PROVIDING CLARITY FOR FAULT-BASED LIABILITY IN INTERNATIONAL SPACE LAW: A PRACTICAL APPROACH THROUGH PRINCIPLES OF GENERAL INTERNATIONAL LAW

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I. INTRODUCTION

The number of satellites in orbit has grown vastly in the last decade, and indications suggest that space use and space traffic will continue to grow. Non-governmental entities, such as SpaceX, are deploying mega-constellations that increase the amount of space objects from private actors in space.[1] SpaceX alone has launched 1,443 satellites for its Starlink constellation, and the constellation could increase to 42,000 spacecraft based on current projections.[2] More mega-constellations are planned from other non-government entities, which will significantly increase space traffic and congest

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[1] Bill Beyer & Nicholas Nelson, *Viewpoint: Space Congestion Threatens to 'Darken Skies'*, NAT'L DEF. INDUS. ASS'N (Jun. 28, 2018), https://www.nationaldefensemagazine.org/articles/2018/6/28/viewpoint-space-congestion-threatens-to-darken-skies.

[2] Darrell Etherington, *SpaceX launches 60 more Starlink satellites, now at 300 launched in just over one month,* TECHCRUNCH, https://techcrunch.com/2021/04/07/spacex-launches-60-more-starlink-satellites-now-at-300-launched-in-just-over-one-month/ (last visited Nov. 11, 2021).

sought after orbits.[3] Additionally, the availability of smaller satellites and decreasing launch costs is opening further access to space use.

Increasing space traffic and objects naturally increases the risk for collisions. "In September 2019, the European Space Agency (ESA) performed evasive maneuvers with one of its satellites in order to avoid a collision" with a cluster of small satellites operated by SpaceX.[4] ESA's satellite was equipped with an anti-collision device, but the device was not activated.[5] Fortunately, adequate supervision and control allowed ESA to fire the satellite's thrusters, increase its altitude and avoid a collision. [6] This instance of successfully performing an emergency maneuver to avoid a collision with active satellites was a first for ESA, but it will not be the last.[7] ESA noted that the maneuver was a time-consuming operation that will not be possible as additional manmade objects enter space.[8]

The international community has considered responsibility for space activity since nearly the beginning of the space age. In 1963, the United Nations' Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space included provisions about both State responsibility and liability.[9] The Declaration noted that a State is internationally responsible for national activities in outer space carried on by the State's government or non-government entities.[10] Additionally, the Declaration noted that "each State which launches or procures the launching of a [space] object", or from whose "territory or facility a [space] object

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[3] *See* Sorge, Marlon, *Space Traffic Management: The Challenge of Large Constellations, Orbital Debris, and the Rapid Changes in Space Operations 187-200* (Sept. 2020), https://aerospace.org/sites/default/files/2021-05/Aerospace_CompilationBk_20210401_Web.pdf.

[4] Corinne Baudoin et al., *The Space Legal Issues with Mega-Constellations*, SPACE LEGAL ISSUES (Nov. 3, 2020) https://www.spacelegalissues.com/mega-constellations-a-gordian-knot/.

[5] *Id.*

[6] *ESA satellite forced into 'first ever' emergency maneuver to avoid crash with SpaceX constellation,* RT, Sept. 3, 2019, https://www.rt.com/news/467848-esa-satellite-collision-spacex-maneuver/.

[7] *Id.*

[8] *Id.*

[9] Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, UNGA Res. 1962 (XVIII) (Dec. 13, 1963), ¶¶ 5, 8 [hereinafter Declaration].

[10] *Id.* ¶5.

is launched," would be internationally liable for damage caused by such objects.[11] How such liability would be established was left unexplained. The Declaration also identified international responsibilities for States, including authorizing and providing continuing supervision of non-governmental activities in outer space by "the State concerned."[12] Numerous important words and phrases were left undefined.

In 1967, 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) provided the basis for international space law.[13] Principles regarding State responsibility, liability and the obligations to authorize and provide continuing supervision from the 1963 Declaration were incorporated into the treaty with only minor changes in wording.[14] Although the Outer Space Treaty expanded on the Declaration, key terms were again left undefined. A standard to assign liability was also not provided.

A *lex specialis* governing liability, the Convention on International Liability for Damage Caused by Space Objects (Liability Convention), came in 1972.[15] The Liability Convention provided a regime of absolute liability for damage caused by space objects on the surface of the Earth and to aircraft in flight.[16] For damage caused by space objects to another State's space objects, or persons or property on such space objects, the Liability Convention established a fault-based liability regime.[17] However, what exactly constitutes fault was left unclear and questions still loom around this issue today.

As the likelihood of damage from increased space activity rises, States and non-governmental entities alike should have a better understanding of fault-based standards as they relate to

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[11] *Id.* ¶8.

[12] *Id.* ¶5.

[13] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

[14] *Compare Id.* at art. VI., *with* Declaration, *supra* note 9, at 5.

[15] Convention on the International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.D.T. 2389, 961 U.N.T.S 187 [hereinafter Liability Convention].

[16] *Id.* at art. I.

[17] *Id.* at art. III.

liability for space activity. In the *Rainbow Warrior* arbitration, the Tribunal noted a fundamental principle of international law concerning State responsibility, stating "any violation by a State of any obligation, of whatever origin, gives rise to State responsibility and consequently, to the duty of reparation."[18] This article draws upon fundamental principles of international law to demonstrate how failing to meet international obligations, such as the fundamental duties of authorizing and supervising non-governmental entities' space activity, when a State knows or should know that the obligation has been triggered, constitutes an internationally wrongful act, and thereby establishes fault of the responsible State.

This article focuses on fault-based liability for damages elsewhere than on the surface of the Earth or to aircraft in flight. The article begins by discussing three avenues of recovery for damage caused by space related activities and highlights relevant considerations for where fault is a factor in determining liability. Section III discusses the international responsibilities that accompany authorizing and providing continuing supervision for non-governmental entities' space activities and who the "appropriate State" for such responsibilities may be. Next, Section IV discusses artificial intelligence (AI) and autonomous capabilities as these technologies relate to State obligations for authorizing and supervising space activity. Finally, Section V applies principles of international law to demonstrate that failing to authorize or supervise requisite space activities constitutes a wrongful act in breach of an international obligation, and that such conduct renders the responsible State at fault for purposes of establishing fault-based liability for relevant damage.

II. LIABILITY FOR DAMAGE CAUSED BY SPACE OBJECTS: THREE AVENUES FOR RECOVERY

There are at least three theories, excluding a resort to domestic legal systems, under which a State whose natural or juridical persons suffer damage from another State's space object could obtain compensation. Although this article focuses on fault-based liability, which is only explicitly part of the Liability Convention, each

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[18] France v. New Zealand, 82 I.L.R. 500, ¶75 (France-New Zealand Arb. Trib. 1990), http://legal.un.org/riaa/cases/vol_XX/215-284.pdf, [hereinafter, Rainbow Warrior].

of the theories for recovery are briefly discussed both for context and because fault-based liability may apply to other avenues for recovery. Notably, while responsibility and liability in international space law overlap, the two are not attributed based on the same criteria.[19] States are responsible for their national activities in outer space, but liability is imposed through Article VII of the Outer Space Treaty and the Liability Convention on launching States.[20] Further, the type of damage suffered, what is damaged and where the damage occurs demand different requirements for proof—a wrongful act may be required in some circumstances while in other contexts causing damage alone triggers liability.

A. State Responsibility Theory

A victim State could seek to recover for damages caused by another State's space activities through the concept of State responsibility. Perhaps the least mentioned or contemplated method, as Franz van der Dunk states, is "there is no principled reason why the more general concept of State responsibility could not be used also for obtaining compensation for damage in cases where the liability concept may not offer a particular relief."[21] Through the State responsibility theory, a harmed State could seek compensation from another State that was responsible for damage by failing to meet responsibilities specified in Article VI of the Outer Space Treaty. The responsible State would not need to meet the technical requirements of Article VII of the Outer Space Treaty or the Liability Convention.[22] Such technical requirements include a responsible State not meeting the definition of a launching State, or damage that is beyond the scope of the Liability Convention's definition.[23]

In general international law, States are responsible for internationally wrongful acts or omissions attributable to the State.[24] An

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[19] Frans von der Dunk, *International Space Law, in* HANDBOOK OF SPACE LAW 29, 52 (Frans von der Dunk & Fabio Tronchetti eds., 2015).

[20] Outer Space Treaty, *supra* note 13, arts. VI -VII; Liability Convention, *supra* note 15, art. II.

[21] *See* Von der Dunk, *supra* note 19, at 51-2.

[22] *Id* at 52.

[23] Liability Convention, *supra* note 15, art. I.

