</sup> Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

<sup>24</sup> Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, *opened for signature* Dec. 18, 1979, 1363 U.N.T.S. 21 [hereinafter Moon Agreement].

<sup>25</sup> Convention on International Liability for Damage Caused by Space Objects, *opened for signature* Mar. 29 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention].

<sup>26</sup> Convention on Registration of Objects Launched into Outer Space, *opened for signature* Nov. 12, 1974, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

COPUOS itself was established with the purpose of codifying and developing legal rules pertaining to the activities of private parties and States in outer space.<sup>27</sup>

The importance of the Outer Space Treaty is stressed by the fact that its principles have received wide acceptance and all space faring nations are parties to it. Indeed, from a historical point of view, it was quite remarkable that the treaty was drafted and widely accepted in a relatively short span of time, when all eyes were on the Cold War.<sup>28</sup> Looking back, one can safely assume the reason for this was the expected space landing by either the Soviet Union or the USA, in what was famously referred to as the 'Space Race or War'<sup>29</sup>. The most relevant part of the treaty was that for the first time, States were legally obliged and responsible to a set of rules. While there are many drawbacks of the Treaty, which will be discussed below, it is pertinent to note that the binding legal value of the Treaty itself has never been brought into question.

Before, we expand on the drawbacks of the Treaty; one would do well to remember that first and foremost the Outer Space Treaty was a treaty of principles, which implied that the aim of the treaty was not to solve all problems that could arise. Secondly, and a major point for criticism was that the Treaty was written in general terms and exact legal meaning of the terms was not provided for, which led to wide-ranging interpretations.

### *B. Relevant Parts From The Treaty Are Now Analyzed And Explained*

Of all the provisions that define the legal status of outer space, and may have the largest impact on its future, Article I and II are the most important as they define the character of space. For the

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<sup>27</sup> United Nations Office for Outer Space Affairs, *Committee on The Peaceful Uses of Outer Space(COPUOS)*, (last visited April 25, 2015), <http://www.unoosa.org/oosa/en/our-work/copuos/index.html>.

<sup>28</sup> FABIO TRONCHETTI, *THE EXPLOITATION OF NATURAL RESOURCES OF THE MOON AND OTHER CELESTIAL BODIES- A PROPOSAL FOR A LEGAL REGIME* 19, (Martinus Nijhoff, 2009).

<sup>29</sup> The BBC, *The BBC on this Day: 1961: Soviets Win the Space Race*, [http://news.bbc.co.uk/onthisday/hi/dates/stories/april/12/newsid\\_2477000/247715.stm](http://news.bbc.co.uk/onthisday/hi/dates/stories/april/12/newsid_2477000/247715.stm), (last visited July 28, 2016).

The term 'Space War' or 'Space' became a very popular as a reference to the rivalry in spaceflight capability between the US and the Soviet Union during the Cold War crisis.

purposes of this paper only Article I and II will be explained in detail, as their principles are also the source of major debate.

### *Article I*

The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.

Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall facilitate and encourage international cooperation in such investigation.<sup>30</sup>

Article I (2) establishes the freedom of exploration and use of outer space, which is one of the most important principles. This confirms the *res communis omnium* character of space.<sup>31</sup> *Res communis omnium* as opposed to *res nullius* refers to things or objects which area available to all and cannot be owned by anyone, including States. The air and sea are good examples of this concept.

Likewise attention must be paid to the use of the words ‘without discrimination of any kind’ during exploration and ‘on a basis of equality’ which means that all States have equal rights to access and use outer space without discrimination based on their economic development.<sup>32</sup> It also means no State can be prevented from exercising this right, and any violation would be tantamount to a violation of the Treaty.

Drawbacks: Article 1(2) of the Treaty sets out three basic rights: the rights of free access, the right of free exploration and the

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<sup>30</sup> Outer Space Treaty, *supra* note 23.

<sup>31</sup> Tronchetti, *supra* note 28, at 21.

<sup>32</sup> *Id.* at 23.

right of free use. However it does not define these terms.<sup>33</sup> This is one of the faults of the Treaty. Since there is no explanation or definition provided, their meaning and implications arising from that understanding is not clear at all.

However an attempt can be made to understand these terms. The term 'exploration' does not generate much debate. It refers to activities in space for the purpose of discovery and scientific reasons. The problems arise with regards to the interpretation of the term 'use.' The 'use' of outer space and its resources may refer to use for either commercial or scientific purposes. While there is a general consensus on the fact that the latter is allowed, questions remain over the former. The major and most striking question that exists is whether the term 'use' does or does not include or encompass the term 'exploitation.'

While the three rights (free access, exploration, and of use of outer space) give States a wide ambit for activities in space, they are not unlimited. The term 'province of all mankind' means the exploration and use of space is aimed at serving the interests of all mankind acting collectively, by way of international cooperation.

While this is a noble concept, scholars argue that the 'province of mankind' concept is just a moral obligation without any legal value as the Treaty fails to lay down how exploration for all should place, nor does it prescribe a method for sharing of resources derived from space activities.<sup>34</sup>

Though Article I establishes fundamental principles that is recognized by all States and treated as the customary law that it is, the vagueness of the terms raises serious questions. It underlines the importance of international cooperation but does not specify the extent to which States have to cooperate. What 'space benefits' means in practical terms finds no mention at all.

The 1996 Declaration on Space Benefits was a result of negotiations to clarify the text of Article I. The UN General Assembly

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<sup>33</sup> *Id.* at 24.

<sup>34</sup> *Id.* at 24.

adopted the Declaration, a product of COPUOS, in 1996.<sup>35</sup> However, the very nature of a declaration makes its chances of enforcement far lesser than even the Outer Space Treaty.

### *Article II*

Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means<sup>36</sup>

The 'non-appropriation' principle contained here is a fundamental concept of space law. Article II says that 'outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of occupation, or by any other means'.<sup>37</sup>

The non-appropriative nature of space was the best possible guarantee for preserving peace for the creators of the space law regime.<sup>38</sup> It clearly laid down that States were not allowed to extend their sovereignty rights over outer space and neither could they consequently, claim property rights over outer space and its parts. It could be argued that the non-appropriation principle is the first among equals as only with the existence of this principle in its form can other activities like exploration guaranteed by other Articles be fulfilled.

Drawbacks: One of the major drawbacks in Article II is that it does not expressly prevent private appropriation of outer space. However, this can be put down to the fact that when this Treaty was signed, States were the only players in the space arena.<sup>39</sup> Scholars argue that the absence of any reference to private appropriation does not mean private operators can claim property rights in outer space. On the contrary, as stated in Article VI, it is the responsibility of States to regulate activities in outer space whether carried

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<sup>35</sup> Declaration on International Co-operation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking Into Particular Account the Needs of Developing Countries, United Nations, (13 December, 1996), <http://www.un.org/documents/ga/res/51/a51r122.htm> (last visited July 30, 2016).

<sup>36</sup> Outer Space Treaty, *supra* note 23, at art. II.

<sup>37</sup> Tronchetti, *supra* note 28, at 26.

<sup>38</sup> *Id.* at 27.

<sup>39</sup> *Id.* at 29.

out by governmental or non-governmental agencies, which effectively means that prohibition of appropriation that extends to States applies implicitly by extension to private parties. Article VI continues, saying that all activities in outer space will require the authorization and supervision by the appropriate State Party to the treaty.

In recent years questions have arisen as to whether Article II should be amended to allow appropriation of the outer space and its resources in the current commercial space age. Many argue that the existing space law restrains the commercial development of space. They feel that the law as it stands would discourage private parties from entering space and would affect development.

Though it may be true that amendments should be considered in light of technological developments and the want for space commercialization, any changes made should be carefully considered so as to not abrogate the status of Article II as the guiding principle for present and future activities in space.

#### V. THE NEED FOR A LEGAL REGIME & DISPUTE SETTLEMENT MECHANISM

There are two ways to resolve any probable dispute in International law: The first being dispute resolution, which aims at settling an existing dispute between the parties concerned. The second method involves developing mechanisms that help prevent disputes in the first place.

We can predict that 'Asteroid Mining', much like the period of Gold Rush in the late 19<sup>th</sup> century will drive Governments, private companies and individuals in their private capacity or through crowd-funding to invest in this enterprise in a frenzy never seen before. If this was allowed to be done in an uncontrolled manner, it would lead to several issues. Further, assurances would be needed to be given to investors like private companies who will potentially be spending billions of dollars on this venture. Concerns would remain- Whether the Government will allow marketing of mined products at their prices? Would taxation norms and policies be a setback? The possibility of a dispute arising between two private companies over exclusivity of mining rights over an asteroid would also need to be examined.

State Governments would have their own difficulties; with powerful nations setting aside budgets for their state-run space programmes, while developing nations will not be able to do so. Nonetheless, just like nuclear power, even developing and certain underdeveloped nations would like to invest in mining of asteroids but its viability would always be questioned as the government may not be able cut down on its welfare or defense budget. Furthermore, even after investments it may not be able to recover its initial capital. Besides a private company's aim would be profit maximization, but should the government have the same aim? Should they mine and market for welfare of the people or for profit maximization? Questions like these would have to be answered first.

Many mining enthusiasts are of the opinion that asteroid mining should be carried out solely for procuring platinum. This is in fact a myth that we wish to debunk. Though platinum is a useful commodity, there are far greater treasures on asteroids waiting to be employed, as we have enumerated earlier. Platinum is one of the rarest metals on earth and it is true that platinum we have mined till date does not exceed the size of a room. To lend some perspective to this, a single asteroid when mined could yield more platinum than we have ever mined on Earth. Despite its patent benefits it could prove to be a major problem. A look back at history right from the tulip mania to the housing bubble in the United States shows us that anything in excess will lead to a fall in prices followed by lack of demand for the product. In the case of platinum, we have evolved in a way where we do not require platinum beyond a certain point as we have managed to use substitutes. If excess platinum is mined, it may lead to a fall in demand and prices subsequently, and asteroid mining ventures may not be able to recover the billions they have invested which may in turn further harm other explorations. The price of platinum is approximately \$1140 USD per ounce and it is primarily used in chemical reactors and in vehicles as a catalytic converter, facilitating the complete combustion of unburned hydrocarbon passing through the exhaust.<sup>40</sup> Scientists have started using metals like Rhenium, tungsten and molybdenum as substitutes. This shows that despite being rare it is not an essential

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<sup>40</sup> NASDAQ Markets, *Latest Price & Chart for Platinum*, <http://www.nasdaq.com/markets/platinum.aspx>, (last visited July 27, 2016).

metal for human beings, and any mining exploration will have to take a considered view of the same.

There are three steps to asteroid mining. The first step involves research, development and exploration, it means determining if mining a certain asteroid is viable. The second step is the actual mining phase and the third step involves commercialization of the mined products. For the planned and organized development of extraterritorial natural resources it is important to determine how these three phases will be structured and what principles and rules are to be applied to them. This will make space enterprises aware about the legal framework from the beginning and will act according to the formulated rules and regulations.

Some critics are of the opinion that the money and resources that will be spent on asteroid mining can better be utilized for welfare of people at large and development on earth. This argument maybe true because the amount of investment may exceed every breakthrough technology we have ever invested in but such arguments will need to be compared to the possible benefits (which have been enumerated earlier in the paper) that will arise out of mining these asteroids.

The law of space is not consummated but some important points are established- Principles enumerating that no one can own any property on space, while space exploration (including taking samples) is permissible. This is as far as it goes, as there is complete silence over commercialization of asteroids and other planetary bodies. Before any system or rules of law are affected they must contain a balance between overregulation and inadequate regulation. Too much bureaucracy and ruling would discourage potential enterprises from undertaking exploitation activities. Too vague or limited regulation may fail to ensure proper legal environment for development of industrial use of lunar and other celestial bodies resources.<sup>41</sup> To deal with these shortcomings in the law, we propose the formation of an 'International Space Body' that regulates asteroid mining exclusively.

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<sup>41</sup> Tronchetti, *supra* note 28, at 240.

*A. International Space Body*

One possible proposition is the formation of an ‘International Space Body’ (ISB), which should be a separate, independent legal entity which functions as a part of the United Nations and is accorded the status of a specialized agency. under the garb of the United Nations. Just like the General Assembly, all the nations must be its members. These members must in turn elect a panel of experts and must lay down the powers and functions of the panel. The panel must then formulate rules and regulations applicable to whole range of activities that exploitation of celestial bodies would consist of. The panel will decide which asteroid must be mined out of several viable options, with their decision based on several factors such as the risk involved, demand in the market, possible adverse effects on the market or individual consumers etc. The ISB must also formulate a way of issuing licenses for mining of asteroids. It must also consider any liability arising for any damage caused to a third party or the space environment as a result of any activity related to asteroid mining. The panel must also create a dispute settlement mechanism. Their aim must be the benefit of people at large. Only once the panel adopts the above-mentioned rules should it start the process of allocating asteroids.

Private companies and Government bodies should be encouraged to apply via tenders based on their plan, financial strength and resources and a license may then be granted to the most capable enterprise or government agency. The ISB must also establish conditions and terms according to which exploitation must be carried out, the duration, the location, the right of licensee, third parties rights, etc. The rights of the licensee to obtain property rights over the extracted minerals must be laid down.<sup>42</sup> The ISB must also have the power to revoke the license and impose fines in cases of non-compliance of the terms and conditions by the licensee. In return the licensee must have undisturbed access of the select asteroid mentioned in the license for the purpose and time period specified.

The body must be given the power to have a final say on the execution of the mining process. The ISB must determine the prices

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<sup>42</sup> *Id.* at 245.

of mined products in a way that enables companies to make profits, but not supernatural profits.

Funding of an asteroid mining project could be done in two major ways—either the official, elected government of member States or private companies could finance it. Two or more private companies/governments may collaborate to make a bid. The most popular way to raise money seems to be crowd funding. The only asteroid mining companies today—Planetary Resources and Deep Space Industries, which are still in a nascent stage, have not yet revealed their funding plans. Space Tourism could emerge as a possible source of revenue for asteroid mining. Companies like Virgin Galactic where over 700 tickets valued at over \$250,000 have been sold for space tourism can definitely enter the asteroid mining race<sup>43</sup>. In addition, in this decade alone, a private citizen has paid \$20 million dollars to travel to space, while eight other citizens have also undertaken the same journey, with many more to certainly follow.<sup>44,45</sup> Space Adventures suggests that this number could increase fifteen-fold by 2020<sup>46</sup>. Even companies like Blue Origin, Boeing, Space X and Sierra Nevada Corporation are in the fray to start their own space tourism expeditions. The Russian Space agency also has plans to take space tourists to the International Space Station from 2018<sup>47</sup>. This only goes to show that Space Tourism is a goldmine waiting to be utilized.

Appointment of Experts: The following factors must be considered while appointing experts to the panel:<sup>48</sup>

- Panels shall be composed of well-qualified governmental and/or non-governmental individuals, including persons

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<sup>43</sup> Virgin Galactic.com, *Why We Go: Exploring Space Makes Life Better on Earth*, <http://www.virgingalactic.com/why-we-go/>, (last visited July 27, 2016).

<sup>44</sup> Pete Spotts, *A Space Tourism Trip to the Moon? It Could Happen by 2015*, The Christian Science Monitor, May 6, 2011, <http://www.csmonitor.com/USA/2011/0506/A-space-tourism-trip-to-the-moon-It-could-happen-by-2015>.

<sup>45</sup> The BBC, *Profile: Tito the Spaceman*, <http://news.bbc.co.uk/2/hi/science/nature/1297924.stm>, (last visited July 16, 2016).

<sup>46</sup> Spotts, *supra* note 44.

<sup>47</sup> TASS-Russian News Agency, *Russian Space Agency to Resume Regular Tourist Flights to ISS as of 2018*, <http://tass.ru/en/russia/784497>, (last visited July 27, 2016).

<sup>48</sup> World Trade Organization, *Understanding on Rules and Procedures Governing the Settlement of Disputes- Uruguay Round Agreement-Article 8*, [https://www.wto.org/english/docs\\_e/legal\\_e/28-dsu\\_e.htm](https://www.wto.org/english/docs_e/legal_e/28-dsu_e.htm), (last visited July 27, 2016).

who have served on or presented a case to a panel, served as a representative of a Member or of a contracting party to the International Space Body. Member countries may make their recommendations for the constitution of the panel.

- Panel members should be selected with a view to ensuring the independence of the members, a sufficiently diverse background and a wide spectrum of experience.
- Citizens or representatives of those countries, whose asteroid mining rights and interests are to be decided by the panel, will not serve as members for that particular decision to ensure independence and fairness.
- Panelists shall serve in their individual capacities and not as government representatives, nor as representatives of any organization. Members shall therefore not give them instructions nor seek to influence them as individuals with regard to matters before a panel.
- Panelists must have representation from different professional backgrounds. For example, Economists, Space Scientists, Lawyers, NGO's, etc.

### *B. Dispute Settlement*

#### 1. Appeal To The International Court of Justice (ICJ)

As stated above, the decision of the panel of experts with regard to any proposed asteroid mining expedition is to be final and binding on all parties concerned. However, in the interests of justice and fair play, contingencies have to be made which would allow an appeal to a duly authorized international adjudicatory body like the International Court of Justice. Taking inspiration from the Arbitration & Conciliation Act, 1996<sup>49</sup> an appeal can be preferred by any of the parties on the following grounds:

- i If the party furnishes proof that any expert on the panel has acted under some incapacity, or in a biased or prejudiced manner;

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<sup>49</sup> Indian Arbitration & Conciliation Act Ch.VII §34 (1996).

- ii If the decision of the panel is not valid or in conflict with international law, or the law to which the parties are subject;
- iii The decision of the panel is based on grounds which were not part of the original proposal made to it, or if it contains decisions on matters which prima facie fall outside its authority;
- iv The composition of the panel or appointment of experts was not in accordance with the procedure laid down and agreed to by all member countries;
- v Any other ground on which the ICJ is of the opinion that an appeal should be allowed based on the facts and circumstances of the case, in light of the principles of justice, equity and good conscience.

## 2. The Concept Of A Multi-Door Courthouse

Though parties would be advised and would rightly so stick to a proven dispute resolution mechanism like the ICJ, it is worth mentioning the novel idea of the Multi-Door Courthouse that may be the future of dispute resolution in all forms, and not only for asteroid mining.

A multi-door courthouse is a means of directing cases filed in court to various “dispute resolution doors” or options.<sup>50</sup> Parties are referred to different dispute resolution options in an effort to select that option which best suit the needs of their particular dispute. The dispute resolution options include mediation, arbitration, conciliation, case evaluation and finally adjudication. In the multi-door courthouse system, trained intake workers inform the parties of the various alternative dispute resolution programs available and direct the parties towards the most appropriate process or series of processes based on factors such as the relationship of the parties, the nature of the dispute, the amount at stake, and the type of relief sought. The goal of the multi-door courthouse is to streamline the court process and afford parties various options to resolve their dis-

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<sup>50</sup> GERARDINE MEISHAN GOH, DISPUTE SETTLEMENT IN INTERNATIONAL SPACE LAW: A MULTI-DOOR COURTHOUSE FOR OUTER SPACE, *Studies in Space Law*, 270, 297 (Martinus Nijhoff Publishers, 2007).

putes beyond the standard option of litigation. Multi-door courthouse programs have been in place in several states for many years and have proven an effective means of channeling cases to alternate options for dispute resolution to meet the specific needs of a case.

With respect to asteroid mining, this process can be used, where instead of referring a dispute to the ICJ directly, alternatively a dispute can be sent to a multi-door courthouse which would have to be set up under the International Space Body with the agreement of all members. The courthouse would then decide which process would best suit the issue at hand.

### 3. Asteroid Mining Legislation: The United States Commercial Space Law Competitiveness Act (2015)

While establishing a legal framework fit to deal with asteroid mining activities is of paramount importance, and is what has been proposed in this paper, it is pertinent to take on record that the United States through the U.S. Commercial Space Law Competitiveness Act<sup>51</sup> which was signed by President Obama in 2015, has become one of the first nations to take a step in this direction by enacting a law that encourages the commercial exploitation of asteroid resources, and also recognizes the right of a U.S. citizen to own the resources so obtained<sup>52</sup>. It also takes a significant step forward by actually defining the terms ‘asteroid resource’ and ‘space resource’. The progressive legislation becomes a hugely important step towards advancing space exploration and by doing so the U.S. has become the first nation to enact a law that deals exclusively with Asteroid Mining.

## VI. CONCLUSION

The law can only be effective when it learns from the past, works on the present, and keeps one eye on the future. To ensure the scales of justice are always balanced, the law must always be

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<sup>51</sup> U.S. Space Launch Commercial Competitiveness Act, Pub. L. 114-90, § 51302, 129 Stat. 704 (2015).

<https://www.congress.gov/bill/114th-congress/house-bill/2262>.

<sup>52</sup> Planetary Resources-The Asteroid Mining Company, *President Obama Signs Bill Recognizing Asteroid Resource Property Rights in Law*

<http://www.planetaryresources.com/2015/11/president-obama-signs-bill-recognizing-asteroid-resource-property-rights-into-law/>, (last visited July, 16, 2016).

rigid enough to enable enforcement, but flexible enough too to meet the needs of changing times. Truth be told, times today are changing faster than they were ever before. Asteroid mining, as we have explained, is not only set to become a reality very soon, but will change the global economy and guarantee large steps in scientific progress unlike anything ever seen before. Even if all we provided is glance on how mining will take place in the future, the possible legal implications and the need for an international regulatory body, we hope to have taken a step in the right direction. If an idea can be judged by its potential for change, the world as a whole is sitting on one major breakthrough. As the late Neil Armstrong said when we took our first small steps into the moon in 1969-“That’s one small step for man, one giant leap for mankind”, he too would be proud to see how far we have come if we mine that asteroid.

## REGULATING THE VOID: IN-ORBIT COLLISIONS AND SPACE DEBRIS

*Timothy G. Nelson\**

Space flight has been a reality for barely fifty years, and yet there have already been several notable incidents involving de-orbiting spacecraft. In 1978, the Soviet satellite *Kosmos 954* crashed in northern Canada, scattering nuclear material across parts of the Arctic and requiring an extensive cleanup operation.<sup>1</sup> In 1979, the U.S. space station *Skylab* satellite landed in rural Western Australia, without causing significant damage.<sup>2</sup>

Many collisions occur within space itself. A recent example was the January 2009 collision, in Low Earth Orbit (LEO) above Siberia, of the “defunct” Russian satellite *Kosmos 2251* with *Iridium 33*, a privately-owned U.S. satellite.<sup>3</sup> The crash occurred at a relative velocity of 10 km/second, destroyed both satellites, and reportedly created a very large field of new debris.<sup>4</sup> As discussed below, there remains significant scope for debate over who if, anyone, is liable for in-orbit collisions from “space debris.”

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<sup>1</sup> See Alexander F. Cohen, *Cosmos 954 and the International Law of Satellite Accidents*, 10 YALE J. INT'L L. 78, 79-80 (1984-85). See also Protocol on Settlement of Canada's Claim for Damages Caused by “Cosmos 954,” Apr. 2, 1981, Can.-U.S.S.R., 20 I.L.M. 689 (1981).

<sup>2</sup> See *Skylab's Spectacular Death*, TIME, July 23, 1979, at 35.

<sup>3</sup> See Henry Hertzfeld & Ben Basely-Walker, *A Legal Note on Space Accidents*, 2010 ZEITSCHRIFT FÜR LUFT UND WELTAUMERECHT (ZLW) 230, 232 (2010).

<sup>4</sup> See *id.*; see also Jared B. Taylor, *Tragedy of the Space Commons: A Market Mechanism Solution to the Space Debris Problem*, 50 COLUM J. TRANSN'L L. 253, 261 (2011)

Fascinating though it may be to the disinterested legal observer, a legal “debate” is not necessarily good news for industry participants. In a capital-intensive industry where the entry costs are high (literally so), and where long-term investment is key, any form of uncertainty can prove problematic. Likewise, from a government standpoint, uncertainty over the legal implications of orbital debris is worrying: orbital space represents a shared environment in which numerous governmental actors participate – and thus have a vested interest in cooperating together and avoiding collisions, both literal and figurative. Finally, from an environmental standpoint, the world community has an interest in minimizing the impact of orbital debris. One does not need to be a wholesale subscriber to the “cascade effect” theory of infinite, domino-like orbital collisions and destruction arising from a single crash (as featured in the movie *Gravity*) to believe that floating space junk should be minimized. All of these factors mean that the international legal community, and the community of space users, have an interest in improving the current system of space debris regulation. This article does not attempt to propose a comprehensive solution; it does, however, attempt to frame and define the current situation, including the gaps in regulation, in the hope that future policymakers may fill them.

### I. THE PHENOMENON OF SPACE DEBRIS

Space debris, or space junk, is a shorthand reference for any man-made objects lingering in space, as a (sometimes inevitable) byproduct of space activities. Science fiction writers sometimes liken space flight to seafaring; however, the analogy is flawed: ships wrecked on the high seas typically sink, with no long-term impact on other surface traffic.<sup>5</sup> Air-flight is likewise a false analogy. Debris from aircraft does not linger in the atmosphere; it falls to

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(noting the *Kosmos 2251/Iridium* crash reportedly created “402 pieces of new orbital debris”).

<sup>5</sup> See Brian Beck, *The Next, Small Step for Mankind: Fixing the Inadequacies of the International Space Law Treaty Regime to Accommodate the Modern Space Flight Industry*, 19 ALB. L.J. SCI. & TECH. 1, 9 (2009).

earth.<sup>6</sup> In space, by contrast, as a simple matter of Newtonian physics, particles in a weightless environment will continue on their current trajectories indefinitely unless or until they collide with other particles, just as the defunct *Kosmos 2251* satellite collided with *Iridium 33*. Moreover, due to the kinetic force of high-velocity objects, even a tiny particle can cause enormous damage. “A 0.5 mm paint chip travelling at 35,000 km/hr (10 km/sec) could puncture a standard space suit.”<sup>7</sup> A one centimeter fragment can damage a space station.<sup>8</sup>

Of course, the remnants of these explosions themselves became space debris.<sup>9</sup> The 1981 destruction of the Soviet *Kosmos 1275* remains unexplained, but was possibly due to space debris,<sup>10</sup> and the same may be true of the 1986 explosion of an Arienne rocket.<sup>11</sup>

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<sup>6</sup> Many also do not appreciate the harshness of space and the short lifespan of some satellites. See Michael W. Taylor, *Orbital Debris: Technical & Legal Issues and Solutions*, 2-3 (Aug. 1, 2006) (unpublished LL.M. thesis, McGill University), available at <http://www.fas.org/spp/eprint/taylor.pdf>. (noting that the “science fiction” view of space often ignores the “unique physical properties” of space – space is a “harsh environment” limiting the functioning life of satellites to an average of 15 years).

<sup>7</sup> Robert C. Bird, *Procedural Challenges to Environmental Regulation of Space Debris*, 40 AM. BUS. L.J. 635, 641 (2003).

<sup>8</sup> *Id.*; see also Gunnar Leinberg, *Orbital Space Debris*, 4 J.L. & TECH. 93, 98 (1989) (“A 3 mm piece of space debris traveling at 10 km/sec has as much kinetic energy as a 12 lb bowling bowl travelling at 60 mph”); Adrian Taghdiri, *Note: Flags of Convenience and the Commercial Space Flight Industry: the Inadequacy of Current International Law to Address the Opportune Regulation of Space Vehicles in Flag States*, 19 B.U. J. SCI. & TECH. L. 405, 420 (2013) (noting that space debris may remain in orbit for “over a century”).

<sup>9</sup> See Tariq Malik, *Satellite Debris Tracked Near Space Station*, SPACE.com (Mar. 19, 2009, 1.21 pm ET) (reporting that NASA was tracking *Kosmos 1275*'s remains to ensure that the International Space Station was not threatened); Leinberg, *supra* n. 8 at 97 (noting the 1986 Arienne rocket explosion increased the debris population by 7%, and involved 500 large pieces of debris).

<sup>10</sup> See *id.* Some consider the breakup in the 1970s of the US “PAGEOS” satellite may have been due to debris. *Id.* at 95; see also Daria Diaz, *Trashing the Final Frontier: An Examination of Space Debris from a Legal Perspective*, 6 TUL. ENVTL. L.J. 369, 371-72 (1993) (noting that “[i]n 1984, the Solar Max satellite was permanently disabled after it collided thousands of times with what may have been nearly invisible pieces of rocket fuel or satellite fragments. Scientists who examined the aforementioned debris also discovered microscopic shards of human urine.”) (footnote omitted); Peter T. Limperis, *Note: Orbital Debris and the Space Faring Nations: International Law Methods for Prevention and Reduction of Debris; and Liability Regimes for Damage Caused by Debris*, 15 ARIZ. J. INT'L & COMP. L. 319, 319 (1998) (noting “possibility that space debris disabled a Japanese climate observation satellite named *Midori* in the summer of 1997”).

<sup>11</sup> See *id.* (noting reports that the Arienne rocket collided with a French *Cerise* spy satellite).

Then there are the seemingly mundane (but in fact potentially deadly) encounters with small bits of debris, such as the paint fleck that struck the Space Shuttle *Challenger* in 1983 and caused \$50,000 worth of damage,<sup>12</sup> plus the disruption caused to launches and *International Space Station* activities when there is a projected possibility of a debris collision.<sup>13</sup> The “weaponization” of space, including the use and testing of anti-satellite weaponry, may also increase the amount of fragmentation debris.<sup>14</sup> The 2007 Chinese anti-satellite test in LEO may have created “a cloud of more than 3,000 pieces of space debris.”<sup>15</sup> During the Cold War, the intentional destruction of satellites for national security reasons may have had a similar effect.<sup>16</sup>

In an exhaustive 1989 study, Howard Baker identified four categories of space debris:

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<sup>12</sup> See Leinberg, *supra* note 8, at 95 (noting that the *Challenger* collision with a 0.2 mm paint fleck “[le]ft a crater approximately 2.4 mm across and 0.63 mm deep that cost \$ 50,000 to replace”); see also *id.* (noting that in 1987, “a cosmonaut’s life was jeopardized in an attempt to remove a plastic ‘baggie’ that was preventing the Soviet craft Kvant from docking with the Mir”); Delbert D. Smith, “The Technical, Legal and Business Risks of Orbital Debris,” 6 N.Y.U. ENV’T L.J. 50, 53-54 (1997-98) (noting that as at the late 1990s, “the Shuttle Orbiter ha[d] experienced an increased frequency of orbital debris damage” and that impacts “as a result of particles greater than one millimeter occurred during each of four recent missions”).

<sup>13</sup> See 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. TRANSNAT’L L. 589, 595 (2011) (noting instances where rocket launches were delayed, or the ISS crew placed on evacuation alert, due to specific threats of debris collision).

<sup>14</sup> See He Qizhi, *Towards International Control of Environmental Hazards of Space Activities*, in INT’L INST. OF SPACE LAW, PROCEEDINGS OF THE THIRTIETH COLLOQUIUM ON THE LAW OF OUTER SPACE, 138, 140 (warning “intentional explosion, such as tests of ASAT [might] intensify the seriousness of the [debris] situation by producing hundreds of thousands of debris and particles”).

<sup>15</sup> Brian Weeden, “2007 Chinese Anti-Satellite Test Fact Sheet” (Nov. 23, 2010), <http://swfound.org/media/9550/2007%20chinese%20asat%20test%20factsheet.pdf>; Imburgia, *supra* note 13, at 600-01; see also Jesse Oppenheim, *Danger at 700,000 Feet: Why the United States Needs to Develop a Kinetic Anti-Satellite Missile Technology Test-Ban Treaty*, 38 BROOKLYN J. INT’L L. 761, 761-63 (2013) (noting effects of the Chinese 2007 ASAT test; further noting that a United States military test of 2008, “Operation Burnt Frost,” involved a sea-launched missile that destroyed *US-193*, a 5,000-pound U.S. spy satellite orbiting at an altitude of 193 nautical miles).

<sup>16</sup> The Former Soviet practice was to explode inactive satellites. David E. Reibel, *Environmental Regulation of Space Activity: The Case of Orbital Debris*, 10 STAN. ENV’T L.J. 97, 105 (1991). These satellites, however, were usually in LEO, *id.*, meaning that atmospheric drag may have eliminated much of this material.

- “inactive payloads” – “former active payloads which can no longer be controlled by their operators”; a category that includes spent orbital satellites and probes;<sup>17</sup>
- “operational debris,” i.e., “objects associated with space activities” that remain in space, mostly comprising “launch hardware” but also other man-made materials discarded in the course of space exploration.<sup>18</sup> Hardware items include rocket bodies, orbital transfer vehicles, kick motors, nose cones, payload separation hardware, “exploded restraining bolts,” “fairings,” “exploded fuels tanks and insulation” and “window and lens covers”;<sup>19</sup>
- “fragmentation debris” caused when objects break up after explosions;<sup>20</sup> and
- “micro particulate matter” between 1 and 100 microns wide, including particulates from solid-fuel transportation systems.<sup>21</sup>

The nature of the problem varies according to orbit. LEO is closest to the atmosphere,<sup>22</sup> the medium earth orbit (MEO) is between 5,600 km to 36,000 km (often used for navigational satellites),<sup>23</sup> while the Geosynchronous Orbit (GEO) – the very valuable orbit utilized by many communications satellites – is a higher orbit.<sup>24</sup> Debris in the LEO is more likely to be dragged down to the

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<sup>17</sup> HOWARD A. BAKER, *SPACE DEBRIS: LEGAL AND POLICY IMPLICATIONS* 4 (1989).

<sup>18</sup> *Id.*

<sup>19</sup> Other items include “raw propellant inadvertently dumped during fuel transfers,” “a camera from an Apollo mission,” an “astronaut’s glove,” lost screws, “food wrappers” from Soviet cosmonauts and “transient bits of frozen sewage” from a Space Shuttle mission. *Id.*

<sup>20</sup> *Id.* at 4-5.

<sup>21</sup> *Id.* at 8-9.

<sup>22</sup> Taylor, *supra* note 6, at 10.

<sup>23</sup> *Id.* at 10 (noting that the US Navstar and Russian Glonass satellites used Medium Earth Orbit).

<sup>24</sup> *Id.* Geosynchronous orbit, at 36,000 km above Earth, is the “second most widely used Earth orbit,” and allows “orbital periods of 24 hours” and “[s]implified communications.” Limperis, *supra* note 10, at 321-22. On the value of geosynchronous orbit within the GEO, see Joel Stroud, *Space Law Provides Insights on How the Existing Liability Framework Responds to Damages Caused by Artificial Outer Space Objects*, 37 REAL PROP. PROB. & TR. J. 363, 371 (2002).

atmosphere, and may diminish over time, but it travels at enormous speed relative to other objects.<sup>25</sup> Orbital debris in the GEO, which “moves in an enormous doughnut shaped ring around the equator as the gravitational forces of the Sun, Moon and Earth pull on the objects,” is “not naturally removed from orbit by atmospheric drag,” and thus is “estimated to last anywhere from a million to 10 million years.”<sup>26</sup>

Moreover, it has been estimated that collision risk in the GEO “is not uniform by longitude,” but instead is “seven times greater in regions centered around the so-called ‘geopotential wells’ which exert a gravity pull on drifting satellites and other debris.”<sup>27</sup> According to the insurer Swiss Re, there are operating satellites worth “hundreds of millions of dollars” that are “in or near these locations.”<sup>28</sup>

Some scientists have warned that the risks posed by space debris may grow – perhaps exponentially – as the use of space increases. One theory, developed by NASA Scientists John Gabbard and Donald Kessler (and dubbed “the Kessler Syndrome”), posits that the population of human-generated space debris might hit a critical mass.<sup>29</sup> One writer explains:

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<sup>25</sup> See Beck, *supra* note 5, at 28 (noting atmospheric drag has effects that continue for hundreds of kilometers, meaning that satellites in LEO need propellant to keep their orbit).

<sup>26</sup> Taylor, *supra* note 22, at 10; see also Steven A. Mirmina, *Reducing the Proliferation of Orbital Debris: Alternatives to a Legally Binding Instrument*, 99 AM. J. INT’L L. 649, 650 (2005) (making similar observation). On the other hand, collision velocities in the GEO may be lower than in the LEO. See Lawrence D. Roberts, *A Lost Connection: Geostationary Satellite Networks and the International Telecommunication Union*, 15 BERKELEY TECH. L.J. 1095, 1125 (2000) (“Differential velocities among active spacecraft and debris tend to be lower, both because the absolute velocity of objects in geosynchronous orbit are lower and because uses of the geosynchronous orbit tend to confine the direction and orbital angle of working satellites, derelicts, and other forms of debris to similar vectors.”).

<sup>27</sup> *Id.*

<sup>28</sup> Swiss Re, *Space Debris: On a Collision Course for Insurers*, available at [http://media.swissre.com/documents/Pub111\\_Space+debris.pdf](http://media.swissre.com/documents/Pub111_Space+debris.pdf) (hereinafter “Swiss Re Report”); see also *id.* at 6-7, 11-13 (discussing technical factors driving collision risk and GEO orbital characteristics).

<sup>29</sup> See Brian Weeden, *Saving Earth Orbit, One Piece of Junk at a Time*, SPACE NEWS BLOG (Aug 11, 2010), <http://www.spacenews.com/article/guest-blog-saving-earth-orbit-one-piece-junk-time>.

Proponents of the cascade effect hypothesize that large space debris pieces will increasingly collide, break apart, and fill the orbit with smaller and more numerous bits of debris. These smaller pieces of debris will further collide and break apart, creating more fragments and increasing the chance of new impacts. When the space debris population reaches a certain threshold, collisions between objects will create so much new debris that it will increase independently of further space operations. Left unchecked, this self-generation could actually create a debris belt around the Earth.<sup>30</sup>

On this theory, the “collisional cascading” process will “pose a greater risk to spacecraft than the natural debris population of meteoroids.”<sup>31</sup> Indeed, some consider that debris is already expanding at an “astonishing” rate, and that without proper mitigation “[e]arth’s orbit, and eventually the entire solar system, will become an unusable wasteland of dangerous debris.”<sup>32</sup>

The risks posed from space debris has attracted attention from the insurance sector. In a recently-published study, Swiss Re observed that orbital debris had doubled over the last 20 years, and warned that “debris has the potential to damage or destroy high-value, operational satellites with resulting revenue losses in the billions of dollars or euros.”<sup>33</sup>

## II. CALLS FOR ACTION AND POLICY PROPOSALS

The principal response to the “debris” issue has been “mitigation” – the adoption of guidelines to modify spacecraft design to reduce the amount of space debris created in flight, such as those

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<sup>30</sup> Bird, *supra* note 7, at 643; *see also* Natalie Pusey, *The Case for Preserving Nothing: The Need for a Global Response to the Space Debris Problem*, 21 COLO. J. INT’L ENVTL. L. & POL’Y 425, 432 (2010) (noting that “if humans add no additional debris to Earth orbit, but also fail to remediate the problem, the amount of debris in orbit could still grow exponentially”); Imburgia, *supra* note 13, at 597-99.

<sup>31</sup> Weeden, *Saving Earth’s Orbit*, *supra* note 28.

<sup>32</sup> *See* 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, 1, 59 (2007); *see also id.* at 1 (noting 32% increase in orbital objects during the first two months of 2007).

<sup>33</sup> Swiss Re Report, *supra* note 28, at 1.

adopted by the United Nations Inter-Agency Space Debris Coordination Committee (“IADC”) and NASA<sup>34</sup> – as well as the reporting and tracking of existing space junk. Other mitigation practices include the de-orbiting of inactive satellites (if in LEO), or, if in GEO, the removal from active orbit of inactive satellites to retirement orbits.