[24] Int'l Law Comm'n, Draft Articles on the Responsibility of States for Internationally Wrongful Acts, with commentaries, arts. 1-2 [hereinafter ILC Draft Articles], in Int'l Law Comm'n, Rep. on the Work of Its Fifty-Third Session, U.N. Doc. A/56/10, at 26

internationally wrongful act must constitute breach of the State's international obligation and the act or omission must be attributable to the State.[25] "The general rule is that the only conduct attributed to the State at the international level is that of its organs of government, or of others who have acted under the direction, instigation or control of those organs, i.e., as agents of the State."[26] An international obligation is breached when an act of the State fails to conform with what is required of the State by the obligation, "regardless of its origin or character."[27] Obligations may arise from a treaty, a rule of customary international law "or by a general principle applicable within the international legal order."[28]

The Outer Space Treaty's Article VI contains two fundamental international obligations. These obligations are for States to authorize and provide "continuing supervision" of the space activities of their non-governmental entities.[29] The obligations apply to State parties to the treaty, and the obligations may also apply to States who are not parties as a matter of customary international law.[30] Article VI of the Outer Space Treaty reverses the general rule that States usually are not responsible for actions of their private citizens not acting under the direction or control of States. According to Article VI, State parties "bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities."[31] What exactly

(2001). The full text and commentaries of the ILC's Draft Articles are also found in JAMES CRAWFORD, THE INTERNATIONAL LAW COMMISSION'S ARTICLES ON STATE RESPONSIBILITY: INTRODUCTION, TEXT, AND COMMENTARIES (Cambridge University Press 2002) [hereinafter CRAWFORD, ILC ARTICLES].

[25] ILC Draft Articles, *supra* note 24, art. 2.

[26] CRAWFORD, ILC ARTICLES, *supra* note 24, at 91. *See also* JAMES CRAWFORD, IX BROWNLIE'S PRINCIPLES OF PUBLIC INTERNATIONAL LAW 524-551 (9th ed. 2019) [hereinafter CRAWFORD, BROWNLIE'S PRINCIPLES].

[27] ILC Draft Articles, *supra* note 24, art. 12.

[28] CRAWFORD, ILC ARTICLES, *supra* note 24, at 126. *See also* North Sea Continental Shelf (Den. v. Neth.), Judgment, 1969 I.C.J. 3, 38-39, ¶63 (Feb. 20); Military and Paramilitary Activities in and against Nicaragua (Nicar. v. U.S.), Judgment, 1986 I.C.J. Rep. 14, 94-95, ¶177 (June 27) (noting that identical international treaty laws and customary international laws may exist); International Fisheries Co. (U.S. v. Mexico) (1931), 4 R.I.A.A. 691, 701 ("some principle of international law"); Armstrong Cork Co. Case (U.S. v. Italy) (1953) 14 R.I.A.A. 159, 163 ("any rule whatsoever of international law").

[29] Outer Space Treaty, *supra* note 13, art. VI.

[30] *See infra* notes 90-91 and accompanying text.

[31] Outer Space Treaty, *supra* note 13, art. VI.

constitutes "national activities" is unclear—it is an example of an ambiguous term in the Outer Space Treaty.[32] However, Article VI of the Outer Space Treaty does make clear that States bear responsibility in outer space for actions of their private actors, thus the space activities of non-governmental entities are attributable to the State.[33] Further, after the English version of the Outer Space Treaty notes *responsibility* for national activities in Article VI, it then specifies in Article VII that a State is *liable* for damage caused by space objects when the State is a launching State of the space object.[34]

The nuance of this first theory of liability relates to the difference in terms used for accountability—"responsibility" and "liability."[35] Unlike the English version of the Outer Space Treaty, the same generic phrase was used for both terms in the Russian, Spanish and French versions, which are equally authentic.[36] In international law, "responsibility" means answerability, "authorship of an act or omission."[37] Liability is a subset of responsibility.[38] If a legal rule is breached and the result is damage to another, a legal obligation (legal responsibility) attaches to the breaching party to restore the victim, ordinarily to the extent possible through reparations, to the position the victim would have likely been in if the breach had not occurred.[39] The term "liability" is "merely one aspect of responsibility and a consequence of responsibility in case the person responsible breaches an obligation that is incumbent upon it and, in doing so, causes damage to another."[40]

A mere accident would not likely suffice for liability in the State responsibility theory. Absolute liability is the exception, not the rule, in international law.[41] However, an argument can be made

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[32] BIN CHENG, STUDIES IN INTERNATIONAL SPACE LAW 487 (1997) [hereinafter CHENG, INTERNATIONAL SPACE LAW]

[33] Outer Space Treaty, *supra* note 13, art. VI.

[34] Outer Space Treaty, *supra* note 13, arts. VI, VII.

[35] See Von Der Dunk, *supra* note 19, at 50-53, for a discussion of liability and responsibility.

[36] *Id.* at 51; Outer Space Treaty, *supra* note 13, art. XVII.

[37] CHENG, INTERNATIONAL SPACE LAW, *supra* note 32, at 603.

[38] *Id.* at 604.

[39] *Id.* at 603 (citing The Factory at Chorzów (Ger. v. Pol.), Judgment, 1928 P.C.I.J. (ser. A) No. 17, at ¶268.).

[40] *Id.* at 604.

[41] Von Der Dunk, *supra* note 19, at 89.

that space activities are ultra-hazardous activities for which absolute liability is appropriate under certain circumstances.[42] More likely, the standard—absolute liability or some degree of fault—would depend upon where the damage occurred and what was damaged. If the damage occurred on the surface of the Earth or to aircraft in flight, the standard may likely be absolute liability, while damage between space objects or damage occurring in space would probably be fault-based.[43] The probable standard for damage on the surface of the Earth and to aircraft in flight reflects the principle that an actor creating circumstances with "the possibility of acute and catastrophic danger is liable without proof of fault to pay compensation if that danger eventuates."[44] Similarly, the probable standard requiring some degree of fault, but not absolute liability, for damages occurring among space objects or elsewhere than on the Earth's surface or to aircraft in flight reflects "sharing these risks among those engaged in space activities."[45]

A harmed State may attempt to recover through a State responsibility theory because it offers advantages over other theories of liability in certain circumstances. One such advantage includes not having a limited scope of compensable damages.[46] For example, the harmed State may incur damage "by electronic interference and indirect, consequential and loss-of-revenue types of damage," that is likely excluded in the Liability Convention.[47] Another practical reason this theory would be pursued is in the case of a private actor from a non-launching State purchasing or otherwise acquiring a space object, such as a satellite, from a launching State and taking over all operation and control of the satellite. If the satellite subsequently causes damage to the harmed State, the harmed State may wish to pursue a claim against the acquirer's State, arguing that the acquirer's State is a responsible State under Article VI of the Outer Space Treaty for its non-governmental entity's activities in

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[42] *Id.* at 88-89.

[43] *Id.* at 87-89; CHENG, INTERNATIONAL SPACE LAW, *supra* note 32, at 291; Liability Convention, *supra* note 15, arts. II-III; FRANCIS LYALL & PAUL B. LARSEN, SPACE LAW: A TREATISE 99-100 (2016).

[44] LYALL & LARSEN, *supra* note 43, at 99.

[45] *Id.* at 100.

[46] Von Der Dunk, *supra* note 19, at 53. *See* Liability Convention, *supra* note 15, art. I(a).

[47] Von Der Dunk, *supra* note 19, at 53.

outer space.[48] Although the launching State remains liable for damage caused by the satellite pursuant to both the Outer Space Treaty and Liability Convention, the harmed State could seek to recover from the responsible State that does not meet the Outer Space Treaty and Liability Convention requirement that a liable party must be a launching State.[49] The responsible State theory may be a more attractive option if the "responsible State" has deep pockets and the launching State does not.

B. Liability Pursuant to Article VII of the Outer Space Treaty

The second method of recovery comes from the Outer Space Treaty. In 1967, the Outer Space Treaty memorialized the foundation for space related liability in Articles VI and VII. These articles mostly incorporated principles five and eight of the United Nations 1963 Declaration on Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space.[50] Article VI renders a State responsible for the national activities in outer space, including the Moon and other celestial bodies, of its government entities, non-government entities and international organizations in which the State participates.[51] Article VI also places the responsibility on States to authorize and provide continuing supervision for space activities of their non-government entities.[52] According to Article VII,

> 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.[53]

Neither Article VII nor the rest of the Outer Space Treaty define "damages," thus the scope of damages that Article VII applies

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[48] Outer Space Treaty, *supra* note 13, art. VI.
[49] *Id.* at art. VII.
[50] CHENG, INTERNATIONAL SPACE LAW, *supra* note 32, 289-291.
[51] Outer Space Treaty, *supra* note 13, art VI.
[52] *Id.*
[53] *Id.* at art. VII.

to is broader than damages contemplated in the Liability Convention with its specified definition of damages.[54]

Although the Outer Space Treaty established the general principle that a State is liable for the damage caused by its space objects or the objects' component parts, the Outer Space Treaty left many questions about what the standard for liability is.[55] Is absolute liability the standard, or is the standard merely some degree of fault? Does the standard differ for damage caused in outer space, in air space, or on the surface of the Earth? It is unclear whether Article VII applies to objects that fail to reach outer space and how liability is to be shared when more than one launching State may be liable for damage caused.[56]

Bin Cheng noted that under the Outer Space Treaty, liability "is sometimes assumed to be absolute and not based on fault," but he points out that "the article itself refrains from saying so."[57] The assumption of absolute liability is based on customary international law applying absolute liability for "damage caused by space objects to third parties on the surface of the earth and celestial bodies, and to their aircraft in flight."[58] Additionally, the assumption of absolute liability as it relates to damage on the surface of the Earth aligns with the 1952 Rome Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface.[59] However, Cheng notes that it is questionable whether the assumption of absolute liability also applies to collisions between space objects, regardless of where the collision occurs.[60] Despite the assumptions, doubt remains "whether the article implies fault or no-fault liability."[61] The Liability Convention's distinction between absolute and fault-based liability depending on where damage is caused, and the general international consensus when establishing the related Articles in the

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[54] *See infra* note 65 and accompanying text.

[55] Outer Space Treaty, *supra* note 13, art. VII.