Some call for more vigorous action. Writing in 1990, Albert Gore stated that “[o]rbital debris [was] already a problem of considerable importance; consequently, laws to control further proliferation will be needed.”<sup>35</sup> Commentator Brian Weeden has called for the introduction of an enhanced, more comprehensive debris tracking system and other technologies to reduce debris.<sup>36</sup> Others have called for the creation of a “superfund” or multilateral treaty system

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<sup>34</sup> The UN guidelines, developed through the Inter-Agency Debris Committee, call for a series of vehicle-design and operational measures to reduce the extent of space debris produced by space vehicles. They also call for disposal of defunct satellites orbiting in the LEO and the adoption, for defunct satellites in the GEO, of retirement orbits above the GEO. See United Nations Office for Outer Space Affairs, *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010), available at [http://orbitaldebris.jsc.nasa.gov/library/Space%20Debris%20Mitigation%20Guidelines\\_COPUOS.pdf](http://orbitaldebris.jsc.nasa.gov/library/Space%20Debris%20Mitigation%20Guidelines_COPUOS.pdf).

The United States has adopted similar guidelines. See NASA, “Orbital Debris Mitigation,” available at <http://orbitaldebris.jsc.nasa.gov/mitigate/mitigation.html> (last visited Jan. 25, 2013); Swiss Re Report, *supra* note 28, at 28. The International Telecommunications Union similarly encourages mitigation, advocating “disposal” or “graveyard orbits” 300 km above GEO for otherwise non-functional or derelict satellites. Pusey, *supra* note 30, at 428. Also relevant are the regulations of the Federal Communications Commission of the United States, which in 2004 issued a requirement that satellite operators must, as part of the licensing process, provide information on their debris mitigation strategies, as well as “end-of-life” assurances that their satellites will be repositioned to a disposal orbit. See Federal Communications Commission, “Mitigation of Orbital Debris,” 69 FED. REG. 54581 (Sept. 9, 2004).

<sup>35</sup> Albert Gore, Jr., *Outer Space, The Global Environment, and International Law: Into The Next Century*, 57 TENN. L. REV. 329, 334 (1990).

<sup>36</sup> See Brian Weeden, *Billiards in Space*, THE SPACE REVIEW (Feb. 23, 2009), available at <http://www.thespacereview.com/article/1314/1> (arguing it would be “criminal” not to devote the “rather low amount of resources” to tracking debris, given the “hundreds to thousands of close approaches among the entire satellite catalog every day”).

to subsidize remediation efforts/research,<sup>37</sup> as well as bans of particular kinds of material (e.g., nuclear fuel) in orbit.<sup>38</sup> A possible variant is the creation of a “market share” or polluter-pays system where space users are required to “purchase” the ability to create debris.<sup>39</sup>

Other more ambitious projects would include the recapture of defunct satellites, perhaps aided by a maritime-style “salvage” regime.<sup>40</sup> Technologically, however, the options are limited:

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<sup>37</sup> Joseph S. Imburgia, *supra* note 13, at 654 (proposes new Space Treaty to mandate prevention/mitigation and establish a Space Sustainability Authority with power to effect removal of space debris); Agatha Akers, Note and Comment: *To Infinity and Beyond: Orbital Space Debris and How to Clean it Up*, 33 U. LA VERNE L. REV. 285, 311-13 (2012) (arguing in favor of a space access fee of \$5 million per unmanned object launched and a \$1 million fee per manned launch, modeled after California’s Electronic Waste Recycling Fee, to fund an orbital maintenance program); *see also* Taghdiri, *supra* note 8 at 430 (calling for greater regulation; arguing that space debris risks are increasing due to risks of growing space tourism, “lax” regulation and/or the use of “flags of convenience”; calling for treaties to be amended to include “comprehensive compliance regimes,” possibly featuring “an international space tribunal, international space safety regulations, and a mandatory international insurance plan”); Oppenheim, *supra* note 15 at 794-95 (arguing for a ban on kinetic anti-satellite missile tests, among other things, to reduce risks of orbital debris); Elise Epperson Crow, Note & Comment: *Waste Management in Space: Addressing the Challenge of Orbital Debris*, 18 SW. J. INT’L L. 707, 716-20 (2012) (calling for reform of the treaty system, including burden-shifting rules “to shift the burden of proof of negligence to the debris-creating states,” as well as laws to promote space salvage).

<sup>38</sup> As a result of Cold War era technology, there reportedly are 1500kg of radioactive materials orbiting Earth. Pusey, *supra* note 30, at 432. In 1978, President Carter called for a ban on nuclear satellites in the wake of the *Kosmos 954* crash, but this failed to come to fruition. *See* Cohen, *supra* note 1, at 90.

<sup>39</sup> *See* Taylor, *supra* note 1, at 279 (arguing for a tradable allowance scheme). For a trenchant criticism of the “market share liability” school, *see* Allen Rostron, *Beyond Market Share Liability: A Theory of Proportional Share Liability for Nonfungible Products*, 52 UCLA L. REV. 151, 201-02 (2004) (noting problems with compiling reliable data about orbital debris as well as the varying properties of debris based on location and velocity).

<sup>40</sup> *See* James Dunstan & Berin Szorka, *Beware of Space Junk*, FORBES.COM, <http://www.forbes.com/2009/12/17/space-junk-environment-global-opinions-contributors-berin-szorka-james-dunstan.html> (Dec. 17, 2009) (“While maritime law encourages the cleanup of abandoned vessels as hazards to navigation, space law discourages debris remediation by failing to recognize debris as abandoned property, and making it difficult to transfer ownership of, and liability for, objects in space — even junk. By adapting maritime precedents, space law could make orbital debris removal feasible, once the right economic incentives are in place. Entrepreneurs may even find ways to recycle and reuse on orbit the nearly 2,000 metric tons of space debris, which includes ultra-high grade aerospace aluminum and other precious metals.”); *see also* Glenn Reynolds, *Space Junk and the Law of Space Collisions*, POPULAR MECHANICS (Oct. 1, 2009) *available at*

One involves sending a satellite to known debris and either capturing the debris or attaching a device (tether or engine) that would enable the debris to reenter Earth's atmosphere. The primary problem with this concept is that the propellant expenditure to visit more than one piece of debris per launch is enormous. . . . The only other potential remediation measure involves using ground-based lasers to perturb the orbit of debris and cause it to reenter the Earth's atmosphere more quickly. However, the tracking ability of lasers, the ability to discriminate among active satellites and debris, and the high energy levels required to have any noticeable effects makes this proposal currently impractical.<sup>41</sup>

On this view, "currently there are no economically or technically feasible ways to remove space debris from space."<sup>42</sup>

### III. DO THE OUTER SPACE TREATY AND LIABILITY CONVENTION REGULATE SPACE DEBRIS?

#### A. *The Legal Framework*

The Outer Space Treaty of 1967<sup>43</sup> articulates a series of governing principles about the use and exploration of space that, while extremely important to space law generally, do not directly address the status of space debris. Among other things, the Outer Space

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<http://www.popularmechanics.com/science/space/4303567> (arguing that there should be a "salvage law [which would] give a shot in the arm to commercial space efforts").

<sup>41</sup> Taylor, *supra* note 32, at 43-44 (footnotes omitted).

<sup>42</sup> *Id.* at 79. A physical removal regime might also trigger legal problems, especially as many satellites are subject to national security claims. For example, Gerry Oberst notes that the United States "ITAR" Regulations still apply to in-orbit objects meaning that "taking control of debris could technically be an 'export' subject to all the ITAR rules." Gerry Oberst, *Legal Issues for Space Debris Removal*, SATELLITE TODAY, <http://www.satellitetoday.com/via/globalreg/38524.html> (Apr. 1, 2012). Oberst also notes that "many if not most, technical proposals for debris removal have some overtones of military applications." *Id.*

<sup>43</sup> Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, *opened for signature* Jan. 26, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty]. As at the present date, 101 states have ratified, and a further 26 states have signed, the Outer Space Treaty. See *Status of International Agreements Relating to Activities in Outer Space*, U.N. Office for Outer Space Affairs, <http://www.oosa.unvienna.org/oosa/en/SpaceLaw/treatystatus/index.html> (last visited Jan. 26, 2013).

Treaty provides that space is the “province of all mankind”;<sup>44</sup> that the “exploration and use of outer space [shall be conducted] in accordance with international law”;<sup>45</sup> that states are generally responsible for the activity of their nationals in outer space;<sup>46</sup> that states “shall retain jurisdiction and control” over “objects launched into outer space”<sup>47</sup> and shall generally be “liable for damage” from such objects;<sup>48</sup> and that states shall avoid “harmful contamination” of space and activities that interfere with other states’ rights and exploration.<sup>49</sup>

In the 1972 Liability Convention,<sup>50</sup> contracting states agreed to create absolute liability for damage on the surface of the earth (or to aircraft) “caused by its space object[s],”<sup>51</sup> and further imposes “fault”-based liability on states for damages “caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State.”<sup>52</sup> Inter-state claims may be resolved through “Claims Commissions”; a quasi-arbitral procedure.<sup>53</sup>

These presuppose that governments are responsible for many facets of space travel and that the principal claims arising in space law will be government-to-government in nature. This is a product of the era in which they were negotiated. As one commentator remarked of the Outer Space Treaty:

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<sup>44</sup> Outer Space Treaty, Art. I.

<sup>45</sup> *Id.* at Art. III.

<sup>46</sup> *Id.* at Art. V.

<sup>47</sup> *Id.* at Art. VIII.

<sup>48</sup> *Id.* at Art. VII.

<sup>49</sup> *Id.* at Arts. IX, XI.

<sup>50</sup> Convention on International Liability for Damage Caused by Space Objects, *opened for signature* Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter *Liability Convention*]. The Liability Convention has been adopted by 88 countries, with 23 further signatories. *See generally*, Hertzfeld, *supra* note 3, at 233.

<sup>51</sup> Liability Convention, Art. II; *see also id.* at Art. I(a) (defining “damage” as “loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations”).

<sup>52</sup> *Id.* at Art. III.

<sup>53</sup> *Id.* at Arts. XIV-XX. For a criticism of the current claims commission structure, *see* Dan St. John, *The Trouble with Westphalia in Space: The State-Centric Liability Regime*, 40 *DENV. J. INT’L L. & POL’Y* 686, 696 (2012) (arguing that the current state-centric structure is a “vestige” of the Westphalian system of international law, in which private actors must enlist the cooperation of their home states to bring a claim).

Because it was drafted at a time when space activity meant rare and expensive government forays, little attention was paid to the possibility of pollution of the space environment. Instead the provisions of the treaty focused on ensuring freedom of access and forestalling the exercise of national control, not operational efficiencies.<sup>54</sup>

### *B. Arguments in Favor of Liability for Launching States*

None of the space treaties contains a “per se” ban on “[l]ittering the outer space environment” or specific rules about space debris.<sup>55</sup> Thus, arguments for state liability for space debris have often been based upon the more general statements contained in the Outer Space Treaty, particularly Article VII, which provides:

Each State Party to the Treaty that launches or procures the *launching of an object into outer space*, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the moon and other celestial bodies.<sup>56</sup>

As all space debris originates from materials launched into outer space, it might be argued that any piece of space debris is an “object[] launched into space” and that collisions involving such “objects” trigger the international liability provisions of Article VII of the Outer Space Treaty. Those who urge such a theory of liability on states under Article VII may argue that such liability is fortified by Article VIII, providing for states to “retain jurisdiction and control” over “objects launched into outer space,”<sup>57</sup> as well as Article VI, providing that states are “bear international responsibility for national activities in outer space . . . whether such activities are

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<sup>54</sup> Roberts, *supra* note 26, at 1124 (footnotes omitted).

<sup>55</sup> Diaz, *supra* note 10, at 377 and Baker, *supra* note 17, at 86.

<sup>56</sup> Outer Space Treaty, Art. VII (emphasis added). *See also* Hertzfeld, *supra* note 3, at 233.

<sup>57</sup> Outer Space Treaty, Art. VIII.

carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the [Outer Space Treaty].”<sup>58</sup>

Indeed, although Article VI’s reference to responsibility is somewhat “vague,”<sup>59</sup> its terms state that the “activities” of “non-governmental entities” in outer space are to remain subject to “authorization and continuing supervision” of the appropriate state parties.<sup>60</sup> On this view:

Because non-governmental entities may conduct activities in outer space only with the authorization of and under the supervision of the appropriate nation, any liability of such an entity is imputed to the nation-state which authorized its space activities. In this way, article VI renders the nation-state liable for the activities of non-governmental entities.<sup>61</sup>

A similar line of argument could be made with respect to the Liability Convention, using its fault-based liability for in-orbit collisions. If its definition of “space object,” which includes “component parts of a space object as well as its launch vehicle and parts thereof,”<sup>62</sup> were viewed as including the *remnants* of all launched objects,<sup>63</sup> then states could arguably become liable for damage

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<sup>58</sup> *Id.* at Art. VI.

<sup>59</sup> Lucinda R. Roberts, *Orbital Debris: Another Pollution Problem for the International Legal Community*, 11 FLA. J. INT’L L. 613, 618 (1997).

<sup>60</sup> Specifically, Article VI of the Outer Space Treaty provides that “States Parties to the Treaty shall bear international responsibility for national activities in outer space,” regardless of whether such activities are carried out by “governmental agencies or by non-governmental entities,” and imposes a further duty to “assur[e] that national activities are carried out in conformity with” the Outer Space Treaty. An analogy in this regard could be made to the responsibility of states for the activities of its nationals who operate mining activities on the sea-bed floor; a topic recently explored by the Sea-Bed Disputes Chamber of the International Tribunal for the Law of the Sea. *See generally* Responsibilities & Obligations of States Sponsoring Persons & Entities with Respect to Activities in the Area, Advisory Opinion, ITLOS Sea-Bed Dispute Chamber, ¶¶ 110-25 (Feb. 1, 2011) (hereinafter Sea Bed Advisory Opinion). This issue is discussed further in a customary international law context. *See infra* note 111.

<sup>61</sup> Marc S. Firestone, *Problems in the Resolution of Disputes Concerning Damage Caused in Outer Space*, 59 TUL. L. REV. 747, 751-52 (1985)

<sup>62</sup> Liability Convention, Art. I(d).

<sup>63</sup> At the time of ratification, the United States Senate was told by the State Department that “payload” in the Liability Convention meant “the space object, its component parts, and all property on or within the space object . . . even those parts which are not

caused by debris that could be traced back to it. Things, however, are not that simple.

*C. Legal Uncertainties Concerning Launch State Liability for Debris*

1. Uncertainty over the Meaning of “Space Object”

At the most basic level, there remains uncertainty over the meaning of “space object”/“object launched into space” for purposes of the Outer Space Treaty and the Liability Convention.<sup>64</sup> Manfred Lachs reportedly considered that “a space object is any object to be placed in orbit as a satellite of the earth, the moon or any other celestial body to traverse some other course to, in or through outer space.”<sup>65</sup> Cheng considered that a space object is anything launched into space, even “a lump of rock launched into outer space for no reason at all but the fun of it.”<sup>66</sup> Thus, on an expansive view, even “non-functional space objects” remain “space objects.”<sup>67</sup> “[S]hattered fuel tanks or flakes of paint from space objects” will be treated as “space objects.”<sup>68</sup> So, according to Cheng, will “refuse generated in space.”<sup>69</sup>

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intended to go into orbit or beyond” may be considered payload. Carl Q. Christol, *International Liability for Damage Caused by Space Objects*, 74 AM. J. INTL. L. 346, 357 (1980).

<sup>64</sup> See Hertzfeld, *supra* note 3, at 234 (discussing uncertainty over whether things like component parts are space objects, as well as past uncertainty over whether explosive bolts should be regarded as space objects). In this regard, there is a possible gap between the definition of “space object” in Article I(d) of the Liability Convention (specifically defined as including the launch vehicle and its component parts) and the potentially vaguer concept of “objects launched into outer space” appearing in Article VIII of the OST. See Baker, *supra* note 17, at 63; see also Imburgia, *supra* note 13, at 616-18.

<sup>65</sup> Leinberg, *supra* note 8, at 99.

<sup>66</sup> BIN CHENG, *STUDIES IN INTERNATIONAL SPACE LAW* 506 (1997).

<sup>67</sup> *Id.*

<sup>68</sup> *Id.*

<sup>69</sup> *Id.* The Soviet government’s voluntary settlement of the *Kosmos 954* matter with Canada could be argued to reflect an implicit recognition of its potential treaty liabilities. In turn, this might be said to support the view that a satellite’s reactor, and other components of a satellite, are “space objects” under I(d) of the Liability Convention. Ultimately, however, the no-admission nature of the settlement prevents us from drawing firm conclusions. *Id.* at 656.

But *space debris* creates additional problems. While it could be argued that an intact (but non-functioning) satellite is a “space object,” can the same be said of an exploded satellite? Are “fragments from a space object” a “space object”?<sup>70</sup> Cheng considers that they might be, but also considers that states may disclaim ownership in discarded or disused objects, rendering them owner-less, or *res derelicta*.<sup>71</sup> But this remains controversial.<sup>72</sup> Baker, while noting the United States position that “space refuse” is potentially a “space object” for purposes of the Liability Convention and Outer Space Treaty, nevertheless considers the issue to be “unclear.”<sup>73</sup> He further observes:

... The status of inactive satellites and spacecraft is uncertain, since Article I(d) [of the Liability Convention] gives no indication as to whether a payload must be active to qualify as a “space object.” If, however, “space object” is defined as an object “designed for use in outer space,” then inactive payloads would not be included.<sup>74</sup>

## 2. Problems with the “Fault” Standard in the Liability Convention

Article III of the Liability Convention imposes liability upon states for in-orbit collisions that are “its fault or the fault of persons for whom it is responsible.”<sup>75</sup> But it is silent on the standard for determining “fault” with regard to a particular object, and thus silent on how “fault” can be ascribed for space debris (assuming this

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<sup>70</sup> Pusey, *supra* note 30, at 436.

<sup>71</sup> Cheng considers that the jurisdiction and ownership rules “do not appear to preclude States from abandoning those of their space objects which have outlived their usefulness,” Cheng, *supra* note 65, at 466, arguing that states should only be liable for non-disowned space objects (and that such a rule would aid in addressing the space debris problem by removing legal obstacles to the removal of space debris). *Id.* at 509.

<sup>72</sup> See generally Kunihiro Tatsuzawa, *The Protection of Space Environment: the Problem of Space Wreckages*, in INT’L INST. OF SPACE LAW, PROCEEDINGS OF THE THIRTY-SECOND COLLOQUIUM ON THE LAW OF OUTER SPACE, 173, 174-76 (1989) (noting disagreement among commentators over whether objects in space can be abandoned or disowned (*res derelicta*)).

<sup>73</sup> Baker, *supra* note 17, at 62-63.

<sup>74</sup> *Id.* at 64.

<sup>75</sup> Liability Convention, Art. III.

to be a space “object”).<sup>76</sup> Some might argue that the “gap” is filled by the IADC Guidelines establishing standards with respect to debris mitigation,<sup>77</sup> but this is not a universal consensus and the guidelines by no means resolve all controversies.

This is exemplified by the academic debate over the *Kosmos 2251/Iridium* crash of 2009 (an incident that, officially at least, does not seem to have given rise to any liability claims at this date). Even assuming Iridium’s activities were attributable to the U.S. (per Articles VI and/or VII of the Outer Space Treaty), determining the applicable “fault” standard remains problematic.<sup>78</sup> As for *Kosmos 2251*, some might criticize Russia for failing to de-orbit this satellite when it became inactive in 1995. But although under *today’s* remediation standards, it may be appropriate to de-orbit a defunct satellite, this was arguably not the case in 1995, when *Kosmos 2251* ceased to be active. Indeed, in 1995, “nations routinely abandoned unused or decommissioned satellites.”<sup>79</sup>

Furthermore, although the Outer Space Treaty “imputes” private actions to states, there is some doubt as to whether this rule holds true for the Liability Convention, which “does not specifically incorporate the Outer Space Treaty’s doctrine of imputability.”<sup>80</sup> Some have therefore argued that it is “unclear whether a respondent under the Liability Convention will be liable for damage caused by its nationals under the Outer Space Treaty.”<sup>81</sup>

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<sup>76</sup> Baker, *supra* note 17, at 80. See also Limperis, *supra* note 10, at 331; Smith, *supra* note 12, at 58; Christol, *supra* note 62, at 368-69; Swiss Re Report, *supra* note 28 at 24. This “lacuna” in the Liability Convention was a “conscious decision of the negotiators.” *Id.* at 369.

<sup>77</sup> See Hertzfeld, *supra* note 3, at 236 n.28 (noting that the IADC guidelines, while “not binding law, . . . are likely to become customary practice among responsible nations and therefore could be found to be a reasonable standard of care”).

<sup>78</sup> Although Iridium was launched from Kazakhstan, it was subsequently acquired by U.S. private interests. *Id.* at 235. Arguably, “in the final analysis, the United States *should* be the logical state responsible for [Iridium].” *Id.* at 236. Hertzfeld notes that it might be argued that the U.S. was at “fault” for failing to track alternative routes for Iridium and for not providing satellite tracking information to the private operators. *Id.* at 237-38.

<sup>79</sup> See *id.* at 236.

<sup>80</sup> Firestone, *supra* note 58, at 759 (citing Foster, *The Convention on International Liability for Damage Caused by Space Objects*, 10 CAN. Y.B. INT’L L. 137, 165 (1972)).

<sup>81</sup> *Id.* at 760.

### 3. The Definition of “Damage”

Article I(a) of the Liability Convention defines “damage” as “loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations.”<sup>82</sup> Article VIII(1) permits “[a] State which suffers damage, or whose natural or juridical persons suffer damage” to make claims,<sup>83</sup> and Article XII calls for compensation to be

determined in accordance with international law and the principles of justice and equity, in order to provide such reparation in respect of the damage as will restore the person, natural or juridical, State or international organization on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred.<sup>84</sup>

But beyond those general statements, the Convention does not indicate clearly whether “damage” extends to the costs of environmental remediation or of other injury that did not directly affect life or economic property. This became evident during the *Kosmos 954* episode, where the main “damage” claimed was the cost of environmental cleanup to property that was not being used for farming or industrial use. Although the Soviet Union eventually paid around half of the C\$6m claimed by Canada as part of a voluntary settlement, the Canadian side was initially concerned that the Soviets might deny the existence of any “damage” under the Liability Convention.<sup>85</sup> This “illustrate[d] one of the Liability Convention’s main weaknesses: its definition of damages is too vague.”<sup>86</sup>

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<sup>82</sup> Liability Convention, Art. I(a).

<sup>83</sup> *Id.* at Art. VIII(1).

<sup>84</sup> *Id.* at Art. IX.

<sup>85</sup> See Cohen, *supra* note 1, at 89 n. 72 (“It was not clear that the radioactive remnants . . . injured Canada under the Liability Convention’s definition of injury . . . . Canadian elites were relieved that the U.S.S.R. chose not to avoid payment on these grounds”).

<sup>86</sup> Van C. Ernest, Note: *Third Party Liability of the Private Space Industry: To Pay What No One Has Paid Before*, 41 CASE W. RES. L. REV. 503, 526 (1991). See also Swiss Re Report, *supra* note 28, at 25 (noting that the provisions of Article XII of the Liability Convention, which refer generally to the principle of compensation to “restore” the injured party to its former position, remain unclear); St. John, *supra* note 53, at 703-04 (noting the uncertainty over whether the definition of damage includes “lost profits” or “indirect” damage: conventions provide “no clear guidance[,] and a staggering amount of

#### 4. Debris as “Harmful Contamination”?

It has been argued that space debris triggers Article IX of the Outer Space Treaty, which obligates states to avoid “harmful contamination” of space.<sup>87</sup> Others, however, maintain that Article IX refers only to *biological* contaminants, with the result that it applies only to materials that could affect astronauts and spacecraft – not debris.<sup>88</sup> Some have argued that “debris” was not intended to be regarded as “harmful contamination,” because it is “impossible to operate in space without creating some amount of debris,” and thus it would have been odd for Article IX to have applied to a seemingly inevitable byproduct of space exploration.<sup>89</sup> Similarly, while Article V of the Outer Space Treaty requires states to report “phenomena” that may be “a danger to the life or health of astronauts,” some question whether space debris is a “phenomenon” for purposes of this article.<sup>90</sup>

Furthermore, Article IX’s obligation to “consult” with other users about activities that might cause causing “harmful interference” with activities of other states is hardly an “absolute injunction”

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indirect damage could potentially be attributed to a state,” noting as an example the debate over a 2005 expression of concern by Canada that “a Titan IV rocket booster launched from Cape Canaveral” might “fall near an oil platform in Newfoundland,” possibly causing significant financial loss).

<sup>87</sup> Outer Space Treaty, art. IX. See also Cheng, *supra* note 66, at 506 (opining that “deliberate and harmful release” of refuse or debris “would doubtless come under Article IX of the Space Treaty . . . relating to harmful contamination”); Baker, *supra* note 17, at 62 (considering that “inactive satellites” are capable of being regarded as “contamination” for purposes of article IX of the OST). A related question is whether Article IX’s provisions about “the introduction of extraterrestrial matter” to the “environment of the Earth” might apply to space debris; this, however, would require an interpretation that includes orbital areas as within the Earth’s “environment.” *Id.*; see also Roberts, *supra* note 59, at 618-19.

<sup>88</sup> See Tatsuzawa, *supra* note 72, at 175 (quoting Professor Reijnen as contending that “contamination” is merely one particular kind of pollution, and denotes damage having a “medico-biological” effect, and thus is inappropriate to littering in space); Diaz, *supra* note 10, at 377 (noting that there is no clear definition of what constitutes “harmful contamination” for purposes of Article IX of OST); and Imburgia, *supra* note 13, at 614-15.

<sup>89</sup> Taylor, *supra* note 22, at 41. See also Taylor, *supra* note 32, at 25.

<sup>90</sup> See Leinberg, *supra* note 8, at 102 (“[O]rbital debris probably does not qualify as ‘phenomena.’”). Others have argued that the obligation in Article IX to avoid harmful contamination “apparently applies only to those activities directed at the study and exploration of space,” because the word “use” is “omitted” – thus implying that non-exploratory “use” of space is not subject to Article IX. Smith, *supra* note 12, at 56.

against risky activities,<sup>91</sup> and, in any event it only applies to “future planned space activities,” not “activities already completed,” meaning that Article IX, even if applicable, may be of little utility in dealing with space debris (which usually is created through past activities).<sup>92</sup>

## 5. Other Issues

There are serious practical issues in actually identifying the source of a collision, especially for fragmentary debris.<sup>93</sup> For example, “[i]f a piece of debris one centimeter in diameter destroys a space station, it would be nearly impossible to find that piece of debris after the disaster and identify it.”<sup>94</sup> This problem, combined with the absence of a fault standard, can “make recourse under the Liability Convention largely futile.”<sup>95</sup> The same can be said of Article VII of the Outer Space Treaty, which “does not indicate what

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<sup>91</sup> Pusey, *supra* note 30, at 437. *See also* Limperis, *supra* note 10, at 331 (noting uncertainties in Article IX with respect to space debris); Jennifer M. Seymour, Note: *Containing the Cosmic Crisis: A Proposal for Curbing the Perils of Space Debris*, 10 GEO. INT'L ENVTL. L. REV. 891, 899 (1998) (similar observation).

<sup>92</sup> Smith, *supra* note 12, at 57.

<sup>93</sup> Weeden notes that the tracking of the launching state for a piece of debris can be “extremely challenging.” Brian Weeden, *The Numbers Game*, THE SPACE REVIEW (July 13, 2009), available at <http://www.thespacereview.com/article/1417/1>. He also notes that there are discrepancies between the 14,800 objects in orbit according to the Space Track website and the over 19,000 figure being quoted by “military and NASA officials” – due in part to “uncataloged” objects. *Id.* Notably, the United Nations has since 1962 maintained a registry of objects launched into outer space. *See Registration of Objects Launched into Outer Space*, U.N. Office for Outer Space Affairs, <http://www.oosa.unvienna.org/oosa/SORegister/index.html>. The 56 parties to the Registration Convention are required, by Article II(1) thereof, to maintain a register of space objects launched by them into outer space, and to inform UN Secretary General of the existence of the registry. *See* Convention on Registration of Objects Launched into Outer Space, *opened for signature* Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15, art. II(1) [hereinafter *Registration Convention*]. Even assuming full compliance with the Registration Convention, however, this does not solve the technological impediments to tracking debris. One privately funded organization that has collected significant data on satellite orbits, and which is dedicated to assisting in space safety and debris mitigation, is the Space Data Association, *see* <http://www.space-data.org/sda/>.

<sup>94</sup> Beck, *supra* note 5, at 28. *See also* Leinberg, *supra* note 8, at 97 (noting that the U.S. government’s Colorado Springs tracking station “cannot detect space debris smaller than 10cm at altitudes of 500 km and higher”).

<sup>95</sup> James P. Lampertius, Note: *The Need for an Effective Liability Regime for Damage Caused by Debris in Outer Space*, 13 MICH. J. INT'L L. 445, 447 (1991). *See also* Christopher D. Williams, *Comment: Space: the Cluttered Frontier*, 60 J. AIR L. & COM. 1139, 1153-54 (1995) (even assuming Articles VI and VII of the OST create “responsibility” of

recourse a participating State has if the damaging debris is unidentifiable.”<sup>96</sup>

The Liability Convention’s dispute resolution provisions, which envisage state-to-state dispute resolution, are expressed as being without prejudice to a private party’s ability to bring claims in the “national courts” or agencies of contracting states.<sup>97</sup> In the absence of legislation or precedent on the issue, however, it is far from clear how the world’s various national courts would handle the matter.<sup>98</sup>

In sum, the Outer Space Treaty and Liability Convention provide “minimal specific guidance to the drafters of a space debris framework.”<sup>99</sup> One observer has said that “it is apparent that any prohibition on the generation of space debris could only be found in the spirit of the treaty and not in its text.”<sup>100</sup>

#### *D. Calls for Legal Reform*

Many have called for a better-defined treaty regime to govern space debris.<sup>101</sup> Taylor, for example, argues forcefully that the jurisdictional and control rule in Article VIII arguably is “an impediment to proposed solutions for the orbital debris problem,”<sup>102</sup> and that there is an urgent need to define “space object” “to make clear that it applies to orbital debris.”<sup>103</sup> He further argues that, although

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states for debris, it “is virtually impossible to identify the source of any particular piece of debris”) and Beck, *supra* note 5, at 28 (arguing that the existing space treaty regime “provides no incentive for launching state or companies to limit space debris” because of the uncertain fault standard and difficulty in identifying the source of debris).

<sup>96</sup> Limperis, *supra* note 10, at 331.

<sup>97</sup> Liability Convention, Art. XI(2).

<sup>98</sup> The Swiss Re Report constructs a hypothetical litigation scenario between a UK and US operator, and suggests that the outcome of a claim in the California courts would be difficult to predict. Swiss Re Report, *supra* note 28, at 26.

<sup>99</sup> Bird, *supra* note 7, at 655. *See also* Imburgia, *supra* note 13, at 618; Swiss Re Report, *supra* note 28, at 35 (concluding that the existing legal framework leaves liability “shrouded in uncertainty”).

<sup>100</sup> Seymour, *supra* note 7, at 900.

<sup>101</sup> Lampertius, *supra* note 91, at 466 (urging “multilateral approach” to debris control in order to “fill the gaps” in Liability Convention). *See also* Hertzfeld, *supra* note 3, at 240 (“As space becomes increasingly utilized and future space accidents occur, it remains to be seen if the current approach to space law will be able to withstand the legal, economic and diplomatic challenges of the future.”) and Smith, *supra* note 12, at 67-71.

<sup>102</sup> Taylor, *supra* note 22, at 80 (emphasis added).

<sup>103</sup> *Id.* at 95.

voluntary mitigation is commendable, “[t]he current *lacuna* of international law concerning orbital debris needs to be filled with enforceable rules and definitions that provide certainty and accountability.”<sup>104</sup> A new regime, he acknowledges, might involve collective and individual sacrifices (in terms of fuel carrying, mission life and other costs), but he considers these justified in the interests of a safer environment.<sup>105</sup>

Others warn that this is not a “realistic possibility,” given the slow-moving nature of the UN’s space law committees.<sup>106</sup> For its part, the United States took the position in 2004 that it was “premature” for the UN subcommittee to consider the legal aspects of space debris.<sup>107</sup>

#### IV. CUSTOMARY INTERNATIONAL LAW

Treaties represent but one source of law; existing alongside “international custom, as evidence of a general practice accepted as law,” as well as “the general principles of law recognized by civilized nations.”<sup>108</sup> To prove customary international law as to a particular point, the proponent must show the existence of a rule of law, as evidence by “extensive and virtually uniform” practice of states, “including that of States whose interests are specially affected,” that show conformity to the rule in question, accompanied by *opinio juris*, i.e., that the states have conducted themselves “in such a way as to show a general recognition that a rule of law or legal obligation is involved.”<sup>109</sup>

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<sup>104</sup> *Id.* at 98. *See also* Imburgia, *supra* note 13, at 634 (calling for treaty to “preserve the near-Earth space environment, and the U.S. space-based national security interests that reside there”) and *id.* at 636-41 (setting forth terms of draft treaty to research problem assets and fund solutions).

<sup>105</sup> Taylor, *supra* note 22, at 98. *See also* Seymour, *supra* note 89, at 914 (urging that “it is imperative that techniques . . . be employed as soon and as widely as possible” to address space debris).

<sup>106</sup> Mirmina, *supra* note 26, at 661.

<sup>107</sup> *Id.* at 652 note 19 (quoting 2006 United States spokesman).

<sup>108</sup> Statute of the International Court of Justice, Art. 38(1).

<sup>109</sup> North Sea Continental Shelf (Ger. v. Den.; Ger. v. Neth.), 1969 I.C.J. 3, ¶ 74, at 43 (Feb. 20); *accord* Continental Shelf (Libya v. Malta), 1985 I.C.J. 13, ¶ 27, at 29 (“[T]he material of customary international law is to be looked for primarily in the actual practice and *opinio juris* of states . . . .”); Military and Paramilitary Activities in and Against Nicaragua (Nicar. v. U.S.), 1986 I.C.J. 14, ¶207, at 108-09 (June 27) (“For a new customary rule to be formed, not only must the acts concerned ‘amount to settled practice,’ but they must be accompanied by the *opinio juris sive necessitatis*.’ Either the States taking

Some treaties have been held to represent a codification of law;<sup>110</sup> other treaties, if drafted by a wide membership of the international community, may be viewed as “binding upon all members of the international community” even prior to ratification “because [they] embod[y] or crystallize[] a pre-existing or emergent rule of customary law.”<sup>111</sup> In this vein, commentators such as Cheng have viewed the Outer Space Treaty’s terms, except the “registry” requirement, as “declaratory of general international law.”<sup>112</sup> Moreover, Article 3 of the Outer Space Treaty, requiring states to carry on the exploration and use of space “in accordance with international law,” may further indicate that the rules of customary international law, as they apply between states, extend to space activities.

Customary international law has been said to impose an obligation “not to allow knowingly [a state’s] territory to be used for

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such action or other States in a position to react to it, must have behaved so that their conduct ‘is evidence of a belief that this practice is rendered obligatory by the existence of a rule of law requiring it.’” (citations omitted). Moreover, although past international decisions “are not a source of international law,” HERSCH LAUTERPACHT, *THE DEVELOPMENT OF INTERNATIONAL LAW BY THE INTERNATIONAL COURT*, 20-21 (1958), they may, however, “serve as illustrations of customary international law if they involve an examination of customary international law, as opposed to a treaty-based, or autonomous, interpretation.” *Glamis Gold, Ltd. v. United States*, NAFTA UNCITRAL, ¶ 605 (June 8, 2009), available at <http://www.state.gov/documents/organization/125798.pdf>. This will only be the case, however, where the award in question has the necessary persuasive force. See, e.g., *Ahmadou Sadio Diallo (Guinea v. Dem. Rep. Congo)*, Preliminary Objections, 2007 I.C.J. 582, ¶¶ 89-91, at 615 (May 24) (holding that a particular series of past arbitral decisions did not represent customary international law on espousal of diplomatic claims).

<sup>110</sup> See, e.g., *Dispute Regarding Navigational and Related Rights (Costa Rica v. Nicar.)*, 2009 I.C.J. 214, ¶ 47, at 237 (July 13) (holding, with respect to Articles 31 and 32 of the 1969 Vienna Convention on the Law of Treaties, that those provisions were a “reflect[ion]” of “customary international law on the subject”); *Sovereignty over Pulau Ligitan & Pulau Sipadan (Indon. v. Malay)*, 2002 I.C.J. 625 ¶ 37, at 645 (Dec. 17) (similar holding); *Maritime Delimitation and Territorial Questions between Qatar and Bahrain (Qatar v. Bahr)*, 2001 I.C.J. 40 ¶ 185, at 97 (Mar. 16) (holding that certain provisions of the 1982 Convention on the Law of the Sea concerning delimitation of the territorial sea are reflective of customary international law).

<sup>111</sup> *Continental Shelf (Tunisia/Libya)*, 1982 I.C.J. Rep. 18 ¶ 24, 38 (Feb. 24).

<sup>112</sup> Bin Cheng, *supra* note 66, at 466-67; see also P. Malanczuk, *Space Law as a Branch of International Law*, 1994 NETH Y.B. INT’L L. 143, 159 (1995) (observing that the it is appropriate to treat OST as reflecting custom where its “essential principles . . . have been accepted by all States active in outer space by practice and with *opinio juris* after ratification, and where no evidence of dissenting practice on the part of non-ratifying States is available”); Christol, *supra* note 63, at 353.

acts contrary to the rights of other States.”<sup>113</sup> This doctrine, known by some as the “transboundary rule,” was expressed as follows in the *Trail Smelter* arbitration:

[N]o state has the right to use or permit the use of its territory in such a manner as to cause injury . . . in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence.<sup>114</sup>

The ICJ in *Corfu Channel*, finding Albania liable for minefields placed in its territorial waters, likewise referred to “every State’s obligation not to allow knowingly its territory to be used for acts contrary to the rights of other States.”<sup>115</sup> The 1972 Stockholm Declaration – an influential document in international environmental law, but arguably a statement of emerging principle rather than settled law – called upon states to “ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.”<sup>116</sup> More recently, in the 2009 *Pulp Mills* case, the ICJ, after reaffirming the *Corfu Channel* principle of prevention, held:

A State is thus obliged to use all the means at its disposal in order to avoid activities which take place in its territory, or in

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<sup>113</sup> Taylor, *supra* note 32, at 29 (citation omitted); *see also* Taylor, *supra* note 22, at 49 (citation omitted).

<sup>114</sup> *Trail Smelter* (U.S. v. Can.), 3 R.I.A.A. 1905, 1965 (*ad hoc* Arbitral Tribunal Mar. 11, 1941). The *Trail Smelter* case involved alleged transboundary pollution from a Canadian factory in British Columbia that caused damage to landowners in the nearby U.S. state of Washington. In the same vein, in the *Lac Lanoux* arbitration between Spain and France—a case concerning riparian rights over the Carol River—in the it was held that an upstream state could not divert the waters of a river in such a manner as would cause injury to the interests of a downstream state. *Lac Lanoux* (France v. Spain), 12 R.I.A.A. 281 (*ad hoc* Arbitral Tribunal Nov. 16, 1957).