[56] *See* CHENG, INTERNATIONAL SPACE LAW, *supra* note 32, at 291.

[57] *Id.*

[58] *Id.*

[59] Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, Oct. 7, 1952, 310 U.N.T.S. 181-182 [hereinafter Rome Convention]. *See also* LYALL & LARSEN, *supra* note 43, at 99 n.128 (discussing limited areas in international law where absolute liability is applied).

[60] CHENG, INTERNATIONAL SPACE LAW, *supra* note 32, at 291.

[61] *Id.* at 613.

Liability Convention,[62] further supports that fault-based liability may be the applicable standard under Article VII for damage not caused on the Earth's surface or to aircraft in flight.

C. The Liability Convention

In 1972, the Liability Convention expanded on foundations for liability existing in international law on the basis of the *Trail Smelter Arbitration* (1938, 1941),[63] the *Corfu Channel Case* (1949),[64] and the Outer Space Treaty. The Liability Convention defined "damage," and "space object," and it clarified that a launch includes an attempted launch.[65] Notably, damages contemplated by the Liability Convention include "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."[66] Similar to the Outer Space Treaty, a space object "includes the component parts of a space object as well as its launch vehicle and parts thereof."[67] "Launching State" is defined consistently with the Outer Space Treaty and other space related treaties. States are considered a launching State through one of four ways:

> i) The State that launches the space object, its component parts, its launch vehicle or parts thereof;
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> ii) The State that procures the launch of a space object, its component parts, its launch vehicle or parts thereof;
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> iii) The State from whose territory a space object, its component parts, its launch vehicle or parts thereof is launched;

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[62] *See infra* notes 72, 82 and accompanying text.

[63] Trail Smelter Arbitration (U.S. v. Can.), 3 R.I.A.A. 1905, 1963 (Apr. 16, 1938, Mar. 11, 1941) (addressing the obligation to prevent transborder damage by air pollution, the Tribunal stated, "A State owes at all times a duty to protect other States against injurious acts by individuals from within its jurisdiction.").

[64] Corfu Channel Case (U.K. v. Alb.) 1949 I.C.J. 4 (Apr. 9) (referencing a "State's obligation not to allow knowingly its territory to be used for acts contrary to the rights of other States").

[65] Liability Convention, *supra* note 15, art. I.

[66] *Id.* at art. I(a).

[67] *Id.* at art. I(d).

iv) The State from whose facility a space object, its component parts, its launch vehicle or parts thereof is launched.[68]

Since the Liability Convention is more recent in time than the Outer Space Treaty and specific to the issue of liability, it is the applicable treaty to determine liability claims for incidents where a potentially liable State and a State suffering compensable damages are both parties to the Liability Convention.[69] While the *pacta tertiis* principle prevents a State that is not party to the Liability Convention from invoking the treaty or having the Liability Convention applied to itself, the principles of the Liability Convention may apply if proved to be rules of customary international law.[70] Despite the Liability Convention providing additional clarity, there are still important, unanswered questions related to liability for space related activities.

1. Damage on the Surface of the Earth or to Aircraft in Flight – Absolute Liability

The Liability Convention imposes absolute liability for damage caused by space objects on the surface of the Earth or to aircraft in flight, providing a clear legal standard not based on fault.[71] The Legal Sub-Committee of the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) did not encounter significant opposition to agreement in principle on Article II of the Liability Convention.[72] The lack of opposition likely reflects that the standard already had international support, as reflected by the 1952 Rome Convention on Damage Caused by Foreign Aircraft to

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[68] *Id.* at art. I(c).

[69] Vienna Convention on the Law of Treaties, art. 30, May 23, 1969, 1155 U.N.T.S. 331 [hereinafter Vienna Convention] (stating the general rule that later treaties take precedence except when in conflict with the United Nations Charter. Although the US is not party to the Vienna Convention, the US Dept. of State has stated that the US believes many of the rules as stated in the Vienna Convention reflect customary international law on the law of treaties.

[70] CHENG, INTERNATIONAL SPACE LAW, *supra* note 32, at 306.

[71] Liability Convention, *supra* note 15, art. II.

[72] CHENG, INTERNATIONAL SPACE LAW, *supra* note 32, at 326; Comm. On the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. On Its Sixth Session, U.N. Doc. A/AC. 105/37, ¶17 (1967).

Third Parties on the Surface[73] and the notion of the "ultrahazardous nature of space activity, as well as the fact that a space object poses nonreciprocal risks to those on the surface of the Earth."[74] The Liability Convention provides for a launching State's "exoneration from absolute liability" to the extent the claimant State suffers damages as a result of its own or its natural or juridical persons' gross negligence or act or omission done with intent to cause damage.[75]

2. Damage Caused Elsewhere Than on the Earth's Surface – Fault Based Liability

Article III of the Liability Convention provides a fault-based liability standard for damage caused by a space object to another State's space object, or to the persons or property on board another launching State's space object "elsewhere than on the surface of the earth…."[76] A State will be at fault if damage is "due to its fault or the fault of persons for whom it is responsible."[77] Notably, Article III of the Liability Convention applies fault based liability in both airspace and outer space when damage is caused by a launching State's space object to another launching State's space object, or to persons or property on board the other State's space object.[78] Also recall that, pursuant to Article VI of the Outer Space Treaty, States are responsible for the space activities of not only their government entities, but their non-government entities and international organizations in which they participate.[79] Additionally, the appropriate State is responsible to authorize and provide continuing supervision for the space activities of non-government entities, although

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[73] *See* Rome Convention, *supra* note 59, at 181-182; *see also* LYALL & LARSEN, *supra* note 43, at 99 n. 128 (discussing limited areas in international law where absolute liability is applied).

[74] Paul S. Dempsey, *Liability for Damage Caused by Space Objects Under International and National Law*, 8 (2011) (unpublished comment) (on file with McGill University).

[75] Liability Convention, *supra* note 15, art. VI.

[76] *Id.* at art. III.

[77] *Id.*

[78] *Id.*

[79] Outer Space Treaty, *supra* note 13, art.VI.

ambiguity exists regarding the term "appropriate State."[80] The Liability Convention fails to elaborate further on elements needed to prove liability, especially as to what constitutes fault.[81]

Similar to Article II, agreement in principle on Article III in the Liability Convention did not encounter significant difficulty.[82] The reasoning for the lack of opposition, and more broadly for fault-based liability when damage by space objects is caused elsewhere than on the surface of the Earth, is represented by rationale from Judge Manfred Lachs. Judge Lachs reasoned that the underlying premise for fault-based liability "is obviously that once space objects (including any that may suffer damage) have left the ground all launching States may be presumed to have taken similar risks. Thus none is favoured by the law."[83] The rationale that States engaging in space activity should be liable for damages to each other in a fault-based regime, and absolutely liable to States not engaged in space activities and suffering damage on the Earth's surface or to their aircraft in flight, is also informative and reasonable for liability considerations under a State responsibility theory or Article VII Outer Space Treaty theory.

Finally, Article III of the Liability Convention has two potential meanings.[84] First, it may mean that "a launching State is liable only to the extent of its fault."[85] Alternatively, it could mean "a State becomes liable for the totality of the damage as soon as it has been established that there is fault on its part, and there is a causal connection between this fault and the damage."[86] In either case, some degree of fault must be proven, but what could constitute such fault is unclear. Regardless of which meaning is correct, fault must

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[80] *Id.*; CHENG, INTERNATIONAL SPACE LAW, *supra* note 32, at 659 (stating clarity is needed to determine who is the appropriate state to authorize and provide continuing supervision).

[81] Dempsey, *supra* note 74, at 8.

[82] CHENG, INTERNATIONAL SPACE LAW, *supra* note 32, at 326. *See* Comm. on the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its Seventh Session, U.N. Doc. A/AC.105/45 ¶10 (1968); Comm. on the Peaceful Uses of Outer Space, Summary Record of the Ninetieth to the Hundred and First Meetings, U.N. Docs. A/AC.105/C.2/SR.91, 92 and 94 (1968).

[83] MANFRED LACHS, THE LAW OF OUTERSPACE: AN EXPERIENCE IN CONTEMPORARY LAW-MAKING, 117 (1972).

[84] CHENG, INTERNATIONAL SPACE LAW, *supra* note 32, at 328.

[85] *Id.*

[86] *Id.*

be proven. Unfortunately, "'[f]ault' as such, however, has not been defined" or what could constitute fault for purposes of establishing liability.[87]

3. Joint and Several Liability and Apportionment

The Liability Convention contemplates more than one State being liable for damages caused by space activities. Article IV of the Liability Convention allows a claimant State to hold a launching State or States jointly or severally liable for damages.[88] Such liability remains absolute for damage caused on the surface of the Earth or to aircraft in flight.[89] For damage caused not on the Earth's surface to a space object of the claimant State or to persons or property on board that space object, liability is based on the fault of either the launching States or the fault of the persons for whom a launching State is responsible.[90] The burden of compensation for damage is apportioned between launching States "in accordance with the extent to which they were at fault,"[91] but if that extent cannot be ascertained, "the burden of compensation shall be apportioned equally between them."[92] Again, "fault," or what constitutes it, is not defined.

Regardless of the avenue that a harmed State pursues to recover for damage suffered by it or its natural or juridical persons, if the damage occurs elsewhere than the surface of the Earth or to aircraft in flight, fault-based liability will likely be applied, and a wrongful act will need to be proven for liability to attach to the responsible State or States.

III. RESPONSIBILITIES FOR SPACE RELATED ACTIVITIES

A general principle of international law is that breach of an international obligation entails the responsibility of the State in breach.[93] Such responsibility often concerns reparations for damages caused by the unlawful act or omission in breach of an

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[87] Von Der Dunk, *supra* note 19, at 88.
[88] Liability Convention, *supra* note 15, art. IV.
[89] *Id.* at art. IV 1(a).
[90] *Id.* at art. IV 1(b).
[91] *Id.* at art. IV 2.
[92] *Id.* at art. IV 2.
[93] CRAWFORD, BROWNLIE'S PRINCIPLES, *supra* note 26, at 524.

obligation.[94] While entirely lawful acts related to space activities can still be the basis for liability,[95] as is the case with absolute liability for damage caused by a space object on the surface of the Earth or to aircraft in flight, damage caused elsewhere by space objects entails fault-based liability.[96] Even where an activity is lawful and fault-based liability is applicable, States may incur responsibility for "damage caused by poor judgment or poor management in carrying out the [lawful] activity," let alone a State's responsibilities.[97] For example, a lack of due diligence regarding a State's lawful space activities, or fulfilling its responsibilities, could result in liability.[98]

This section will focus on State obligations for space activities as specified in Article VI of the Outer Space Treaty. The Outer Space Treaty lacks clarity related to the scope and requirements for authorization and continuing supervision. Additionally, it is unclear within the Outer Space Treaty who the appropriate State responsible for authorizing and supervising required space activities is, or whether there can be more than one appropriate State. Clarity is not provided in the current space treaties.

A. Responsibilities

Article VI of the Outer Space Treaty not only "removes all doubts concerning imputability" for activities carried out in outer space by non-governmental entities,[99] and it obligates States to ensure space activities of their non-governmental entities are authorized and supervised.[100] Specifically, "the appropriate State" is required to authorize and provide continuing supervision of all activities of non-governmental entities in outer space.[101]

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[94] *Id.*

[95] *Id.*

[96] Liability Convention, *supra* note 15, arts. II-III. *See* discussion *supra* Section II.C.2.

[97] CRAWFORD, BROWNLIE'S PRINCIPLES, *supra* note 26, at 544.

[98] *Id.*

[99] LACHS, *supra* note 83, at 114.

[100] *Id.*

[101] Outer Space Treaty, *supra* note 13, art. VI.

B. Authorization

Article VI of the Outer Space Treaty obligates States to authorize non-governmental entities' space activities, but the depth of the obligation and how it should be conducted was not specified.[102] Though the Outer Space Treaty applies only to its numerous State parties, several of its obligations may apply to all States because the obligations have crystallized into rules of customary international law.[103] According to some scholars, State responsibility for national activities and the activities of its nationals in outer space, along with the accompanying obligation to authorize such activities of its nationals in outer space as reflected in Article VI of the Outer Space Treaty, are customary international law.[104] Thus, regardless of whether a State is a party to the Outer Space Treaty, it likely has an international obligation to authorize the space activities of its nationals.

The responsibility of States for the activities of its non-governmental entities reflects a compromise between the Soviet Union and the United States. The Soviet Union wanted to forbid private activities in outer space, while the United States wanted to allow for such possibilities.[105] The two States agreed to allow private activities in outer space but place ultimate responsibility for the private space activities on the States.[106] Notably, State responsibility in this context differs from its meaning in general international law where it refers to attribution.[107] State responsibility for non-government entities in the context of Outer Space Treaty Article VI duties

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[102] *Id.*

[103] ROUTLEDGE HANDBOOK OF SPACE LAW, 8 (Ram S. Jakhu & Paul Stephen Dempsey eds., 2017)("There is general agreement that many of these principles contained in the Outer Space Treaty are also customary in nature, since they hail from the 1963 U.N. Declaration of Legal Principles Governing Activities of States in the Exploration and Use of Outer Space.").

[104] LYALL & LARSEN, *supra* note 43, at 64; Ram S Jakhu & Steven Freeland, *The Relationship Between the Outer Space Treaty and Customary International Law*, 59th I.I.S.L. Colloquium on the Law of Outer Space (2016) (stating "it appears that the prerequisite tests of consistent state practice and opinio juris have been met, and the terms of article VI have become a part of customary international space law applicable to all states.").

[105] Irmgard Marboe, *National Space Law, in* HANDBOOK OF SPACE LAW 127, *supra* note 19, at 131.

[106] *Id.*

[107] *Id.*

refers to a State's international obligations—duties to ensure space activities by non-government entities comply with Outer Space Treaty obligations.[108] Although it does not mandate States to ensure compliance through enacting national legislation, "Article VI of the Outer Space Treaty represents the most important legal basis for national space legislation."[109]

A State's obligation to authorize or refuse to authorize space activities affords the State an opportunity to ensure specific conditions are met and evaluate risk.[110] The authorization process also provides an opportunity to minimize the risk for damage[111] and for adequate consideration of relevant factors for new and emerging technology prior to engaging in space activities. Relevant considerations should include "safety, public order, protection of the environment, international obligations and policy interests of the respective states,"[112] as well as adequate insurance.[113]

The Legal Sub-Committee of the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) established a working group on the topic of national legislation relevant for the peaceful exploration and use of outer space.[114] This group determined that its final report should provide a basis for recommendations on national space legislation.[115] Consensus on the recommendations was reached, and the recommendations included eight elements for States to consider when enacting national space legislation.[116] Included in the elements is "the authorities and procedures"

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[108] *Id.* at 132.

[109] *Id.*

[110] *Id.* at 185.

[111] *Id.* at 138.

[112] *Id.* at 185.

[113] *Id.*

[114] Comm. On the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its Forty-Sixth Session, U.N. Doc. A/AC./105/891, ¶136 (2007), https://www.unoosa.org/pdf/reports/ac105/AC105_891E.pdf .

[115] Comm. On the Peaceful Uses of Outer Space, Rep. of the Working Group on National Legislation Relevant to the Peaceful Exploration and Use of Outer Space on the Work Conducted Under Its Multi-year Workplan, UN Doc. A/AC.105/C.2/101, ¶6 (2012), https://www.unoosa.org/pdf/reports/ac105/C2/AC105_C2_101E.pdf [hereinafter Workplan].

[116] Comm. On the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its Fifty-First Session, UN Doc. A/AC.105/1003, Annex III (2012), https://www.unoosa.org/pdf/reports/ac105/AC105_1003E.pdf.

and "conditions for authorization."[117] The national legislation of numerous States, including major spacefaring States like the United States, Russia and China, contain conditions for authorization of space activities.[118]

Similarly, the International Law Association's (ILA) Committee on Space Law began work on a model law in 2008 related to commercialization of outer space.[119] The committee used its "building blocks" from its 2004 work that considered the building blocks to be "essential cornerstones of future space legislation in view of the international law obligations of States stemming from the Outer Space Treaty and the Liability Convention."[120] The building blocks included "authorization of space activities" among four other key components.[121] Based on the building blocks, a model law was completed with 14 articles, including articles on authorization and conditions for authorization.[122] Notably, definitions for key terms were included. These terms include authorization, supervision and space activity.[123] The committee also provided comments indicating what responsible authorization entails. Prior to authorization, an applicant should establish a secure financial position.[124] Additionally, "requirements of foreign policy, national security, public safety, international telecommunication regulations and insurance should be fulfilled."[125] The committee's work is now known as the Sofia Guidelines for a Model Law on National Space Legislation.[126]

Although there is no international obligation requiring States to have national space legislation, consideration of international requirements and State practice demonstrates the need for such

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[117] *Id.* at Appendix.

[118] Marboe, *supra* note 105, at 180, 183; See also Comm. On the Peaceful Uses of Outer Space, Schematic Overview of National Regulatory Frameworks for Space Activities, U.N. Doc. A/AC.105/C.2/2012/CRP.8 (2012), https://www.unoosa.org/pdf/limited/c2/AC105_C2_2012_CRP08E.pdf [hereinafter Schematic].

[119] Marboe, *supra* note 105, at 181.

[120] *Id.*

[121] *Id.*

[122] Comm. On the Peaceful Uses of Outer Space, Information on the Activities of International Intergovernmental and Non-governmental Orgs. Relating to Space Law, U.N. Doc. A/AC./105/C.2/2013/CRP.6, at 1 (2013), https://www.unoosa.org/pdf/limited/c2/AC105_C2_2013_CRP06E.pdf [hereinafter Information].

[123] *Id.* at art. 2.

[124] *Id.* at art. 4.

[125] *Id.*

[126] Marboe, *supra* note 105, at 184.

legislation. For States with non-government entities engaging in space activities, the requirements to authorize and continuously supervise space activities makes national space legislation addressing these requirements "necessary and at least advisable."[127] Additionally, the growing number of States with national space legislation and the resources available, including the Sofia Guidelines for a Model Law on National Space Legislation, the building blocks that the model law was based off of, and the elements for consideration proposed by the UNGA resolution on national space legislation further support the necessity of national space legislation that at least addresses international obligations related to space activities of non-governmental entities. The lack of legislation to ensure responsible authorization is not a violation of the State's authorization obligation, but it certainly casts doubt on whether the State is exercising due diligence in authorizing space activities of non-government entities in the absence of established legislation or at least similar administrative regulations.