<sup>115</sup> *Corfu Channel* (U.K. v. Alb.), 1949 I.C.J. 4, 22 (Apr. 9).

<sup>116</sup> “States have . . . the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.” Declaration of the United Nations Conference on the Human Environment, June 16, 1972, U.N. Doc. A/CONF.48/14/Rev.1, Principle 21 (1972), *reprinted in* 11 I.L.M. 1416 (1972) [hereinafter *Stockholm Declaration*]; *accord* Rio Declaration on Environment and Development, June 14, 1992, U.N. Doc. A/CONF.151/5/Rev.1, Principle 2 (1992), *reprinted in* 31 I.L.M. 876 (1992). By 1989, some commentators considered that this had been “accepted as a rule of customary international law.” Baker, *supra* note 17, at 73; Christol, *supra* note 63, at 353.

any area under its jurisdiction, causing significant damage to the environment of another State. This Court has established that this obligation “is now part of the corpus of international law relating to the environment”.<sup>117</sup>

In his study on space debris, Baker tied this principle to the provisions of the Outer Space Treaty.<sup>118</sup> Article VI, he observed, extends state responsibility to activities “carried on by non-government entities” and requires states to “assur[e] that national activities are carried out in conformity with the provisions” of the Outer Space Treaty, including through “authorization and continuing supervision” by the applicable states.<sup>119</sup> These may support a “heightened duty to protect other States”; thus, he argued, “the effect of Articles II and VI of the [Outer Space Treaty] is to apply the *Corfu Channel* and *Trail Smelter* principles to governmental and non-governmental activity in outer space and to heighten a State’s duty of due diligence.<sup>120</sup> Put another way:

In the absence of any specific agreement to the contrary, there is a customary rule of international law which provides that States, either individually or together with other States in international organizations, are liable for damages caused to other States through acts committed within their jurisdiction, particularly where those acts are committed with a high degree

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<sup>117</sup> Pulp Mills on the River Uruguay (Argentina v. Uruguay), 2010 I.C.J. 14 ¶ 101 at 44-45 (Apr. 20) (quoting Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1966 I.C.J. Reports 226 ¶ 29, at 242 (July 8)). See also *id.* ¶ 139, at 56 (speaking of obligation “to prevent any significant transboundary harm which might be caused by potentially harmful activities planned by either one of them.”) and Sea Bed Advisory Opinion ¶ 135 (commenting on “precautionary approach” and noting “a trend towards making this approach part of customary international law”). See generally Duncan French, *From the Depths: Rich Pickings of Principles of Sustainable Development & General International Law on the Ocean Floor □ the Seabed Disputes Chamber’s 2011 Advisory Opinion*, 26 INT’L J. OF MARINE AND COASTAL LAW 525 (2011) (discussing the general implications of the *Sea-Bed Advisory Opinion* on the law relating to the sustainable use of shared resources).

<sup>118</sup> Baker, *supra* note 17, at 73; see also Christol, *supra* note 63, at 349-50 (arguing that the Stockholm Declaration is applicable to outer space).

<sup>119</sup> Outer Space Treaty, Art. VI.

<sup>120</sup> Baker, *supra* note 17, at 74; see also Christol, *supra* note 63, at 353-54 (expressing similar view).

of State participation and supervision. Launching of space objects would appear to fall within that kind of category.<sup>121</sup>

This proposition is, to say the least, provocative. The notion that the *Trail Smelter* principle has any application at all in the realm of space will be unacceptable to many. As a threshold matter, the concept of “jurisdiction” may be hard to translate to a space context, and may be regarded as completely inappropriate when applied to an environment (and objects) that are not always subject to direct, real-time control.

The clearest case where “money changed hands” after a legal claim was the Soviet Union’s accepted financial responsibility in the *Kosmos 954* incident of 1978 in response to Canada’s claim under both the 1972 Convention and “general” principles of international law.<sup>122</sup> Even then, however, the eventual payment, made grudgingly, was expressed as voluntary and without admission – meaning its status remains highly debatable.<sup>123</sup>

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It remains difficult to ascertain the precise boundaries of the Outer Space Treaty or Liability Convention as regards space debris, and equally difficult to ascertain customary international law (if any) on the same topic. This uncertainty, however, cuts both ways, because it clouds future investments in space and complicates the

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<sup>121</sup> *Id.* at 352-53. Any such duty (if it exists), might not be absolute, and may also remain at all times highly context-specific. In the *Sea-Bed Advisory Opinion*, in addressing Article 139 of the Law of the Sea Convention and related provisions (imposing on states a “responsibility to ensure” their nationals’ activities complied with the treaty’s provisions), the Chamber stated:

The sponsoring State’s obligation “to ensure” is not an obligation to achieve, in each and every case, the result that the sponsored contractor complies with the aforementioned obligations. Rather, it is an obligation to deploy adequate means, to exercise best possible efforts, to do the utmost, to obtain this result. To utilize the terminology current in international law, this obligation may be characterized as an obligation “of conduct” and not “of result”, and as an obligation of “due diligence”. *Sea Bed Advisory Opinion* at ¶ 110.

<sup>122</sup> See Beck, *supra* note 5, at 15 (noting that although the Soviet Union only paid 50% of the amount claimed by Canada, “[t]he *Cosmos 954* incident appeared to validate an international norm that underlies the Liability Convention: nations have some responsibility to compensate states that are damaged by their fallen spacecraft”).

<sup>123</sup> See *id.*; Cohen, *supra* note 1, at 88; Ernest, *supra* note 85, at 626; and Swiss Re Report, *supra* note 28, at 25.

process of insuring space risks.<sup>124</sup> Beyond the continuation and broadening of existing mitigation guidelines, a case can thus be made for some kind of reform that will limit and/or cap the liability of space users who have observed certain basic precautionary practices, either in the design or deployment of spacecraft.<sup>125</sup> An argument can also be made for a licensing system where space users are required to submit to compulsory private arbitration of disputes concerning in-orbit collision.<sup>126</sup>

The existing uncertainty ought to incentivize all users of space – states and private entities alike – to remain focused upon the issue and to work together to find a more definite and predictable means of addressing it. Unlike space, the law abhors a vacuum.

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<sup>124</sup> See generally, Swiss Re Report, *supra* note 28, at 35.

<sup>125</sup> See *id.* at 641 (arguing in favor of a new treaty and statutory regime “to increase the uniformity and predictability of litigation,” with a “cap on damages in order to further advance uniformity and predictability”; this would “reduce uncertainty and reserve the limited amount of insurance available on the world market for compensation of economic loss”).

<sup>126</sup> See Henry R. Hertzfeld & Timothy G. Nelson, *Binding Arbitration as an Effective Means of Dispute Settlement for Accidents in Outer Space*, 2013 PROCEEDINGS OF THE INTERNATIONAL INSTITUTE OF SPACE LAW 129 (ed. Corinne Jorgenson 2014).

# GLOBAL CAP AND TRADE SYSTEM FOR SPACE DEBRIS: PUTTING A PRICE ON SPACE HAZARDS

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## I. INTRODUCTION AND CONTEXT

### *A. Space Debris*

Earth orbital space is a finite natural resource which is steadily being polluted due to human space activities and the emission of different kinds of uncontrollable objects into Earth orbit. The creation of space debris is not legal nor illegal *per se*, however due to the current state of technology it is unavoidable as it is difficult to launch a space object without emitting any inoperable objects. Space debris poses a great threat to all space activities and might eventually also endanger life on Earth as big objects regularly re-enter the Earth's atmosphere.<sup>1</sup> According to the Kessler-Theory, even if no more debris objects are produced, the already existing pieces will multiply in a cascading effect which will lead to rendering the Low Earth Orbit (LEO) impassable.<sup>2</sup> Future space activities

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\* This paper was first presented at the China University of Political Science and Law's Beijing Conference on Space Security and Long-Term Sustainability of Outer Space Activities, May, 25<sup>th</sup>, 2014. Anja Nakarada Pecujlic is a PhD Candidate at the Cologne University, Germany.

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<sup>1</sup> Meaghan R. Plantz, *Orbital Debris: Out of Space*, 40 GA. J. INT'L & COMP. L. 585, 594 (2012); Nicholas D. Welly, *Enlightened State-Interest – A Legal Framework for Protecting the “Common Interest of All Mankind” from Hardinian Tragedy*, 36 J. SPACE L. 273, 275 (2010).

<sup>2</sup> STELLA TKATCHOVA, SPACE-BASED TECHNOLOGIES AND COMMERCIALIZED DEVELOPMENT: ECONOMIC IMPLICATIONS AND BENEFITS 213 (2011)

will thereby be precluded and the further use of existing space technologies and facilities hindered.<sup>3</sup> Hence, the space industry as a whole will be endangered.

Space debris is defined by the United Nations as “all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non functional”.<sup>4</sup> There are different kinds of orbital debris, namely:<sup>5</sup> a) inactive payloads; b) operational debris, which is any object intentionally or accidentally released during a mission (including hardware, propellant tanks, and even frozen sewage). c) fragmentation debris, consisting of very small objects from breakups of space objects; and d) micro-particulate debris, consisting of minute particles.<sup>6</sup>

This approach, however, will only target two categories of space debris: inactive payloads and operational debris. These two categories are chosen based on the fact that these two types of debris can be more easily reduced by precautionary measures or active removal.

### *B. Cap and Trade Systems in General*

In recent years, the climate change issue brought carbon dioxide (CO<sub>2</sub>) and other greenhouse gases, to the centre of attention. CO<sub>2</sub> is the main pollutant responsible for global warming.<sup>7</sup> Although this problem is environmental in nature, it affects all spheres

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<sup>3</sup> Plantz, *supra* note 2, at 596, 597; Weeden, *The Non-Technical Challenges of Active Debris Removal*, IAF WORKSHOP ON ACTIVE DEBRIS REMOVAL, VIENNA AUSTRIA, 14 (Feb. 11, 2013) available at [http://swfound.org/media/100609/bw\\_adr\\_iaf\\_copusstsc\\_feb112012.pdf](http://swfound.org/media/100609/bw_adr_iaf_copusstsc_feb112012.pdf).

<sup>4</sup> UN Office of Outer Space Affairs, *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2008) available at <http://www.unoosa.org/documents/pdf/spacelaw/sd/COPUOS-GuidelinesE.pdf> (last visited July 17, 2016)

<sup>5</sup> Plantz, *supra* note 2, at 592; Mark J. Sundahl, *Unidentified Orbital Debris: The Case of Market-share Liability Regime*, 24 HASTINGS INT'L & COMP. L. REV. 125, 128 (2000);

<sup>6</sup> Sundahl, *supra* note 6, at 128.

<sup>7</sup> Air pollution comes from many sources. See generally, National Wildlife Federation, *Effects on Wildlife and Habitat Facts About Global Warming Problems*, <http://www.nwf.org/Wildlife/Threats-to-Wildlife/Global-Warming/Effects-on-Wildlife-and-Habitat.aspx> (last visited June 27, 2016); Bill Chameides, *The Greenhouse Effect Explained*, ENVIRONMENTAL DEFENSE FUND: CLIMATE 411, July 25, 2007, [http://blogs.edf.org/climate411/2007/07/25/greenhouse\\_effect/](http://blogs.edf.org/climate411/2007/07/25/greenhouse_effect/); Roberta C. Barbalace, *CO<sub>2</sub> Pollution and Global Warming, When does carbon dioxide become a pollutant?*

of life, including poverty, economic development, population growth, sustainable development and resource management. Therefore it is not surprising that a market based and legal solution was explored in order to limit greenhouse gas production and output, namely emission trading.<sup>8</sup>

Emission trading or "cap and trade" is a market-based approach used to control pollution by providing economic incentives and it consists of two parts.<sup>9</sup> First, there is the "cap" or limit, which defines total amount of certain greenhouse gases that can be emitted by factories, power plants and other installations in either globally and/or in one country, on a national level.<sup>10</sup> Second, within the cap, users receive, purchase by auction or buy emission allowances on the market (in the EU in 2016, for example, one ton of CO<sub>2</sub> emission costs 4,75€)<sup>11</sup> which they can "trade" with one another as needed.<sup>12</sup> If a company reduces its emissions, it can keep the spare allowances to cover its future needs or else sell them to another company that is in need of additional allowances.<sup>13</sup> On an intergovernmental level, dependent on the drafting of the system, companies seated in different countries, and even states themselves, can trade their remaining allowances with each other across national

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ENVIRONMENTALCHEMISTRY.COM, Nov. 7, 2006, <http://environmentalchemistry.com/yogi/environmental/200611CO2globalwarming.html>; NATIONAL RESEARCH COUNCIL ET AL., *ADVANCING THE SCIENCE OF CLIMATE CHANGE* (2010).

<sup>8</sup> United Nations Framework Convention on Climate Change, *Background on the UNFCCC: The International Response to Climate Change*, [http://unfccc.int/essential\\_background/items/6031.php](http://unfccc.int/essential_background/items/6031.php) (last visited June 28, 2016).

<sup>9</sup> Robert N. Stavins, *Experience with Market-Based Environmental Policy Instruments*, Resources for the Future, Discussion Paper 01-58, 26-33 (2001) available at <http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-01-58.pdf>.

<sup>10</sup> *Id.*; European Commission, Emission Cap and Allowances, [http://ec.europa.eu/clima/policies/ets/cap/index\\_en.htm](http://ec.europa.eu/clima/policies/ets/cap/index_en.htm) (last visited June 28, 2016).

<sup>11</sup> European Energy Exchange, European Emission Allowances, <https://www.eex.com/en/market-data/emission-allowances/spot-market/european-emission-allowances#!/2016/07/13> (last visited, July 13, 2016).

<sup>12</sup> See generally W. David Montgomery, *Markets in Licenses and Efficient Pollution Control Programs*, 5 J. ECON. THEORY 395-418 (1972); and Cameron Hepburn, *Regulating by Prices, Quantities, or Both: A Review of Instrument Choice*, 22/2 OXFORD REV. ECON. POL'Y 226-247(2006)

<sup>13</sup> William D. Nordhaus, *To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming*, 1 REV. ENVIRON'L ECON. & POL'Y 26-44 (2007) and A. Denny Ellerman & Barbara K. Buchner, *The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results*, 1 REV. ENVIRON'L ECON. & POL'Y 66-87 (2007).

boundaries.<sup>14</sup> While companies must surrender enough allowances to cover all their emissions in order to avoid penalties, the respective state must also comply with the set overall national cap.<sup>15</sup>

The most successful market putting a price on the CO<sub>2</sub> pollutant and executing the Cap and Trade System so far has been European Union (EU) with its EU Emission Trading System (EU ETS).<sup>16</sup> Today, it covers over 11000 big scale installations as well as airlines in 28 Member States, Iceland, Norway and Liechtenstein.<sup>17</sup> The trading scheme is divided into three phases since 2005 and while the current phase covers the years 2013 – 2020, a fourth phase (until 2030) is already being discussed.<sup>18</sup> In spite of critical opinions regarding the success of EU ETS (which mainly regard the low carbon price as a result of the surplus of allowances due to the economic crisis and other factors<sup>19</sup>), numbers and figures testify for an obvious cut in emissions. In 2012, emissions were reduced over 8%, even though new Member States had joined the EU and the

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<sup>14</sup> ZhongXiang Zhang, Using Emissions Trading to Regulate Global Greenhouse Gas Emissions in Climate Change, Human Systems and Policy (Volume 3; Antoaneta Yotova eds. 2009) 107f;

<sup>15</sup> Jean-Marc Burniaux et al., *The Economics of Climate Change Mitigation: How to Build the Necessary Global Action in a Cost-Effective Manner*, OECD Economics Department Working Papers No. 701 (2009); Hermann E. Ott, *Emissions Trading in the Kyoto Protocol, Finished and Unfinished Business*, 43 LINKAGES JOURNAL, <http://www.iisd.ca/journal/ott.html> (1998); and Joseph Kruger et al., *Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy*, 1 REV. ENVIRON'L ECON. & POL'Y 112-133 (2007).

<sup>16</sup> European Commission, The EU Emissions Trading System (ETS), [http://ec.europa.eu/clima/news/articles/news\\_2016052001\\_en.htm](http://ec.europa.eu/clima/news/articles/news_2016052001_en.htm) (last visited July 27, 2016) and Richard Sandor et al., SUSTAINABLE INVESTING AND ENVIRONMENTAL MARKETS: OPPORTUNITIES IN A NEW ASSET CLASS (2014), at 61 and Laing et al., *Assessing the Effectiveness of the EU Emission Trading System*, Centre for Climate Change Economics and Policy Working Paper No. 126 (2013), <http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/02/WP106-effectiveness-eu-emissions-trading-system.pdf>;

<sup>17</sup> European Commission, The EU Emissions Trading System (ETS), [http://ec.europa.eu/clima/news/articles/news\\_2016052001\\_en.htm](http://ec.europa.eu/clima/news/articles/news_2016052001_en.htm) (last visited July 27, 2016)

<sup>18</sup> European Commission, The EU Emissions Trading System (ETS), [http://ec.europa.eu/clima/news/articles/news\\_2016052001\\_en.htm](http://ec.europa.eu/clima/news/articles/news_2016052001_en.htm) (last visited July 27, 2016); European Commission, Revision for phase 4 (2021 – 2030), [http://ec.europa.eu/clima/policies/ets/revision/index\\_en.htm](http://ec.europa.eu/clima/policies/ets/revision/index_en.htm) (last visited July 27, 2016)

<sup>19</sup> Reforms to cut the surplus in emissions are already being implemented. See European Commission, Structural Reform of the EU ETS, [http://ec.europa.eu/clima/policies/ets/reform/index\\_en.htm](http://ec.europa.eu/clima/policies/ets/reform/index_en.htm) (last accessed July 27 2016)

economic crisis had an impact on the market.<sup>20</sup> By 2014, EU emissions were 24 % below 1990 levels, while the economy expanded by 48% in said period of time.<sup>21</sup> Today, emission levels are still falling.<sup>22</sup> The EU ETS has been more effective than other energy-environmental policy instruments and most importantly it also has affected investment decisions.<sup>23</sup> The essences of EU's effective system are transparent and accurate monitoring and reporting procedures<sup>24</sup>, as the data is annually monitored, reported and verified, which is called the "compliance cycle."<sup>25</sup>

The Scheme originated as a European effort within the framework of the Kyoto Protocol, which provides for Emission Trading Systems as a measure to combat global warming (see Chapter II.B). Worldwide there are many other examples of emission trading systems in force, including the schemes in the U.S (the Acid Rain Program<sup>26</sup>, the Regional Greenhouse Gas Initiative and the California Cap-and-Trade), the Québec Cap and Trade System<sup>27</sup> in Canada,

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<sup>20</sup> The EU ETS is delivering emission cuts. See ENERGY AND CLIMATE CHANGE COMMITTEE, THE EU EMISSIONS TRADING SYSTEM: TENTH REPORT OF SESSION 2010-12, VOL. 1, H.C. 14761t 7 (U.K.).

<sup>21</sup> European Commission, Progress made in cutting emissions, [http://ec.europa.eu/clima/policies/strategies/progress/index\\_en.htm](http://ec.europa.eu/clima/policies/strategies/progress/index_en.htm) (last visited July 27, 2016)

<sup>22</sup> European Commission, Slight decrease in emissions in 2015, [http://ec.europa.eu/clima/news/articles/news\\_2016052001\\_en.htm](http://ec.europa.eu/clima/news/articles/news_2016052001_en.htm) (last visited July 27 2016)

<sup>23</sup> Laing et al., *Assessing the Effectiveness of the EU Emission Trading System*, Centre for Climate Change Economics and Policy Working Paper No. 126 (2013), <http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/02/WP106-effectiveness-eu-emissions-trading-system.pdf>

<sup>24</sup> Grubb et al., *Climate Policy and Industrial Competitiveness: Ten Insights from Europe on the EU Emissions Trading System*, German Marshall Fund Climate & Energy Paper Series 09 (2009), <http://www.accc.gov.at/pdf/FINALCS-GMFPaper5Aug09.pdf> (last visited, July 29, 2006)

<sup>25</sup> European Commission, Monitoring, Reporting and Verification of EU ETS Emissions, [http://ec.europa.eu/clima/policies/ets/monitoring/index\\_en.htm](http://ec.europa.eu/clima/policies/ets/monitoring/index_en.htm) (last visited July 29, 2016); European Commission, EU ETS Handbook, 101, available at [http://ec.europa.eu/clima/publications/docs/ets\\_handbook\\_en.pdf](http://ec.europa.eu/clima/publications/docs/ets_handbook_en.pdf) (last visited July 13, 2016)

<sup>26</sup> Laing et al., *supra* note 24 and Steffan Brunner et al, *Emissions Trading Systems: An Overview*, Potsdam Institute for Climate Impact Research Discussion Paper (2009) available at <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.535.2125&rep=rep1&type=pdf>.

<sup>27</sup> International Carbon Action Partnership Canada – Québec Cap-and-Trade System, [https://icapcarbonaction.com/en/?option=com\\_etsmap&task=export&format=pdf&layout=list&systems%5B%5D=73](https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&systems%5B%5D=73) (last visited July 28, 2016) and

and other systems in Kazakhstan, Korea, China, Japan and New Zealand.<sup>28</sup>

The EU ETS (alongside other such systems) has shown that it is possible to trade in greenhouse emissions and that these emissions are falling as intended. The success of the EU ETS is an inspiration to expand this system also to other types of emissions and to launch cap and trade schemes as well for space debris.

## II. PROPOSAL FOR A GLOBAL CAP AND TRADE SYSTEM FOR SPACE DEBRIS

### A. *Economic Aspects*

At the very heart of emissions trading lays the desire for a market based, economically efficient scheme which will be adhered to by grand scale polluters as it grants powerful incentives. In direct comparison to other policy instruments like taxes, tax-payer-funded programmes or command and control regulation, emission trading is preferable, as it encourages operational excellence and provides exactly for the needed stimulus.<sup>29</sup>

As pollution rights (allowances) are made tradable within the cap and trade system, they gain value, which raises awareness for environmental matters, triggers behavioural changes and makes “going green” profitable.<sup>30</sup> Those who emit less greenhouse gases need to spend less for allowances and/or can profit from selling spares. The sourced savings or profits can be invested in green technologies which in turn allocate further savings and profits. If the price for allowances persists on a robust and high level, clean, low-carbon technology will be additionally promoted.<sup>31</sup>

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<sup>28</sup> Laing et al., *supra* note 24 and International Carbon Action Partnership, Emissions Trading Worldwide: Status Report 2015, at 8, available at [https://icapcarbonaction.com/images/StatusReport2015/ICAP\\_Report\\_2015\\_02\\_10\\_online\\_version.pdf](https://icapcarbonaction.com/images/StatusReport2015/ICAP_Report_2015_02_10_online_version.pdf);

<sup>29</sup> International Emissions Trading Association, Emissions Trading, <http://www.ieta.org/Emissions-Trading> (last visited July 27, 2016);

<sup>30</sup> Laing et al., *supra* note 24 and International Carbon Action Partnership, Emissions Trading Worldwide: Status Report 2015, at 8, available at [https://icapcarbonaction.com/images/StatusReport2015/ICAP\\_Report\\_2015\\_02\\_10\\_online\\_version.pdf](https://icapcarbonaction.com/images/StatusReport2015/ICAP_Report_2015_02_10_online_version.pdf);

<sup>31</sup> European Commission, The EU Emissions Trading System (ETS), [http://ec.europa.eu/clima/news/articles/news\\_2016052001\\_en.htm](http://ec.europa.eu/clima/news/articles/news_2016052001_en.htm) (last visited July 27, 2016)

The flexibility of the system ensures that emissions can be cut where it costs least, which is an additional important profit-incentive to major corporations.<sup>32</sup> All these incentives are important in order to ensure, that environmental protection does not come with decreases in economic growth.

Finally, it should be noted that cap and trade has the ability to adjust to the new prices automatically in the case of inflation and no further legislative or regulatory action is needed.<sup>33</sup>

### *B. Legal Aspects*

There are no binding legal documents explicitly addressing the problem of space debris and non-binding guidelines have proven to be inefficient.<sup>34</sup> However, in international law, a general obligation to avoid harmful long-term contamination of outer space does exist in the regime of the Outer Space Treaty and customary international law.<sup>35</sup> Article I of the Outer Space Treaty enshrines the duty to use Space for the benefit of all and space debris hinders other states' free access to polluted areas of outer Space.<sup>36</sup> Article IX of the Outer Space Treaty stipulates that states should avoid harmful contamination, and space debris is perceived as such a form of contamination.<sup>37</sup> Article IX of the Outer Space Treaty also requires states to adopt appropriate measures to help avoid contamination,

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<sup>33</sup> TOM TIETENBERG & LYNNE LEWIS, ENVIRONMENTAL & NATURAL RESOURCE ECONOMICS (10th ed.) at 369 (2016)

<sup>34</sup> Martha Mejia-Kaiser, *Informal Regulations and Practices in the Field of Space Debris Mitigation*, 34 J. AIR & SPACE L. 21, 23 (2009).

<sup>35</sup> GEORGE T. HACKET, SPACE DEBRIS AND THE CORPUS IURIS SPATIALIS, at 115 (1994); Treaty on Principles Governing the Activities of States in the Exploration and use of Outer Space, Including the moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205, Art. IX [hereinafter Outer Space Treaty]; Declaration of the United Nations Conference on the Human Environment, U.N. Doc. A/Conf.48/14/Rev. 1, Princ. 21 (1973) [hereinafter Stockholm Declaration]; 1992 Rio Declaration on Environment and Development, UN Doc. A/CONF.151/26 (vol. I), Art. 3 (June 14, 1992) [hereinafter Rio Declaration]; and Mejia-Kaiser, *supra* note 35, at 30.

<sup>36</sup> Outer Space Treaty Art. 1; FRANCIS LYALL & PAUL LARSEN, SPACE LAW - A TREATISE 307 (2009).

<sup>37</sup> Michael Gerhard, *National Space Legislation – Perspectives for Regulating Private Space Activities* in Essential Air and Space Law, (Benkö et al. eds. 2005), 85; Martha Mejia-Kaiser, *supra* note 35, at 23

which is interpreted by some as an obligation to mitigate space debris.<sup>38</sup> Additionally, Article 21 of the Stockholm Declaration and Article 2 of the Rio Declaration, which are seen by most as customary obligations<sup>39</sup>, state that States have to ensure that activities within their jurisdiction and control do not damage areas beyond national jurisdiction, such as outer space.<sup>40</sup>

As for a legal basis for implementing cap and trade regarding the mitigation of space debris on an international level, one possibility would be to create a legal obligation for the majority of space faring nations through drafting an international treaty. Models for this can be found in the international conventions on Climate Change, such as the Kyoto Protocol<sup>41</sup> or the new Paris Agreement<sup>42</sup>. The Kyoto Protocol is an international treaty, which commits State parties to reduce emissions to a previously agreed level.<sup>43</sup> Under this Protocol countries must reach these levels primarily through their national mechanisms or alternatively through three market-based methods<sup>44</sup>, first of them being the International Emission Trading. In this way, the Kyoto Protocol explicitly underlined the significance of a cap and trade system for a successful emission reduction on a national level, as well as on an international. Furthermore, the Paris Agreement is the newest adopted agreement regarding climate change. This Agreement is still not in force, nonetheless, it is already seen as historic, since 195 states pledged to reduce greenhouse gas emissions on a (non-binding) level that

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<sup>38</sup> Outer Space Treaty Art. IX; UN Comm. on the Peaceful Uses of Outer Space, Technical Report on Space Debris, U.N. Doc. A/AC.105/720, at B.III.12 (2005) and K. Gorove, *Protection of the Space Commons: New Customary Law*, 26 J. SPACE L., 208, 209 (1998); S Marchisio, Article IX, *Cologne Commentary of Space Law* (Hobe et al.eds.), 2012, Chapter 11;

<sup>39</sup> Dinah Shelton, Stockholm Declaration (1972) and Rio Declaration (1992) (2008) Max Planck Encyclopedia of Public International Law [MPEPIL] IX:602 ,para 17, 42 , Stockholm Declaration, *supra* note 36 and Rio Declaration, *supra* note 36.

<sup>41</sup> Kyoto Protocol to the United Nations Framework Convention on Climate Change UN Doc FCCC/CP/1997/7/Add.1, Dec. 10, 1997;

<sup>42</sup> Paris Agreement, *FCCC/CP/2015/L.9/Rev.1*

<sup>43</sup> UNFCCC, Kyoto Protocol, [unfccc.int/kyoto\\_protocol/items/2830.php](http://unfccc.int/kyoto_protocol/items/2830.php) (last visited July 29, 2016)

<sup>44</sup> these are (i) International Emission Trading, (ii) Clean Development Mechanism (iii) Joint Implementation. See UNFCCC, The Mechanisms under the Kyoto Protocol: Emissions Trading, the Clean Development Mechanism and Joint Implementation, [http://unfccc.int/kyoto\\_protocol/mechanisms/items/1673.php](http://unfccc.int/kyoto_protocol/mechanisms/items/1673.php) (last visited July 30, 2016)

will limit the rise in global temperatures.<sup>45</sup> The Paris Agreement leaves it to States' discretion to adopt adequate national measures in order to reach these goals, and already about 90 countries have included some form of carbon pricing in their plans.<sup>46</sup> These examples testify that there is a global willingness among States to adopt measures in order to reduce emissions and that there is also a common view regarding the best way to achieve this, namely by using cap and trade system. This current momentum should be used to start negotiating a separate international treaty, which would expand emission reduction to space debris as well.

Alternatively, if drafting a new treaty is seen as a too lengthy and complex process, another possibility to find a legal basis for the implementation of the cap and trade system for space debris could be through amendments to the two above mentioned legal documents. Articles 20 and 21 of the Kyoto Protocol offer possibility to adopt amendments, and for the Paris Agreement it is anticipated that it will have amendments in the future. Therefore, the scope of these documents for climate protection could be extended to space environment protection, and articles could be added that address the mitigation of space debris.

On a regional level, the above-mentioned EU ETS is enforced by the European Commission and finds its legal basis in the European Parliament's Directive of 2003.<sup>47</sup> Concerning a European effort for space debris mitigation, it would be possible to promulgate a legislation similar to the amendment to the EU ETS of 2008, adding norms for the regulation of aviation-emissions.<sup>48</sup> The legal basis for such legislation is to be found in accordance with Article 191 Treaty on Functioning of the EU (TFEU), namely the obligation to a prudent and rational utilisation of natural resources such as the

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<sup>45</sup> Thomson Reuters, Has Paris deal injected life into carbon market?, <http://blog.financial.thomsonreuters.com/has-paris-deal-injected-life-into-carbon-market/> (last visited July 30, 2016)

<sup>46</sup> C. Davenport, "Carbon Pricing Becomes a Cause for the World Bank and I.M.F.," *The New York Times*, April 23, 2016

<sup>47</sup> Parliament and Council Directive 2003/87/EC, O.J. (L 275) 32 (EU).

<sup>48</sup> Directive 2008/101/EC of the European Parliament and of the Council of 19 November 2008 amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community, OJ L 8, 13.1.2009, p. 3–21

Earth orbit, and the procedural requirements under Article 192(1) TFEU.<sup>49</sup>

### *C. Proposed Objectives*

#### 1. Global Limit for Debris Emission

In order to find a sensible cap to successfully mitigate space debris, the number of space debris produced globally on an annual basis has to be found. However, sources offer no consistent numbers, depending on what is presumed to be space debris by the tracking service. On average, according to most sources from the 1980s and 1990s, around 200-250 debris pieces per year were produced.<sup>50</sup> One has to take into consideration that since then, the number of space debris has increased with the number of space activities.<sup>51</sup> In 2006, for example, 517 new debris objects were tracked and categorized.<sup>52</sup> A year later, a single event caused a major contribution to the number of debris, namely, the Chinese anti-missile test which created more than 3300 tracked fragments.<sup>53</sup> The first in orbit collision ever between the Russian Kosmos satellite and the American Iridium satellite caused more than 2200 tracked fragments.<sup>54</sup> In 2013 around 70 new debris objects caused by launching alone were tracked by the online service Space-Track.org. It can be concluded that certain specific events, such as major launches, in-orbit accidents and missile tests in space can substantially increase the number of debris objects at a single stroke. However, it is estimated that during an average mission, approximately 7.5 objects are categorized per launch.<sup>55</sup>

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<sup>49</sup> *Id.*

<sup>50</sup> U.S. Congress, Office of Technology Assessment, *Orbiting Debris: A Space Environment Problem - Background Paper*, at 34 (1990).

<sup>51</sup> *Id.*

<sup>52</sup> UN INSTITUTE FOR DISARMAMENT RESEARCH, CELEBRATING THE SPACE AGE: 50 YEARS OF SPACE TECHNOLOGY, 40 YEARS OF THE OUTER SPACE TREATY, 121, (April 2007).

<sup>53</sup> ESA, Space Debris FAQ: Frequently Asked Questions, [http://www.esa.int/Our\\_Activities/Operations/Space\\_Debris/FAQ\\_Frequently\\_asked\\_questions](http://www.esa.int/Our_Activities/Operations/Space_Debris/FAQ_Frequently_asked_questions) (last visited July 30, 2016)

<sup>54</sup> ESA, Space Debris FAQ: Frequently Asked Questions, [http://www.esa.int/Our\\_Activities/Operations/Space\\_Debris/FAQ\\_Frequently\\_asked\\_questions](http://www.esa.int/Our_Activities/Operations/Space_Debris/FAQ_Frequently_asked_questions) (last visited July 30, 2016)

<sup>55</sup> NICOLAY N. SMIRNOV, SPACE DEBRIS: HAZARD EVALUATION AND DEBRIS MITIGATION 61 (2001)

All of these numbers might not strike as overwhelmingly shocking, however, the rate of space debris will increase rapidly due to natural processes of collision in orbit as there are already estimated 29,000 debris objects in orbit, which are sized larger than 10cm.<sup>56</sup>

The proposed market based approach seeks to limit the active and intentional emission of space debris annually.<sup>57</sup> This approach, on the one hand, sets the allowed cap for the numbers of debris emitted during launch activities and, and on the other hand, also sets a limit for the number of inactive payloads in orbit. The emission of space debris is categorized, depending on the kind of debris – i.e. operational debris and inactive payloads. On a national level there would be a cap limiting debris emission from both private industry and national agencies, and on an international level there will be a cap limiting debris emission globally.

In effect, this system would be divided into three or more phases, following the EU ETS model. Phase One is a three to five year pilot phase where, in the absence of reliable debris data, caps are set on the basis of best estimates. A suggestion for the cap for launch debris would be at seven categorized objects per launch, which is near the number of objects averagely emitted per launch. Regarding inactive payloads, all newly launched payloads have to have the capacity to be de-orbited and, at the end of their life-span have to be actually de-orbited. In phase two, the cap for launch debris will be decreased to a suggested 3-4 objects, depending on the state of technology. Additionally, a cap for inactive payloads in orbit is introduced, depending on the number of existing inactive satellites per member state. The proposed cap could be introduced at 2/3 of the existing payload debris per country.

In phase three, contingent upon success of the prior phases, the state of technology and the compliance of the Member States, these caps will be marginally increased.

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<sup>56</sup> ESA, How many Space Debris Objects are currently in orbit? [http://www.esa.int/Our\\_Activities/Space\\_Engineering\\_Technology/Clean\\_Space/How\\_many\\_space\\_debris\\_objects\\_are\\_currently\\_in\\_orbit](http://www.esa.int/Our_Activities/Space_Engineering_Technology/Clean_Space/How_many_space_debris_objects_are_currently_in_orbit) (last visited July 13, 2016)

<sup>57</sup> DAVE BAIOCCHI & WILLIAM WELSER IV, CONFRONTING SPACE DEBRIS: STRATEGIES AND WARNINGS FROM COMPARABLE EXAMPLES INCLUDING DEEPWATER HORIZON 42 (2010).

## 2. Tradable Permits

Space debris permits (or allowances) would work in such a way that they would make the producers of debris pay for the emissions they cause in outer space. After agreeing on the socially acceptable global cap and respective national caps of the space faring nations, permits would be issued in correspondence to these numbers. Modelled after existing schemes, permits can be issued for free in a primary transition period and auctioned in later periods. The total number of allowances has to be limited in order to ensure their value.<sup>58</sup> Over time, the global and national caps will be reduced in total so that a reduction in the annual debris output can be reached.

Space agencies, companies and private individuals that wish to pursue space activity which will create debris must hold permits corresponding to their pollution quotes.<sup>59</sup> Consequently, they will choose their contractors and subcontractors depending on the “sustainability” of their products in space. This encourages all space actors and the space industry to be more efficient when they are creating and launching space objects or parts of them. Furthermore, space actors will try to avoid fines, which would be substantial.

As a result, cleaner agencies and private actors benefit more. Not only do they save money and are able to invest in new technologies but also they save their reputation, which plays a big role when it comes to tenders and contractors. This creates an additional pressure for companies if they want to maintain their competitiveness.<sup>60</sup>

Therefore, as mentioned earlier, this approach gives the necessary economic incentives and triggers behavioral changes<sup>61</sup> in order to minimize the creation of non-functional objects in space.

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<sup>58</sup> European Commission, The EU Emissions Trading System (EU ETS), [http://ec.europa.eu/clima/policies/ets/index\\_en.htm](http://ec.europa.eu/clima/policies/ets/index_en.htm) (last visited July 3, 2016).

<sup>59</sup> Thierry Senechal, *Orbital Debris: Drafting, Negotiating, Implementing a Convention*, masters thesis, Massachusetts Institute of Technology, at 66 (June 2007) available at <http://web.mit.edu/stgs/pdfs/Orbital%20Debris%20Convention%20Thierry%20Senechal%2011%20May%202007.pdf>.

<sup>60</sup> Senechal, *supra* note 60., 66; W. David Montgomery, *Markets in Licenses and Efficient Pollution Control Programs*, 5 J. ECON. THEORY 395–418 (1972).

<sup>61</sup> Montgomery, *supra* note 61, 395–418.

### 3. Penalty System

Enforcement is the most significant aspect since without an affective enforcing system the value of allowances is forfeited.<sup>62</sup>

In order to enforce a sanction, one has to once again consider the overall limit. The first cap is determined on a global level, however national legislation regulates caps and allowances within domestic systems. Therefore, the penalty system has two levels. First, the national level, where the State has to make sure that their respective national space agencies and private actors stay within the cap. In cases where a private entity has not fulfilled its obligations, a State must levy a sanction upon the entity. Sanctions are enforced by domestic law and can be either of administrative or judicial, civil or criminal nature.<sup>63</sup> For example, substantial penalty payments or deductions from future (e.g. next year's) allowances can be imposed.<sup>64</sup> These two measures can also be combined.<sup>65</sup> In case of the national agencies, cuts in budget and other means can be used to ensure compliance.

Second, at the international level, the whole emissions of a state are measured which consequently also observes the performance of the national space agencies and impedes preferential treatment of state-owned actors. States must follow the globally accepted cap, otherwise the state will suffer a penalty for overstepping the cap, which can again be monetary or a reduction in future allowances<sup>66</sup>. The (in an optimal situation legally binding) interna-

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<sup>62</sup> Ott, *supra* note 16.

<sup>63</sup> T. H. Tietenberg, EMISSIONS TRADING, PRINCIPLES AND PRACTICE (SECOND EDITION), 170 (2010)

<sup>64</sup> UNFCCC, An Introduction to the Kyoto Protocol Compliance Mechanism, [http://unfccc.int/kyoto\\_protocol/compliance/items/3024.php](http://unfccc.int/kyoto_protocol/compliance/items/3024.php) (last visited July 13, 2016), UN Framework Convention on Climate Change, *Bodies*, <https://unfccc.int/bodies/items/6241.php> (last visited July 3, 2016) and International Carbon Action Partnership, Linking <https://icapcarbonaction.com/en/about-emissions-trading/linking> (last visited July 27, 2016)

<sup>65</sup> International Carbon Action Partnership, Linking <https://icapcarbonaction.com/en/about-emissions-trading/linking> (last visited July 27, 2016)

<sup>66</sup> UNFCCC, An Introduction to the Kyoto Protocol Compliance Mechanism, [http://unfccc.int/kyoto\\_protocol/compliance/items/3024.php](http://unfccc.int/kyoto_protocol/compliance/items/3024.php) (last visited July 13, 2016)

tional agreement on which the cap and trade system would be established, the rules of international relations and reciprocity, and public annual reports would additionally ensure compliance<sup>67</sup>.

#### 4. Compliance System

In order to implement and monitor the mitigation of space debris pursuant to the present approach, a two-stage compliance system is proposed, which involves reporting at both, the national and international levels.

Private space actors and operators are required to have an approved monitoring plan, according to which they monitor and report their emission of space debris during the year to the national organ in charge. The monitoring and the reports must follow a certain style and guidelines, in order to simplify inspections. In the style of the EU ETS, a ‘compliance circle’ could be installed, which includes in addition to the monitoring plan and the reporting system, an annual verification of the submitted numbers by an accredited verifier.<sup>68</sup>

The annual total of the debris emissions of private space actors and national space agencies of each participating state is then forwarded to an international monitoring organ, which processes and catalogues the numbers. One possibility would be to consign the Secretary-General of the United Nations with this position, as it also maintains the registry for space objects.<sup>69</sup>

#### 5. Investment in Innovative Technologies

According to the “Kessler Syndrome”<sup>70</sup>, the current extent of space debris in orbit may already render LEO impassable.<sup>71</sup> Even if no more debris objects are emitted, dysfunctional objects could

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<sup>67</sup> T. H. Tietenberg, *EMISSIONS TRADING, PRINCIPLES AND PRACTICE* (SECOND EDITION), 170 (2010)

<sup>68</sup> European Commission, *Monitoring, Reporting and Verification of EU ETS Emissions*, [http://ec.europa.eu/clima/policies/ets/monitoring/index\\_en.htm](http://ec.europa.eu/clima/policies/ets/monitoring/index_en.htm) (last visited July 3, 2016).

<sup>69</sup> Convention on the Registration of Objects Launched into Outer Space, *opened for signature* Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15, Art III.

<sup>70</sup> Donald J. Kessler and Burton G. Cour-Palais, *Collision Frequency of Artificial Satellites: The Creation of a Debris Belt*. *JOURNAL OF GEOPHYSICAL RESEARCH* **83**: 2637–2646 ((1978)..

<sup>71</sup> Tkatchova, *supra* note 3, 213.

multiply in a cascading effect through collisions and break-ups.<sup>72</sup> According to Prof. Klinkrad, head of ESA's Debris Office, "only the active removal of five to 10 large objects per year can reverse the debris growth".<sup>73</sup> Therefore, revenues and collected penalties from the cap and trade system would be used to promote scientific research and funding for innovative projects for active space debris removal. Monetary penalties would be paid into a compliance fund to be used for remediation, for example with the creation of a "Clean Space Fund," depending on how the cap and trade System will be legally implemented.

Similarly, the system has a remedial effect on the national level as the private Space operators will be able to use their revenues from selling emission permits as investments into "greener technologies," i.e. debris-neutral launches, the use of material which prevents the creation of minute particles or bigger break-ups in orbit, and de-orbiting capacities for all the launched payloads.

### III. CONCLUSION

The market-based approach of a cap and trade system in Space is the most cost-effective solution for long-term sustainability. It provides economic incentives for decreasing the emission of space debris and in the contrary to existing cap and trade systems it doesn't offer an easy "buy-out" as there would also be an obligation to invest. This is made possible as the resulting profits from saved allowances are to be used for investment in new technologies which will substantially improve mitigation efforts. This system enables to set a clear time frame for the targeted level of reduction. A global cap and trade system for space debris is thus warranted and would benefit the society as a whole.

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<sup>72</sup> Tkatchova, *supra* note 3, 213.

<sup>73</sup> Jonathan Amos, 'Urgent Need' to Remove Space Debris, BBC NEWS, Apr. 25, 2013, <http://www.bbc.com/news/science-environment-22299403>.

# EFFECTIVE EXERCISE OF ‘IN-SPACE JURISDICTION’: THE US APPROACH AND THE PROBLEMS IT IS FACING

*Frans G. von der Dunk\**

## I. INTRODUCTION

As mankind moves closer to the fiftieth anniversary of the conclusion of the Outer Space Treaty<sup>1</sup>, the framework international treaty laying down the baseline regime for space activities, it may be considered a major achievement that the treaty, as well as some of its off-spring – notably the Rescue Agreement<sup>2</sup>, the Liability Convention<sup>3</sup> and the Registration Convention<sup>4</sup> – seem to be as relevant as ever. This is a major feat in an international era of many fundamental changes in the geopolitical, economic and social context.

Nevertheless, the increasing involvement of private entities in many fields of space activity, beyond the (by now) more ‘traditional’ ones of satellite communications and to lesser extents launching and satellite remote sensing, has given rise to many new legal issues, even questions about the continuing validity and appropriate-

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<sup>1</sup> Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies London/Moscow/Washington, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereafter Outer Space Treaty].

<sup>2</sup> Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, *opened for signature* Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119 [hereinafter Rescue and Return Agreement].

<sup>3</sup> Convention on International Liability for Damage Caused by Space Objects, *opened for signature* Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereafter Liability Convention].

<sup>4</sup> Convention on Registration of Objects Launched into Outer Space, *Opened for signature* Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereafter Registration Convention].

ness of the broad regime resulting from the abovementioned treaties. Nowhere is this probably more true than in the case of the United States, the world's leading spacefaring nation in particular also in the context of extended private participation in activities in outer space.

In the United States, various serious commercial enterprises are eyeing the possibilities of exploiting the mineral resources of asteroids or other celestial bodies. Also in the United States, the various companies that are close to selling tickets to outer space to the rich, famous, and a few others are converging – even if Richard Branson's Virgin Galactic originally was a British company, and SXC, planning to launch from the Dutch Caribbean island of Curaçao, was a Dutch company before its merger with XCOR. Except for satellite communications and a few isolated examples in launching and remote sensing operations, all private operators with advanced plans for, or actually ongoing, space operations are US or US-led companies.

This also means that the development of legal tools within the United States to properly handle such new private endeavours should be of great interest to the rest of the world as well. Indeed, various non-US countries and other interested parties in this realm are closely following the developments within the United States in this regard.

One important aspect thereof concerns the use of national legislative and regulatory instruments to address international responsibility and liability of the United States under the treaties for the activities of such private entities in outer space or in an outer-space-context, further to Articles VI and VII of the Outer Space Treaty.<sup>5</sup>

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<sup>5</sup> Art. VI, Outer Space Treaty, *supra* note 1, provides for “international responsibility for national activities in outer space, including” where “such activities are carried on (...) by non-governmental entities.” Art. VII provides: “Each State Party to the Treaty that launches or procures the launching of an object into outer space (...) and each State Party from whose territory or facility an object is launched, is internationally liable for damage” caused by that space object. *See generally* F.G. von der Dunk, *Private Enterprise and Public Interest in the European ‘Spacescape’: Towards Harmonized National Space Legislation for Private Space Activities in Europe* 17-26 (1998) (unpublished Ph.D. dissertation, International Institute of Air and Space Law, Faculty of Law, Leiden University) and J. Nagvanshi & A. Sharma, *Jurisdiction in Outer Space: Challenges of Private Individuals in Space* in CURRENT DEVELOPMENTS IN AIR AND SPACE LAW 324-39 (eds. R. Singh, S.D. Rao & S. Kaul 2012).

At the same time, the United States turns out to present a rather unusual picture from the perspective of domestic implementation of international obligations under the space treaties and domestically specifying the agencies exercising jurisdiction for the purpose. It does not have a single national framework space act from which all further detailed regulations follow (which is essentially what all other countries with dedicated national space laws have availed themselves of), but a set of separate, to some extent even disparate national acts handling different aspects and elements. While historically understandable, and so far not having raised major legal problems, this is rapidly changing now under the pressure of such new developments as sketched above.

For that reason, the present article addresses the US approach to handling its international obligations under the space treaties specifically *vis-à-vis* private actors, the issues arising from that approach and the discussions currently gearing up to try and handle those issues more profoundly, comprehensively and, in a sense, logically. In short: how does and should, the United States arrange for the exercise of domestic jurisdiction over any relevant space or space-related operations by private actors, in line with applicable international law and, more precisely, in line with relevant clauses of the Outer Space Treaty and the Registration Convention.

## II. THE NEED FOR EFFECTIVE EXERCISE OF US 'IN-SPACE' JURISDICTION: THE PRIVATE 'SPACESCAPE'

The size and importance of the US private commercial space industry not just for the United States but also from a global perspective is beyond question. It requires both appropriate levels of control and regulation by the US government, for purposes of national policy and compliance with relevant international obligations of the United States, and, to the extent compliant with international law, appropriate stimulation equally to be reflected in legislation and regulation.

From this perspective, within the broader sector of the private commercial space sector, *prima facie* roughly seven categories of private commercial space activities warrant special attention, running the gamut from already being operational to being in the general stage of preliminary mission consideration. All fundamentally

raise the issue of the exercise of US jurisdiction over private activities conducted in or with respect to outer space.

The first four categories of these roughly fall within the sub-sector of private human spaceflight, whereas the fifth and sixth category deal with the sub-sector of private robotic on-orbit operations and the seventh with private exploitation of celestial bodies' resources, which for the time being is envisaged to be undertaken by way of unmanned missions (although this may change at a later stage). It is these three sub-sectors which consequently will be addressed by the present contribution.

### *A. Private Human Spaceflight*

'Private human spaceflight' should be defined as "flights of humans intended to enter outer space (a) at their own expense or that of another private person or private entity, (b) conducted by private entities, or (c) both."<sup>6</sup> As said, currently this means there are four types of private human spaceflight at issue in the US context (or indeed, generally speaking, globally).

First, there are the impending 'space tourism' flights of a sub-orbital nature. Following the conquest of the X-Prize in October 2004 especially US companies Virgin Galactic and XCOR seem to be getting close to launching the first commercial short-duration flights with paying passengers into a 'sub-orbital' trajectory, aiming for an apogee in the range of 100 to 120 km above the Earth's surface.<sup>7</sup>

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<sup>6</sup> This double criterion is formulated to exclude scenarios where governments or intergovernmental organizations pay for the flight of a particular human *and* undertake the actual flight operations, in which case the flight is legally speaking still comprehensively 'public' in nature. Flights such as carried out by private operators on behalf of NASA however are still included by virtue of criterion (b), whereas flights such as those of Mr. Dennis Tito to the *ISS* remain included by virtue of criterion (a). See for further analysis Frans G. von der Dunk, *Legal Aspects of Private Manned Spaceflight*, in *HANDBOOK OF SPACE LAW* 266-67 (ed. Frans G. von der Dunk 2015); cf. E. Walter, *The Privatisation and Commercialisation of Outer Space*, in *OUTER SPACE IN SOCIETY, POLITICS AND LAW* 496-500 (eds. C. Brünner & A. Soucek 2011); M. Gerhard, *Article VI* in *COLOGNE COMMENTARY ON SPACE LAW, VOL. I* 110-4 (eds. S. Hobe, B. Schmidt-Tedd & K.U. Schrogl 2009); and P. Atrey, *Space Tourism – Future Industry*, in *CURRENT DEVELOPMENTS IN AIR AND SPACE LAW* 417-29 (eds. R. Singh, S.D. Rao & S. Kaul 2012).

<sup>7</sup> Currently, both companies provisionally plan for such first flights to take place in the course of 2017 or soon thereafter. See Virgin Galactic <http://www.virgingalactic.com> (last visited July 4, 2016) and XCOR Aerospace, <http://www.xcor.com> (last visited July 4, 2016).

Second, several US companies are currently involved in NASA's Commercial Crew Development (CCDev) program in preliminary work for manned space transportation<sup>8</sup> and the follow-on Commercial Crew & Cargo Program (C3PO) to have privately-developed and privately-operated spacecraft transporting astronauts to and from the International Space Station, presumably as from 2017 onwards.<sup>9</sup> Recently, Space-X, Boeing and Sierra Nevada Corporation have been awarded commercial crew funding through Space Act Agreements. While Orbital Sciences, now Orbital ATK, was unable to obtain NASA funding at this stage, it continues to develop plans for similar spaceflight projects. While the focus is on transporting NASA and guest astronauts to the *International Space Station (ISS)*, once the technology would be proven there would be little doubt those companies would in principle also be interested in offering such orbital transportation flights to other destinations and/or for other customers than NASA, such as Bigelow Aerospace. Such operations would then raise essentially the same legal questions as sub-orbital space tourism, at least as for the outer space elements thereof.

Third, the year 2001 witnessed the beginning of 'orbital space tourism' with the visit of Dennis Tito to the *ISS*. However, the orbital space tourist trips from there on were, and likely will remain for the foreseeable future, one-off occasions never resulting for instance in two tourists being on board the *ISS* at the same time. Thus, whilst falling within the definition of private human spaceflight quoted above, this category of private human spaceflight for the time being would not seem to require further analysis from the

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<sup>8</sup> On the COTS and CCDev programmes see FED. AVIATION ADMIN, 2011 US COMMERCIAL SPACE TRANSPORTATION DEVELOPMENTS AND CONCEPTS: VEHICLES, TECHNOLOGIES, AND SPACEPORTS 38-45 (Jan. 2011) available at [https://www.faa.gov/about/office\\_org/headquarters\\_offices/ast/media/2011%20DevCon%20Report.pdf](https://www.faa.gov/about/office_org/headquarters_offices/ast/media/2011%20DevCon%20Report.pdf); FED. AVIATION ADMIN., THE ANNUAL COMPENDIUM OF COMMERCIAL SPACE TRANSPORTATION: 2012 60-1 (Feb. 2013) available at [http://www.faa.gov/about/office\\_org/headquarters\\_offices/ast/media/Annual\\_Compendum\\_of\\_Commercial\\_Space\\_Transportation\\_2012\\_February\\_2013.pdf](http://www.faa.gov/about/office_org/headquarters_offices/ast/media/Annual_Compendum_of_Commercial_Space_Transportation_2012_February_2013.pdf); S. Chaddha, *US Commercial Space Sector: Matured and Successful*, 36 J. SPACE L. 29-30 (2010); and T. Brannen, *Private Commercial Space Transportation's Dependence on Space Tourism and NASA's Responsibility to Both*, 75 J. AIR L. & COMM. 667 (2010).

<sup>9</sup> On the C3PO programme see Fed. Aviation Admin., ANNUAL COMPENDIUM, *supra* note 8, 60 (as consisting of 'CCDev2' and 'CCiCap'); Chaddha, *supra* note 8, 30-1; and A. Lele, *Security Connotations of Space Tourism*, 11 ASTROPOLITICS 219-20 (2013).

perspective of the issue of ‘in-space jurisdiction’. Moreover, the governmental nature of both the spacecraft flying orbital space tourists to their destination and back, and that destination itself – so far exclusively the *ISS* – means that the potential issues requiring the proper exercise of US jurisdiction in outer space over their activities have basically been taken care of within the legal framework pertaining to the *ISS* and NASA’s leadership role in that respect.<sup>10</sup>

Fourth, Bigelow Aerospace intends to offer ‘in-orbit’ hotel and other space station capacity within a few years from now.<sup>11</sup> The major difference between this category of private orbital tourism and that of orbital tourism on board the *ISS* concerns the private character of the former facility, which would again raise the issue of the appropriate exercise of – presumably – US jurisdiction on board as differently from that already taken care of by NASA.

In general furthermore, the operators currently developing vehicles for sub-orbital space tourism and orbital service flights are partly viewing their respective projects as precursors to full-fledged sub-orbital point-to-point transportation much along the lines of (international) air transportation. Such long-haul flights would again raise issues of jurisdiction, in particular as long as the vehicles concerned would not be squarely defined as ‘aircraft,’<sup>12</sup> so as to make national and international air law applicable to their operations. In the context of any such operations, the “range of in-space activity” conducted on board of the spacecraft would not anymore be, more or less, “pre-ordained” and/or remain closely related to the actual operation of the vehicles, but may now encompass many ordinary activities humans are conducting on earth all the time – and humans “make mistakes, commit violence, develop afflictions, and so on,” and may well “behave in ways that regulators have not contemplated beforehand.”<sup>13</sup>

Thus, each of these various impending spaceflight activities requires a substantive level of US regulatory control over them, both to comply with international obligations of the United States under international law and to ensure a proper and balanced legal

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<sup>10</sup> See further *infra*, § IV.A.

<sup>11</sup> See generally Bigelow Aerospace, *Genesis I & II*, <http://bigelowaerospace.com/genesis> (last visited July 5, 2016).

<sup>12</sup> Note the standard definition of aircraft discussed in greater detail *infra*, at § III.C.

<sup>13</sup> B. Perlman, *Grounding US Commercial Space Regulation in the Constitution*, 100 GEORGETOWN L. J. 940, 941 (2012).

and regulatory framework allowing this particular sector of private activities to prosper. Whilst a considerable body of US national law does in principle exist to address commercial spaceflight in general, under the strain of these new and rapid developments certain cracks, gaps and loopholes now start to become evident and call for a more fundamentally coherent approach.

### *B. Private Robotic On-orbit Operations*

So far, two closely related categories comprise the sub-sector of private unmanned orbital operations: the activities of on-orbit servicing and active debris removal. Both these two activities, for economic reasons, for the time being seem to be beyond the capability of the private sector in terms of both technologies and financial incentives. Even the major space-faring nations seem to stand only at the beginning of developing such operations in any detailed and structured fashion. However, on-orbit servicing proposals are currently being floated with increasing frequency and urgency, and developments could move faster than anticipated – as well as require substantial lead-times for complementary legal and regulatory tools to be developed. This would consequently still warrant taking them into consideration at this point in time in the discussions on jurisdictional issues.

Certainly such activities would raise a number of salient and thorny political and additional international legal issues which would need to be solved before they would become feasible, notably the issues of international responsibility and liability, and dual-use technology export controls in addition to more specifically legal issues such as the definition of ‘space debris’, the possibilities to legally ‘abandon’ a space object and to involve insurance in the context of ‘salvage’-like operations.<sup>14</sup>

Moreover, once private operators would become involved in those operations, in addition essentially the same overarching issue of ‘in-space’ jurisdiction arises as is discussed in more detail in the present contribution for the areas of private human spaceflight and

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<sup>14</sup> Cf. M.P. Schaefer, *Analogues Between Space Law And Law Of The Sea/International Maritime Law: Can Space Law Usefully Borrow Or Adapt Rules From These Other Areas Of Public International Law?*, in 2012 PROCEEDINGS OF THE INTERNATIONAL INSTITUTE OF SPACE LAW 316-30 (ed. Corinne Jorgenson 2013) and F. LYALL & P.B. LARSEN, *SPACE LAW – A TREATISE* 309-10 (2009).

private exploitation of celestial bodies' resources. For that reason, from the perspective of aiming for the most comprehensive approach to the exercise of relevant US jurisdiction, on-orbit servicing and active debris removal should also be taken summarily into account in the present analysis.

### *C. Private Exploitation of Celestial Bodies' Resources*

Looking also into the future and for the time being not foreseeing manned missions, various serious projects have been announced to undertake mining missions to asteroids, most notably those being planned by Planetary Resources and Deep Space Industries, two US companies with major funding and expertise behind them. Both the former, originally founded November 2010, and the latter, founded January 2013, intend to follow-up reconnoitring missions to asteroids rich in water and other mineral resources with actual effort to harvest, process, and manufacture those.<sup>15</sup>

Whilst the actual harvesting and further commercial exploitation are deemed to be at least one or two decades away, in view of the major upfront investments in the current timeframe needed if these ventures are to succeed at all relatively soon more legal certainty should be offered to operators such as these two as regards the legal parameters, rights, and obligations which would pertain to their harvesting and exploitation activities once actually taking off.<sup>16</sup>

Since the two leading contenders in this venture are both US companies, this is of primary concern for the United States within the broader international legal framework applicable to space activities and its responsibility for private activities in that context. The exercise of US jurisdiction should thus ensure that such harvesting and exploitation will take place both taking into consideration the international obligations of the United States in this context and the interests in allowing such private companies to benefit

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<sup>15</sup> See generally Planetary Resources, <http://www.planetaryresources.com> (last visited July 5, 2016) and Deep Space Industries, <http://deepspaceindustries.com> (last visited July 5, 2016).

<sup>16</sup> Cf. F. TRONCHETTI, *THE EXPLOITATION OF NATURAL RESOURCES OF THE MOON AND OTHER CELESTIAL BODIES* (2010), 1-3; Lyall & Larsen, *supra* note 14, 190-7 and S. Hobe, P. Stubbe & F. Tronchetti, *The 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, in *COLOGNE COMMENTARY ON SPACE LAW*, VOL. II 338-41 (eds. S. Hobe, B. Schmidt-Tedd & K.U. Schrogl 2013).

as much as possible and appropriate from their entrepreneurial activities.

Indeed, the US legislative branch has undertaken the first steps in this particular direction by enunciating the U.S. Commercial Space Launch Competitiveness Act.<sup>17</sup> Title IV of the Act addresses ‘Space Resource Exploration and Utilization’, adding a Chapter 513 to Title 51 of the United States Code. In terms of jurisdiction, it is careful to apply personal jurisdiction only, addressing “United States citizens” as defined and thus not claiming any US territorial sovereignty over celestial bodies or their resources.<sup>18</sup>

### III. THE EXERCISE OF JURISDICTION IN OUTER SPACE SO FAR: THE LEGAL STATUS QUO AND THE GENERIC OPTIONS

#### A. *Exercising Jurisdiction in Outer Space: The General Framework*

‘Jurisdiction’ of a state as a key notion of public international law has been defined as “its lawful power to act and hence (...) its power to decide whether, and if so, how to act, whether by legislative, executive or judicial means”; it refers “primarily, but not exclusively, [to] the lawful power to make and enforce rules.”<sup>19</sup> It thereby constitutes one of the fundamental legal hallmarks of a sovereign state, as opposed to non-governmental or international organizations. It is the baseline legal instrument for states also to exercise legal control for the sake of meeting responsibilities and liabilities in international law.

In view of the complexities of today’s societies, moreover, such jurisdiction and its exercise is in reality usually rather fragmented and distributed across a multiplicity of government agencies, in particular where it concerns the monitoring, implementation and

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<sup>17</sup> U.S. Commercial Space Launch Competitiveness Act; Public Law 114-90, 114<sup>th</sup> Congress, 25 November 2015; Ch. 513, 51 U.S.C.

<sup>18</sup> Sec. 51302. Note that Title IV or also explicitly refers to “accordance with the international obligations of the United States”, referring among others to Art. II, Outer Space Treaty.

<sup>19</sup> B.H. Oxman, *Jurisdiction of States*, in THE MAX PLANCK ENCYCLOPEDIA OF PUBLIC INTERNATIONAL LAW, vol. VI 546 (Ed. R. Wolfrum 2012). See also B. Schmidt-Tedd & S. Mick, *Article VIII*, in COLOGNE COMMENTARY ON SPACE LAW, VOL. I 156-60 (eds. S. Hobe, B. Schmidt-Tedd & K.U. Schrogl 2009), 156-60; Nagvanshi & Sharma, *supra* note 5, 325-6; and A.J. YOUNG, LAW AND POLICY IN THE SPACE STATIONS’ ERA 152-53 (1989).

enforcement of laws and regulations once properly enunciated. Thus, national jurisdiction from that perspective can very well turn out to be effectively exercised by a distinct subordinate body, organ, or even agency of the government at large, entrusted with such day-to-day monitoring, implementation and enforcement.

This is no different in principle for space law, even as territorial jurisdiction cannot extend to outer space on a territorial basis.<sup>20</sup> While international space law does provide for some legal distinctions between the ‘void’ of outer space itself and celestial bodies orbiting therein, this does not extend to the application of jurisdiction in a generic manner.<sup>21</sup> Also, celestial bodies cannot be appropriated by any particular state, hence also their national laws cannot extend to such celestial bodies as if they were outlying parts of national territory.<sup>22</sup>

Consequently, territorial jurisdiction only applies indirectly to outer space activities to the extent it can be asserted over anyone conducting space activities from the territory of a particular state. On the other hand, personal jurisdiction of a state over its citizens (natural or legal) continues to apply as well – even if those persons would happen to be, and be active, in outer space.

In addition, Article VIII of the Outer Space Treaty provides states with the opportunity to exercise, through registration of spacecraft, jurisdiction on a quasi-territorial basis on board of such spacecraft and even over personnel thereof if out on EVAs.<sup>23</sup> No further clues are offered regarding the extent or form that the exercise

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<sup>20</sup> Cf. Outer Space Treaty, *supra* note 1, Art. II.

<sup>21</sup> Effectively, this distinction is mainly relevant in the context of military usages of outer space. Cf. *Id.* at Art. IV, Art. XII.

<sup>22</sup> From this perspective, also, the various offers to ‘buy’ plots on the Moon or other celestial bodies are legally speaking hoaxes, as private ownership rights over real estate crucially depends on national law which only applies to national territory, whereas celestial bodies could never become part of national territory. See Statement by the Board of Directors of the International Institute of Space Law (IISL) On Claims to Property Rights Regarding the Moon and Other Celestial Bodies, [http://www.iislweb.org/docs/IISL\\_Outter\\_Space\\_Treaty\\_Statement.pdf](http://www.iislweb.org/docs/IISL_Outter_Space_Treaty_Statement.pdf) (2004) and Statement of the Board of Directors of the International Institute of Space Law (IISL). <http://www.iislweb.org/docs/Statement%20BoD.pdf> (2009). See also F.G. von der Dunk et al., *Surreal estate: addressing the issue of Immovable Property Rights on the Moon*, 20 SPACE POLICY 151-56 (2004).

<sup>23</sup> Art. VIII of the Outer Space Treaty provides: “A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a

of such jurisdiction should take. Thus, the clause should be read as allowing individual states maximum leeway in exercising such jurisdiction as long as taking place within the (broad) boundaries of general public international law, including those pertaining to a state's individual responsibility and liability. This also results from the precise formulation of Article VIII, which refers to the right "to retain jurisdiction,"<sup>24</sup> in other words to extend existing types of jurisdiction as appropriate, not to create or establish a new type of jurisdiction.

The application of such registration-based jurisdiction is not so much triggered by entry into outer space as such, but by the involvement of a 'space object,' which in turn, due to the rather summary and partly circular definition contained in the Registration Convention, is usually considered to refer to man-made objects intended to be launched into outer space.<sup>25</sup> This does bring back the issue of delimitation of outer space, even if, as it were, through the backdoor – without defining the altitude which a certain object is intended to reach, it remains to that extent uncertain whether that object qualifies as a space object. Moreover, the applicability of the Registration Convention is generally considered to be further premised on such objects actually going into "Earth orbit or beyond."<sup>26</sup>

Following the Registration Convention's regime as well as more generally the need to take care of international responsibility and liability under Articles VI and VII of the Outer Space Treaty and the Liability Convention, various states having sent or about to send space objects into outer space have asserted such jurisdiction in outer space by specific, legislative means. For example, the United States by way of its Patents in Outer Space Act<sup>27</sup> extended

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celestial body." Arts. I and II of the Registration Convention further clarify how such jurisdiction is to be applied.□

<sup>24</sup> Emphasis added.

<sup>25</sup> See Registration Convention, *supra* note 4, Art. I(b). See also M. LACHS, THE LAW OF OUTER SPACE 68-9 (1972); B. Cheng, *Convention on International Liability for Damage Caused by Space Objects*, in MANUAL ON SPACE LAW, VOL. I 116-17 (eds. N. Jasentuliyana & R.S.K. Lee 1979); and G. ZHUKOV & Y. KOLOSOV, INTERNATIONAL SPACE LAW 85-86 (1984).

<sup>26</sup> Cf. Registration Convention, *supra* note 4, Art. II(1) on the national registry to be developed. As for the purpose of the international registry under Articles III and IV, the information to be provided should include "basic orbital parameters" (Art. IV(1)(d)).

<sup>27</sup> Patents in Outer Space Act, Pub. L. No. 101-580; 104 Stat. 2863 (1990).

the scope of application of existing US patent legislation to inventions made on board of US-registered space objects. Following the conclusion of the Intergovernmental Agreement on the *ISS* and the build-up and operation of that station, Germany and Italy have similarly extended the scope of their national intellectual property right laws to – in this case – inventions made on board the European module of the *ISS*.<sup>28</sup>

Finally, Article VI of the Outer Space Treaty effectively calls for the exercise of at least some level of jurisdiction when it comes to private space activities, as it states that “[t]he activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require *authorization and continuing supervision* by the appropriate State Party to the Treaty.”<sup>29</sup> In view of the close correlation to the concept of international responsibility as this is posited by Article VI, such authorization and continuing supervision should at least suffice for the state at issue to reasonably assure other states that the activities at stake would be “carried out in conformity with the provisions set forth in the present Treaty,” in other words: to assure no violations of international space law occur.<sup>30</sup> Thus, also the requirement of ‘continuing supervision’ should be read in this light as a fairly general and broad

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<sup>28</sup> Agreement among the Government of Canada, Governments of Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America concerning Cooperation on the Civil International Space Station (hereafter Intergovernmental Agreement), art. 21(2), Jan. 29 1998, T.I.A.S. No. 12927. See also A.M. Balsano & J. Wheeler, *The IGA and ESA: Protecting Intellectual Property Rights in the Context of ISS Activities*, in *THE INTERNATIONAL SPACE STATION* 67 (eds. F.G. von der Dunk & M.M.T.A. Brus 2006).

<sup>29</sup> Outer Space Treaty, *supra* note 1, Art. VI (emphasis added). Though strictly speaking ‘authorization and continuing supervision’ could be exercised through other means than the formal exercise of jurisdiction. See A. Kerrest de Rozavel & F.G. von der Dunk, *Liability and Insurance in the Context of National Authorisation*, in *NATIONAL SPACE LEGISLATION IN EUROPE* 150-5 (ed. F.G. von der Dunk 2011) on the example of France until the enunciation in 2008 of the Loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales [Law on Space Operations], unofficial English translation in 34 *J. SPACE L.* 453 (2008). It is widely recognized that establishment of a national licensing system and appropriate form of national space legislation would offer the most comprehensive, transparent and effective tool for ensuring such authorization and continuing supervision. See also Gerhard, *supra* note 6, 117-22 and J. HERMIDA, *LEGAL BASIS FOR A NATIONAL SPACE LEGISLATION* 28-60 (2004).

<sup>30</sup> Outer Space Treaty, *supra* note 1, Art. VI. The reference to ‘the provisions set forth in the present Treaty’ is generally perceived to refer to *all* of international law applicable

provision; not as automatically requiring a level of intensive supervision that would fundamentally hinder any relevant activity in outer space.

This represents the core of Article VI-responsibility: the focus is on compliance with international law, offering a structural tool for states to ensure such compliance also when private entities are involved in the space activities at issue. As the current substance of obligations under international space law is relatively limited in size and scope, in particular as regards the specifics of private activities and their rights and interests, the requirement resting upon states to actually and effectively exercise and implement jurisdiction could still result in a rather 'light' version thereof.

In many respects it thus amounts more to a requirement to establish general regulatory authority in outer space than to a requirement to establish detailed legislation – in the end, namely, this essentially is a matter of sovereign discretion, as the outer space treaties make clear that the states concerned are going to be held responsible *in any event* for any violation of international space law and liable for any damage caused by space objects launched with their involvement, that is in first instance regardless of whether they exercised this jurisdiction to any substantial extent.

#### *B. The Benefits of Exercising US Jurisdiction in Outer Space: General Aspects*

The exercise of US jurisdiction (or any national jurisdiction for that matter) from this perspective would also have a mirror-side to it which is easily overlooked in the usual anxiety of the business sector that the net result of the exercise of US jurisdiction would be the continuing establishment of new legislation stifling economic and private commercial development of space activities, including the exploitation of space resources.

First, in view of the current absence of much international space law specifically targeting private space endeavours, developing the legal instruments to exercise of US jurisdiction over space activities and in outer space in a balanced manner might well set a world-wide precedent and example for an international regime and

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to outer space activities in the light of the fundamental character of the Outer Space Treaty and its reference to general international law as per Art. III.

the substance thereof. This is, of course, precisely why the current analysis should also be of interest to other spacefaring nations than the United States to the extent that private participation in relevant space activities presently is a fact or at least envisaged fairly soon.

In 1945 the Truman Declaration establishing the concept of the Continental Shelf<sup>31</sup> as endowing coastal states with the entitlement to exercise jurisdiction over economic exploitation of the mineral resources in the area at issue including the right to license private operators within its jurisdiction in that context quickly evolved into an international rule of customary law ultimately also enshrined in international treaties. Similarly, a profound and balanced effort at establishing a detailed level of control over private entities and their space operations might evolve into the international standard and beyond that into proper international law. In such a manner any risk that an international regime adopted by other states could arise which might be contrary to the rights and interests of both the United States and US private enterprise would at least largely be pre-empted.

Currently, for example, the envisaged activities of extraterrestrial mineral resource exploitation operators such as Deep Space Industries and Planetary Resources would, though under present international space law not prohibited as such, meet with too many legal uncertainties for a reasonably secure investment climate.<sup>32</sup> Such uncertainties concern, among others, their rights to operate in certain areas of outer space or celestial bodies exclusively (that is with an accompanying right to keep others out of such areas

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<sup>31</sup> Proclamation No. 2667, Policy of the United States With Respect to the Natural Resources of the Subsoil and Sea Bed of the Continental Shelf (Sept. 28, 1945), <http://www.presidency.ucsb.edu/ws/?pid=12332>. See also P.T. Stoll, *Continental Shelf*, in THE MAX PLANCK ENCYCLOPEDIA OF PUBLIC INTERNATIONAL LAW, VOL. II 720 (ed. R. Wolfrum 2012) and M.D. Evans, *The Law of the Sea*, in INTERNATIONAL LAW 642 (ed. M.D. Evans 2003).

<sup>32</sup> The 'global commons' status of outer space and the fundamental freedom of space activities, including notably exploration and use of outer space, as per Arts. I and II of the Outer Space Treaty, are currently perceived by most countries and experts to legitimize any exploitation for commercial purposes as long as other parameters and obligations of international (space) law are complied with, but in view of the absence of any specific rules on this and the opposition of a still-sizeable portion of world community and authors alike to such legitimacy, any actual exploitative operations might continue to give rise to considerable international controversy, essentially at a political level but likely spilling over soon into the legal domain.

and/or under what conditions) and the extent to which their ownership of extracted minerals would be contested by other countries or their entities, not only politically but also legally. A rudimentary legal framework addressing such issues is therefore needed at the international level, and US efforts to achieve such a framework at least nationally might well lead the way here.

Once again, an example from the law of the sea would be elucidating. The 1982 United Nations Convention on the Law of the Sea had provided for application of a 'common heritage of mankind' regime to the ocean floor and the mineral resources to be discovered thereon, including notably technology-transfer and benefit-sharing commitments.<sup>33</sup> Those clauses were considered by the United States and other leading Western countries to stifle commercial exploitation initiatives in that area, and by that token unacceptable. These states by and large refused to ratify the Convention, and instead in some cases developed national ocean floor mining licensing regimes to be applied unilaterally to any relevant private party so interested.<sup>34</sup>

When a 1994 *de facto* amendment of the 1982 Convention however resulted in considerable mitigation of the disputed clauses, most of those countries became parties to the 1982 Convention as per that 1994 Agreement, which had meanwhile entered into force and was enjoying continuously increasing partisanship.<sup>35</sup> More and

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<sup>33</sup> See United Nations Convention on the Law of the Sea, Montego Bay, Arts. 133-191, esp. Arts. 136-137, 144, 150-153, 170, Dec. 10 1982, 1833 U.N.T.S. 3 [hereinafter UNCLOS]. See also L. VIHKARI, FROM MANGANESE NODULES TO LUNAR REGOLITH 52ff (2002).

<sup>34</sup> This notably concerned the 1980 US Deep Sea Bed Hard Mineral Resources Act, 30 U.S.C. Secs. 1401 *et seq.* (2016); 1981 West German Act on the Interim Regulation of Deep Sea Bed Mining, 20 I.L.M. 393 (1981); 1981 UK Deep Sea Bed Mining (Temporary Provisions) Act, Ch. 53, 20 I.L.M. 1219 (1981); 1982 French Deep Seabed Mineral Resources Exploration and Mining Law, *Loi no. 81-1135*, 21 I.L.M. 808 (1982); 1982 Japanese Law on Interim Measures for Deep Seabed Mining, 22 I.L.M. 102 (1983) and Italian Law No. 41 of 1985, 24 I.L.M. 983 (1985). See also Tronchetti, *supra* note 16, 104-13 and Viikari, *supra* note 32, Ch. 4.

<sup>35</sup> This concerned the Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 New York, July 28, 1994, 1836 U.N.T.S. 3 [hereafter New York Agreement]. The New York Agreement amounted to an understanding to interpret and apply the disputed Part XI-clauses of the 1982 Convention in a much more private enterprise-friendly way. See Viikari, *supra* note 32, 73-8 and Tronchetti, *supra* note 16, 113-8.

more, the United States came to stand alone in refusing to ratify the Convention and formally adhere to the resulting legal regime.

Any US private company favouring the very-pro-private-enterprise regime that the United States continued to apply domestically, might therefore perhaps legally-technically speaking have been at liberty to ignore the international licensing regime now in existence under the revised regime, and (just) apply for a US license. Nevertheless, once Lockheed Martin was quite far advanced in actually initiating ocean floor harvesting activities, rather than take that route, it established a UK subsidiary, UK Seabed Resources specifically to apply for a *UK* license.<sup>36</sup> The United Kingdom meanwhile having become a party to the 1982 Convention as per the 1994 Agreement, such a license would be subject to the international legal parameters and boundaries established by the latter. The benefit of a license enjoying almost world-wide recognition and respect obviously outweighed any licensing and operating requirements that would be more burdensome on the US operator than those that would have applied under a national US license.