C. Continuing Supervision

Article VI of the Outer Space Treaty also obligates States to provide continuing supervision of non-governmental entities' space activities.[128] Similar to authorization, no further detail is given regarding continuing supervision or how the duty is to be executed. Scholars argue that the obligation has crystallized into a rule of customary international law, as did its companion obligation to provide authorization.[129] If true, whether or not States are party to the Outer Space Treaty, they are responsible for the actions of their nationals in outer space and obliged to authorize and provide continuing supervision for such activities.[130]

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[127] *Id.* at 138.

[128] Outer Space Treaty, *supra* note 13, art. VI.

[129] LYALL & LARSEN, *supra* note 43, at 64; ROUTLEDGE, *supra* note 103, at 9 ("teachings of the most highly qualified publicists" as a subsidiary source of international law when primary sources are insufficient. Statute of the International Court of Justice art. 38(1)(d), Jun. 26, 1945, 33 U.N.T.S. 993. The teachings of highly qualified publicists, amongst other resources, may be instrumental in identifying when a rule of customary international law has crystalized, such as the obligations in Article VI of the Outer Space Treaty.").

[130] Vienna Convention, *supra* note 69, art. 38.

Similar to authorization, there is no requirement for national legislation to ensure the continuing supervision duty is met. However, the UNGA has encouraged States conducting space activities to enact and implement "national laws authorizing and providing for continuing supervision of the activities in outer space of non-governmental entities under their jurisdiction."[131] State practice and prudence also suggest the necessity for national legislation related to continuing supervision is no less important than for ensuring responsible authorization.[132] The UN COPUOS Legal Sub-Committee's recommendations for national space legislation included ways and means of supervision of space activities as an element.[133] Additionally, supervision of space activities is part of the building blocks and the ILA Committee on Space Law's Sofia Guidelines for a Model Law on National Space Legislation.[134] The model law notes that continuing supervision shall be conducted according to "an implementing decree or regulation."[135] Supervision is part of numerous States' national space legislation, including major space faring States like the United States, Russia and China.[136]

Responsible continuing supervision should ensure the underlying conditions for authorization continue to be met during and after space activities are conducted. Continuing supervision provides States with an opportunity to minimize risk for damage, ensure compliance with international obligations, and make sure appropriate conditions are met for space activities.[137] Indeed, the initial authorization goes together with continuing supervision. Relevant national legislation and regulations help ensure compliance with international obligations, responsible use of outer space, and that those involved in space activities are "technically, financially and operationally fit, and [have] proper compliance disposition with relevant law, including environmental and safety regulation."[138]

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131 G.A. Res. 59/115, Application of the Concept of the Launching State (Jan. 25, 2005).

132 *See* discussion *supra* Section III.B.

133 Workplan, *supra* note 115, at 10.

134 Information, *supra* note 122, at 1, art. 5.

135 *Id.* at art. 5.

136 Marboe, *supra* note 105, at 183; *See* Schematic, *supra* note 104, at 4,8.

137 Marboe, *supra* note 105, at 138, 185.

138 Dempsey, *supra* note 74, at 3 n.8.

D. The Appropriate State(s)

Article VI of the Outer Space Treaty places responsibility for authorization and continuing supervision of non-governmental activities in outer space squarely on "the appropriate State Party to the Treaty."[139] If Article VI of the Outer Space Treaty has crystallized into a rule of customary international law, then the same responsibilities exist for non-State parties to the Outer Space Treaty too.[140] The Article VI obligations, combined with related Articles VII and VIII in the Outer Space Treaty, make transfers of space objects with private parties challenging.[141] Additionally, Articles VII and VIII lead scholars in different directions as to what State, or States, should be the appropriate State for Article VI obligations.

Article VII of the Outer Space Treaty, consistent with other major space treaties, including Article I(c) of the Liability Convention, contemplates the possibility of multiple States being defined as launching States and thereby being subject to liability for damages caused by their space objects.[142] Some scholars argue that the appropriate State should be a launching State because Article VII places liability on launching States.[143] However, defining the appropriate State as a launching State raises the problem of what to do when there are multiple launching States, despite the singular use of "State" in Article VI.

Article VIII of the Outer Space Treaty ensures jurisdiction and control over a space object and its personnel, if any, is retained by the State of registry. Notably, there can only be a single State of registry, which must also be a launching State.[144] Some scholars argue that the State of registry is the appropriate State in Article VI because the State of registry retains jurisdiction and control of the space object and its personnel.[145] However, Bin Cheng pointed

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[139] Outer Space Treaty, supra note 13, art. VI.

[140] LYALL & LARSEN, *supra* note 43, at 64; ROUTLEDGE, *supra* note 103, at 8.

[141] LYALL & LARSEN, *supra* note 43, at 415.

[142] Outer Space Treaty, *supra* note 13, art. VII; Liability Convention, *supra* note 15, art. I(c); Convention on Registration of Objects Launched into Outer Space art. I, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

[143] H.L. Van Traa-Engelman, *Commercial Utilization of Outer Space* 62-63 (1993).

[144] *See* Outer Space Treaty, *supra* note 13, art. VIII; Registration Convention, *supra* note 142, art. I(c).

[145] Gijsbertha Cornelia Maria Reijnen, *The United Nations Space Treaties Analysed* 114 (1992).

out major flaws with the State of registry approach to defining the appropriate State.[146] First, if responsibility for Article VI obligations rests solely on the State of registration when other launching States exist for a space object, the other launching States would not have international responsibility for the space activities of their non-governmental entities.[147] As Cheng notes, the result "would obviously not be what Article VI has in mind."[148] The second major issue is that States may choose a poorer State for registration to mitigate their own financial liability.[149] Thus, using a State of registry to determine the "launching State" for Article VI obligations could incentivize a "registry of convenience."[150]

Both the launching State and State of registry concepts share a major disadvantage—the launching State designation cannot be shed at a later time.[151] In modern times, space objects are "bought and sold in orbit on a regular basis," which was not envisioned by the drafters of the Outer Space Treaty.[152] If a transfer of a space object divests an original launching State from any practical interest in a space object, it is illogical that the original launching State should maintain the obligations of authorization and continuing supervision—such obligations should belong to a State to whose non-governmental entity the space object was transferred to and is controlling the space object. The rigidity of the launching State concept has led some scholars to argue it "should not be used to interpret the much more flexible concept of the 'appropriate State.'"[153]

Unlike the definition of launching State or State of registry, the Outer Space Treaty or subsequent space treaties do not expand on who the appropriate State is or whether there can be more than

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[146] Bin Cheng, *Article VI of the 1967 Space Treaty Revisited – "International Responsibility", "National Activities", and "The Appropriate State,"* 26 J. SPACE L. 7, 21-22 (1998) (Cheng's concerns were raised in the context of defining "national activities" under Article VI of the Outer Space Treaty, but his concerns equally apply to defining the appropriate state for Article VI obligations since a failure to meet such obligations would likely incur responsibility and, where damage occurs because of the breach of the international obligation, liability.) [hereinafter Cheng, *Space Treaty Revisited*].

[147] *Id.* at 21.

[148] *Id.*

[149] *Id.* at 22.

[150] *Id.*

[151] Marboe, *supra* note 105, 133.

[152] *Id.* at 134.

[153] *Id.*

one appropriate State. Paragraph 5 of the 1963 UN Declaration of Legal Principles Concerning the Activities of States in the Exploration and Use of Outer Space is substantially similar to Article VI of the Outer Space Treaty.[154] However, the term "State concerned" from the 1963 UN Declaration became "the appropriate State Party to the Treaty" in Article VI of the Outer Space Treaty.[155] Noting the singular form used in both the 1963 UN Declaration and the Outer Space Treaty, Lyall and Larsen argue that regardless of "how one may interpret 'concerned' or 'appropriate' it is clear that the concept is in the singular and that the drafters intended only one state to authorise and supervise, and therefore be responsible for a particular private space activity."[156]

Despite the singular term in the 1963 UN Declaration and the 1967 Outer Space Treaty, Bin Cheng made a practical argument that the singular terms do not preclude a plurality of appropriate States.[157] Cheng argues that every State that may be held responsible under Articles VI or VII of the Outer Space Treaty "should not be entitled, or even under a duty, to subject its national activities in space to its authorization and continuing supervision," thereby making each State an "appropriate State."[158] In one scenario, State A's nationals could procure the launching of a space object in State B, unbeknownst to State A if State B is not a mature or responsible State.[159] Such actions could still place responsibility for Article VI Outer Space Treaty obligations on State A, even though State A was wholly unaware of the actions based on no fault of State A. Placing responsibility on State A, even though it technically is responsible for Article VI Outer Space Treaty obligations related to its national's space activities, makes little sense when State B could be a second appropriate State and thereby the State that should be held international responsible for failing to meet international obligations related to the space activity that State A's national procured in State B.

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[154] *Compare* Declaration, *supra* note 9, at ¶5, *with* Outer Space Treaty, *supra* note 13, art. VI.

[155] *Id.*

[156] LYALL & LARSEN, *supra* note 43, at 415.

[157] Cheng, *Space Treaty Revisited*, *supra* note 146, at 28.

[158] *Id.*

[159] *Id.*

Nothing prohibits relevant States from agreeing to which State or States will authorize and provide continuing supervision for a certain space activity. However, any State concluding such an agreement should remember that, regardless of the agreement and its provisions related to which State or States will authorize and supervise a space activity, States cannot delegate their responsibility and liability from the Outer Space Treaty or Liability Convention.[160] "Once a launching state, always a liable one."[161]

IV. THE IMPACT OF AUTONOMOUS SYSTEMS AND ARTIFICIAL INTELLIGENCE ON STATE RESPONSIBILITY AND LIABILITY

The role of computer technology and software cannot be understated in its importance to space use and exploration. Such technology has supported human spaceflight, humans landing on the Moon and exploration of the Solar System. Additionally, advancements in multiple areas, including computer technology and software, has led to a massive global space economy. In 2018, the global space economy was valued at approximately $350 billion.[162] That value is projected to increase to as much as $1 trillion in the 2040s.[163] With the significant economic impact and projected growth of the global space economy, it is reasonable to expect increased space traffic and utilization.

Space objects are likely to include more autonomous operating systems and AI as these technologies offer increased capabilities and safety mechanisms. The technical complexity of systems grows in tandem with the systems' autonomy, shifting more decisions and actions from human operations to the systems.[164] As such, States (at least the "appropriate State" for each space object) will be internationally responsible to ensure authorization and continuing

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[160] *Id.*; Liability Convention, *supra* note 15, art. V.

[161] Von Der Dunk, *supra* note 19, at 52.

[162] Jeff Foust, *A Trillion-Dollar Space Industry Will Require New Markets*, SPACENEWS, July 5, 2018, https://spacenews.com/a-trillion-dollar-space-industry-will-require-new-markets/; Michael Sheets, *The Space Industry Will Be Worth Nearly $3 Trillion In 30 Years, Bank Of America Predicts*, CNBC, Oct. 31, 2017, https://www.cnbc.com/2017/10/31/the-space-industry-will-be-worth-nearly-3-trillion-in-30-years-bank-of-america-predicts.html.

[163] Foust, *supra* note 162.

[164] Leslie Jane Smith, *Legal Aspects of Satellite Navigation, in* HANDBOOK OF SPACE LAW 554, *supra* note 19, at 610.

supervision of more non-governmental space activities with autonomous systems and AI in the space objects.

Both the Outer Space Treaty and the Liability Convention provide that States are liable for damages caused by their space objects or the component parts of such objects.[165] "Component parts" is an ambiguous term in the context of the Outer Space Treaty and Liability Convention.[166] One meaning is that the term in its context is meant to just cover physical damage from a component part colliding with another space object or persons or property on such space object. Alternatively, the term may include damage caused when a component part malfunctions, thereby resulting in damage. One example of the latter is the case of a space object's autonomous system or other part using AI, such as a collision avoidance system, causing the space object to collide with another State's space object on orbit. This section will explore the impacts of autonomous systems and AI on States' authorization and supervision responsibilities and relevant liability concerns.

A. Automation, Autonomous Systems and Artificial Intelligence

A detailed history of automation, autonomous systems and AI is beyond the scope of this article, but understanding basic concepts about them is necessary to understand their impacts on responsibilities and liability. While conventional automatic systems generally perform one repetitive task, autonomous systems can react to external stimuli and decide how best to react.[167] There is no universally accepted definition of AI, although several proffered definitions exist.[168] A helpful definition from Nils Nilsson, is that "artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment."[169] AI

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[165] Outer Space Treaty, *supra* note 13, art. VII; Liability Convention, supra note 15, art. I(d).

[166] *See* Vienna Convention, *supra* note 69, art. 31.1-31.4.

[167] Smith, *supra* note 164, at 610.

[168] STUART RUSSELL & PETER NORVIG, ARTIFICIAL INTELLIGENCE, A MODERN APPROACH 5 (1995), (stating eight definitions from different textbooks representing differing historical approaches to defining the concept).

[169] NILS J. NILSSON, *THE QUEST FOR ARTIFICIAL INTELLIGENCE: A HISTORY OF IDEAS AND ACHIEVEMENTS* 13 (Cambridge, UK: Cambridge University Press, 2010), https://ai.stanford.edu/~nilsson/QAI/qai.pdf.

also includes multiple subfields, such as machine learning, that increase the capacity for machines to exhibit intelligent behavior. Machine learning "includes abstruse statistical techniques that enable machines to improve at tasks with experience."[170]

Another way to think of AI is to consider algorithms as part of the evaluation process within a system that helps the system process stimuli (including learning from experience) and output a decision or reaction.[171] Algorithms are essentially step-by-step instructions for a computer to follow.[172] When algorithms are chained together, the product is AI—"a domain-specific illusion of intelligent behavior."[173] There are two important considerations for AI algorithms. First, AI "algorithms typically deal with probabilities rather than certainties."[174] The second consideration is the role of the programmer related to the algorithms.[175] For traditional algorithms, a programmer tells the algorithm what instructions to follow.[176] In AI, the programmer does not tell the algorithm what to do through preprogrammed instructions, but how to train itself what to do.[177] To make such a determination, the AI algorithm will rely on data and the rules of probability.[178]

Another important consideration for autonomous systems is rationality. A system (or other actor) is rational if it does the "right thing."[179] To do the right thing, the system needs to be programmed to know what the right thing to do is or how to make such an assessment. Additionally, to act rationally a system needs parameters and criteria to assess expected outcomes for potential actions. Such criteria are called performance measures.[180] Thus, a rational system will use its built-in knowledge and experience it has gathered

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[170] *What You Need to Know About Artificial Intelligence*, CALIPSA (Oct. 22, 2019), https://www.calipsa.io/blog/what-you-need-to-know-about-artificial-intelligence.

[171] NICK POLSON & JAMES SCOTT, A*IQ: HOW ARTIFICIAL INTELLIGENCE WORKS AND HOW WE CAN HARNESS ITS POWER FOR A BETTER WORLD* 3 (2018).

[172] *Id.*

[173] *Id.*

[174] *Id.* at 4.

[175] *Id.*

[176] *Id.*

[177] *Id.*

[178] *Id.*

[179] RUSSELL & NORVIG, *supra* note 168, at 4.

[180] *Id.* at 32.

to select an action that allows it to be most successful in light of its performance measure(s).[181]

B. Considerations for Authorization and Continuing Supervision for Space Activities Including Autonomous Systems and AI

Keen insights for ensuring responsible authorization and continuing supervision of space objects with autonomous systems and AI can be drawn from numerous sources. Some scholars have noted the importance of real-time monitoring for anomaly detection.[182] For "AI, this means scanning a stream of data points and identifying ones that don't match the typical pattern."[183] To adequately do this, one must understand what is expected on average and normal variability around the average.[184] The concept is not hard, sports teams, race car teams, banks and governments, amongst many others, do this on a daily basis.[185] The key is that there is a reliable understanding of what the expected average is and an understanding of variability around the average. Similar considerations apply to monitoring autonomous systems.

Max Tegmark notes lessons learned from various sectors, four of which are pertinent to this discussion. First, verification that the system is built right is critical.[186] Verification is the process of "ensuring software completely satisfies all the expected requirements," and verification should be thoroughly completed.[187] Verification should catch "bugs" in software, thereby avoiding preventable mishaps. Even simple software glitches for space activities can have catastrophic results. The European Space Agency's Ariana 5 rocket in 1996, and NASA's Mariner 1 mission to Venus exploded shortly after launch because of faulty software (for the Mariner 1, the problem was as simple as an incorrect punctuation mark).[188] NASA's

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[181] *Id.*

[182] POLSON & SCOTT, *supra* note 171, at 148.

[183] *Id.*

[184] *Id.* at 148, 164.

[185] *Id.*

[186] MAX TEGMARK, *LIFE 3.0: BEING HUMAN IN THE AGE OF ARTIFICIAL INTELLIGENCE*, 95-97 (2018).

[187] *Id.*

[188] *Id.*; Jaques-Louis Lions et al., Ariane 501 Inquiry Board, Ariane 5: Flight 501 Failure 12, Jul. 19, 1996, http://esamultimedia.esa.int/docs/esa-x-1819eng.pdf; Arthur G.

Mars Climate Orbiter accidently veered into Mars' atmosphere and burned up due to a software error affecting its "rocket-engine thrust control."[189] For verification, software is both the issue and the solution since advancements and improvements in AI can "improve the verification process."[190] Demonstration of verification is imperative for responsible authorization of space activities including the use of autonomous systems and AI because verification provides an opportunity to avoid significant and preventable harm.

Second, validation ensures the right system is built for the intended purpose.[191] "[A]utomatic trading programs from many companies found themselves operating in an unexpected situation" on May 6, 2010.[192] The systems' "assumptions were not valid," leading to the so-called trillion dollar "Flash Crash."[193] The cause of the Flash Crash teaches that there must be assurance that systems will not rely on "assumptions that may not always be valid."[194] Validation seeks to ensure the right system for the expected activities is built, and to properly handle situations where the system will encounter uncertainty.[195] Reasonable assurance that space activities including systems with automation and AI have been validated to ensure systems will not rely on faulty assumptions and can properly handle uncertainty should be a factor for responsible authorization. Responsible continuing supervision may also entail assurance that assumptions remain valid, especially when new or significant information that could affect such assumptions becomes available.

Control is the third important lesson—the "ability for a human operator to monitor the system and change its behavior if necessary."[196] Verification and validation alone may not be enough to

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Stephenson et at., Mars Climate Orbiter Mishap Investigation Board Phase I Rep. 6, Nov. 10, 1999, http://sunnyday.mit.edu/accidents/MCO_report.pdf.

189 TEGMARK, *supra* note 186, at 95 (The issue was traced to an incorrect hand-transcription of a single mathematical symbol (a missing overbar)); Peter Neumann, *Mariner I – no holds BARred*,, 8 THE RISK DIGEST 75(1989), http://catless.ncl.ac.uk/Risks/8.75.html#subj1.