Thus, while a unilateral national regime is exactly what Title IV of the U.S. Commercial Space Launch Competitiveness Act is trying to achieve, if such a regime ultimately is to be found at fundamental odds with any emerging global regime outside the United States, its value might become intrinsically marginalized or at least subject to serious repercussions, if not legal than political. This is also why the Act makes reference to the obligation of the US President to “(1) facilitate commercial exploration for and commercial recovery of space resources by United States citizens; (2) discourage government barriers to the development in the United States of economically viable, safe, and stable industries for commercial exploration for and commercial recovery of space resources in manners consistent with the international obligations of the United States; and (3) promote the right of United States citizens to engage in commercial exploration for and commercial recovery of space resources

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<sup>36</sup> See UK Government sponsors Lockheed Martin, Lockheed Martin UK subsidiary for licence to harvest Polymetallic Nodules, Mar. 14, 2013, <http://www.lockheedmartin.com/uk/news/press-releases/2013-press-releases/uk-government-sponsors-lockheed-martin-uk-subsiidiary-for-licence.html>.

free from harmful interference, in accordance with the international obligations of the United States and subject to authorization and continuing supervision by the Federal Government.□”<sup>37</sup>

The Act effectively guarantees the protection of legitimate ownership rights in resources once extracted, as well as judicial means to solve disputes concerning conflicting exploitation activities, as long as in conformity with US obligations under international space law.<sup>38</sup> Whether the balance between such conformity with international obligations and providing private operators with sufficient legal guarantees is actually appropriately achieved, however, as indicated is already subject to debate, evidencing the existence of the current legal gaps.<sup>39</sup>

Second, the establishment and exercise of US jurisdiction in outer space and/or over private space activities also means that the United States as a sovereign power squarely endorses activities allowed following the exercise of such jurisdiction, and would be legally entitled under general public international law to exercise so-called diplomatic protection with regard to the interests of US entities if legally challenged by other countries or their entities. Further to such exercise, for example specific protection zones and property rights can be established which could be upheld against such foreign claims, since they can be defended as a logical – and so far really the only – elaboration of the rather general principles pertaining to safety zones and suchlike.<sup>40</sup> This presumes developments such as have taken place with regard to the ocean floor regime would not take place with regard to outer space or its celestial bodies – in other words: where a domestic US regime to be developed would come to lack any international recognition, it might actually backfire.

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<sup>37</sup> Sec. 51302.

<sup>38</sup> See Sec. 51303.

<sup>39</sup> Cf. e.g. F. Tronchetti, *Private property rights on asteroid resources: Assessing the legality of the ASTEROIDS Act*, 30 SPACE POL’Y 193-6 (2014).

<sup>40</sup> Cf. Outer Space Treaty, *supra* note 1, Art. XII requiring “reasonable advance notice of a projected visit” to “stations, installations, equipment and space vehicles on the Moon and other celestial bodies.”

*C. Exercising Jurisdiction Specifically vis-à-vis Human Spaceflight*

So far in the context of human spaceflight, jurisdictional issues in a broad sense have remained confined to the relatively few instances of public human spaceflight, where the capacity of the astronauts and cosmonauts as employees of governmental space agencies basically guaranteed the appropriate level of exercise of jurisdiction over their behaviour, largely already by way of their employment contracts. Thus, even in the context of the *ISS*, the most pronounced legal environment for human space operations in view of the multi-national construction, it generally sufficed for each partner to register its own modules per Article 5 of the Intergovernmental Agreement. Apart from the specific issue of intellectual property rights referred to above only the issue of possible exercise of criminal jurisdiction needed to be more specifically addressed, which was effectuated by means of Article 22.<sup>41</sup>

With the impending likely arrival on the scene of private ‘space tourism’ flights however, this picture will change profoundly. For the time being, the flights contemplated by those operators perhaps will remain little more than sub-orbital hops, barely entering into outer space before starting to re-enter, but for the further future they intend to aim for longer flights, from sub-orbital transportation between various continents to semi-orbital or orbital transportation to ‘space hotels’ such as Bigelow is in the process of developing. Essentially, spaceflight participants who have no employment contract with a space agency but fly on their own account and out of their own interest – and whose selection and training, even if not negligible, will be far less extensive than those of professional astronauts and cosmonauts – will enter outer space in a purely private context.

From the perspective of current space law, the first issue which then arises in the context of the jurisdictional questions is the aforementioned fact that the Registration Convention, providing the default instrument to establish and exercise jurisdiction over spacecraft, only formally addresses space objects “launched

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<sup>41</sup> Intergovernmental Agreement, *supra* note 27, Art. 22 addresses this issue by in first instance allowing individual states to exercise active personal jurisdiction over personnel for criminal law purposes, adding a certain fallback option for other duly affected states to exercise criminal jurisdiction.

into Earth orbit or beyond.”<sup>42</sup> This has usually been taken to mean that sub-orbital flights like the ones envisaged by Virgin Galactic and XCOR would not be subject to the Convention’s regime. However, the phrasing ‘Earth orbit or beyond’ would seem to refer to a certain *area* being (intended to be) reached by the space object at issue for the Convention to apply. So a sub-orbital space object which would achieve an altitude ‘beyond’ an ‘Earth orbit’ – in other words, in outer space as it is most commonly defined with reference to the lowest-orbit approach – could well fall within the ambit of the Convention.<sup>43</sup>

In addition, Article VIII of the Outer Space Treaty, which allows states to retain jurisdiction over space objects launched into outer space, does not limit such retention of jurisdiction to space objects ‘launched into Earth orbit or beyond’. As soon as a space object is intended to reach an area called ‘outer space,’ the state registering it may exercise its jurisdiction over and on board of that space object. To the extent therefore these two phrases – of ‘Earth orbit or beyond’ and ‘outer space’ – would *not* be seen as referring to the same geographical area, it is the ‘outer space’ label of the two which prevails in determining, for example, whether an object triggers the application most notably of the Liability Convention, since that is the term used by that Convention.<sup>44</sup>

In other words: the national jurisdiction of a registration state of a space object, as provided for and regulated by Article VIII of the Outer Space Treaty and the Registration Convention, principally allows exercise of such jurisdiction over that object in outer space regardless of whether any orbit(al velocity) has been or will be achieved – or was even aimed for.

In the absence of a well-established and generally-acknowledged lower boundary of outer space, however, in particular within the United States, the question as to whether the sub-orbital vehicles now giving rise to the discussion regarding ‘on-orbit jurisdiction’ would (intend to) enter into outer space can not be definitively answered. This also means that the question whether they are

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<sup>42</sup> Registration Convention, *supra* note 4, Art. II(1).□

<sup>43</sup> See for a very extended analysis and argument F.G. von der Dunk, *Beyond What? Beyond Earth orbit?...! The Applicability of the Registration Convention to Private Commercial Manned Sub-Orbital Spaceflight*, 43 CAL. W. INT’L L. J. 269-341 (2013).

<sup>44</sup> See Liability Convention, *supra* note 3, Arts. I-V.

'space objects' in the sense of the space treaties cannot be finally answered – at least not authoritatively as for the United States.<sup>45</sup>

At the same time, in view of their technologies and intended trajectories and activities, the only reasonable alternative to qualifying those vehicles as 'space objects' would be to qualify them as 'aircraft.' 'Aircraft' have been defined as "any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface."<sup>46</sup> The International Civil Aviation Organization (ICAO), though acknowledging the applicability of the general definition of 'aircraft' to most of the vehicles currently being designed for private sub-orbital flight, decided to desist so far from developing Standards and Recommended Practices (SARPs) for such sub-orbital vehicles or the operations conducted with them.<sup>47</sup> On the other hand, at this point in time ICAO seems to be reconsidering such an approach once more.<sup>48</sup>

In the last resort however, this would not make a principled difference. Also a qualification of the vehicles at issue as 'aircraft' would still give rise to the full-fledged possibility for the state concerned to exercise jurisdiction on board of that vehicle, as "[a]ircraft

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<sup>45</sup> It may be noted however that outside the United States a growing convergence of opinion on an altitude of 100 km (62.5 miles) as the legal boundary between airspace and outer space can be discerned. Also, within the United States, that particular altitude has already popped up in the context of (non-legal) federal agency documents, state legislation discussions, and – of course – the private operators touting their incumbent sub-orbital flights as entering into outer space; see further F.G. von der Dunk, *International Space Law*, in HANDBOOK OF SPACE LAW 64-72 (ed. F.G. von der Dunk 2015).

<sup>46</sup> See Convention on Civil Aviation, Dec. 7, 1944, 15 U.N.T.S. 295 [hereinafter Chicago Convention]; Annex 7, Aircraft Nationality and Registration Marks, at definitions (5<sup>th</sup> ed. 2003) available at [http://www.icao.int/safety/airnavigation/NationalityMarks/annexes\\_booklet\\_en.pdf](http://www.icao.int/safety/airnavigation/NationalityMarks/annexes_booklet_en.pdf); Annex 8, Airworthiness of aircraft, at definitions (10<sup>th</sup> ed., April 2005) available at [http://www.icao.int/safety/airnavigation/NationalityMarks/annexes\\_booklet\\_en.pdf](http://www.icao.int/safety/airnavigation/NationalityMarks/annexes_booklet_en.pdf). See also V.J. Vissepó, *Legal Aspects of Reusable Launch Vehicles*, 31 J. SPACE L. 185-9 (2005).

<sup>47</sup> See Working Paper on Concept of Suborbital Flights, ICAO Council, 175th Session, C-WP/12436 (May 30, 2005). See generally T.R. Hughes & E. Rosenberg, *Space Travel Law (and Politics): The Evolution of the Commercial Space Launch Amendments Act of 2004*, 31 J. SPACE L. 76-77 (2005) and Vissepó, *supra* note 43, 179-85. SARPs are the detailed elaborations of general obligations and requirements under the regime created by the Chicago Convention.

<sup>48</sup> Cf. Reuters: A. Lampert, *UN Aviation body to mull space safety as space taxis ready for flight*, REUTERS, Sept 19, 2014, <http://uk.reuters.com/article/2014/09/19/aerospace-space-icao-idUKL1N0RK2LS20140919>.

have the nationality of the State in which they are registered,”<sup>49</sup> and such nationality *ipso facto* allows the state of nationality to exercise its national jurisdiction on board.

In other words, it would even be possible for the United States to start addressing the issue of fundamental and comprehensive jurisdiction on board of US-registered sub-orbital, orbital or beyond-orbital vehicles for the time being *without* having to address the question of where outer space should be deemed to begin. After all, this jurisdiction would focus on the registration of vehicles and the resulting right to exercise jurisdiction in first instance regardless of whether the registered vehicles would be registered as aircraft, as space objects or even as both at the same time.<sup>50</sup>

#### *D. Exercising Jurisdiction Specifically vis-à-vis Resource Exploitation*

In the absence of specific possibilities for states to regulate the exploitation of mineral resources on celestial bodies on a ‘traditional’ basis due to the legal impossibility to exercise territorial jurisdiction on such celestial bodies, basically only two theoretical approaches would be available to establish a certain level of legal certainty regarding the applicable rights and obligations for potential private exploitation missions.

The one option concerns the development of an international regime somehow allowing private entities to be licensed to undertake exploitation activities on celestial bodies within a set of rules further specified by an international instrument. Noting that also the high seas constitute an area outside of any individual state’s territorial jurisdiction, this approach was originally used in the context of deep seabed mining, where the United Nations Convention on the Law of the Sea<sup>51</sup> provided for a complicated system of exploitation licenses under an international regime. As discussed, only after a considerable restructuring of the original approach, bending

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<sup>49</sup> Chicago Convention, *supra* note 43, Art. 17.

<sup>50</sup> It should be noted that analyses of these issues so far largely ignore the possibility for (component parts of) a vehicle *ab initio* to be registered as both an aircraft and a space object, and assume for instance that registration as an aircraft automatically and comprehensively excludes the possibility of concurrent registration as a space object.

<sup>51</sup> See UNCLOS, *supra* note 32.

the regime to make it considerably more market-friendly, did this regime start to achieve world-wide credibility and acceptance.<sup>52</sup>

For similar reasons, the approach taken by the Moon Agreement,<sup>53</sup> which also applies to other celestial bodies in the solar system, did not go very far. While it is in force, it is in force only for sixteen non-major-spacefaring nations, thus strictly speaking would not constitute an obstacle for *inter alia* the United States to take a different approach. At the same time, the Moon Agreement's lack of credibility and widespread adherence also means there is essentially *no* internationally-agreed legal regime of appreciable detail applicable to any prospective mining operations, allowing major uncertainties to remain as the Outer Space Treaty continues to apply but does not provide much helpful specifics.

The other option follows a unilateral bottom-up approach, whereby individual states license national operators under national regimes, basically on the basis of personal jurisdiction, to proceed with such exploitation activities. Even if such national licenses would be granted in full deference to existing international law on the subject, the risks of unenforceability of licensee rights under such national licensing regimes against third states and their entities, and of competing claims to particular areas considered of interest would present a major level of legal uncertainty, which might well make celestial bodies resource exploitation an already legally speaking very risky venture.<sup>54</sup>

At the same time, as long as the number of countries potentially capable of undertaking (or allowing their private operators to undertake) such activities would remain fairly small, such a national approach may well be the starting point from various perspectives. It would co-determine the international regime which would ultimately have to arise for full-fledged global acceptability of a particular national system, such as by requiring 'due care' for

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<sup>52</sup> As discussed, this was achieved mainly by way of the New York Agreement, *supra* note 34.

<sup>53</sup> Agreement Governing the Activities of States on the Moon and Other Celestial Bodies New York, Dec. 18, 1979, 1363 U.N.T.S. 3 [hereafter Moon Agreement].

<sup>54</sup> *Cf.* the discussion *supra* at § II.B.

other states' activities for example under Article IX of the Outer Space Treaty.<sup>55</sup>

#### IV. THE EXERCISE OF JURISDICTION OVER SPACE OBJECTS IN THE US CONTEXT

Other countries have so far established a single coherent piece of national space legislation to ensure the desired level of exercise of national jurisdiction over duly registered space objects,<sup>56</sup> which also testifies to the fundamental interest in such exercise being both comprehensive and coherent. By contrast, however, the situation in the US context has developed into a complicated one by the existence of a number of acts and statutes addressing specific aspects or elements of space operations conducted with US spacecraft and/or by US private operators.

##### A. NASA 'Jurisdiction' over Human Space Activities

To the extent the United States itself has been involved in human spaceflight and this was considered to require any exercise of jurisdiction on the part of the US government, NASA was the governmental agency to handle this, being tasked to "exercis[e] control over aeronautical and space activities sponsored by the United States."<sup>57</sup> Thus, the NASA Administrator "shall be responsible for the exercise of all powers and the discharge of all duties of the Administration and shall have authority and control over all personnel and activities thereof."<sup>58</sup>

As already indicated, the application of US jurisdiction to completely public space operations and spacecraft did consequently not

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<sup>55</sup> The Outer Space Treaty thus provides "States Parties to the Treaty (...) shall conduct all their activities in outer space (...) with due regard to the corresponding interests of all other States Parties to the Treaty." Outer Space Treaty, *supra* note 1, Art. IX

<sup>56</sup> See e.g. the United Kingdom, Outer Space Act, 1986, c. 38, Sec. 1 (U.K.) ("This Act applies to (...) any activity in outer space."); Russia, , Law of the Russian Federation on Space Activities, No. 5663-1, Art. 9(2), 1993 in NATIONAL SPACE LEGISLATION OF THE WORLD, VOL. I 101 (2001) ("Subject to licensing shall be the space activities (...) in conjunction with Art. 2(1), defining the term "space activities" for the purposes of the Law); and Sweden, Act on Space Activities, 1982:963, Sec. 1 in NATIONAL SPACE LEGISLATION OF THE WORLD, VOL. I 398 (2001) ("This Act applies to activities in outer space (space activities).")

<sup>57</sup> 51 U.S.C. § 20102(b).

<sup>58</sup> 51 U.S.C. § 20111(a).

require specific acts of extension of such jurisdiction since the nationality of the people, entities and craft<sup>59</sup> involved guaranteed that at least US personal jurisdiction, as well as, through the contract of government-employed astronauts, effective control by the relevant government agency could be asserted.<sup>60</sup>

This also applied to the US contribution to, and activities undertaken in, the context of the *ISS*, where obviously modules from other states, registered with such states, as well as astronauts and cosmonauts from other states were also implicated, and issues of jurisdiction had to be carefully and internationally negotiated. The only specific elements to be further so arraigned, as discussed, concerned criminal law, where NASA would not have any such jurisdiction properly speaking,<sup>61</sup> and intellectual property jurisdiction, which involves NASA potentially only as an intellectual property-owner.<sup>62</sup>

It was NASA therefore which took care (as far as the US interests were concerned) of the complications caused by the visit of the first 'space tourist' to the *ISS* in 2001. It did so by firstly agreeing with Russia and the other *ISS* partners on a special *ad hoc* arrangement, taking care of, among other issues, potential third-party liability risks resulting from the visit of Tito. NASA then concluded with the *ISS* partners the Principles Regarding Processes and Criteria for Selection, Assignment, Training and Certification of *ISS* (Expedition and Visiting) Crewmembers towards the end of 2001.<sup>63</sup>

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<sup>59</sup> Though formally speaking, Art. VIII of the Outer Space Treaty does not provide for a 'nationality' of a spacecraft, for all practical purposes the effect of registration of a space object amounts to precisely that, following from the fundamental right to exercise jurisdiction on a quasi-territorial basis and the fact that a space object can only have one registration state. *Cf.* Registration Convention, *supra* note 4, Art. II(2).

<sup>60</sup> See also Young, *supra* note 18, 154-6.

<sup>61</sup> The registration of the US modules, as per Art. 5 of the Intergovernmental Agreement, basically could have allowed US criminal law to be applied on board those modules on a quasi-territorial basis, were it not that Art. 22 imposed nationality as the basis for exercising jurisdiction in a criminal law context. Intergovernmental Agreement, *supra* note 27, Art. 5. In view of its nature, NASA obviously would not be part of any such US exercise of criminal jurisdiction, but that is essentially a US sovereign choice, not predicated by international law. See also *infra* § V.

<sup>62</sup> *Cf.* 51 U.S.C. § 20135 for the relevant arrangements in US law in this context. See also Young, *supra* note 18, 171-4.

<sup>63</sup> At Principles Regarding Processes and Criteria for Selection, Assignment, Training and Certification of *ISS* (Expedition and Visiting) Crewmembers, <http://www.space-ref.com/news/viewsr.html?pid=4578> (Nov. 2001). See also R.P. Veldhuyzen & T.L. Masson-Zwaan, *ESA Policy and Impending Legal Framework for Commercial Utilisation of*

This document defines ‘spaceflight participants’ as including crew-members of non-Partner space agencies, engineers, scientists, teachers, journalists, filmmakers or tourists, and provides for specific guidance regarding the extent to and conditions under which amongst others such tourists might be allowed on board of the *ISS*.

Whilst it still makes sense to have NASA continuing to exercise this pragmatic version of US jurisdiction in the specific context of NASA-operated, -owned, and -controlled spacecraft, *vice versa* any extension of such exercise of jurisdiction *outside* of that context makes considerably less sense – and consequently is unlikely to come about. Even where the option of NASA astronauts flying on private vehicles is now being arranged for within the federal government, this only addresses the issue of whether the Federal Aviation Administration’s (FAA) exercise of *its* jurisdiction over such private vehicles, notably the safety-related aspects of their flights, is sufficient for NASA to ‘entrust’ its astronauts to flights on them.<sup>64</sup>

### B. FCC Jurisdiction over Space Communication Activities<sup>[11]</sup><sub>SEP</sub>

Ever since the 1934 Communications Act, the US Federal Communications Commission (FCC) has the authority to license the use of “all the channels of radio transmission” within the United States or from US-registered vessels or aircraft elsewhere,<sup>65</sup> which as of 1970 has officially been confirmed to include the licensing competence *vis-à-vis* persons or entities interested in operating such channels to or from satellites in outer space.<sup>66</sup> In other words, with the help of licenses the United States through the FCC in principle

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*the European Columbus Laboratory Module of the ISS*, in THE INTERNATIONAL SPACE STATION 54-6 (eds. F.G. von der Dunk & M.M.T.A. Brus 2006).

<sup>64</sup> See, for example, D. Messier, NASA, FAA Cooperate on Commercial Crew Program, PARABOLIC ARC, Feb., 27 2014, <http://www.parabolicarc.com/2014/02/27/nasa-faa-cooperate-commercial-crew-program/>. For the FAA’s exercise of jurisdiction, see *infra* § IV.D.

<sup>65</sup> , Communications Act, 47 U.S.C. 151, §301 (2016). The scope of the Act does not only refer to US territory, but also includes in quasi-territorial fashion vessels and aircraft with US nationality. See P.A. Vorwig, *Regulation of Satellite Communications in the United States*, in NATIONAL REGULATION OF SPACE ACTIVITIES 422ff (ed. R.S. Jakhu 2010) and P.A. SALIN, SATELLITE COMMUNICATIONS REGULATIONS IN THE EARLY 21<sup>ST</sup> CENTURY 149-90 (2000).

<sup>66</sup> See Establishment of Domestic Communications Satellite Facilities by Non-Governmental Entities, Report and Order, 22 F.C.C. 2d 86, Appendix C, p. 1 (1970).

exercises jurisdiction over any satellite or other spacecraft – including human – operated from US territory or US-registered vessels or aircraft, namely to the extent that the use of radio transmission channels is at issue.

As to this licensing competence, furthermore, it allows the FCC both to ensure upfront, by way of the license requirements, that the use of radio channels in outer space will take place in conformity with the requirements considered necessary by the US government, and to monitor (at least in theory; with spacecraft obviously site visits are impossible and monitoring could only be done by radio-contact and other telemetry, tracking, and control devices) that post-grant the licensee will continue to comply with such requirements.<sup>67</sup>

By definition, however, this is limited to those requirements predicated by the FCC, hence effectively envisaged necessary prior to the actual launch of the space object (although there would be a limited opportunity to suspend a license post-grant in case one of the events specifically listed would occur<sup>68</sup>), and then of course only limited to those related to the actual use of radio channels. A fallback clause offering further possibilities to exercise jurisdiction also post-launch arises from the authority to “[m]ake such rules and regulations and prescribe such restrictions and conditions, not inconsistent with law, as may be necessary to carry out the provisions of this chapter, or any international radio or wire communications treaty or convention, or regulations annexed thereto, including any treaty or convention insofar as it relates to the use of radio, to which the United States is or may hereafter become a party.”<sup>69</sup>

An interesting final element in the exercise of FCC jurisdiction, in particular within the context of active debris removal, concerns the imposition by the FCC in the context of licensing satellite operators of orbital debris mitigation standards, notably an orbital

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<sup>67</sup> Cf. Communications Act, *supra* note 62, § 303, esp. *sub* (b), (e), (f), (h)-(n) for such requirements and monitoring competences. *See also Id.* at §§ 307, 308, 312, 318.

<sup>68</sup> *See id.* at §§303(m)(1), 316.

<sup>69</sup> *Id.* at §303(r). While this provision has purportedly on occasion been used to address ‘character’ violations, including court-adjudicated criminal conduct unconnected as such to the radio station’s activities, it remains questionable to what extent the FCC might be the proper authority to address such criminal law issues – read: whether this does not amount to a certain ‘competence creep’, better to be undercut by way of proper establishment of jurisdiction of the appropriate US authorities.

debris mitigation plan. This particular FCC authority emanates from a primary responsibility to license the use of satellites and operations for the general public's benefit also beyond the core of licensing their use of radio frequencies and orbital positions, and to effectively ensure that the occupation of orbital positions during or beyond the operational life of the satellite does not result in undue hazards to others operating in the same environment – or indeed to third-parties elsewhere, in particular on the ground.<sup>70</sup>

At the same time, the Commercial Space Launch Act<sup>71</sup> provides for the FAA's AST (the present 'label' of the Office for Commercial Space Transportation) to undertake a payload review for every launch to be licensed with the aim "to determine whether (...) launch [of the payload] would jeopardize public health and safety, safety of property, U.S. national security or foreign policy interests, or international obligations of the United States."<sup>72</sup> From that perspective, one could even argue that the FCC's exercise of its jurisdiction on this particular issue amounts to a sort of 'competence creep,' as orbital debris only tangentially relates to the proper issue of use of radio frequencies over which the FCC's core regulatory authority is to be exercised and would, from many perspectives, be more logically included as part of the payload review to be conducted by the FAA's AST.<sup>73</sup>

In any event, neither of the two would be able to currently address in any comprehensive fashion an effort at active debris removal. And while certainly laudable from an overall perspective of preserving outer space for future activities and developing international (space) law on the matter, this FCC 'competence creep' again

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<sup>70</sup> 47 U.S.C. §303. Licenses should be handed out only if, *i.a.*, "the public interest" will be served thereby. *Id.* at § 309. *See also* 47 C.F.R. Pts 5, 25 & 97 (2016); and Futron, *Orbital Debris Mitigation: Regulatory Challenges and Market Opportunities*, at 3 (Mar. 15 2006).

<sup>71</sup> Commercial Space Launch Act, Pub. L. No. 98-575 (1984). *See also infra* §IV.D.

<sup>72</sup> 14 C.F.R. 415.51. For purposes of this review, the FAA AST will notably consult with the Departments of Defense, Department of State, and any other appropriate federal agencies such as NASA. *See* §415.57. For more on the FAA's role see *infra* §IV.D.

<sup>73</sup> It may be further noted that NASA, *inter alia* giving rise to its role in co-establishing the Inter-Agency Space Debris Coordination Committee, had started to address space debris and relevant mitigation measures as early as the beginning of the 1980s. *See* C. Williams, *Space: The Cluttered Frontier*, 60 J. AIR L. & COMM. 1166-67 (1995) and P.S. Dempsey, *Overview of the United States Space Policy and Law*, in NATIONAL REGULATION OF SPACE ACTIVITIES 392 (ed. R.S. Jakhu 2010).

raises issues as to how the exercise of US jurisdiction in outer space more generally should be established on a more coherent footing.

*C. NOAA Jurisdiction over Space Remote Sensing Activities*<sup>[1]</sup><sub>SÉP</sub>

A further US government entity exercising some substantial and direct measure of US jurisdiction over space activities concerns the National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce. Under the two national acts addressing the licensing of private remote sensing satellite operators, the 1984 Land Remote-Sensing Commercialization Act<sup>74</sup> as then superseded by the 1992 Land Remote-Sensing Policy Act,<sup>75</sup> NOAA was the government agency actually handling the licensing.<sup>76</sup> The licensing competence refers to private remote sensing systems, more particularly their operation and the follow-on handling of data generation, treatment, and distribution – and to only those aspects.<sup>77</sup>

Whilst the soon-to-be-expected private sub-orbital flights may not likely become involved in remote sensing operations (which would then essentially be private in nature, hence possibly subject to the application of the Land Remote-Sensing Policy Act), somewhat further into the future one cannot exclude such involvement either. The two currently leading contenders in prospective sub-orbital ‘space tourism’, Virgin Galactic and XCOR, have both indicated they would also entertain opportunities to fly certain small experimental payloads into the lower regions of outer space, and sooner or later a research or other institute might be interested in flying a remote sensing-experiment, with or without an accompanying researcher on board. At the same time, the general understanding is that NOAA jurisdiction is even further limited to *orbiting* remote sensing devices; excluding for example at least according to the letter both Moon missions and the aforementioned sub-orbital flights.

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<sup>74</sup> Land Remote-Sensing Commercialization Act, Pub. L. No. 98-365 (1984).

<sup>75</sup> Land Remote Sensing Policy Act, Pub. L. No. 102-555 (1992). See also E. Sadeh, *Politics and Regulation of Earth Observation Services in the United States* in NATIONAL REGULATION OF SPACE ACTIVITIES 455-58 (ed. R.S. Jakhu 2010).

<sup>76</sup> See 51 U.S.C. §60121.

<sup>77</sup> 51 U.S.C. § 60121(a). *cf. esp. sub (2)*: “In the case of a private space system that is used for remote sensing and other purposes, the authority of the Secretary under this subchapter shall be limited only to the remote sensing operations of such space system.”

*D. FAA Jurisdiction over Private Human Spaceflight*

Obviously, the most directly relevant element of US jurisdiction for the current discussion is that of the FAA over private human spaceflight. Like the specific US government agency competences of FCC and NOAA addressed above, this competence also started out as a competence addressing robotic space activities.

When in 1984 with the Commercial Space Launch Act<sup>78</sup> the first fundamental possibility was created for private entities to start engaging in the provision of launch services for commercial purposes subject to a licensing regime, under the Secretary of Transportation's responsibility the Office for Commercial Space Transportation (OCST), which eleven years later was relocated<sup>79</sup> to the FAA, was made directly responsible for properly licensing those activities.<sup>79</sup>

Addressing the relevant possibilities for such private launch service providers to offer launches with expendable launch vehicles to customers interested in having their payload – usually a commercial communication satellite – launched into the desired orbit, the licensing focused essentially on the launch phase. This phase was supposed to begin at the “commencement of licensed launch activities” and to end, for “orbital launches, until the later of (i) Thirty days following payload separation, or attempted payload separation in the event of a payload separation anomaly; or (ii) Thirty days from ignition of the launch vehicle.”<sup>80</sup> For non-orbital launches, this phase supposedly came to an end upon “completion

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<sup>78</sup> See Commercial Space Launch Act, *supra* note 68. See also P.A. Vorwig, *Regulation of Private Launch Services in the United States* in NATIONAL REGULATION OF SPACE ACTIVITIES 405-16 (ed. R.S. Jakhu 2010).

<sup>79</sup> *Cf.* 51 U.S.C. §50903(d), indicating that the Secretary of Transportation, formally charged under the Act with supervising commercial launches, could call upon an executive agency to perform such tasks; in conjunction with § 50921, headed “Office of Commercial Space Transportation.”

<sup>80</sup> 14 C.F.R. §440.11. Note that this ‘definition’ strictly speaking remains confined to the required insurance coverage or financial responsibility of the licensee. The Commercial Space Launch Act itself does not define launch other than as the effort “to place or try to place a launch vehicle or re-entry vehicle and any payload, crew, or space flight participant from Earth (A) in a suborbital trajectory, (B) in Earth orbit in outer space; or (C) otherwise in outer space, including activities involved in the preparation of a launch vehicle or payload for launch.” 51 U.S.C. Sec. 50902(4). See also Kerrest de Rozavel & Von der Dunk, *supra* note 28, 146.

of licensed launch activities at the launch site,” which presumably includes flight control and monitoring of the launch at the launch site.<sup>81</sup>

The Commercial Space Launch Act and its implementing regulations focused their licensing requirements on the safety and security aspects of the launch, which included third-party liability – partly since the United States as such might be held liable if such damage occurred in an international setting triggering the application of the Liability Convention.<sup>82</sup> Thus, a license is to be granted “[c]onsistent with the public health and safety, safety of property, and national security and foreign policy interests of the United States”;<sup>83</sup> the licensing authority “may establish procedures for safety approvals”<sup>84</sup> or prescribe “any additional requirement necessary to protect the public health and safety, safety of property, national security interests, and foreign policy interests of the United States.”<sup>85</sup>

Once actual launches of private manned launch vehicles were being contemplated seriously, the FAA firstly was provided with the authority to, mirror-wise as it were to the launch, also regulate and exercise its licensing competence *vis-à-vis* the re-entry of such vehicles – as obviously these launch vehicles should also return safely, and, as a matter of fact, the operators-to-be were focusing on reusable vehicles for commercial reasons as well. This was purportedly done by way of the 1998 Commercial Space Act<sup>86</sup> which resulted in the Commercial Space Launch Act to be “amended (...) to address liability and government indemnification concerns and to address licensing authority for RLVs [reusable launch vehicles],” thus allowing the FAA already in principle to start licensing re-entry operations in addition to launches.<sup>87</sup>

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<sup>81</sup> 14 C.F.R. §440.11. Also, this provision actually addresses the required insurance coverage or financial responsibility of the licensee only.

<sup>82</sup> Cf. Liability Convention, *supra* note 3, Arts. I(c), II, III.

<sup>83</sup> E.g. 51 U.S.C. §50905(a)(1).

<sup>84</sup> 51 U.S.C. §50905(a)(2).

<sup>85</sup> 51 U.S.C. §50905(b)(2)(B).

<sup>86</sup> Commercial Space Act, Pub. L. No. 105-303 (1998). The Act was enunciated for addressing several and rather varied issues of space commercialization and the resulting involvement of private entities in space operations. See Dempsey, *supra* note 70, 389-90.

<sup>87</sup> Hughes & Rosenberg, *supra* note 44, 4. See also *Id.* at 19-24 (including references to FAA regulations drafted in consequence, 14 C.F.R. §401.5 (2000)). Cf. Commercial Space Act, *supra* note 83, §§14751-14753.

With the victory of Scaled Composites in the X-Prize contest<sup>88</sup> and the ensuing establishment of Virgin Galactic this process quickly gave rise to the conclusion that the most appropriate way to handle such flights on a more consolidated basis in the future would be to adapt the regime of the Commercial Space Launch Act, which had regulated launch activities precisely for similar reasons of public interests (notably safety-, liability-, and national security-related) to the specifics of launches with humans on board.<sup>89</sup> The result was the 2004 Commercial Space Launch Amendments Act<sup>90</sup> amending the 1984/1988 Act to achieve such goals, followed by further legal measures as part of the Code of Federal Regulations.<sup>91</sup>

Most fundamentally, the licensing obligation was now also applied to re-entry, whereas formerly it only applied to launches.<sup>92</sup> ‘Re-entry’ is defined to mean “to return or attempt to return, purposefully, a reentry vehicle and its payload, crew, or space flight participants, if any, from Earth orbit or from outer space to Earth”;<sup>93</sup> in other words, still a somewhat vague and potentially broad definition, as no specific point of begin of a re-entry phase is indicated (whilst that phase may of course be presumed to have ended at the latest upon actual landing). The House Committee on Science then fortunately shed some further light in narrowing this loose ‘definition’ down to “that phase of the overall space mission during which re-entry is intentionally initiated,” more specifically “when the vehicle’s attitude is oriented for propulsion firing to place the vehicle on its reentry trajectory.”<sup>94</sup> This seems to allow determination of the beginning of the re-entry phase rather precisely.

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<sup>88</sup> Note that the FAA licensed the first-ever private flight into the edge of outer space of Scaled Composites’ SpaceShipOne on 1 April 2004 using the Commercial Space Launch Act as amended in 1988. Commercial Space Launch Act Amendments, Pub. L. No. 100-657 (1988). Although an experimental airworthiness certificate under 14 C.F.R. Pts. 21 & 91 was also required. Hughes & Rosenberg, *supra* note 44, 37-8 & 66-7.

<sup>89</sup> *See Id.* at 21 ff. and P. van Fenema, *Suborbital Flights and ICAO*, 30 AIR & SPACE L. 399-400 (2005).

<sup>90</sup> Commercial Space Launch Amendments Act, Pub. L. No. 108-492 (2004).

<sup>91</sup> To wit 14 C.F.R. Chap. III: Commercial Space Transportation, Federal Aviation Administration, Department of Transportation.

<sup>92</sup> See also 51 U.S.C. §50904(a). See furthermore §§50904-50905, for the general licensing requirements. *See also* Hughes & Rosenberg, *supra* note 44, 21 ff.

<sup>93</sup> 51 U.S.C. §50902(13).

<sup>94</sup> Commercial Space Act of 1997, H.R. Rep. No. 105-347, 105th Cong., 1st Sess. at 21 (quoted in Hughes & Rosenberg, *supra* note 44, 20). *See also* Hughes & Rosenberg, *supra* note 44, 21.

Interestingly the broadness in particular of the applicable concept of 'launch' allowed the FAA to *de facto* regulate the whole sub-orbital trajectory at least as far as the near-term private sub-orbital flight projects are concerned, with the launch more or less seamlessly transitioning into the re-entry – and as far as public safety is directly at issue.

Launch and re-entry operations are still far from routine and actually presumably still hazardous – witness the 'informed consent' requirement giving rise to a strong defence by the operator against any claim for damage under contractual liability by a spaceflight participant now also giving rise to a waiver of liability.<sup>95</sup> Consequently, almost any behaviour of such a spaceflight participant that would be out of sync, whether during ascent, descent or even during the five minutes or so of micro-gravity to be experienced, such as for example what would make a spaceflight participant an 'unruly passenger' as this concept is known in aviation, would raise safety-related concerns, hence at least in theory be addressable under FAA rules, in the sense that licensing conditions could include specific requirements protecting the safety of flight in light of such 'unruly passengers.' Whether such paper requirements could actually preclude such unruly behaviour from endangering the safety of flight, *vice versa* whether more forceful instruments were to be called for *and* would be feasible (such as requiring physical restraint), would then of course be the next issue to be addressed.

Still, as long as sub-orbital flights do not provide transportation services across major sections of the globe effectively the comprehensive flight could essentially be thus regulated – as far as this concerns the safety-related activities in the broadest sense of the word. But what if two passengers marry on board or completely peacefully engage in another contract's signature? Or if, indeed, they start taking commercially-valuable high-resolution pictures from their windows, noting that presumably this would fall outside of NOAA's jurisdiction?

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<sup>95</sup> Cf. Sec. 112, U.S. Commercial Space Launch Competitiveness Act. See also R.A. Yates, *State Law Limitations on the Liability of Spaceflight Operators*, 9/1 THE SCITECH LAWYER 15 (Summer 2012) and T. Knutson, *What is "Informed Consent" for Space-Flight Participants in the Soon-to-Launch Space Tourism Industry?*, 33 J. SPACE L. 105 (2007).

This is where the issue of absence of ‘on-orbit’ jurisdiction – the standard US term for jurisdiction in the realm of outer space<sup>96</sup> – for the FAA as asserted by the US Congress becomes a real issue. The FAA was authorized only to license launch and re-entry,<sup>97</sup> wherefore this jurisdiction does not amount to proper commercial, civil, or criminal jurisdiction. This lack of ‘in-space jurisdiction’ would in particular start to become a problem once flights would be extended beyond the sub-orbital ‘hops’ currently envisaged. □ Such a development would also essentially open up a major gap between, on the one hand, the international liability and responsibility of the United States under the space treaties for example for damage caused or threatened by commercial spaceflight operations due to unruly passengers being the root cause of such damage or threat thereof, and, on the other hand, the seeming possibility for – especially – the FAA to try and make sure by way of regulation that such unruly passengers will be duly restrained and prosecuted.

### C. *Jurisdiction over Celestial Bodies Resource Exploitation?*

Looking yet further ahead, such an absence of ‘in-space’ jurisdiction also would become problematic in case of missions launched for the purpose of celestial bodies resource exploitation. While the

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<sup>96</sup> Cf. Perlman, *supra* note 13, 940-1.

<sup>97</sup> Cf. 51 U.S.C. §50904 and Perlman, *supra* note 13, 930, 935-7. See also GOV'T ACCOUNT. OFF., INDUSTRY TRENDS, GOVERNMENT CHALLENGES, AND INTERNATIONAL COMPETITIVENESS ISSUES, GAO-12-836T, 19 (2012). Strictly speaking, §50904 only refers to ‘launch’ and ‘re-entry,’ without specifying whether this does encompass (parts of) the flight in outer space, which of course also means that in the licensing process the FAA will keep an eye out also for what might happen in the outer space-portions of any space object’s flight, if only for international third-party liability reasons, and insert as possible relevant conditions, for example in a safety approval if at issue. Furthermore, firstly §50902(4), defines launch with reference to placing or trying to place spacecraft, manned or unmanned, into outer space, *suggesting* that the in-space part of the operations should no longer be defined as part of the launch – but since normal payload separation *does* take place in outer space, one cannot simply assume that there is *no* FAA jurisdiction in outer space whatsoever as such. Secondly, it may be noted that 14 C.F.R. §440.11 requires insurance obligations under a launch license to cover the period up to thirty days from payload separation alternatively from the launch properly speaking, apparently extending FAA authority over the licensed operations to that extent into outer space also. The underlying rationale for these limitations largely seems to refer back to a hesitation on the part of the United States to exert extra-territorial jurisdiction in the ‘global commons’ of outer space. Cf. Perlman, *supra* note 13, 942ff. Nevertheless, the whole approach could obviously be made much more straightforward, simple, transparent and coherent.

FAA could and would, again, regulate launch and re-entry, possibly extending somewhat into any in-between operations as long as related to the overall safety of the flight and the consequent re-entry, such jurisdiction normally speaking does not extend to any on-site harvesting operations of the licensee. This, in spite of the risk that such operations may invoke the United States' international responsibility and liability, as well as require some US protection in the international realm in view of the discussion referred to earlier on political and legal ramifications.<sup>98</sup>

While Title IV of the U.S. Commercial Space Launch Competitiveness Act represents a laudable effort to develop a first measure of US regulatory authority over private resource exploitation missions on celestial bodies, it still leaves open the question regarding which part of the US government should actually exercise that authority for the purpose indicated, as it merely provides that a report is to be submitted around the time of writing "that specifies – (1) the authorities necessary to meet the international obligations of the United States, including authorization and continuing supervision by the Federal Government; and (2) recommendations for the allocation of responsibilities among Federal agencies for the activities" concerned.<sup>99</sup> To that extent also the new Act still begs the question how such 'in-space' jurisdiction should be established and exercised in the US context, in this particular realm of celestial bodies resource exploitation – and more generally in outer space when private US companies are concerned.

Again, the current absence of any detailed regime both gives rise to an unacceptable measure of legal uncertainty for any *bona fide* endeavours to undertake celestial bodies resource exploitation, and would allow the United States to take the lead and set the precedent at the international level for such a regime. It would also, consequently, give the United States a strong legal argument to protect any such activities duly licensed, including with due regard for the global public interest as reflected in US obligations under international space law.

For example, the licensing regime should reflect and respect the absence of territorial sovereignty and appropriation, the impos-

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<sup>98</sup> See *supra* at §III.D.

<sup>99</sup> Sec. 51302(b).

sibility for permanent ownership of celestial bodies as such (as contrasting in particular to that over mineral resources once extracted), should not prejudice other states' rights, interests and potential activities with regard to the celestial body at issue, including in particular as regards scientific exploration, and should incorporate an appropriate registration, liability, and insurance regime. As said, the reference in Title IV to continued compliance by the United States with its international obligations should be seen as addressing precisely these issues.<sup>100</sup>

#### V. TOWARDS SOME FORM OF 'IN-SPACE' JURISDICTION OVER SPACE OBJECTS IN THE US CONTEXT

Interestingly, even apart from the specific realm of intellectual property right protection the United States does already exercise jurisdiction of a rather more comprehensive nature in outer space – namely when it comes to criminal jurisdiction *per se*. The Federal Criminal Code applies to “[a]ny vehicle (...) in space and on the registry of the United States pursuant to the [Outer Space Treaty] and the [Registration Convention], while that vehicle is in flight.”<sup>101</sup> In other words, the United States applies its criminal jurisdiction on a quasi-territorial basis to US-registered space objects.

While that application thus addresses crimes, including economic crimes such as money laundering, in space, it might not seem to address more normal commercial behaviour, mining activities outside of US-registered space objects or even such events on board as ‘unruly passengers’ if they would not meet the threshold of criminal conduct.<sup>102</sup>

More importantly, it is far from clear how the US criminal law system would (attempt to) apply to such ‘in-space’ activities in practice, without any expert agency involved to make it work. □ In spite of its official stance that no boundary should be formally established (yet) between airspace and outer space, this application of the Federal Criminal Code also implicitly recognizes the clear international legal difference between the two realms. As for airspace namely, the Tokyo Convention – to which the United States is also

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<sup>100</sup> See Sec. 51302.

<sup>101</sup> 18 U.S.C. §7(6) (2006), as quoted by Perlman, *supra* note 13, 937.

<sup>102</sup> So *e.g.* Perlman, *supra* note 13, 937.

a party – provided that the state *in whose airspace* an aircraft registered with another state is flying is the primary state entitled to exercise its “criminal jurisdiction over an offence committed on board” that aircraft – although the former state should not do so unless other criteria apply.<sup>103</sup>

What is missing, then, is firstly, some actual temporary enforcement competence. Like the captain of an aircraft, the ‘captain’ of a suborbital spaceship should perhaps be endowed with the right to exercise temporary police powers during flight in order to be able to take appropriate measures of physical restraint – as necessary and, of course, feasible – until formal enforcement can take over after landing (back on earth).<sup>104</sup> Interestingly, the aforementioned Tokyo Convention in establishing such powers for an aircraft commander *does* seem to apply to “any act regardless whether it is an ‘offence’ that may or actually does jeopardize safety or good order and discipline on board. It would thus apply, e.g., to unruly conduct such as smoking on board when it is prohibited, use of electronic equipment when prohibited, rude behaviour” and suchlike.<sup>105</sup>

Similar enforcement questions would have to be answered with respect to resource exploitation activities on celestial bodies, once allowed under a licensing system as per Title IV of the U.S. Commercial Space Launch Competitiveness Act.

Secondly, the application of federal law in civil and commercial matters over US-registered space objects and/or celestial bodies resource exploitation facilities should be principally established. Of course Congress might wish to effectively limit its application to

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<sup>103</sup> Namely, if “(a) the offence has effect on the territory of such State [being overflown]; (b) the offence has been committed by or against a national or permanent resident of such State; (c) the offence is against the security of such State; (d) the offence consists of a breach of any rules or regulations relating to the flight or manoeuvre of aircraft in force in such State; [or] (e) the exercise of jurisdiction is necessary to ensure the observance of any obligation of such State under a multilateral international agreement.” Convention on Offences and Certain Other Acts Committed on Board Aircraft, Art. 4, in conjunction with Art. 1(2), , Tokyo, 14 September 1963, 704 U.N.T.S. 219 [hereinafter Tokyo Convention]. See R. Abeyratne, *Space Tourism – Parallel Synergies Between Air and Space Law?*, 53 *ZLW* 190-3 (2004) and M. Chatzipanagiotis, *The legal status of space tourists in the framework of commercial suborbital flights* 43-4 (2011).

<sup>104</sup> See Tokyo Convention, *supra* note 99, Art. 6-9. Cf. Perlman, *supra* note 13, 954 (linking this to the US obligation under Art. VI of the Outer Space Treaty to authorize and continuously supervise its “national activities in outer space.”)

<sup>105</sup> M. MILDE, *INTERNATIONAL AIR LAW AND ICAO* 225 (2012) (emphasis added).

particular statutes or particular parts of a statute, and then determine which particular parts of, for example, family law, commercial law or contract law, would actually extend to such registered objects, and how. Carve-outs would probably be needed for example to the extent that the use of radio-frequencies would be involved, as per FCC competencies, respectively as far as concerning remote sensing activities as per NOAA competencies. All that, however, should not stand in the way of establishing such fundamental ‘in-space’ jurisdiction in and of itself.

As there is no inherent reason at the international level obstructing such exercise of US jurisdiction, the solution is essentially one that could and should be found by the United States itself. The main theoretical-legal problem the United States in that context would have to address, at least with respect to the sub-sector of private human spaceflight, concerns the delimitation of airspace and outer space – which it has so far been unwilling to tackle head-on – as (only) in outer space such jurisdiction over registered spacecraft would not be faced with any substantive legal obstacle, but in airspace the ruling ‘territorial’ sovereignty might well put such obstacles in front of such exercise.

Obviously, however, from the perspective of public international law this is mainly a problem of international dimensions, namely once the airspace of other countries than the United States would be at issue. As long as such flights would only cross US airspace and the parts of outer space above it, establishing ‘in-space’ jurisdiction would just require aligning the FAA’s AST authorities with the FAA’s competences in regulating the National Air Space.<sup>106</sup>

This would for the time being not require any definitive decision on (1) where, vertically speaking, the boundary-line between the US National Air Space and outer space would lie, or even whether such a boundary should be determined at all; (2) whether ‘on-orbit’ jurisdiction as the applicable label should not consequently be formally replaced also in US documents with ‘in-space’ jurisdiction, requiring a solution at least in theory regarding the

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<sup>106</sup> See 49 U.S.C. Subtitle VII, esp. Part A.

extent to which the lower boundary of outer space would be equivalent to the lowest possible orbit<sup>107</sup>; and/or (3) whether a workable definition of ‘space object’ for the purposes of arranging for US liabilities under international space law can exist without reference to a well-defined area of ‘outer space’ into which such objects are intended to be launched.□

Following Perlman in his extensive analysis, there is on the one hand ample reason to expect a growing need for such regulation of more normal commercial and (un)civil behaviour on board of US-registered vehicles, potentially being used for longer and longer flights, and on the other hand there do not exist principled obstacles even within the US context itself to the exercise of such US jurisdiction on a more profound and coherent basis than hitherto.<sup>108</sup>

In between the extensive discussion at the 7<sup>th</sup> Annual University of Nebraska-Lincoln’s Washington Conference on Space Law on 3 November 2014 of the White Paper with key stakeholders from the various government agencies and the industry and the drafting of the present contribution, a Staff Working Draft dated 11 March 2015<sup>109</sup> had proposed to include a Section 7, entitled “Space authority,” in the then-Bill on space resource mining being discussed, notably stating the following:

(a) IN GENERAL.—Not later than 120 days after the date of enactment of this Act, the *Secretary of Transportation*, in consultation with the Secretary of State, the Administrator of the National Aeronautics and Space Administration, and the heads of other relevant Federal agencies shall—

(...)

(2) *identify any gaps in oversight authority* for the activities described in paragraph (1);

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<sup>107</sup> See for the discussions on this issue see M. BENKÓ & E. PLESCHER, SPACE LAW – RECONSIDERING THE DEFINITION/DELIMITATION QUESTION AND THE PASSAGE OF SPACECRAFT THROUGH FOREIGN AIRSPACE 3ff (2013).

<sup>108</sup> See Perlman, *supra* note 13, 937-66.

<sup>109</sup> Staff Working Draft, Mar. 11 2015 (on file with author).

(3) *recommend an oversight regime* that would prioritize safety, promote the U.S. commercial space sector, and meet the United States' obligations under international treaties (...).<sup>110</sup>

The initiative would thus have lied with the Secretary of Transportation, under whose *aegis* the FAA AST operates, whereas other relevant Federal agencies and NASA shall be consulted – presumably to ensure no extension of FAA AST jurisdiction for the purpose would unduly encroach upon their respective authorities.

Unfortunately, this proposed clause did not make it into the Act as it was enunciated November 2015; in particular, the suggested lead role of the FAA was erased, and no Federal agency specifically named.<sup>111</sup> Thus, there is no guarantee that other outcomes than providing the FAA AST with something close to 'in-space' jurisdiction could not occur, even if from a logical perspective this would be the clearly preferable course but in any event the first step seems to have been made. To paraphrase a well-weathered but never worn-out statement: this may well be a small step for a government, but a giant leap for commercial operators – at least in the United States.

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<sup>110</sup> *Id.* at §7 (emphasis added).

<sup>111</sup> See Sec. 51302(b).

## COMMENTARIES

# THE LEGALITY OF MINING CELESTIAL BODIES

*Thomas Gangale\**

### I. THE CONTROVERSY

On 25 November 2015, U.S. President Barack Obama signed into law H.R. 2262, the U.S. Commercial Space Launch Competitiveness Act of 2015. Section 51303 provides:

A United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States.<sup>1</sup>

The new law set off a flurry of reportage in the online popular media. The Canadian Broadcasting Corporation reported of Ram Jakhu, a law professor at the Institute for Air and Space Law at McGill University:

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<sup>1</sup> U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90 (2015) [hereinafter CSLCA].

He said the 1967 Outer Space Treaty, signed by the U.S. and other countries, including Canada, makes it clear that the surfaces and contents of asteroids and other celestial bodies are protected from commercial harvesting.<sup>2</sup>

Gbenga Oduntan, a law professor at the University of Kent, wrote of H.R. 2262:

It goes against a number of treaties and international customary law which already apply to the entire Universe.

The act represents a full-frontal attack on settled principles of space law which are based on two basic principles: the right of states to scientific exploration of outer space and its celestial bodies and the prevention of unilateral and unbridled commercial exploitation of outer-space resources. These principles are found in agreements including the Outer Space Treaty of 1967 and the Moon Agreement of 1979.

...[T]he Moon Agreement (1979) has in effect forbidden states to conduct commercial mining on planets and asteroids until there is an international regime for such exploitation. While the US has refused to sign up to this, it is binding as customary international law.<sup>3</sup>

Granted, the online popular media is not the best venue for legal argumentation. It can be asserted plausibly, however, that any declaration to the online popular media that the recent act does *not* violate international law would be received as something less than sensational.

The present article traces backward through time a consistent chain of statements contained in the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement); the 1967 Treaty on Principles Governing the Activities of States in the Exploration of Outer Space, Including the Moon and other Celestial Bodies (Outer Space Treaty); the U.S.

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<sup>2</sup> *U.S. space-mining law seen leading to possible treaty violations*, CBC NEWS, Nov. 26, 2015. <http://www.cbc.ca/news/technology/space-mining-us-treaty-1.3339104> (accessed 8 December 2015).

<sup>3</sup> Gbenga Oduntan, *Who owns space? US asteroid-mining act is dangerous and potentially illegal*, THE CONVERSATION, Nov. 25, 2015, <https://theconversation.com/who-owns-space-us-asteroid-mining-act-is-dangerous-and-potentially-illegal-51073>

Senate hearings on the aforesaid treaty; and United Nations General Assembly Resolutions 1962 (XVIII) and 1721 (XVI), together with the *travaux préparatoires* of the aforesaid U.N. treaties and resolutions, to show the following:

- There is no moratorium on the mining of celestial bodies in international law.
- Historically in international space law, the term “national appropriation” has meant an effortless and immoderate taking beyond present necessity, whether by a State directly or through the agency of a nongovernmental entity subject to its jurisdiction, and the prohibition of “national appropriation” does not in any way derogate the natural law principle of creating property through the mixing of labor and soil.
- The Committee on the Peaceful Uses of Outer Space (COPUOS) recognized as early as 1959 that exploration, settlement and exploitation of natural resources raised distinguishable problems, and that only settlement and exploitation raised serious problems of possible claims to sovereignty. As these did not appear likely in the near future, issues pertaining to settlement and exploitation were removed from the COPUOS working agenda until revived in the context of work on the Moon Agreement in 1969. Since these issues were deliberately excluded from consideration between 1959 and 1969, no provision of the aforesaid U.N. resolutions or of the Outer Space Treaty, including the “national appropriation” principle expressed therein, pertains to the settlement or exploitation of celestial bodies.

## II. BINDING LAW

To begin, if human law applies “to the entire Universe,” one cannot choose but wonder how this presumption of human jurisprudence is viewed by nonhuman sentient beings elsewhere in the universe. More to the point, however, Article 1, paragraph 1 of the Moon Agreement states:

The provisions of this Agreement relating to the moon shall also apply to other celestial bodies within the solar system,

other than the earth, except in so far as specific legal norms enter into force with respect to any of these celestial bodies.<sup>4</sup>

It can be seen that the Moon Agreement applies only within our own Solar System, not “to the entire Universe.” Second, although “the right of states to scientific exploration of outer space and its celestial bodies” is settled law, “the prevention of unilateral and unbridled commercial exploitation of outer-space resources” certainly is not settled law. Oduntan’s assertion notwithstanding, the latter principle is not found either in the Outer Space Treaty or in the Moon Agreement.

Third, the Moon Agreement is not “binding as customary international law.” The 1945 Statute of the International Court of Justice, Article 38, paragraph (1) (b) refers to “international custom as evidence of a general practice accepted as law”<sup>5</sup> as one of the sources of international law. Some writers have found this formulation curious, as it is the practice which is evidence of the emergence of a custom. What is clear is that the definition of custom comprises two distinct elements: (1) “general practice” and (2) its acceptance as law. Although a treaty may encompass rules which also have the force of “customary international law,” a treaty is not in and of itself evidence of state practice. It may be that Oduntan meant to say that the Moon Agreement is *ius cogens*, “compelling law” that is binding on all, regardless of whether a state is a party to this or that treaty. Ordinarily, the “consent of a State to be bound by a treaty” is required,<sup>6</sup> and

[e]very treaty in force is binding upon the parties to it and must be performed by them in good faith.”<sup>7</sup>

“Positivist voluntarism” is at the very heart of the international legal system, which holds that “international legal rules emanate exclusively from the free will of states as expressed in conventions or by usages generally accepted as law.”<sup>8</sup>

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<sup>4</sup> Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, *opened for signature* Dec. 18, 1979, 1363 [hereinafter Moon Agreement].

<sup>5</sup> U.N. Charter.

<sup>6</sup> *Id.*, Art. 10 through 15.

<sup>7</sup> *Id.*, Art. 26.

<sup>8</sup> LORI FISLER DAMROSCH ET AL., INTERNATIONAL LAW: CASES AND MATERIALS 58 (4th ed. 2001).

...[T]here can be no question today, any more than yesterday, of some “international democracy” in which a majority or representative proportion of states is considered to speak in the name of all and thus be entitled to impose its will on other states. Absent voluntarism, international law would no longer be performing its function.<sup>9</sup>

The concept of *ius cogens* is a rare derogation of this principle of positivist voluntarism. It pertains to nearly universal acceptance of certain international norms, such as the prohibition of piracy, human trafficking, genocide, nuclear proliferation, *et cetera*. If the Moon Agreement had something approaching 190 states parties, one could argue convincingly that it had attained the stature of *ius cogens*; in fact, it has only 16 states parties, and none of them have the independent means to access outer space (although there are launch facilities in Kazakhstan, they are owned and operated by Russia). The Moon Agreement is binding only on its 16 states parties, and not on the United States.

Fourth, even were the Moon Agreement binding on the United States, it is untrue that the Agreement “has in effect forbidden states to conduct commercial mining on planets and asteroids until there is an international regime for such exploitation.” Endogenously, the assertion is logically inconsistent with the provision of Article 11, paragraph 5:

States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible.<sup>10</sup>

On what basis could the international community determine that the exploitation of natural resources was about to become feasible if no one were allowed to prove the commercial practicality of exploiting natural resources until an international regime were established?

On the last day of the 1979 COPUOS session, 3 July, after consensus was reached on the Moon Agreement, S. Neil Hosenball, the U.S. permanent representative to COPUOS, stated:

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<sup>9</sup> Prosper Weil, *Relative Normativity in International Law?*, 77 AM. J. INT'L L. 413-420 (1983) (quoted in Damrosch et al., *supra* note 8, at 58).

<sup>10</sup> Moon Agreement, *supra* note 4, Art. 11.

The draft agreement-and I am particularly pleased about this, as a member of the National Aeronautics and Space Administration (NASA)-as part of the compromises made by many delegations, places no moratorium upon the exploitation of the natural resources on celestial bodies, pending the establishment of an international regime. This permits orderly attempts to establish that such exploitation is in fact feasible and practicable, by making possible experimental beginnings and, then, pilot operations, a process by which we believe we can learn if it will be practicable and feasible to exploit the mineral resources of such celestial bodies.<sup>11</sup>

Oduntan's erroneous assertion regarding a Moon mining moratorium also overlooks paragraph 65 of the official statement of COPUOS as reported to the United Nations General Assembly in 17 August 1979:

Following a suggestion for further clarification of article VII, the committee agreed that article VII is not intended to result in prohibiting the exploitation of natural resources which may be found on celestial bodies other than the Earth but, rather, that such exploitation will be carried out in such manner as to minimize any disruption or adverse effects to the existing balance of the environment.<sup>12</sup>

It must be understood that this COPUOS report accompanied the Moon Agreement itself as it was transmitted to the General Assembly, approved by that body, and opened for signature and ratification. Article 31, paragraph 2 of the 1969 Vienna Convention on the Law of Treaties states:

The context for the purpose of the interpretation of a treaty shall comprise, in addition to the text, including its preamble and annexes:

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<sup>11</sup> UNCOPUOS, 203 mtg., U.N. Doc. A/AC.105/PV.203 (July 3, 1979).

<sup>12</sup> UNCOPUOS, *Report of the Committee on the Peaceful Uses of Outer Space*, ¶65, U.N. Doc. A/34/20 (Aug. 14, 1979).

(a) Any agreement relating to the treaty which was made between all the parties in connexion with the conclusion of the treaty;<sup>13</sup>

At the very least, paragraph 65 of the COPUOS report should be considered to fall within the meaning of subparagraph 2(a), but arguably it falls within the meaning of the parent paragraph 2 itself, in that the preamble to UNGA Resolution 34/68, the instrument by which the General Assembly opened the Moon Agreement for signature and ratification, and to which the Moon Agreement was annexed, made specific reference to paragraph 65; that is to say, the citation of paragraph 65, being in the preamble of General Assembly Resolution 34/68, preceded the body of the resolution, which in turn preceded the annex of the resolution, which was, to wit, the Moon Agreement. Thus, any opinion contrary to the interpretive declaration of the committee which originated the Moon Agreement is without merit.

There is yet more evidence that the Moon Agreement intended no moratorium on commercial mining. Any statement made in COPUOS without contradiction by another member of the committee is an expression of the consensus of the committee. This is one of the highest sources of interpretation for the Agreement.

[The agreement] places no moratorium upon the exploitation of the natural resources on celestial bodies, pending the establishment of an international regime. This permits orderly attempts to establish that such exploitation is in fact feasible and practicable, by making possible experimental beginnings and, then, pilot operations, a process by which we believe we can learn if it will be practicable and feasible to exploit the mineral resources of such celestial bodies.<sup>14</sup>

This statement by S. Neil Hosenball, the U.S. permanent representative to COPUOS, “drew no response, and this silence is... a part of the history of the treaty.”<sup>15</sup> This U.S. position was made very clear early in the negotiation of the Agreement. Quoting from the

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<sup>13</sup> Vienna Convention on the Law of Treaties, hereinafter the Law of Treaties, May 23, 1969, *entered into force* Jan. 27, 1980, 1155 U.N.T.S. 331 [hereinafter VCLT].

<sup>14</sup> UNCOUOS, 203 mtg., *supra* note 11, at 22.

<sup>15</sup> Arthur M. Dula, *Free Enterprise and the Proposed Moon Treaty*. 2 HOUS. J. INT'L L. 3, 8-9 (1979).

U.S. statement in the UNCOPUOS Legal Sub-Committee by Herbert K. Reis on 19 April 1973:

...[A]s I have at this session repeatedly, although I hope politely, made clear, the United States is not prepared to accept an express or implied prohibition on the exploitation of possible natural resources before the international conference meets and agrees on appropriate machinery and procedures and a treaty containing them takes effect. In our view, the Moon agreement cannot reasonably seek to require that exploitation must await the establishment of the treaty-based regime.<sup>16</sup>

Oduntan's assertion notwithstanding, the Moon Agreement does not impose a moratorium on "commercial mining on planets and asteroids until there is an international regime for such exploitation."<sup>17</sup>

### III. AN IDEOLOGICAL BATTLE

One statement in Oduntan's opinion editorial is undeniable: an "ideological battle over ownership of the cosmos" is underway.<sup>18</sup> It is an ideological battle, but it is not a legal battle, for the legal bases for his assertions and for those of Jakhu do not exist. Nevertheless, to the extent that they are believed, they gain traction in the popular media, for as Lee Atwater, political consultant for U.S. presidents Ronald Reagan and George H. W. Bush, once said, in politics, "perception is reality." In law, however, this maxim should be as tiny a truth as can be devised by the better angels of our nature; if law is to be truly a science, its prevailing influences should be evidence and logic, rather than politics and rhetoric.

Both Jakhu and Oduntan base their assertions against H.R. 2262 on the Outer Space Treaty, Article II of which states:

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<sup>16</sup> U.S. Representative's statement before the Legal Subcommittee of UNCOPUOS, April 19, 1973. to verbatim record. For the Report of the Subcommittee, see UN COPUOS Leg. Subcomm., *Report of the Legal Sub-committee on the Work of its Twelfth Session*, U.N. Doc. A/AC. 105/115 (Apr. 27, 1973).

<sup>17</sup> Oduntun, *supra* note 3.

<sup>18</sup> *Id.*

Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.<sup>19</sup>

How should Article II be interpreted? Article 32 of the Law of Treaties states:

Recourse may be had to supplementary means of interpretation, including the preparatory work of the treaty and the circumstances of its conclusion, in order to confirm the meaning resulting from the application of article 31, or to determine the meaning when the interpretation according to article 31:

- (a) Leaves the meaning ambiguous or obscure; or
- (b) Leads to a result which is manifestly absurd or unreasonable.<sup>20</sup>

Let us stipulate that the interpretation Article II of the Outer Space treaty according to Article 31 of the Law of Treaties “leaves the meaning ambiguous or obscure, or leads to a result which is manifestly absurd or unreasonable.” That the meaning is either “ambiguous or obscure” is evidenced by the differing interpretations of it. However, the notion that the United States, the United Kingdom, a dozen or so other first tier industrialized capitalist states, and several dozen second tier industrialized capitalist states would have knowingly ratified a treaty which provided “that the surfaces and contents of asteroids and other celestial bodies are protected from commercial harvesting,” if not “manifestly absurd or unreasonable,” must be greeted with considerable skepticism. We then have recourse to the *travaux préparatoires* of the Outer Space Treaty.

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<sup>19</sup> Treaty on Principles Governing the Activities of States in the Exploration of Outer Space, Including the Moon and other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

<sup>20</sup> VCLT, *supra* note 13, Art. 32.

IV. *TRAVAUX PRÉPARATOIRES* OF THE OUTER SPACE TREATY

On 7 May 1966, U.S. President Lyndon Johnson proposed a draft treaty on the exploration of the Moon and other celestial bodies, which, according to the White House Deputy Press Secretary, provided:

The moon and other celestial bodies should be free for exploration and use by all countries. No country should be permitted to advance a claim of sovereignty.<sup>21</sup>

On 11 May 1966, U.S. Permanent Representative to the U.N. Arthur Goldberg gave a written "Outline of Points for Inclusion in Celestial Bodies Treaty" to the Soviet Permanent Representative to the U.N. Nikolaj Fyodorenko. Point 2 was

that "Celestial bodies should not be subject to any claim of sovereignty."<sup>22</sup>

On 30 May 1966, Soviet Foreign Minister Andrej Gromyko declared in a letter regarding space exploration to U.N. Secretary General U Thant:

No one State has the right to regard its achievements in this sphere as a basis for claims to dominion over the moon and other celestial bodies or to use those achievements for activities directed against other States,<sup>23</sup>

Additionally, Foreign Minister Gromyko proposed "the conclusion of an international agreement, which could be based on the following principles governing the activities of States in the exploration and conquest of the moon and other celestial bodies," among them:

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<sup>21</sup> *Space Treaty Proposals by the United States and the U.S.S.R.*, S. Doc. 65-822, at 1 (1966) (Staff Rep.).

<sup>22</sup> *Id.* at 6.

<sup>23</sup> *Id.* at 4.

The exploration and use of the moon and other celestial bodies shall be carried on for the good and in the interest of all mankind; the moon and other celestial bodies shall not be subject to appropriation or territorial claims of any kind.<sup>24</sup>

Article 2 of the draft treaty which the U.S.S.R. submitted on 16 June 1966 stated:

Outer space and celestial bodies shall not be subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.<sup>25</sup>

Article 1 of the draft treaty which the U.S. submitted on 16 June 1966 stated:

Celestial bodies are free from [*sic*] exploration and use by all States on a basis of equality and in accordance with international law. They are not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by other means.<sup>26</sup>

In a U.S. Senate document dated 28 July 1966, Eilene Galloway provided the following analysis of the Soviet and U.S. drafts of the Outer Space Treaty:

Articles 1, 2, and 3 are similar in providing for equality of all states and free access, the applicability of international law, international law, and no claims of sovereignty. The U.S. articles apply to celestial bodies while the Soviet articles apply to outer space and celestial bodies. The provisions in both drafts that activities be carried on “in accordance with international law” and that there shall not be claims of sovereignty are similar to the wording of paragraphs in United Nations Resolution 1962 (XVIII), December 13, 1963.<sup>27</sup>

The text of article which Working Group L.7 accepted on 2 August 1966 stated:

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<sup>24</sup> *Id.* at 5.

<sup>25</sup> Letter from U.S.S.R. to U.N. Secretary General, U.N. Doc. A/6352, at 2 (June 16, 1966).

<sup>26</sup> UNCOPUOS Leg. Subcomm., *Report of the Legal Subcommittee on the Work of its Eleventh Session*, U.N. Doc. A/AC.105/35, at 6 (Sept. 16, 1966).

<sup>27</sup> S. Doc. 65-822, *supra* note 21, at 17.

Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.<sup>28</sup>

Does any of this bring us closer to understanding the intent of Article II? One thing that does stand out is that Article II was one of the earliest articles of the Outer Space Treaty to be reported out of its working group. There appears to have been little, if any, controversy regarding it. It should be recalled that in mid-1966, NASA's schedule of Apollo missions projected a first attempt at a manned landing on the Moon in the first quarter of calendar year 1968, approximately 18 months in the future.<sup>29,30</sup> It was a given that astronauts would obtain lunar samples and transport them to Earth. It is also a fact of history that the Soviet Union hoped to return cosmonauts from the Moon, together with lunar samples, ahead of the United States. Yet there is no record of any controversy regarding the legal ownership of those samples in the Legal Subcommittee of COPUOS. The logical conclusion is that it was understood that any lunar material retrieved by a U.S. Government mission to the Moon would become the property of the U.S. Government, just as any lunar material retrieved by a Soviet Government mission to the Moon would become the property of the Soviet Government. Any notion to the contrary certainly would have generated a discussion which would have left an evidentiary trail; it did not. There is not a shred of evidence in the *travaux préparatoires* of the Outer Space Treaty that it was intended to prohibit reducing lunar material to possession by the act of removing such material from its natural place, whether by a scientific expedition or by a commercial enterprise; scientific expeditions were permitted to do so, and commercial enterprise were not explicitly prohibited from doing so.

The U.S. Senate Committee on Foreign Relations held hearings on the Outer Space Treaty on 7 March, 13 March, and 12 April

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<sup>28</sup> UNCOPUOS Leg. Subcomm., *Interim Report by the Chair*, U.N. Doc. A/AC.105/C.2/L.16, at 8 (Sept. 6, 1966)

<sup>29</sup> Enclosure: Saturn Apollo Applications Launch Schedule, Rev 4/21/66, HSI-142814. Johnson Space Center Archives, University of Houston.

<sup>30</sup> Proposed Apollo launch schedule, Interim Apollo program directive 4-F, dated 11/15/66, HSI-28774. Johnson Space Center Archives, University of Houston.

1967. The following exchange regarding Article II occurred on 7 March:

Chairman (Senator Clinton Anderson): "Can we go to article II?"

Ambassador Arthur Goldberg: "I will try to run more quickly."

Chairman Anderson: "We will have to or we will never get through with this treaty."

Ambassador Goldberg: "Yes. Article II is a statement that outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means, which means that outer space is the province of mankind. It is complimentary to article I.

Chairman Anderson: "Any further questions?"

Senator Frank Church: "It cannot be claimed for Ferdinand and Isabella."

Ambassador Goldberg: "That is correct."

That was all there was to it; the committee immediately turned to consider Article III. Senator Church's remark is illuminating, in that it was probably an oblique reference to the writings of Jean-Jacques Rousseau:

When Nuñez Balboa, standing on the seashore, took possession of the South Seas and the whole of South America in the name of the crown of Castile, was that enough to dispossess all their actual inhabitants, and to shut out from them all the princes of the world? On such a showing, these ceremonies are idly multiplied, and the Catholic King need only take possession all at once, from his apartment, of the whole universe, merely making a subsequent reservation about what was already in the possession of other princes.<sup>31</sup>

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<sup>31</sup> JEAN-JACQUES ROUSSEAU. *THE SOCIAL CONTRACT*, at I 9 (1762; trans. G. D. H. Cole 1782) available at <http://www.constitution.org/jjr/socon.htm>.

In any case, there was no trepidation expressed in the committee hearings that the Outer Space Treaty attempted to overthrow the natural law theory of property. As expressed by John Locke:

Though the Earth, and all inferior creatures, be common to all men, yet every man has a property in his own person: this no body has any right to but himself. The labour of his body, and the work of his hands, we may say, are properly his. Whatsoever then he removes out of the state that nature hath provided, and left it in, he hath mixed his labour with, and joined to it something that is his own, and thereby makes it his property. It being by him removed from the common state nature hath placed it in, it hath by this labour something annexed to it, that excludes the common right of other men: for this labour being the unquestionable property of the labourer, no man but he can have a right to what that is once joined to, at least where there is enough, and as good, left in common for others.<sup>32</sup>

To assert that the United States Senate would have ratified a treaty in the full understanding that it overturned this principle is “manifestly absurd and unreasonable.” The term “national appropriation” referred only to an effortless and immoderate taking beyond present necessity, whether by a State directly or through the agency of a nongovernmental entity subject to its jurisdiction, and the prohibition of “national appropriation” did not in any way derogate the natural law principle of creating property through the mixing of labor and soil.

#### V. *TRAVAUX PRÉPARATOIRES* OF RESOLUTIONS 1721 (XVI) AND 1962 (XVIII)

There are more *travaux préparatoires* to consider with respect to the term “national appropriation,” since that term was not original with the Outer Space Treaty. Preceding the treaty, on 13 December 1963, the United Nations General Assembly adopted Resolution 1962 (XVIII), Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space. Principle 3 states:

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<sup>32</sup> JOHN LOCKE, THE TRUE ORIGINAL, EXTENT, AND END OF CIVIL-GOVERNMENT (1689) available at <http://www.constitution.org/jl/2ndtr00.htm>.

Outer space and celestial bodies are not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.<sup>33</sup>

Preceding Resolution 1962 (XVIII) in turn, on 20 December 1961, the United Nations General Assembly adopted Resolution 1721 (XVI), International Cooperation in the Peaceful Uses of Outer Space. The resolution states two legal principles regarding outer space, the second of which is:

Outer space and celestial bodies are free for exploration and use by all States in conformity with international law and are not subject to national appropriation.<sup>34</sup>

On 2 December 1961, Australia, Canada, Italy, and the United States of America presented a draft resolution, International Cooperation in the Peaceful Uses of Outer Space. Section A, paragraph 1(b) stated:

Outer space and celestial bodies are free for exploration and use by all states in conformity with international law, and are not subject to national appropriations by claim of sovereignty or otherwise.<sup>35</sup>

According to the Verbatim Record of the Twelve Hundred and Eleventh Meeting of the First Committee of the United Nations on 5 December 1961, referring to the Report of the Committee on the Peaceful Uses of Outer Space, Mr. Ferreira of Argentina stated:

As regards the juridical status of outer space, my Government decisively upholds the thesis that this is *res communis omnium extra commercium*. In other words, as the eminent Uruguayan jurist Eduardo Gimenez Arechaga, as pointed out, This space, and objects in it, cannot be occupied or be appropriated by any

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<sup>33</sup> Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, G.A. Res. 1962(XVIII), U.N. Doc. A/RES/1962(XVIII) (Dec. 13, 1963)..

<sup>34</sup> International Cooperation in the Peaceful Uses of Outer Space, G.A. Res. 1721(XVI), U.N. Doc. A/RES/1721(XVI) (1961).

<sup>35</sup> Australia, Canada, Italy, and the United States of America: Draft Resolution, U.N. Doc. A/C.1/L.301, at 2 (Dec. 2, 1961).

specific State and is free for the common and perpetual use of all States.”<sup>36</sup>

...[T]his use must be for [the] benefit of all mankind there must be no occupation or appropriation on the part of any State.<sup>37</sup>

*Res extra commercium* is a doctrine holding that certain things may not be the object of private rights, and are therefore insusceptible to being traded, and no doubt it means different things to different people. It is beyond the scope of the present work to fully explore the implications of this term since it occurs only once in the *travaux préparatoires*, but it may be pointed out briefly that the high seas beyond exclusive economic zones are subject to a common freedom of exploitation without exercising national sovereignty, yet this does not prohibit the commercial taking of fish.

In the same meeting of the First Committee of the United Nations on 5 December 1961, Mr. Martino of Italy stated:

To permit full exploitation of outer space for peaceful purposes, a declaration of principles is needed, to be subscribed to by all nations, that outer space and celestial bodies are free and not subject to appropriation by anybody.<sup>38</sup>

Víctor Andrés Belaunde of Peru stated:

...[O]uter space cannot be appropriated; it cannot be exploited;<sup>39</sup> it cannot be used exclusively by one Power or one group of Powers with the material means to do so, because there is a human interest involving mankind's right to the use of outer space.<sup>40</sup>

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<sup>36</sup> UNCOPUOS, 16<sup>th</sup> Sess., 1211 mtg., at 7, U.N. Doc. A/C.1/PV.1211 (Dec. 5, 1961).

<sup>37</sup> *Id.* at 11.

<sup>38</sup> *Id.* at 36.

<sup>39</sup> The statement did not address natural resources specifically, but outer space generally. It expressed no desire to prohibit exploitation, rather it was a statement opposing the monopolization or oligopolization of exploiting outer space. For example, the orbiting of Telstar in 1962 was not to be interpreted as an initial step in the monopolization of satellite telecommunications either by the American Telephone and Telegraph Company or the United States; other entities remained free to also exploit outer space for telecommunications and other purposes.

<sup>40</sup> *Id.* at 42.

...[T]he draft resolution sets forth the opinion of all international thinkers, that outer space does not fall within the competence or ownership of any nation....<sup>41</sup>

The *travaux préparatoires* of Resolution 1962 (XVIII) begins with the Summary Record of the First Meeting of the COPUOS Legal Sub-Committee on 28 May 1962, which includes the opening statement of its chairman, Manfred Lachs of Poland:

A very important principle of law had been confirmed by the resolution, namely, that the jurisdiction of international law and of the United Nations Charter extended to outer space and celestial bodies, which were completely free for exploration and use by all States, and were not subject to national appropriation.<sup>42</sup>

Grigoriy Tunkin of the Soviet Union stated that:

According to that unanimously adopted resolution, international law, including the United Nations Charter, extended to outer space and celestial bodies, which were thus free for exploration and use by all States and were not subject to national appropriation.<sup>43</sup>

Leonard Meeker of the United States said that:

The General Assembly had adopted a resolution embodying the principles that international law, including the United Nations Charter, applied to outer space and celestial bodies, and that outer space and celestial bodies were free for exploration and use by all States in conformity with international law and were not subject to national appropriation.<sup>44</sup>

On 10 September 1962, the Soviet Union presented a draft Declaration of the Basic Principles Governing the Activities of States Pertaining to the Exploration and Use of Outer Space. Principle 2 stated:

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<sup>41</sup> *Id.* at 52.

<sup>42</sup> UNCOPUOS Leg. Subcomm., 1<sup>st</sup> mtg., U.N. Doc. A/AC.105/C.2/SR.1, at 4 (June 30, 1959).

<sup>43</sup> *Id.* at 6.

<sup>44</sup> *Id.* at 8.

2. Outer space and celestial bodies are free for exploration and use by all States; no State may claim sovereignty over outer space and celestial bodies.<sup>45</sup>

Verbatim records of COPUOS meetings of 11 through 14 September 1962 depict a great deal of Cold War wrangling and vituperation over such issues as potentially harmful experiments (Project West Ford, 9 April 1962; and Project Starfish Prime, 9 July 1962), reconnaissance satellites, and the activities of private enterprise; the issue of national appropriation was mentioned only once in passing,<sup>46</sup> and then only to reiterate its presence in Resolution 1721 (XVI). In the summary records of COPUOS meetings 17 April to 3 May 1963, the issue of national appropriation was mentioned only once in passing,<sup>47</sup> and then only to reiterate its presence in Resolution 1721 (XVI) and its reformulation in the United Kingdom's draft declaration.<sup>48</sup> The inference is that the term was not a matter of controversy, that there was a common understanding of its meaning, and that it was accepted unanimously.