190 TEGMARK, *supra* note 186, at 95.

191 *Id.* at 97.

192 *Id.* at 96.

193 *Id.*

194 *Id.* at 97.

195 TEGMARK, *supra* note 186, at 96-7.

196 *Id.* at 99.

prevent an accident, thus having a human on the loop that can take control of a system is important.[197] Control requires both the ability for effective human-machine communication and a user-friendly interface. Effective sensors leading to simple warning lights and noises can contribute to effective communication, as is commonly seen with lane assist and related automobile technology today.[198] Air Inter Flight 148's tragic crash in France demonstrates the importance of non-confusing interfaces.[199] Due to the pilots' screen being too small to show the mode their system was in, when they entered "33" on the plane's keypad intending to descend at a 3.3 degree angle, the autopilot interpreted their command to mean descend at 3,300 feet per minute, resulting in the death of all 87 persons on board.[200] Adequate assurance that circumstances warranting transfer to human control have been identified as space objects include more autonomous systems and AI will be an important consideration prior to authorization. Similarly, proper planning and capability for timely transfers will also be important. Continuing supervision should include reasonable assurance that non-governmental entities maintain adequate control of space objects and ensure proficiency should human operator intervention become necessary.

Even where responsible actors validate, verify and have proper abilities for human control of space objects with AI and autonomous systems, poor security could lead to foreseeable, preventable mishaps. Drawing lessons learned from numerous hacking and malware incidents, Tegmark points out the need for security against "deliberate malfeasance."[201] Although significant emphasis must be placed by designers and builders of space objects on functionality, cybersecurity should not be overlooked, and reasonable safeguards should be a prerequisite for authorization of space activities involving autonomous systems.[202] Likewise, continuing supervision should ensure reasonable safeguards are maintained after a space object is launched.

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[197] *Id.*

[198] *Id.*

[199] *Id.* at 100.

[200] TEGMARK, *supra* note 186, at 100.

[201] *Id.* at 103.

[202] JACOB G. OAKLEY, *CYBERSECURITY FOR SPACE: PROTECTING THE FINAL FRONTIER* 1-2 (2020).

C. Space Debris Mitigation Guidelines and Authorization and Continuing Supervision of Space Activities Including the Use of Automation and AI

In 2001, UN COPUOS asked the Inter-Agency Space Debris Coordination Committee (IADC) to develop space debris mitigation guidelines. Subsequently, the IADC presented to the Scientific and Technical Sub-Committee (STSC) of UN COPUOS in 2003.[203] The STSC thereafter established the Working Group on Space Debris in 2004.[204] The working group was charged with developing debris mitigation guidelines on the basis of the IADC's previously submitted guidelines and consider comments from States about the guidelines.[205] The STSC did so, and both the STSC and the UN COPUOS accepted the new guidelines in 2007.[206] Further, the UN General Assembly endorsed the guidelines in 2007, noted that the guidelines reflected existing practices by multiple national and international organizations, and invited member States to implement the guidelines.[207]

Although the Space Debris Mitigation Guidelines are not legally binding, guideline three informs prudent design of spacecraft using automation and AI.[208] According to guideline three, which focuses on limiting the probability of accidental collisions in orbit, "[i]n developing the design and mission profile of spacecraft and launch vehicle stages, the probability of accidental collision with known objects during the system's launch phase and orbital lifetime should be estimated and limited."[209] Use of autonomous systems and AI for collision avoidance systems may reduce the risk of accidental collisions in orbit, especially when combined with proper control protocols and procedures for humans to change the behavior

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[203] *See* Comm. On the Peaceful Uses of Outer Space, Rep. of the Sci. & Tech. Subcomm. on Its Thirty-Eighth Session, U.N. Doc. A/AC.105/761, ¶130 (2001), https://www.unoosa.org/pdf/reports/ac105/AC105_761E.pdf; *See also* Comm. on the Peaceful Uses of Outer Space, Space Debris Mitigation Guidelines, ST/SPACE/49, iii (2010), www.oosa.unvienna.org/pdf/publications/st_space_49E.pdf [hereinafter SDMG].

[204] SDMG, *supra* note 203, at iv.

[205] *Id.*

[206] *Id.*

[207] *Id.*; G.A. Res. 62/217, ¶27, International Cooperation in the Peaceful Uses of Outer Space (Feb. 1, 2008).

[208] *See* discussion *infra* Section V.D.

[209] SDMG, *supra* note 203, at 3.

of space objects when necessary. During the design phase, and as a prerequisite for authorization, verification and validation that software includes the known location and trajectory of space debris (and space objects) and has been programmed with valid assumptions to avoid collisions would meet the intent of guideline three. Additionally, continuing supervision should include verification that systems receive regular updates of newly identified space objects and debris.

The existence and location of all space debris that could result in an accident or loss of control of a space object is unknown, so engineering and programming should account for how space objects using autonomous systems and AI will address the uncertainty. Coordination and industry standards will be necessary for autonomous space objects to make valid assumptions leading to rational actions that will avoid collisions when autonomous systems encounter each other. Lastly, the importance of continuous monitoring of space objects so that a human that can take control, if necessary, is vital to reducing the risk of avoidable collisions.

V. A PRACTICAL FRAMEWORK TO ANALYZE FAULT-BASED LIABILITY RESULTING FROM STATES FAILING TO AUTHORIZE OR PROVIDE CONTINUING SUPERVISION

Proof of fault is essential to establish liability under Article III of the Liability Convention. However, regardless of which theory of recovery a harmed State seeks to recover for damage caused by a space object of another State elsewhere than on the surface of the Earth or to aircraft in flight, fault will likely be a key element for a liability determination.[210] Thus, determining what constitutes fault is imperative. This section argues that fault may be shown by, *inter alia*, a State's knowing, or in circumstances where a State should have known, failure to uphold its international obligation to authorize or provide continuing supervision for the space activities of its non-governmental entities. Even when a State does authorize and supervise relevant space activities, failing to do so with due diligence may also breach a State's international obligation, and thereby constitute fault when damage results from such failure.[211]

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[210] *See* discussion *supra* Section II.

[211] Cheng, *Space Treaty Revisited*, *supra* note 146, at 18.

Although this article focuses on the international obligations of authorizing and supervising space activities, the analysis in this section would be the same for other breaches of international obligations that otherwise cause relevant damage.

A. The ILC's Articles on State Responsibility as a Framework for Analysis

The ILC's Articles on State Responsibility provides valuable insight to analyze a State's responsibility and liability resulting from damages caused by a State's failure to meet its responsibilities of authorization and supervision. The Articles on State Responsibility are not binding, but they provide a widely accepted approach to determine State responsibility for internationally wrongful acts.[212] Referring to the Draft Articles on State Responsibility provisionally adopted by the ILC at the time, the International Court of Justice (ICJ) in the *Gabčikovo-Nagymaros Project* case declared that it is "well established that, when a State has committed an internationally wrongful act, its international responsibility is likely to be involved whatever the nature of the obligation it has failed to respect."[213]

The Articles on State Responsibility are the product of nearly forty years of work to codify State practice and custom on State responsibility.[214] The Articles were adopted by the International Law Commission in 2001, and subsequently referred to the UNGA at its fifty-sixth session the same year.[215] Since then, the Articles have been discussed numerous times, especially in the Sixth Committee. The Sixth Committee of the General Assembly of the United Nations is the primary forum to consider legal questions in the

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[212] CRAWFORD, BROWNLIE'S PRINCIPLES, *supra* note 26, at 524 (the ILC's Draft Articles "have been much cited and have acquired increasing authority as an expression of the customary law of state responsibility"); *Id.* at 524 n.7 (citing U.N. reports identifying 154 cases and an additional 56 decisions, as of 2013, referring to the Articles on the Responsibility of States for Internationally Wrongful Acts); ROUTLEDGE, *supra* note 103, at 8 n.43.

[213] GabCikovo-Nagymaros Project (Hung./Slovk.), Judgment, 1997 I.C.J. Rep. 35, ¶47 (Sept. 25).

[214] CRAWFORD, ILC ARTICLES, *supra* note 24, at ix.

[215] *Id.*; *Sixth Committee (Legal)—71st session,* UNITED NATIONS, https://www.un.org/en/ga/sixth/71/resp_of_states.shtml (last visited Nov. 1, 2021).

General Assembly.[216] During meetings of the Sixth Committee in the seventy-first session in 2016, delegations noted that the Articles have become "a useful and authoritative statement of the rules on State responsibility."[217] Further, delegations noted that "reference to the articles in the practice of States, as well as in the decisions of various international courts, tribunals and other bodies, demonstrated the general acceptance of the articles in the international community."[218] Delegations also noted that the Articles reflect "a widely shared consensus" in their present form.[219] The IJC also found a general rule of law on State responsibility stated in the Articles' text.[220] Thus, the Articles provide a useful framework for analyzing fault as it pertains to liability for space activities and State responsibility.

Article 1 recognizes that "Every international wrongful act of a State entails the international responsibility of that State."[221] According to Article 2, an internationally wrongful act of a State has 2 elements. First, the action or omission must be "attributable to the State."[222] Typically States conduct authorization and supervision through government agencies, which would satisfy this requirement. Second, the action or omission must constitute "a breach of an international obligation of the State."[223] Such international obligations may arise from a treaty, a rule of customary international law, or a "general principle applicable within the international legal order."[224] As previously identified, States have obligations to authorize and provide continuing supervision for their non-governmental entities' space activities.[225] A State is in breach of its international obligation when its conduct "is not in conformity with

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[216] *Sixth Comm. (Legal) of the U.N.G.A.*, UNITED NATIONS, https://www.un.org/en/ga/sixth/.