On 24 September 1962, the United States offered a draft Declaration of Principles Relating to the Exploration and Use of Outer Space, in which Principle 3 was:

Outer space and celestial bodies are not subject to national appropriation.<sup>49</sup>

On 4 December 1962, the United Kingdom submitted its draft, which stated:

Outer space and celestial bodies are not capable of appropriation or exclusive use by any State. Accordingly, no State may claim sovereignty over outer space or over any celestial body,

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<sup>45</sup> U.S.S.R.: Draft Declaration of the basic principles Governing the Activities of States in the Use and Exploration of Outer Space, U.N. Doc. A/AC.105/L.2, at 1 (Sept. 10, 1962).

<sup>46</sup> UNCOPUOS, 13<sup>th</sup> mtg., U.N. Doc. A/AC.105/PV.13, at 26 (Feb 21, 1963).

<sup>47</sup> UNCOPUOS Leg. Subcomm., 18<sup>th</sup> mtg., U.N. Doc. A/AC.105/C.2/SR.18, at 5 (Apr. 19, 1963).

<sup>48</sup> Letter dated 4 December 1962 from the Permanent Representative of the UK to the UN addressed to the Chairman of the First Committee, U.N. Doc. A/C.1/879 (Dec. 4, 1962).

<sup>49</sup> UNCOPUOS, *Report on the Committee for the Peaceful Uses of Outer Space* U.N. Doc. A/5549, at 12 (sept. 24, 1963).

nor can such sovereignty be acquired by means of use or occupation or in any other way.<sup>50</sup>

The revised US draft presented on 8 December 1962 showed no change to Principle 3 from the previous draft:

Outer space and celestial bodies are not subject to national appropriation.<sup>51</sup>

Returning to the analogy of the high seas, they themselves are not subject to national appropriation, yet the fish become property upon being caught. Indisputably, there is a distinction to be made between a region that is subject to a regime and on the other hand the resources that the region contains. The principle that outer space is not subject to national appropriation clearly refers to a region; absent explicit reference to the resources contained within the region of outer space, the application of the non-appropriation principle to the of taking its resources as property is dubious at best.

## VI. EXPLOITED RESOURCES AS PROPERTY

The lack of discussion on outer space resources during the 1961-1967 period could be explained away as the negotiators never having thought of considering the legal implications of resource extraction. This would be a more convincing argument with regard to the earlier years, when the Soviet Union and the United States were struggling to launch the first men into outer space, than to the later years, when the Soyuz and Apollo programs were poised to launch their first manned missions and subsequent flights to the Moon were in sight. Even accepting this excuse does not lead to the conclusion that reducing lunar material to possession by the act of removing it from its natural place, whether by a scientific expedition or by a commercial enterprise, would have been prohibited by international law, for *nulla poena sine lege* is a basic legal principle; one cannot be punished for doing something that is not prohibited by law. If, as an error of omission, no one thought to prohibit the appropriation of extracted resources, then doing so cannot be illegal.

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<sup>50</sup> Letter dated 4 December 1962, *supra* note 48, at 10.

<sup>51</sup> Letter dated 8 December 1962 from the representative of the USA to the Chairman of the First Committee, U.N. Doc. A/C.1/881 (Dec. 8, 1962).

In fact, however, this legal problem was considered as early as 1959. The Summary Record of the First Meeting of the *Ad Hoc* Committee on the Peaceful Uses of Outer Space, Legal Committee, held on 26 May 1959, captures a discussion by Mr. Evans of the United Kingdom:

Celestial bodies in outer space could have the same legal status as outer space itself or could be regarded as a separate problem. Should states be recognized as capable of acquiring sovereignty over them and over their natural resources, or should they be made the subject of some form of international administration? That problem had been posed very clearly by the United States representative in the *Ad Hoc* Committee.<sup>52</sup>

The report of the Legal Committee, dated 27 May 1959, included a working paper submitted by the delegation of the United States:

The Committee was of the view that the exploration of celestial bodies did not itself present any legal problems distinct from those generally raised by space exploration. Problems would arise only if states claimed, on one ground or another, sovereignty over all or part of a celestial body to the exclusion of other States. It was suggested that celestial bodies are incapable of appropriation to national sovereignty. The view was also expressed that some form of international administration over celestial bodies might be adopted.

It was pointed out that exploration, settlement and exploitation of natural resources raised distinguishable problems, and that only settlement and exploitation raised serious problems of possible claims to sovereignty. These did not appear likely in the near future.<sup>53</sup>

On 9 June 1959, the *Ad Hoc* Committee issued its report:

The Committee was of the view that serious problems could arise if States claimed, on one ground or another, exclusive rights over all or part of a celestial body. One suggestion was that celestial bodies are incapable of appropriation to national

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<sup>52</sup> *Ad Hoc* COPUOS, 1<sup>st</sup> mtg., U.N. Doc. A/AC.98/C.2/SR.1, at 7 (June 30, 1959).

<sup>53</sup> *Ad Hoc* UNCOPUOS Leg. Comm., *Report Under Paragraph 1(d) of the GA Res 1348 (XIII)*, U.N. Doc. A/AC.98/L.7, at 8 (May 27, 1959).

sovereignty. It was also suggested that some form of international administration over celestial bodies might be adopted.

The Committee noted that, while scientific programmes envisaged relatively early exploration of celestial bodies, human settlement and extensive exploitation of resources were not likely in the near future. For this reason the Committee believed that problems relating to the settlement and exploitation of celestial bodies did not require priority treatment.<sup>54</sup>

The exploitation of resources was not mentioned again until 13 June 1969, only five weeks before *Apollo 11*'s first manned landing on the Moon, when Argentina raised the "question of the legal status of substances, resources, and products originating from the Moon."<sup>55</sup> The lack of discussion between June 1959 and June 1969 on the legal problems pertaining to the exploitation of natural resources was not an error of omission; rather, it was a deliberate choice. There were much more urgent legal problems that required attention. Thus neither Resolution 1721 (XVI), Resolution 1962 (XVIII), nor the Outer Space Treaty ever addressed the question. This was purposefully left to the negotiation of the Moon Agreement.

## VII. AN INTERPRETIVE DECLARATION

In association with H.R. 2262, the U.S. House of Representatives Committee on Science, Space, and Technology expressed the following views:

### U.S. international obligations

The Committee recognizes that the United States is a Party to the 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'), as well as the Convention on International Liability for Damage Caused by Space Objects, the Convention on Registration of Objects Launched in Outer Space, and Agreement on the Rescue of Astronauts, the Return of Astronauts and Return of Objects

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<sup>54</sup> *Ad Hoc UNCOPUOS, Report of the Working Group to the Legal Committee (Note by the Secretariat)*, U.N. Doc. A/AC.98/C.2/L.1, at 9-10 (June 9, 1959).

<sup>55</sup> U.N. Doc. A/AC.105/C.2/L.54.

Launched in Outer Space. There is nothing in this title which calls for the United States to violate its existing international obligations under these treaties to which it is a Party or to any other treaty to which it is a Party.

#### Claims of sovereignty

This title does not claim sovereignty over outer space or any celestial bodies.

#### National appropriation

Removing, taking possession, and using in-situ celestial resources, including in-situ asteroid resources, is not to be construed as an act of national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.<sup>56</sup>

The committee's view of the term "national appropriation" amounts to a long delayed interpretive declaration regarding Article II of the Outer Space Treaty. It expresses faithfully the understanding which the United States Senate, Arthur Goldberg, and COPUOS had in 1967 as to the meaning of Article II. The U.N. Treaty Handbook provides:

##### 3.6.1 Interpretative declarations

A State may make a declaration about its understanding of a matter contained in or the interpretation of a particular provision in a treaty. Interpretative declarations of this kind, unlike reservations, do not purport to exclude or modify the legal effects of a treaty. The purpose of an interpretative declaration is to clarify the meaning of certain provisions or of the entire treaty.

##### 3.6.3 Time for formulating declarations

Declarations are usually deposited at the time of signature or at the time of deposit of the instrument of ratification, acceptance, approval or accession. Sometimes, a declaration may be lodged subsequently.

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<sup>56</sup> Space Resource Exploration and Utilization Act of 2015, H.R. Rep. No. 114-153 (2015).

#### 3.6.4 Form of declarations

Since an interpretative declaration does not have a legal effect similar to that of a reservation, it need not be signed by a formal authority as long as it clearly emanates from the State concerned. However, since a doubt could arise about whether a declaration in fact constitutes a reservation, a declaration should preferably be signed by the Head of State, Head of Government or Minister for Foreign Affairs or a person having full powers for that purpose issued by one of the above authorities.<sup>57</sup>

Although it may be unusual for a state to make an interpretive declaration regarding a treaty long after its ratification, it is permitted under international law. The bill which was the subject of the Committee's views was signed into law by the President, who is both Head of State and Head of Government. Even so, it would be preferable for the President to send a communication to the Secretary of State reflecting the views of the Committee and directing him to list the interpretive declaration of the Government of the United States, which, pursuant to Article XIV of the Outer Space Treaty, is one of the Treaty's three Depositary Governments.

It should be noted that to date no State Party to the Outer Space Treaty has lodged a declaration asserting the illegality of reducing to possession any obtained space resources.

### VIII. CUSTOMARY INTERNATIONAL LAW

The customary international law regarding property rights in outer space was evidenced by the retrieval of lunar material by American manned *Apollo* missions and Soviet unmanned *Luna* missions during 1969-1973. There was never a serious challenge to the ownership of this material by these two states, and in some cases title has since been transferred to other owners, including private persons.<sup>58</sup> This is evidence of an emergent custom in international law which follows the natural law principle of mixing labor

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<sup>57</sup> UNITED NATIONS, TREATY HANDBOOK (2012) available at <https://treaties.un.org/doc/source/publications/THB/English.pdf>.

<sup>58</sup> There was some discussion on whether it was appropriate for receiving heads of state/government to act as if given Moon rocks were indeed their personal possession, and not something more of a trophy received on behalf of their respective state; however, this question would need to be addressed in the receiving state's municipal law; however,

and soil to create a property right that is transferable. Although the evidence of such a custom would have been stronger had the exploration of the lunar surface continued and had additional material been extracted and reduced to possession, the fact remains that there is no evidence of state practice contrary to such a custom. The 381 kilograms of lunar material, which has been on Earth as property since the 1970s, certainly carries some weight in international law.

#### IX. *TRAVAUX PRÉPARATOIRES* OF THE MOON AGREEMENT

The Moon Agreement codifies this emergent custom. The provision that does so, the first sentence of Article 11, paragraph 3, is clumsily worded:

Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person.<sup>59</sup>

The key phrase is “in place,” and when reworded to be a positively phrased statement rather than a negatively phrased one, it becomes clear that natural resources removed from their place may become property. Again, this follows the natural law principle. Again, it is inconceivable that the government of any capitalist state, including the United States, would have adhered to any interpretation to the contrary at the time that it negotiated the Agreement. Hosenball restated the provision in a more straightforward way, and it is documented that no other state contradicted his statement.

[T]he words “in place”... are intended to indicate that the prohibition against assertion of property rights would not apply to natural resources once reduced to possession through exploitation either in the pre-regime period or, subject to the rules and

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there was no doubt in international law that the Moon rocks were property of the donating state to give, and for some national entity of the other state to receive.

<sup>59</sup> Moon Agreement.

procedures that a regime would constitute, following establishment of the regime.<sup>60</sup>

This is the authoritative interpretation of the provision, as the committee which drafted the Agreement adopted it by consensus, pursuant to Article 31 of the Law of Treaties, paragraph 2(a), which provides that, after first interpreting the text of a treaty “in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context... the context for the purpose of the interpretation of a treaty shall comprise... any agreement relating to the treaty which was made between all the parties in connection with the conclusion of the treaty.” Although it certainly could have been written more clearly, the Moon Agreement contains the strongest provision in international law regarding resource property rights in outer space.

As an *argumentum a contrario*, if Article 11, paragraph 3 represented a radical departure from the “national appropriation” principle in Resolution 1721 (XVI), Resolution 1962 (XVIII), or the Outer Space Treaty, one would expect to discover evidence of a vigorous controversy regarding this issue in the *travaux préparatoires* of the Moon Agreement. Is there such evidence? If so, the burden is on those who oppose resource property rights in outer space to submit their facts to a candid world. If not, once again, we must conclude that the “national appropriation” principle was never meant to apply to natural resources removed from their place.

On the last day of the 1979 COPUOS session, 3 July, after consensus was reached on the Moon Agreement, Hosenball stated:

We note also with satisfaction that Article XI, paragraph 8, by referring to Article VI, paragraph 2, makes it clear that the right to collect samples of natural resources is not infringed upon and that there is no limit upon the right of States parties to utilize, in the course of scientific investigations, such quantities of those natural resources found on celestial bodies as are appropriate for the support of their missions. We believe that this, in combination with the experimental and pilot programmes, will foster and further, and perhaps speed up, the

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<sup>60</sup> UNCOPUOS, 123d mtg., U.N. Doc. A/AC.105/PV.123, at 6 (June 28, 1973).

possibility of the commercial or practical exploitation of natural resources.<sup>61</sup>

No infringement, no limit. Nor does the term “scientific investigations” exclude such investigations conducted by private entities; indeed, most scientific investigations are conducted by private entities. Far from agreeing to a supposed prohibition of commercial exploitation, the U.S. looked forward to accelerating that advent.

#### X. CONCLUSION

H.R. 2262 does not violate international law in any way. It is not in conflict with either Resolution 1721 (XVI), Resolution 1962 (XVIII), or the Outer Space Treaty, since none of these instruments address specifically the extraction of natural resources, and indeed COPUOS deliberately excluded the legal problems of the extraction of natural resources from its deliberations on these instruments. The “Committee Views” regarding the meaning of the term “national appropriation” are consistent with the meaning that COPUOS gave to the term in Resolution 1721 (XVI), Resolution 1962 (XVIII), and the Outer Space Treaty at the time that it concluded its work on these instruments. The act is not in conflict with customary international law, which has its roots in the appropriation of lunar material by the United States and the Soviet Union, without the objection of any state, during the late 1960s and early 1970s, provided that the term “space resource obtained” has the same meaning as a space resource removed from its natural place. Although the United States is not party to the Moon Agreement, nor is the agreement binding on the United States, nevertheless the act is consistent with Article 11, paragraph 3 of the Agreement, again with the proviso that the term “space resource obtained” has the same meaning as a space resource removed from its natural place. There is nothing “dangerous” about it, as Oduntan has written with apparent alarm.<sup>62</sup>

The Canadian Broadcasting Corporation reported:

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<sup>61</sup> UNCOPUOS, 203 mtg., *supra* note 11.

<sup>62</sup> Oduntan, *supra* note 3.

“My view is that natural resources [in space] should not be allowed to be appropriated by anyone—states, private companies, or international organizations,” said Ram Jakhu, a professor at McGill University’s institute of air and space law.<sup>63</sup>

Jakhu’s statement merely expresses his preference of a *lex ferenda*; it is not a pronouncement of the *lex lata*.

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<sup>63</sup> *US Space Mining Law*, *supra* note 2.

# NEW SPACE ACTIVITIES EXPOSE A POTENTIAL LEGAL VACUUM

*Susan J. Trepczynski\**

The international legal regime governing space activities was created at a time when those activities were almost exclusively conducted by government actors. Consequently, the domestic laws implementing international obligations reflected the fact that space was largely a government dominated domain. However, with commercial entities becoming increasingly involved in, and vital to, space activities, it has become necessary for domestic law to evolve to ensure that private and commercial space activities are properly authorized and regulated, both for domestic policy purposes and to ensure such activities remain compliant with our international obligations. While the domestic legal regime is quite well-developed with respect to some established commercial activities, the current proliferation of commercial capabilities and proposed activities has exposed potential holes in the existing regime.

## I. INTERNATIONAL LAW

The United States (U.S.) is a party to the *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),<sup>1</sup> which makes States responsible not only for their own activities in space (i.e., governmental activities), but also for the activities of their nationals. The Outer Space Treaty also contains provisions on liability and jurisdiction and control that carry

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<sup>1</sup> Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

significant implications for States with respect to the space activities of their nationals.<sup>2</sup>

Pursuant to the Outer Space Treaty, States have broad and enduring obligations related to the space activities of their nationals. Article VI establishes that States “bear international responsibility for national activities in outer space . . . whether such activities are carried on by governmental agencies or non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions of” the Outer Space Treaty. Significantly, there is no narrowing of the term “activities,” leaving States essentially responsible for all activities of their nationals in space.

Because States may be held legally responsible for the activities of their nationals, States should have an inherent interest in overseeing and regulating the space activities of their nationals. However, the Outer Space Treaty does not stop at simply placing that implied duty upon States; Article VI goes further by affirmatively requiring States to provide “authorization and continuing supervision” for the space activities of their nationals. While the Outer Space Treaty does not elaborate on the specific requirements for authorization and continuing supervision, certain minimum requirements can be inferred from the language. As a starting point, “authorization” implies there is a requirement for some type of an initial authorization (such as a license) to undertake an activity, but the initial authorization is only the beginning of a State’s responsibility. In order to comply with Article VI obligations, States must also establish a means of continually supervising the activity, for as long as the activity persists. In the case of many space activities, this may require State supervision of ongoing activities for multiple years.

Other provisions of the Outer Space Treaty also contain significant legal implications for States involved in space activities. Article VII provides that the “launching State” is internationally liable for damage caused by its space object (or its component parts) to another State or its nationals.<sup>3</sup> Just as Article VI establishes that

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<sup>2</sup> *Id.* at Art. VI-VIII.

<sup>3</sup> Article VII defines a “launching State” as a State “that launches or procures the launching of an object into outer space” or a State “from whose territory or facility is launched.” This language is echoed in the 1972 Liability Convention, which expands

States are responsible for non-governmental activities, the liability provisions make the launching State liable for damages caused by space objects belonging to its non-governmental entities.<sup>4</sup> Under Article VII of the Outer Space Treaty, such liability extends to damages caused on the “Earth, in air space or in outer space, including the Moon and other celestial bodies.” The Liability Convention adds significant detail to the liability regime created by the Outer Space Treaty, to include establishing that launching States are strictly liable for damages occurring on the surface of the Earth or to an aircraft in flight, but are liable based on fault for damages occurring elsewhere.<sup>5</sup> Finally, Article VIII of the Outer Space Treaty provides that the State of registry has jurisdiction and control over space objects, their component parts, and personnel thereof, and specifically notes that ownership is not affected by the location of the space object (i.e., in outer space, on celestial bodies, or returned to Earth).<sup>6</sup> Because all space objects must have a State of registry, and that State has enduring jurisdiction and control over the object and its component parts, any activities in space that impact space objects are also impacting the interests of a sovereign.

As the above discussion demonstrates, the U.S. has accepted significant international legal obligations with respect to the space activities of its nationals, to include commercial entities. These obligations all must be implemented through domestic legislation.

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upon the liability framework established in the Outer Space Treaty. Convention on International Liability for Damage Caused by Space Objects art. I, *opened for signature* Mar. 29 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention].

<sup>4</sup> Outer Space Treaty, *supra* note 1, Art. VII. Note that for any given launch, there can be more than one launching State and thus more than one State that can be held internationally liable. As previously mentioned, the Liability Convention expands upon the liability concept established in Article VII of the Outer Space Treaty and, with respect to multiple launching States, notes that those States are jointly and severally liable. As such, launching States may conclude agreements with and seek indemnification from each other, but the damaged State has the right to “seek the entire compensation due . . . from any or all of the launching States which are jointly and severally liable.” Liability Convention, *supra* note 3, Article V.

<sup>5</sup> Liability Convention, *supra* note 3, Articles II and III.

<sup>6</sup> While there may be multiple launching States involved in a given launch, there can only be one State of registry. Pursuant to Article I of the Registration Convention, the State of registry must be a launching State. Convention on Registration of Objects Launched into Outer Space art I, *opened for signature* Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention]. In cases where there are multiple launching States, Article II of the Registration Convention requires that they jointly determine which of them will be the State of registry.

While legal and regulatory regimes are well-established with respect to many of the core space activities currently undertaken by commercial actors, such as communications, remote sensing, and launch, the growth of the commercial space sector (particularly its expansion into new markets and activities, and development of new technologies) is revealing that many of these new activities and technologies are potentially unregulated under the existing domestic legal regime. The potential voids in domestic legislation were recognized in the recently passed *Commercial Space Launch Competitiveness Act* (CSLCA), which directs a report identifying “appropriate authorization and supervision authorities” for “current and proposed near-term, commercial non-governmental activities conducted in space,” and recommends “an authorization and supervision approach that would prioritize safety, utilize existing authorities, minimize burdens to the industry, promote the U.S. commercial space sector, and meet the United States obligations under international treaties.”<sup>7</sup>

## II. CURRENT U.S. STATUTORY AND REGULATORY AUTHORITIES FOR SPACE-RELATED ACTIVITIES

Broadly speaking, the current U.S. statutory and regulatory regime for space-related activities can be divided into two categories: (1) laws and regulations relating to payloads (including the functional activities of those payloads) and (2) laws and regulations relating to launch. The U.S. statutory and regulatory system pertaining to two types of payloads – satellite communications (SATCOM) and remote sensing – is well-developed. Commercial operations in both areas are relatively mature, and industry is accustomed to operating within the established laws and procedures, which serve to provide some certainty to operations. Similarly, the launching State focus of the space law treaties, combined with a U.S. policy geared toward the promotion of commercial space launch, has led to a comprehensive statutory and licensing regime for launch providers. While there will certainly be further refinements in these specific areas as industry continues to develop and

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<sup>7</sup> U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, §108 (space authority) (2015) [hereinafter CSLCA].

commercial space activities in these sectors continue to evolve, innovation and the expansion of commercial space into non-traditional sectors will highlight existing statutory and regulatory voids.

### A. Communications

The Federal Communications Commission (FCC) has statutory and regulatory authority over communications satellites, and issues licenses for those systems.<sup>8</sup> In addition to implementing the U.S. obligations arising from the space treaties previously discussed, the FCC regulations also implement U.S. obligations as a member of the International Telecommunication Union (ITU), the UN treaty organization responsible for international telecommunications, including allocating global radiofrequency spectrum and geostationary orbital slots, and setting technical standards related to communications.<sup>9</sup> As regulations pertaining to the use of the radiofrequency spectrum were already well-established by the time commercial SATCOM services were expanding, it is not surprising that the laws and regulations for communications satellites comprehensively implement U.S. international obligations, while simultaneously serving as a means to ensure domestic legal and policy interests are met.

Stating that the FCC regulates communications satellites is useful shorthand, but it is important to note the breadth of the systems impacted by the regulations. FCC regulations cover the use or operation of any “apparatus for the transmission of energy or communications or signals by space or earth stations.”<sup>10</sup> Consequently, a satellite may serve a number of primary purposes (i.e., its primary

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<sup>8</sup> FCC statutory authority is found in the *Communications Act of 1934*, as amended (47 USC § 151 *et seq.*); regulations specific to satellite communications are contained in 47 CFR Part 25, *Satellite Communications*.

<sup>9</sup> See generally *Space Services Department (SSD)*, ITU, <http://www.itu.int/ITU-R/go/space/en> (last visited 27 Jun 2016) (describing the general authorities and responsibilities of the ITU Radiocommunication Sector SSD). The U.S. is bound by ITU documents and implements many of the specific technical obligations through regulations, such as those promulgated by the FCC. Many provisions of the ITU Radio Regulations (RR) are directly incorporated into 47 CFR. For example, 47 CFR § 25.103 notes that “[t]erms with definitions including the ‘RR’ designation are defined in the same way in § 2.1 of this chapter and in the Radio Regulations of the” ITU.

<sup>10</sup> 47 C.F.R. § 25.102(a) (2016). The definitions for “earth station” and “space station” contained in 47 C.F.R. § 25.103 mirror those found in the ITU RR.

purpose may not be SATCOM), but if it makes use of the radiofrequency spectrum, that aspect of its operation must comply with FCC regulations.<sup>11</sup> Because almost all satellites and other spacecraft must in some way utilize the radiofrequency spectrum, the FCC regulations impact a large portion of space objects.<sup>12</sup>

Not only are FCC regulations applicable to a broad range of spacecraft performing many different types of primary missions, they require both initial FCC authorization to transmit and continuing FCC oversight. The FCC has used this regulatory authority to reach beyond transmission capabilities and regulate other aspects of spacecraft operations. For example, applications for space station authorizations are required to provide specific information relating to “the design and operational strategies that will be used to mitigate orbital debris,” to include post-mission disposal plans and the quantity of fuel that will be reserved for post-mission disposal maneuvers.<sup>13</sup> Once the FCC has granted an authorization, it is necessary to seek approval for any subsequent modifications that would affect “the parameters or terms and conditions of the station authorization,” unless those modifications are otherwise excepted by the regulations.<sup>14</sup> Finally, FCC licenses are not indefinite (with a few exceptions, they generally have a period of 15 years),<sup>15</sup> but even within the period of the license, the FCC has the power to revoke the license if milestones specified in the regulations are not met.<sup>16</sup>

### *B. Remote Sensing*

Statutory provisions directing the licensing of commercial remote sensing systems originated with the *Land Remote Sensing*

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<sup>11</sup> Note that FCC regulations apply only to non-governmental actors. In the U.S., federal government use of spectrum is regulated by the National Telecommunications and Information Administration (NTIA).

<sup>12</sup> Oftentimes terms such as “satellite,” “spacecraft,” and “space object” are used interchangeably, though the specific term used may have significance in technical and legal contexts. The FCC Satellite Communications regulations (47 C.F.R. Part 25) define “satellite system,” “space system,” and “spacecraft,” in each instance defining the terms as they are defined in the ITU RRs.

<sup>13</sup> 47 C.F.R. § 25.114(d)(14).

<sup>14</sup> 47 C.F.R. § 25.117

<sup>15</sup> 47 C.F.R. § 25.121

<sup>16</sup> 47 C.F.R. § 25.164. Because licenses are granted before systems are built, the milestones represent required progress toward operational capability.

*Commercialization Act of 1984*, which required that any license issued, among other things, had to “observe and implement the international obligations of the United States.”<sup>17</sup> This provision subsequently appeared in the *Land Remote Sensing Policy Act of 1992*,<sup>18</sup> and was carried through into the legislation as it exists today. The current statutory provisions regarding the licensing of private remote sensing space systems are found in the *National and Commercial Space Programs Act*, which authorizes the National Oceanic and Atmospheric Administration (NOAA), through its Commercial Remote Sensing Regulatory Affairs (CRSRA) office, to issue licenses to private remote sensing operators.<sup>19</sup> Specifically, the CRSRA mission is to “regulate the operation of private Earth remote sensing space systems, subject to the jurisdiction or control of the United States, while preserving essential national security interests, foreign policy and international obligations.”<sup>20</sup> Accordingly, any person subject to the jurisdiction and control of the U.S. requires a NOAA license to operate a private remote sensing system. While a NOAA license is generally valid for the operational lifetime of the system, it is not a blanket license for a system to conduct any and all future activities; the licensee must notify NOAA of certain activities, such as the intent to enter into an agreement with a foreign entity, and is under a continuing obligation to request amendments to the license if certain changes occur, both to business operations or to the technical parameters of the system.<sup>21</sup> NOAA may also revoke the license for various reasons, including non-compliance with the terms and conditions of the license and in cases where the operations are inconsistent with the national security, foreign policy, or international obligations of the U.S.<sup>22</sup>

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<sup>17</sup> Land Remote Sensing Commercialization Act of 1984, Pub. L. No. 98-365 (1984).

<sup>18</sup> Land Remote Sensing Policy Act of 1992, Pub. L. No. 102-555 (1992). The *Land Remote Sensing Policy Act of 1992* repealed the *Land Remote Sensing Commercialization Act of 1984*.

<sup>19</sup> National and Commercial Space Programs, 51 U.S.C. §60101, *et seq.* (2016). Subchapter III deals specifically with the licensing of private remote sensing space systems.

<sup>20</sup> *About Commercial Remote Sensing Regulatory Affairs*, NOAA, <http://www.nesdis.noaa.gov/CRSRA/index.html> (last visited June 27, 2016).

<sup>21</sup> 15 C.F.R. § 960.7–960.9 (2016).

<sup>22</sup> 15 CFR §960.9

While NOAA's statutory and regulatory authority with respect to remote sensing is comprehensive, it may be limited in one significant aspect – by definition remote sensing statutes and regulations only apply to the sensing of the Earth from space.<sup>23</sup> As interest in space situational awareness (SSA) data increases, there has been a growing commercial interest in filling the demand through the development of non-Earth imaging (NEI) capabilities. These NEI capabilities may be included on traditional remote sensing platforms (i.e., satellites that also have the capability and primary purpose of sensing the Earth), but also may be the primary payload on a satellite designed for the purpose of imaging other space objects. Companies moving forward with NEI-based business plans have submitted license applications for NEI activities to NOAA. The presence of NEI sensors on remote sensing satellites initially caused NOAA to deny licenses to several systems, because a “policy and procedure to assess NEI imagery has yet to be developed and agreed to by the IC [intelligence community].”<sup>24</sup> However, NOAA has since

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<sup>23</sup> 51 U.S.C. § 60101(4) defines “land remote sensing” as “the collection of data which can be processed into imagery of surface features of the Earth from an unclassified satellite or satellites . . .” While “land remote sensing” may appear to be a subset of a broader concept of “remote sensing,” the language of the statute seems to clearly limit NOAA's authority to land remote sensing, in that all of NOAA's authorities with respect to remote sensing are derived from 50 U.S.C., Subtitle VI (Earth Observations), in particular the provisions that are found in Chapter 601, *Land Remote Sensing Policy*. The definition applicable to Chapter 601 is “land remote sensing,” which is contained in the first section of the chapter and states that it is applicable to “this chapter.” Logically, regulations promulgated pursuant to this statutory authority, would be limited by the scope of the statute.

<sup>24</sup> Advisory Committee on Commercial Remote Sensing (ACCRES), *Meeting Minutes (June 30, 2015)*, NOAA, <http://www.nesdis.noaa.gov/CRSRA/files/acres-19th-meeting-minutes-091115.pdf> (last visited 27 Jun 2016). In the meeting NOAA also noted that from February 2015 to the date of the meeting “CRSRA has not issued any licenses, particularly in the academic sector because they have a Non Earth Imaging (NEI) component.” *Id.*

evidenced a willingness to take a more expansive view of its statutory and regulatory authorities,<sup>25</sup> and has issued licenses for NEI capabilities.<sup>26</sup>

Historically, the primary policy concern with respect to licensing commercial remote sensing activities was resolution, largely for national security reasons. However, with relatively high resolution imagery readily available today, commercial companies are turning their attention to providing capabilities in a variety of spectrums, and to providing real time (or near real time) access to imagery. In addition, companies are looking to diversify their product by providing not just imagery, but processed information and analytics. The policy concerns that drove the regulation of imagery are also applicable to the integration of various imagery sources, but NOAA has no authority to regulate the use third parties make of imagery, and the imagery itself may only be the raw material for a more focused product. For example, a commercial company may obtain imagery data that was properly collected pursuant to a NOAA license by another company or companies, and use a proprietary process (algorithms, etc.) to create a product that, if one company requested a license to image and/or produce the same information, may have been denied a license. In addition, multi-national corporations and foreign ground stations can further complicate regulatory issues.

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<sup>25</sup> 15 CFR § 960.3 defines “remote sensing space system, licensed system, or system” to mean “any device, instrument, or combination thereof, the space-borne platform upon which it is carried, and any related facilities *capable of* actively or passively sensing the Earth’s surface, including bodies of water, from space by making use of the properties of the electromagnetic wave emitted, reflected, or diffracted by the sensed objects.” (emphasis added) By focusing on the “capable of” qualifier, NOAA is able to argue that licensing NEI capabilities is within its scope of authority because such capabilities are technically “capable of” sensing the Earth (even if they will not actually be used to do so).

<sup>26</sup> See, e.g., NOAA, *The ViviSat Satellite Servicing Mission Extension Vehicle (MEV) for Satellite Servicing*, [http://www.nesdis.noaa.gov/CRSRA/files/vivisat\\_remote\\_sensing\\_license\\_public\\_summary\\_20\\_nov\\_15.pdf](http://www.nesdis.noaa.gov/CRSRA/files/vivisat_remote_sensing_license_public_summary_20_nov_15.pdf) (last visited 27 Jun 2016) (announcing that, on 26 October 2015, NOAA granted a license to ViviSat LLC “to operate a private, commercial space-based remote sensing system of up to ten Mission Extension Vehicle (MEV) satellites to collect images of client satellites during rendezvous and docking operations”). Interestingly, while the NOAA license may resolve the on-orbit imaging question, the ViviSat MEV is also a perfect example of another emerging mission and technology set (on-orbit servicing and the associated rendezvous and proximity operations capabilities) that falls outside the boundaries of the current legal and regulatory regime.

*C. Launch*

The Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST) is authorized by statute to oversee, coordinate, and authorize commercial launch and reentry operations, as well as to encourage, facilitate, and promote commercial launch and reentry activities.<sup>27</sup> The FAA AST authorization and oversight both serves domestic legal and policy interests, and implements U.S. international legal obligations under the space treaties. While the FAA AST statutory authorizations are fairly comprehensive when it comes to launch and reentry activities, the authorizations are limited in scope to those specific activities and do not provide FAA AST any authority to review payloads independent of launch or reentry activities.

FAA AST is statutorily authorized to license the launch and reentry of expendable and reusable launch vehicles, and to issue operator licenses for such vehicles.<sup>28</sup> These statutory authorizations require FAA AST to conduct a payload compliance review as part of the licensing process, which specifically gives the FAA AST the ability to ensure that those seeking licenses or permits have obtained “all required licenses, authorizations, and permits” needed for a given payload, and to deny a launch or reentry license if such requirements have not been met.<sup>29</sup> However, if no such licenses, authorizations, or permits are required for a given payload, FAA AST can only prevent launch or reentry if it is determined it would “jeopardize the public health and safety, safety of property, or national security or foreign policy interest of the United States.”<sup>30</sup> As there are presently separate statutory licensing requirements for remote sensing and communication payloads (under the purview of NOAA and the FCC, respectively), the FAA AST ensures the appropriate licenses have been obtained prior to licensing the launch of such payloads, but conducts no further payload review on payloads subject to NOAA or FCC licensing authorities.<sup>31</sup>

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<sup>27</sup> 51 U.S.C. § 50901 (2016).

<sup>28</sup> FAA AST is also responsible for licensing the operation of non-federal launch sites, or “spaceports.” 51 U.S.C 50904(a).

<sup>29</sup> 51 U.S.C § 50904(b) and (c). The FAA AST has promulgated regulations pursuant to its statutory authorizations, which are found in 14 C.F.R., Chapter III.

<sup>30</sup> 51 U.S.C § 50904(c).

<sup>31</sup> 14 C.F.R § 415.53. The FAA AST payload reviews also exclude payloads owned or operated by the U.S. government.

While it is clear that the FAA AST payload review process does provide some government oversight of all payloads that are launched on vehicles subject to FAA AST licensing authority, the review process is far from comprehensive. The information requirements associated with the review process ensure that basic information is made available, but do not request the type of information that would enable an in-depth technical review of the payload or its capabilities.<sup>32</sup> Furthermore, in order to deny a launch or reentry license on the basis of a payload review, the FAA AST must determine that the payload would jeopardize safety, national security, or a foreign policy interest, which seems to set a fairly high bar for denial. It is also important to note that the license over which the FAA AST has ultimate authority is being granted to the launch company, not the payload owner/operator. The relationship between the launch provider and the payload owner/operator is based on a service contract, with the payload owner paying the launch provider for launch services and the contractual relationship likely terminating once the launch is complete. Consequently, the only information about the payload the launch company is able to provide in its FAA AST license application is the information that was supplied to it by the payload owner pursuant to the launch contract. Logically, such information will be limited to the minimum that is strictly necessary for launch purposes, as a payload owner/operator will generally have an interest in limiting dissemination of technical and operational details for proprietary and competitive reasons.

Finally, it is worth noting two additional points. The first is that once the launch license has been granted, FAA AST has no continuing oversight over the activities of the payload in space. If a payload were capable of maneuvering, manufacturing other space objects, the on-orbit maintenance of other space objects, or any of a number of other activities, those activities would not be subject to FAA AST oversight or control. This would also hold true in the case

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<sup>32</sup> The information requirements for payload review are contained in 14 C.F.R. § 415.59 and include: (1) payload name; (2) payload class; (3) physical dimensions and weight of payload; (4) payload owner and operator, if different from the person requesting the payload review; (5) orbital parameters for parking, transfer, and final orbit; (6) identification of hazardous and radioactive materials, and amounts of each; (7) intended operations during the life of the payload; and (8) delivery point in flight at which the payload will no longer be under licensee's control.

of the spacecraft – once a spacecraft is in orbit, if that spacecraft is capable of maneuver, the FAA AST has no ability to control its movements (i.e., the FAA is not authorized to provide space traffic management services).

The second point relates to the scope of the FAA AST authority, which is licensing launches and reentries that are within its jurisdictional mandate. This scope of authority significantly limits U.S. oversight of many payloads, since there is no legal requirement for non-government payloads to be launched from the U.S.<sup>33</sup> Consequently, if a commercial entity chooses (and is otherwise able under existing U.S. law) to use a foreign launch provider, its payload will not be subject to the FAA AST payload review. Furthermore, if the payload is not one that is otherwise required to be licensed by the FCC or NOAA, the U.S. may effectively have no ability to authorize or continually supervise the functioning or activities of that payload.

### III. EMERGING ACTIVITIES AND THE LAW

While the majority of current commercial space activities still fall within the SATCOM, remote sensing, and launch categories, commercial space companies are starting to develop concepts and pursue technologies that expand upon and push beyond these ‘traditional’ capability areas. As noted, commercial remote sensing is moving from a business concept where imagery is the product, to one where the imagery itself is only part of the equation, which now may include proprietary analytics working in concert with imagery to provide a tailored final product to meet the demands of the consumer. In addition, commercial entities are focusing on utilizing multi-spectral imaging capabilities, improving revisit rates and factoring in latency requirements, and providing video, rather than still images. Commercial companies are looking at fielding constellations of less expensive small satellites, rather than relying on the traditional large and more costly remote sensing satellites that have been the norm until recently. Commercial remote sensing is evolving from providing a snapshot in time, to being able to provide

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<sup>33</sup> Note that U.S. export control laws may impact the ability of U.S. commercial companies to use foreign launch services for certain types of payloads.

change detection/pattern-of-life type capabilities. Commercial companies are also poised to offer their imaging capabilities not just for Earth observation, but for NEI, which would make information that was once almost exclusively in the hands of governments, generally available to the public.

Innovations are occurring in other space sectors as well. Commercial companies are developing habitation modules, researching the possibilities of on-orbit manufacturing, and examining the related concept of utilizing space resources to support such activities. The utilization of space resources presupposes the capability to find and extract those resources, which is another area for which commercial companies are developing business plans. Companies are pursuing on-orbit servicing technologies, looking at opportunities to not just provide the technology, but to provide services (which offers a much more robust business case than one solely dependent on sales of technology, such as satellites). There are also well-publicized ventures underway to support a space tourism industry, with several companies actively taking orders to provide paying customers with a suborbital space experience. All of these activities will contribute to increased activity in space, highlighted by an unprecedented increase in the ability (and need) for space objects to move and maneuver, which itself will lead to requirements for space traffic management.

As commercial space entities explore innovative technologies, products, and services, they are challenging and exposing the boundaries of the existing domestic legal and regulatory regimes. Significantly, these legal and regulatory challenges and voids are not just theoretical or contingent upon the successful development of conceptual technologies. Current capabilities, including new uses of existing technologies, are stretching the limits of the existing legal regime. The need to evolve the law in a way that is responsive to these technological developments and emerging business plans was recognized in the recent CSLCA.<sup>34</sup>

The CSLCA has several provisions directed at areas where the existing legal and regulatory framework may be lacking. In connection with a directed assessment of current and proposed near-term

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<sup>34</sup> CSLCA, *supra* note 7.

space activities, Section 108 mandates the identification of, and recommendations for, appropriate authorization and supervision authorities for such activities. Section 109 notes it is the sense of Congress “that an improved framework may be necessary for space traffic management” and directs an independent study of alternative frameworks. Finally, in a substantive addition to the law, the CSLCA adds the *Space Resource Exploration and Utilization Act* (SREUA) to the United States Code.<sup>35</sup> The SREUA provides that U.S. citizens “engaged in commercial recovery” of asteroid or space resources are entitled to the resource obtained, “including to possess, own, transport, use, and sell” the resource “in accordance with applicable law, including the international obligations of the United States.”<sup>36</sup>

The SREUA has been welcomed by the commercial space sector (especially those with resource-based business plans), as it establishes an enforceable legal right (at least domestically) to the resources they seek to obtain and utilize. However, it is only one provision covering one aspect of a plethora potential space activities. As the CSLCA recognizes, there are open questions as to who should exercise authorization and supervision over emerging commercial space activities, what authorities are required for those activities, and even what the activities themselves are likely to look like in the near future. The need for a regime that addresses these legal and regulatory questions, and is capable of establishing an environment that supports the numerous growth vectors of commercial space, has not gone unnoticed by the executive branch or lawmakers, as is evidenced by both the Office of Science, Technology and Policy (OSTP) report filed pursuant to Section 108 of the CSLCA (OSTP Report)<sup>37</sup> and the April 2016 introduction of a draft comprehensive space policy bill, the *American Space Renaissance Act* (ASRA).<sup>38</sup>

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<sup>35</sup> The Space Resource Exploration and Utilization Act, 51 USC §51301-51303 [hereinafter SREUA].

<sup>36</sup> *Id.* at § 51303.

<sup>37</sup> OFFICE OF SCIENCE TECHNOLOGY AND POLICY, REPORT TO THE COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION OF THE SENATE AND THE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY OF THE HOUSE OF REPRESENTATIVES (April 4, 2016) [hereinafter OSTP Report].

<sup>38</sup> American Space Renaissance Act, H.R. Res. 4945, 114<sup>th</sup> Congress (April 14, 2016) [hereinafter ASRA]. The sponsor of ASRA, Rep. James Bridenstine, stated he does not

The OSTP Report recognizes that the licensing frameworks currently in place for launch and reentry, remote sensing, and communications activities are not adequate to allow the U.S. to meet its international obligations under Article VI of the Outer Space Treaty with respect to emerging commercial space activities, specifically noting the existing frameworks “do not, by themselves, provide clear avenues through the United States Government can fulfill its Article VI obligations in relation to the newly contemplated commercial space activities.”<sup>39</sup> The OSTP Report therefore recommends adopting a “Mission Authorization” framework, which is outlined in a legislative proposal contained in the Report. The legislative proposal requires all U.S. persons receive a mission authorization in order to “conduct missions in outer space” and authorizes the Secretary of Transportation “to grant authorizations for missions in space.”<sup>40</sup> Because the aim of the Mission Authorization proposal is to “establish a process no more burdensome than necessary to enable the United States Government to authorized these pioneering space activities in conformity with its treaty obligations, and to safeguard core public interests such as national security,” it is not intended to be a comprehensive regulatory framework.<sup>41</sup> Accordingly, agency review would only cover “a proposed mission in relation to specified government interests, with only such conditions as necessary for fulfillment of those conditions,” and those activities that are already subject to a comprehensive regulatory framework are specifically exempted from the Mission Authorization legislative proposal.<sup>42</sup>

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expect the bill to pass intact, but to “serve as a conversation piece, as well as a repository for the best ideas that we can plug and play into different pieces of legislation.” Rep. James Bridenstine, *Draft Bill Proposes Wide-Ranging Space Policy Changes*, AMERICAN SPACE RENAISSANCE ACT, <http://spacerenaissanceact.com/draft-bill-proposes-wide-ranging-space-policy-changes/> (last visited June 27, 2016)

<sup>39</sup> OSTP Report, *supra* note 37 at 3. The OSTP Report recognizes the following three broad categories of “unprecedented commercial space activities planned by American companies”: (1) private missions beyond Earth’s orbit; (2) new on-orbit activities; and (3) space resource utilization. *Id.* at 2.

<sup>40</sup> *Id.* at 6

<sup>41</sup> *Id.* at 4. The Report specifically states that the “legislative proposal is not intended to authorize any agency to prescribe substantive, generally applicable regulations.” *Id.*

<sup>42</sup> *Id.* at 6. The legislative proposal specifically exempts three classes of missions from its scope: “(i) Government activities subject to section 50919(g); (ii) Missions for which licensing by the Department of Transportation under Chapter 509 of Title 51 . . . or by the Secretary of Commerce under chapter 601 of Title 51, is sufficient to fulfill the

While the OSTP Report asserts a need for new legislation to sanction the proposed mission authorization framework, the ASRA begins with the proposition that 51 USC § 50904 has already granted the Secretary of Transportation “the authorities necessary to meet the obligations of the United States” under the Outer Space Treaty, such that only additional regulations are required.<sup>43</sup> Accordingly, [rather than trying to establish a new concept of statutorily authorized mission authorizations, ]the ASRA proposes regulations for an “enhanced payload review and determination process” that would be part of the license process under 51 USC, Chapter 509.<sup>44</sup> Interestingly, unlike the OSTP mission authorization proposal, which requires an authorization for all missions in space (other than those that are specifically excluded by the language of the legislative proposal because they are already subject to a regulatory regime), ASRA gives great discretion to the agencies involved in the launch/reentry licensing process to determine whether a payload review and determination is necessary. Under ASRA, the need for an enhanced payload review, which would apply to “payloads and associated activities after deployment,” is established based on disclosures from the payload owner and/or operator during the launch license process. If a review is initiated, planned activities associated with the deployed payload must be approved or denied within 60 days. In addition to an overall approval or denial, the ASRA enhanced payload review process authorizes the imposition of specific license conditions to ensure the “deployment of the payload and associated activities” are consistent with U.S. treaty obligations, are not harmful to U.S. national security, do not cause harmful interference with “approved and operating payloads and associated activities,” and to not harm historic artifacts.<sup>45</sup> Finally, similar to the OSTP mission authorization proposal, the ASRA enhanced payload review process contains specific exemptions for certain payloads, classes of payloads, and associated activities, such as

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United States obligations under the Outer Space Treaty; (iii) Missions, or aspects thereof, conducted for or with one or more United States Government departments or agencies, unless the Secretary and the relevant departments or agencies determine that an authorization is required to provide effective supervision of the mission, or aspects thereof.” *Id.* at 6-7.

<sup>43</sup> ASRA, *supra* note 38, § 309(a)(1)-(2)

<sup>44</sup> *Id.* § 309(a)(2)

<sup>45</sup> *Id.* § 309(a)(2)(C)(ii).

activities currently regulated by the FCC (communications) or Secretary of Commerce (remote sensing) and missions conducted with a federal agency (if already subject to sufficient supervision).

In the midst of this legal and regulatory uncertainty, the inescapable fact that commercial space is evolving remains. Emerging technologies are turning ideas that were once theoretical into actionable business plans. Similarly, the availability of knowledge and technology, combined with potential markets that appear to be receptive to the expanding utility of commercial space, is creating an atmosphere where private investment in commercial space is providing the capital that many of these entities need to take concepts to the next level. As it is established national policy to encourage and support the U.S. commercial space industry,<sup>46</sup> it appears essential for the U.S. to take steps to ensure the domestic legal regime adequately addresses, and does not needlessly hinder, emerging commercial space technologies and activities. The CSLCA recognizes the fact that legal voids exist and it, along with other ongoing legislative efforts, appear poised to attempt to address the issue by building on the existing domestic legal regime that is applicable to the more well-established commercial space activities.

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<sup>46</sup> Barack Obama, National Space Policy 3 (2010) (stating that the U.S. is “committed to encouraging and facilitating the growth of a U.S. commercial space sector that supports U.S. needs, is globally competitive, and advances U.S. leadership in the generation of new markets and innovation-driven entrepreneurship”); Barack Obama, National Space Transportation Policy 3-5 (2013).

## BOOK REVIEWS

### FRANS VON DER DUNK, ED., *HANDBOOK ON SPACE LAW* (EDWARD ELGAR PUBLISHING 2015)

*reviewed by*

*Mahulena Hofmann,\* Andreas Loukakis,\*\* & Simona  
Spassova\*\*\**

#### I. INTRODUCTION

In February 2015, the *Handbook of Space Law* was published by Edward Elgar Publishing Limited, edited by professor of space law at the University of Nebraska, well known and experienced author on space law and space policy issues, as well as Member of the Board of the International Institute of Space Law (IISL), Frans von der Dunk.

The preface, written by Rusty Schweickart, one of the *Apollo 9* astronauts, explains the purpose of the *Handbook*: it should serve as a “research handbook” allowing students and researchers to receive comprehensive information on various issues of space law. It should be noted that von der Dunk interprets space law extensively including all regimes having a significant impact, even if implicitly or indirectly, on at least one type of space activity or major space application. This approach allows him to include areas which are usually covered by specific regulatory regimes such as international trade or insurance law.

The structure of the *Handbook* corresponds these preconditions: Following a general introduction to the history and background of space law, the next four chapters address the main fields

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of law and regulation of space activities from a “formal” perspective. The second section is devoted to the military, defense and security-related aspects of the use of outer space. Chapter 7-12 concentrate on specific space applications such as satellite communications or remote sensing. The fourth section is devoted to crosscutting analyses of specific subjects such as the exploration of celestial bodies or intellectual property rights in the context of space research. The publication is concluded by an analysis of mechanisms of dispute settlement in the area of space activities. Each chapter is accompanied by an impressive number of informational sources. The selection of authors is representative, comprising specialists in the area of the law of outer space, members of the IISL, and/or the Space Law Committee of the International Law Association.

## II. THE CONTENT

This sense of choice of authors can be seen immediately in the first Chapter, which deals with the background and history of space law and was written by Peter Jankowitsch, former president of the UN COPUOS. He explains the connection of space law with the development of rocket technology and the development of nuclear arms and analyses the drafting history of the main international space treaties and describing the transformation of the UN legislative process from treaty making to declarations of legal principles. His insider position enables him to add valuable information on the legal developments in the area of space arms control. The chapter is concluded with an outlook that stresses the importance of the United Nations in the elaboration of space law, both in the treaty and soft law areas.

Frans von der Dunk is author of one of the key elements of the *Handbook*, the chapter entitled “International Space Law.” In his text, he rightly underlines that space law is a branch of public international law, and explains the three main phases of its development. The last one, consisting of the elaboration of non-binding, recommendatory rules in the framework of the UN, lingers to the present day. The author describes the main features of international space law, namely its focus on scientific and military use of outer space and its state-centric approach. The reader finds all necessary information regarding the main outer space treaties including a dis-

cussion of the problem of their territorial scope and various approaches to the still unsettled “boundary question.” Specific attention is devoted to the UN Registration Convention and the obligation of its State Parties to maintain a national register of space objects. The contemporary character of the Handbook can be observed by the deliberations about the duties connected with the registration of sub-orbital flights. Von der Dunk’s next part is devoted to international organizations active in outer space, which can be parties of the majority of the UN space treaties. The chapter further mentions, among other things, the regimes of large space projects or specific multilateral and bilateral agreements on space activities. This chapter is concluded with an evaluation of present space law, which the author describes as “myriad regimes interacting” rather than a coherent set of rights and obligations. One cannot but fully agree with this logical consequence of the extensive interpretation of the notion “space law.”

The chapter by Irmgard Marboe analyzes the issues concerning national space law legislation. It presents, in a very concise manner, the basic characteristics of existing national space law provisions enacted by a number of countries. Marboe begins her analysis by observing that the need for national space legislation has been the consequence of the increasing activities conducted in Outer Space by private actors. She continues by presenting the different legal bases, especially through the angle of international space law, which can be used by states for the enactment of national space legislation. Particularly, she highlights in her analysis that article VI of the Outer Space Treaty is the most representative legal basis for the enactment of legislation, especially dealing with issues such as licensing and authorization of national space activities. In presenting other legal bases that can be used for the initiation of national space legislation, she underlines that both hard law instruments and soft law instruments can be used for the initiation of national space legislation. Some selected examples of countries which are discussed in more detail, are: the USA, Canada, the Russian Federation, Norway, Sweden, France, Belgium, the Netherlands, Australia and South Africa. Interestingly, she observes that at the beginning of the development of national space legislation, there were many differences and a remarkable diversity in the way states regulated space activities. Today the situation has changed

towards a more coherent approach for the adoption of national space legislation, which seems to be beneficial for the near future by avoiding the so called “flag of convenience” problem which may arise within the field of outer space activities.

The next chapter, written by von der Dunk, is dedicated to European space law. First, the text explores Europe’s role in space from a historical perspective: the continent had been lagging behind in space efforts, technologies and regulations in comparison to the US and the USSR and it sought to correct for this delay by pulling its resources together. The chapter offers a comprehensive review of relevant developments in Europe, further explaining events and initiatives also from a political and economic perspective. The central point in the analysis is the formation, development and activities of the European Space Agency (ESA). The complex functioning and operational procedures of the organization are presented – not an easy task in terms of all its complexities, but made understandable through numerous examples and illustrations. The author rightfully points out that ESA does not have any legislative authority, but recognizes the organization’s impact in the field through more indirect lines: ESA became a party to three of the outer space treaties and it qualifies as a launching authority or launching state pursuant to those international agreements. In addition, the argument is made that ESA is playing an important role in the formation of customary international law – a provision yet to be confirmed and clearly contextualized. The second part of this study deals with the space activities of the European Union and their legal basis, as well as the convergence of this supranational organization and ESA. It does not avoid the problem of diverging procuring régimes of both institutions structures, and concludes with presenting two options of their future cooperation – improved cooperation under the status quo, or creating an “EU pillar” with ESA exclusively working for the Union, in accordance with the EU’s legal principles, such as fair competition.

The position of international organizations (IGOs) in space law is analyzed in Chapter 5. In his analysis, von der Dunk observes that IGOs have, throughout time, provided an important forum for the development of public international law in general and space law specifically. The author makes a useful distinction between the

regulatory IGOs and those of a more operational nature, recognizing the contributions of both. In this respect, he first analyzes the contributions of the UN, the ITU, the WTO, WIPO, ICAO, IMO, UNIDROIT and the EU to the development of the law of outer space. Operational IGOs, as further defined by the author, on the other hand, undertake joint activities related to the realm of space exploration. ESA occupies an important place in this group, but since the book already examines it in the previous 4<sup>th</sup> chapter, readers are further acquainted with INTELSAT, INMARSAT, EUTELSAT – prior and post their privatization. In addition, influential organizations such as INTERSPUTNIK and ARABSAT are also included in the examination. The final conclusion reiterates the importance of these IGOs for the formation of international space law, albeit indirectly.

Fabio Tronchetti is the author of the chapter devoted to the legal aspects of the military uses of outer space. He reminds the reader of the fact that military use has been a key feature of space activities since the dawn of space era, and states that the legal rules applicable to this use are distributed among various sources of law. He rightly interprets Article IV of the Outer Space Treaty, prohibiting placement of all kinds of weapons of mass destruction in orbit around the Earth, as not prohibiting conventional weapons. Interestingly, he does not exclude the mere transit of mass destruction weapons through outer space as falling under the scope of the provision. When interpreting the obligation to use the Moon and other celestial bodies exclusively for peaceful purposes, he rejects its interpretation as non-aggressive and stresses the necessity of keeping their full demilitarization. It should be emphasized that the chapter further discusses not only the legal regime of the Moon Treaty, but also the 1963 Partial Test Ban Treaty, the 1977 ENMOD Convention, and the 1972 ABM Treaty. This chapter deals in detail with the specific regimes prohibiting or imposing restrictions on the international transfer of technologies necessary to launch, carry and use nuclear weapons. Tronchetti concludes by stressing that even though there is a large risk of potential weaponization of outer space at the moment, a legal and diplomatic solution acceptable to major space powers seems far from being achieved.

“Legal Aspects of Launch Services and Space Transportation” is title of the contribution submitted by Peter van Fenema who reminds the reader that launching into outer space is the most vulnerable stage of any space endeavor. First, van Fenema gives an overview of the main launch providers and customers, the main attention being devoted to legal aspects of launch safety and space traffic management. He stresses that the aviation rules do not automatically apply to space vehicles, however, these can become relevant in case of launches through national and international airspace. The chapter continues with explorations of the legal aspects of market access and competition rules which are not provided by the international space law. Especially interesting is the part devoted to the satellite technology export controls legislations where the examples of the US, European and international frameworks are discussed. In his conclusion, Peter van Fenema underlines that the development of launch services into regular international trade, comparable to international air transport, continues to be stymied by the military and national security relevance of the “high tech” vehicles and sensitive technologies used for that purpose which stand in the way of the creation of an international intergovernmental organization dealing with safety and sustainability related aspects. In his opinion, this situation will not change until routine passenger transportation and enlightened self-interest in the area of space debris, force the industry and the governments concerned to get their act together.

“No handbook on space law would be thoroughly complete without a section dedicated to the law on satellite communications” according to von der Dunk. This is the most commercially developed field of space technologies and one which is heavily technically regulated. A legal analysis thus presupposes a clear understanding and explanation of the relevant operational aspects which are explained understandably even for non-specialists. The chapter provides a very thorough description of the ITU and the relevant legal regime it created. The historical context during which ITU law started being created is also examined from the Union’s inception in 1865 until the fundamental institutional changes in 1992 and the latest World Radio Conference in 2012. Recognizing that the ITU regulates extremely technical issues – the chapter analyzes the

process of frequencies management, allocation, allotment and assignment. The next step in the exposé is the recognition that satellite communications in space do not only depend on frequencies distribution, but also on the physical position of the satellite in space. The author makes the point that although the ITU has not been granted any formal authority in relation to the physical positioning of objects in space, there is nevertheless an inherent relationship between the location of a satellite and the occupied frequencies. Thus, in an indirect and potentially unintended way, the author argues that the ITU frequency coordination process also impacts the respective positioning of satellites. A specific added value of this chapter is the analysis of the challenges to the ITU regime in the context of satellite communications. The example of the Tongosat affair is given, as well as the auctioning of telecommunications frequencies, trade aspects of satellite communications, IPR and 'public good' issues are raised. The analysis concludes with an acknowledgement as to the uniquely different position occupied by the ITU's legal regime, to its effectiveness, and also to the challenges it will face in the future.

Satellite Remote Sensing is the subject of the chapter written by Fabio Tronchetti. He introduces this chapter with the statement that the legal framework of operation of remote sensing systems is a heterogeneous combination of international laws, national regulations, and data policies, which fails to address these issues in a coherent and efficient way. Tronchetti explains this situation with the fact that the international rules negotiated by the United Nations, especially the UN Remote Sensing Principles do not deal with the privatization and commercialization of remote sensing operations. The national regulations taking the privatization into account are pursuing different strategies and standards. After a substantial part devoted to the technology and evolution of remote sensing technology, the author concentrates in detail on the UN Remote Sensing Principles included in the UN General Assembly Resolution 41/65 of 1986 which he cautiously considers to be customary international law. The second part deals with national regulations on remote sensing, especially with the governmental control of this activity. The reader finds an analysis of the respective legislation of the USA, Canada, Germany and France, enlarged by remarks deal-

ing with other legislation. Further sub-chapters deal with data policy, distribution of data and rights of suppliers and users. The analysis is concluded by stressing that the legal framework of remote sensing has not been able to avoid various barriers imposed on the access and use of remote sensing products. This leads to the positive initiatives of space actors aimed at sharing their space resources, allowing the free distribution of these products especially in the area of natural distress management and rescue operations.

The chapter by Lesley-Jane Smith entitled “Legal Aspects of Satellite Navigation” devotes particular emphasis to the issue of liability connected with the provision of satellite navigational services, especially with scenarios stemming from the loss of signal. The analysis begins by defining the field of satellite navigation. Subsequently, the necessary elements for the operation of satellite navigation, as well as the different Global Navigational Satellite Systems (GNSS) in operation, are presented: the US *Global Positioning System*, the European Union’s *Galileo* and the Chinese *Beidou/Compass* are the main examples in this respect. Following that, she centers upon the issue of liability that may come into play from the use of Global Navigational Satellite Systems. She reviews various liability rules (mainly tort and product liability law rules) that might constitute a possible legal basis for future liability claims arising from the signal in space provisions. The chapter also thoroughly discusses specific areas where liability issues from the signal in space provision would be of importance in the future – in the transport sector, the maritime sector and the aviation sector. In terms of the current law, she observes the absence of a tailor-made specific global legal framework for GNSS liability issues, meaning that its legal parameters are driven by sector-specific international obligations (such as those under the international space treaties) and sector-specific frameworks (such as that for aviation). However, according to her viewpoint, none of these instruments give satisfactory solutions for GNSS liability issues. Smith then concludes by *de lege ferenda* perspectives, particularly addressing the question of whether a unified approach for GNSS liability issues would be a feasible option. In light of the rejection of unified UNIDROIT instrument for GNSS liability issues, she considers such a scenario uncertain; however, if a dedicated liability system is to be introduced for GNSS in the future, limitation of liability will be required,

as well as consensus between states and the operators, whether public or private.

“Legal Aspects of Public Manned Spaceflight and Space Station Operations” is the study written by Carla Sharpe and Fabio Tronchetti. The authors stress that experience with space stations is only limited (*Mir*, *ISS*), but despite this fact, numerous legal solutions taken to serve the international cooperation and the experience with the implementation of this legal framework are noteworthy. The text concentrates on the legal framework of the *International Space Station* involving 15 Partner States, which signed the 1998 Intergovernmental Agreement. The analysis starts from the general international framework applicable to space activities. It reminds the reader of the fact that the USA, Canada, Japan and Russia registered their space modules and, consequently, are entitled to exercise jurisdiction over them. The European modules have been registered by the European Space Agency which has acquired the right to operate as “the State of registration.” As far as criminal jurisdiction is concerned, national jurisdiction is the prevalent factor. The next part of the of the text is devoted to the legal framework applicable to commercial activities on board of the *ISS*, including intellectual property rights: The main principle is that according to the 1998 Agreement, each state shall consider inventions made in its registered elements of the *ISS* as having place in its territory. The text is completed by the deliberation of the legal framework of orbital space tourism. The reader finds, for example, a definition of “space tourist,” compared with the notion of the “astronaut.” The authors conclude that from the legal point of view, the legal basis of the *ISS* offers many models for the future forms of uses of outer space, however, these models have to be adapted to future needs, especially the involvement of private entities in the exploration and exploitation of outer space.

Chapter 12 focuses on “Legal Aspects of Private Manned Space Flights” and is also authored by von der Dunk. This study starts out with the examples of the first space tourist and the first private suborbital flights. It continues with the distinction between private human spaceflights and space tourism – two notions often used interchangeably, but bearing a different significance, especially in relation to their legal aspects. Having established these definitional

characteristics, the chapter is divided based on the legal implications of sub-orbital and orbital flights respectively. Whereas sub-orbital flights refer to those which go up to a very high altitude – crossing the accepted threshold of space they are not sent into Earth orbit. The issue is then dealt with from the perspective of air law, which, as the author argues, is partly relevant as sub-orbital flights have much in common with aviation. At the same time, this is not a clear-cut regime and is dependent on ambiguous definitions such as the geographical frontier between “airspace” and “outer space” as well as on various technologies still being developed. What follows is a simultaneous applicability of space law to such launches. The novelty of the relevant technologies and the uncertain applicability of some international space law provisions to sub-orbital flights inspired the author to more deeply analyze the more developed national regimes. Particularly, from the United States, the Commercial Space Launch Act and its amendments as well as the Code of Federal Regulations are discussed along with 6 individual US state statutes. The second part of the chapter analyzes the relevant space law instruments as applicable to orbital operations: orbital tourism, orbital service flights and orbital hotel operations. The argument for the application of the Liability Convention is made convincingly. As far as orbital service flights are concerned, the author again goes back to US legislation, examining NASA’s and the FAA’s legal undertakings in their efforts to promote private space transportation and crew activities. As a last point, the common legal questions of sub-orbital and orbital private spaceflights are discussed. The first question raised is the definition of an “astronaut” in the context of the Rescue Agreement as well as the Outer Space Treaty. The existing definitional characteristics strictly separate trained spaceflight participants, professionals, from those flying for rather “recreational” purposes and thus, the author argues that the Rescue Agreement should not apply to private spaceflight participants; however, humanitarian considerations should lead to a more flexible approach. Von der Dunk concludes that further technological developments enabling suborbital transportation on the Earth or creation of space hotels shall lead to the need of adopting new definitions and of clarification of the present regulatory framework.

The chapter by Lotta Viikari examines from a critical viewpoint different environmental problems connected with the advent of space activities, with particular attention paid to the issue of space debris. The starting point of this chapter is that currently none of the existing UN space law treaties appropriately address the different environmental problems connected with space activities. She first presents the relevance of existing legal mechanisms (*de lege lata analysis*), principally under the angle of international space law. She convincingly argues that although certain provisions of the existing UN space treaties could be relevant for different environmental concerns arising from space based activities. These provisions have been drafted in a broad and general way without ultimately having any practical significance for environmental concerns. That being said, she applies her analysis to some newly adopted legal mechanisms (mainly soft law instruments) by examining their potential relevance to environmental problems. One example is the International Law Association's Draft Convention on Space Debris, another one the Debris Mitigation Guidelines as adopted in 2007 by the UN COPUOS. In her conclusion she addresses some *de lege ferenda* perspectives. To this end, she proposes different ways for addressing the different environmental hazards connected with space activities; these could include, *inter alia*, the improvement of space technology in general, the adoption of national laws addressing environmental concerns from space activities and last but not least the option for the adoption of a binding international legal convention, especially with regard to the issue of space debris.

Fabio Tronchetti's next chapter deals with the emerging problem of utilization of space resources. His starting point is the fact that existing international space rules leave a great deal of uncertainty as to the legal status of celestial bodies as well as for the possibility of mining and using them for commercial reasons. The cornerstone of the regime is Article II of the Outer Space Treaty, which prohibits "national appropriation" by "any ... means." The author argues convincingly that this rule is applicable also to the private entities the activities of which cannot be performed without an authorization by the appropriate State (Outer Space Treaty Art. VI). In the next part, Tronchetti analyzes the "common heritage of mankind" principle of the Moon Treaty, which is applicable also to

other celestial bodies; however, he reminds that the Moon Treaty has been only marginally ratified. Moreover, the features of the future international regime governing the exploitation of natural resources of celestial bodies, which is envisaged in Article 11 are only vaguely determined. The author concludes with the recommendation to an analogy with the regimes of the seabed mining, of the use of the GSO and the (not entered into force) Wellington Convention regime of the exploitation of the Antarctic mineral resources, which are based on a flexible interpretation of common goods provisions and contain legal rules based on the free-market philosophy allowing at the same time a controlled allocation of limited resources.

The chapter "International Trade Aspects of Space Services" drafted by the editor starts with a part devoted to the development of an international trade regime. It continues with the general aspects of the GATT, GATS and WTO regimes, and observes the areas of satellite communications, launch services, remote sensing and satellite navigation under the optics of these legal instruments. The premise of these analyses is the fact that with the increasing commercialization and privatization of substantial sectors of space activities, the inherently international aspects of those activities start to touch upon issues of free trade and market access in the global arena. Von der Dunk observes that in the context of space communications, this has already given rise to their inclusion into the GATS regime underpinned by the WTO. In many cases the cross-border provision and consumption of satellite communication services is subject to free trade provisions under that regime. In other space sectors connected with sovereignty-related issues, the GATS/WTO regime has not been made to apply, even as seemingly similar issues arise as regards to a global level playing field. He concludes with the provision that if the commercialization and privatization of space activities would continue, inevitably the application of the trade regime also to these areas would require appropriate solutions.

Mark Sundahl concentrates on the legal aspects of financing space ventures. He mentions that the international and supranational character of space activities make the financing of space ventures a particularly complex area of law, and stresses that due to the nature of the new private actors in space, the finance structures will depend increasingly on the reliability of the lender's security

interest in the space asset that is being financed. As a result of this situation, the law of secured transaction would play an ever more significant role in financing of space activities. The chapter further analyzes the nature of finance transactions involving space assets stressing their unique nature, describing the operation of Article 9 of the US Uniform Commercial Code, and explaining the significance of the UNIDROIT Convention on International Interests in Mobile Equipment as well as the Space Assets Protocol. Concerning this legal instrument, the author gives voice both to its supporters and critics, concluding that because of the low signature number, the Protocol is unlikely to enter into force in the near future. In the meantime, space companies and their financiers would have to rely on existing methods of finance and take precautions to avoid inimical domestic laws and minimize the complexities of financing space ventures under a patchwork of local laws.

The chapter by Cecile Gaubert revolves around the issue of insurance for space activities. The study begins by introducing the concept of risk for outer space activities. Following that, it presents and defines the different types of insurance for space activities – the third party liability insurance and property damage insurance. As the author explains, the first type of insurance has been designed in such a way as to address third party liability of a launching agency or satellite operator whose launcher or satellite or part of it, is considered responsible for damages suffered by third parties during the space operation. The second type of insurance is a launch and in orbit insurance, mainly protecting the owner or the operator of the impacted satellite in case of loss or damage caused to the satellite during the launching process or the in orbit operation. According to her viewpoint, insurance has been traditionally subject to the law of contracts (contractual arrangements). However, due to the inherent international dimension of space activities, the commercialization and privatization of space activities as well as the tendency of states to provide binding parameters for insurance requirements concerning third party liabilities, has resulted in some cases for insurance to be a matter of international law (*de facto*) and national space legislation (*de jure*). Following that, she examines both types of insurance, property damage insurance and third party liability insurance under the angles of international space law as well as of selected national space law provisions from states such as

France, the Netherlands, and also the United States. She finally concludes by highlighting the fact that new space activities such as suborbital flights may affect in the future the standard insurance practices already developed for the field of space activities.

Catherina Doldirina analyzes intellectual property rights in the context of space activities. The starting point of her study is the thesis that intellectual property rights (IPRs) represent one of the most suitable and potentially effective mechanisms to protect the results of developing downstream application of space activities, particularly in the environment of privatization, commercialization and increased private investment in space activities. She reminds the reader of the fact that from the plethora of IPR tools, patents and copyright are the most applicable ones to the intellectual or intangible results of space activities. These evolved from a domestic or national form of protecting intellectual or intangible assets, with the principle of territoriality as the central characteristics of this legal regime, to a network of international treaties, which establish certain level of mutual recognition and acceptance of national protection. The chapter devotes specific attention to the interpretation of IP law connected with the activities of the International Space Station (Article 21 of the Intergovernmental Agreement). In order to avoid the absence of a properly harmonized international law approach to patent protection in general, the author suggests that Article VIII of the Outer Space Treaty can be used to extend jurisdiction regarding patent protection of states into outer space.

The chapter by Maureen Williams examines from a critical viewpoint the issue of dispute resolution within the field of space activities. The starting point of this chapter is the fact that currently and due to the intense privatization and commercialization of space activities, the existing dispute settlement mechanisms as provided by the existing UN Space Treaties, do not address the issue of dispute resolution for space activities in an efficient manner. Consequently, Williams advocates the view that the new Optional Rules for Arbitration of Disputes Relating to Outer Space Activities adopted recently by the Permanent Court of Arbitration (PCA) would be a possible alternative for the resolution of disputes relating to space activities. In particular, she reviews the existing dispute settlement mechanisms relevant for space activities (*de lege lata* analysis) examining the various dispute settlement procedures

as provided by the UN Space Treaties and UN Principles relating to space activities. She highlights the basic shortcoming of the existing legal instruments, namely the fact that the current dispute settlement mechanisms focus principally on disputes between traditional actors of public international law. She continues her analysis with the history PCA 2011 Optional Rules for Arbitration of Disputes Relating to Outer Space Activities, and highlights the flexibility of the new Rules, by underlining their broad material and personal scope of application. Finally, she, concludes with *de lege ferenda* perspectives for the issue of dispute resolution. Williams argues that the new PCA Rules would be a flexible alternative and an agile possibility of dispute resolution for space activities in the near future. In light of their broad scope of application, the Rules can be used by State and non-state actors. They do not conflict with the existing mechanisms arising from the existing UN space treaties but rather they complement and enhance the dispute settlement system as embodied within the existing UN space law.

### III. CONCLUSION

The first personal impressions from studying the Handbook of Space Law can be summarized as follows: The text brings a vast amount of information; it covers not only the traditional areas of space activities but brings analyses of practically all modern and prospective forms of the use of outer space. It deals not only with the areas covered by the UN space law, but extends to regional and bilateral agreements, and –usefully – also deals with several spheres only broadly connected with space activities.

The experienced authors worked with the most recent literature and legal instruments, including the *Proceedings of International Institute of Space Law* and relevant UN documents. The text is written in an understandable way, also allowing non-experts to work with it. Some small redundancies are fully explicable by the pedagogical need of a complex analysis in the framework of each chapter. It is important that the legal analyses clearly differentiate between the legal situation *de lege lata* and *de lege ferenda*. Also, the opinions of the authors are always visibly separated from the objective legal analysis. These conditions should be a matter-of-fact rule, but, astonishingly, are not always observed in other publications. All chapters are concluded with a view into the future.

It is highly recommended to study this comprehensive work edited by Frans von der Dunk and have it on the bookshelf as a reliable piece of information and a source of thought provoking ideas – congratulation! The Handbook of Space Law has been published by the Edward Elgar Publishing Limited and costs £205.

**PHILIP DE MAN, *EXCLUSIVE USE IN AN  
INCLUSIVE ENVIRONMENT: THE  
MEANING OF NON-APPROPRIATION  
PRINCIPLE FOR SPACE RESOURCE  
EXPLOITATION* (SPRINGER 2016)**

*Christian J. Robison\**

Philip de Man's recent publication, *Exclusive Use in an Inclusive Environment*, is yet another work that discusses one of the most debated questions in international space law – the use and exploitation of natural resources in outer space. With this work, de Man hopes to propose a workable interpretation of the non-appropriation principle of the Outer Space Treaty in order to accommodate both the existing international space law framework and the increased ability of both public and private actors to use natural resources found in outer space. In short, de Man's solution is not based on *property* but rather on *use*. That is, the author believes that a space actors can exclusively use an outer space resource while also preserving the benefits of such a resource for the international community, thus allowing the international space-faring community to simultaneously preserve both the principles of free exploration and use and non-appropriation.

de Man's argument begins with discussing the traditional interpretations of the Outer Space Treaty regime. Essentially, he analyzes many of the traditional forms of interpreting the Treaty such as the use of Earth-bound analogies (i.e. the law of the sea) and early Roman notions of property. But in doing so, the author dismisses many of these methods of interpretation as either outdated or unworkable. But de Man does not simply stop at dismissing many of the foundational arguments of noted space law scholars. Rather, de Man proposes looking to more non-conventional methods of interpreting the provisions of the Outer Space Treaty.

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In laying this particular foundation, de Man surprisingly asks the reader to consider consulting rather controversial agreements, namely the Moon Agreement of 1979, and reevaluating the arguments of space law scholars who have based their interpretation of the non-appropriation principle strictly upon the notion of property rights and sovereignty. Though the author's proposal may seem rather controversial, his foundational argument does rely upon a vast array of accepted scholarship. In sum, de Man's initial arguments not only provide foundation for his main assertion, but simultaneously provides practical solutions in addressing the non-appropriation principle. Specifically, the author implores the reader and future scholars to no longer attempt to distinguish between different types of outer space resources. According to the author, not only are we allowed to rid ourselves of the distinctions that have caused much confusion around the non-appropriation principle, but we are able to provide a simple, uniform interpretation and application of such a mandate.

After de Man concludes his preliminary arguments, he directly begins to extensively evaluate the workability of the International Telecommunication Union ("ITU") regime, considering that the regime has long been in place in regulating the use, and preventing the appropriation of, orbital positions - a valuable outer space resource. In recounting the structure of the ITU, de Man concludes that the ITU regime is not the exact regime that should be followed for the use of other outer space resources, but that its basic foundations of *use* provide the foundational premise for the use and exploitation of *all* outer space resources.

After such a conclusion, the author ultimately proposes a regime that is based upon exclusive use and dismisses notions of property in outer space altogether. His proposal affords States and private actors alike the ability to exclusively use an outer space resource, *as long* as they are in continued use of that resource and do not preclude use of that resource after exclusive use has terminated. Basically, de Man's *lex specialis* approach creates a non-compromising interplay between Articles I, II, and IX that prevents harmful interference with use of an outer space resource, but does not take away from an entity's right to freely use and explore outer space. Ultimately, de Man's approach is an all-encompassing one

that does not attempt to abrogate or make exceptions to the provisions of the Outer Space Treaty.

All things considered, the author's main assertion is well-crafted and again, supported by ample scholarship. But as stated, de Man rejects key notions of foundational scholarship that has been instrumental in the interpretation of the Outer Space Treaty. For prime example, the author is steadfast in his argument that the legal aspects associated with property or other Earth-bound analogies should be avoided when discussing the non-appropriation principle. However, legal concepts associated with the traditional property axiom "bundle of sticks" or the principles that form the basis of *res communis* are indeed quite helpful to envision the application of the non-appropriation principle to different types of outer space resources, particularly natural resources that could be extracted from a celestial body. Even de Man concedes that his theory of exclusive use is somewhat difficult to apply when it comes to resources on celestial bodies that may be consumed or sold for profit.

But despite the author's various rejections or concessions, *Exclusive Use in an Inclusive Environment* presents a different mode of thinking about natural resources in relation to the Outer Space Treaty regime. de Man's central focus upon use has already found a place in the dynamic of the ITU and is quite workable when it comes to exploring or constructing installations on various celestial bodies. All in all, Philip de Man's work is a credible piece of scholarship that will prove to be useful in the future construction of an effective legal system for the exploitation of natural resources in outer space.

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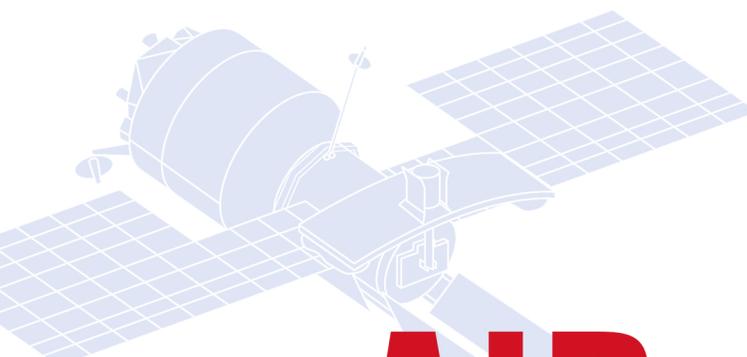
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