[217] *Sixth Committee. (Legal)*—71st session, *supra* note 215.

[218] *Id.*

[219] *Id.*

[220] Application of the Convention on the Prevention and Punishment of the Crime of Genocide (Bosn. & Herz. v. Serb. & Montenegro), Judgment, 2007 I.C.J., ¶431 (Feb. 26) (finding that Article 14 paragraph 3 stated "a general rule of the law of state responsibility" and set out text of that provision in its decision).

[221] ILC's Draft Articles, *supra* note 24, art. 1.

[222] *Id.* at art. 2(a).See Velasquez-Rodriguez Case, Judgment Inter-Am. C.H.R., OEA/ser.C/4, ¶170 (July 29, 1988).

[223] ILC's Draft Articles, *supra* note 24, art. 2(b).

[224] CRAWFORD, ILC ARTICLES, *supra* note 24, at 127.

[225] *See* discussion *supra* Section III.B.

what is required of it" by the international obligation.[226] Lastly, failing to authorize or supervise with due diligence may also breach the international obligation and constitute a wrongful act entailing international responsibility.[227]

B. Fault-based Liability Pursuant to Article III of the Liability Convention

A showing of fault is an essential element to establishing liability pursuant to Article III of the Liability Convention. Under Article III of the Liability Convention, the harmed State must prove that its damage is due to a launching State's fault or the fault of persons for whom it is responsible.[228] States are responsible for their agents' space activities, as well as the space activities of their non-governmental entities and international organizations of which they are part.[229] As discussed, there is no specified standard for establishing fault in international space law. By looking to principles of general international law as reflected in the ILC's Articles on State Responsibility, fault should be proven when a harmed State shows that a responsible State's act or omission breached an international obligation of the State, thereby constituting a wrongful act.[230]

Authorizing and providing continuing supervision of non-governmental entities space activities, per Article VI of the Outer Space Treaty for State parties to the treaty, and as a matter of customary international law for all States, are indeed international obligations.[231] Failure to subject non-governmental space activities to authorization and continuing supervision, or not doing so with due diligence, fails to conform to international obligations, thereby breaching the international obligations, for which the breaching State is responsible.[232] Such a wrongful act should also naturally constitute fault for purposes of assigning liability when relevant damage occurs.

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[226] ILC's Draft Articles, *supra* note 24, art. 12.
[227] Cheng, *Space Treaty Revisited*, *supra* note 146, at 18.
[228] Liability Convention, *supra* note 15, art. III.
[229] *See supra* notes 90-91 and accompanying text.
[230] ILC's Draft Articles, *supra* note 24, art. 2.
[231] *See* discussion *supra* Section III.B.
[232] Cheng, *Space Treaty Revisited*, *supra* note 146, at 13-14.

C. Liability Pursuant to Article VII and State Responsibility Theories

Although not as clear as the Liability Convention, establishing liability through Article VII of the Outer Space Treaty for damage caused by a responsible State's space objects to a harmed State in space may also require proof of fault.[233] Establishing the element of fault for purposes of Article VII of the Outer Space Treaty should be no different than doing so pursuant to Article III of the Liability Convention. If a harmed State can show that a responsible State failed to conform to its international obligation to authorize and supervise a non-governmental entity's space activities, such conduct constitutes a wrongful act in breach of an international obligation. As a result, the responsible State is at fault, and thereby liable for damage caused by the wrongful act.

Similarly, through a State responsibility theory, an internationally wrongful act or omission that breaches an international obligation will be an essential element to ultimately establish liability.[234] If a harmed State seeks recovery through a State responsibility theory, then the harmed State should seek to prove that the failure to authorize or supervise was an international obligation either as a matter of a treaty, if the relevant States are party to the Outer Space Treaty, or as customary international law if a relevant party is not party to the Outer Space Treaty. The harmed State should establish that the responsible State either failed to authorize, supervise, or use due diligence when doing so for a non-governmental entity's space acidity. A violation of the international obligations to authorize or provide continuing supervision would constitute a wrongful act, or omission, for breaching an international obligation. Therefore, the responsible State for the wrongful act would then have the corresponding "obligation to make full reparation for the injury caused by the internationally wrongful act."[235]

D. General Principles Within the International Legal Order

Actions contrary to or inconsistent with general principles applicable within the international legal order may also constitute

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[233] *See* discussion *supra* Section II.B.

[234] *See* discussion *supra* Section II.A.

[235] ILC's Draft Articles, *supra* note 24, art. 31.1.

fault.[236] Even if the Article VI duties of authorization and continuing supervision of space activities of non-governmental entities have not crystallized into rules of customary international law, violation of these norms of behavior may still constitute fault if it can be established that they are principles applicable within the international legal order. At the very least, not acting in conformity with such widely accepted principles dating back to at least 1963 with unanimous UNGA adoption certainly indicates deviation from universally accepted international norms that exist for the purpose of, *inter alia*, ensuring the freedom of exploration and use of outer space for the benefit and in the interest of all countries, and reasonable apportionment of responsibility for engaging in such space related activities.

Similarly, a State not acting in conformity with the Space Debris Mitigation Guidelines may constitute fault. A report from the United Nation's Office of Outer Space Affairs (UN OOSA) Legal Subcommittee in 2019 noted that the Space Debris Mitigation Guidelines "could be an indicator of fault for the purposes of determining the liability of the launching state…"[237] The context of this view was regarding intentional destruction of spacecraft contrary to the SDMGs.[238] However, such a view is still notable because it represents acceptance from the international community of means to provide a meaning for fault. Additionally, the third guideline's requirement to estimate and limit the probability of accidental collisions with known objects during the launch phase and orbital lifetime of spacecraft could be a significant aspect of meeting the international obligation to authorize the space activity of a non-governmental entity.[239] If a State wholly fails to authorize the space activity, or fails to consider in its authorization procedures whether the development of the design and mission profile of a space object complies with the third guideline, such a failure may breach a State's

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[236] CRAWFORD, ILC ARTICLES, *supra* note 24, at 126; International Fisheries Co., *supra* note 28, at 701 ("some principle of international law"); Armstrong Cork Co., *supra* note 28, at 163 ("One must consider as illicit actions… all actions of a State which are in contradiction with any rule whatsoever of international law.").

[237] Comm. On the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its Fifty-Eighth Session, U.N. Doc. A/AC.105/1203, ¶183 (2019), https://undocs.org/pdf?symbol=en/A/AC.105/1203.

[238] *Id.*

[239] SDMG, *supra* note 203, at 3

international obligation, and constitute a wrongful act for which the State would be internationally responsible. As a result, "[t]he responsibility of the State would entail the obligation to repair the damages suffered to the extent that said damages are the result of the inobservance of the international obligation."[240]

E. Objective Standard Required

States should not be responsible for authorizing or supervising their non-governmental entities' space activities unless States know or should have known about the activities. The *Corfu Channel Case* sheds light on fault-based standards.[241] In the *Corfu Channel Case*, the ICJ noted "every State's obligation not to allow knowingly its territory to be used for acts contrary to the rights of other States."[242] Use of the term "knowingly" indicates that States' responsibility in cases where the actions of individuals it is responsible for "remains based on fault."[243] Similarly, a State can be responsible for inaction when it fails "to take appropriate steps" under circumstances when the State is aware such action is requisite.[244] Thus, a State may need to knowingly fail to authorize or provide continuing supervision of its non-governmental entity for the State to be responsible and thereby at fault for the actions or omissions of the non-governmental entity.

To illustrate the issue, assume Canada's SpaceZ Inc., a fictitious Canadian non-governmental entity, procures the launching of a satellite in the Democratic People's Republic of Korea (DPRK) at the Sohae Satellite Launching Station. SpaceZ's satellite will provide commercial uses benefitting SpaceZ and DPRK. DPRK fails to authorize the space activity, or fails to adequately consider the design, mission profile and other key features and aspects of SpaceZ's space object. Desiring to retain jurisdiction and control over the satellite and have the object or any of its component parts found beyond DPRK jurisdiction returned to the DPRK in accordance with Article VIII of the Outer Space Treaty, DPRK registers the object

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[240] Armstrong Cork Co., *supra* note 28, at 163.

[241] Corfu Channel Case, *supra* note 64, at 22-23.

[242] *Id.* at 14.

[243] Cheng, *Space Treaty Revisited*, *supra* note 146, 612.

[244] US Diplomatic and Consular Staff in Tehran (U.S. v. Iran), Judgement, 1980 I.C.J. 31, ¶61 (May 24).

consistent with the requirements in the Convention on Registration of Objects Launched into Outer Space.[245] After the object is launched, it collides with the satellite of a third State, and a subsequent investigation is able to determine that the crash would have been avoided if DPRK had fulfilled its obligation to adequately authorize the space activity of SpaceZ. During the investigation, Canada first learned (or had reason to learn) about SpaceZ's activities in DPRK. As an equitable matter, Canada should not be responsible for failing to authorize or supervise its non-governmental entity that secretly procures the launching of a space object from another State when, through no fault of Canada, it neither had knowledge or any reason to know of SpaceZ's activity. Additionally, the harmed State is not without recourse from a State that should have properly authorized the space activity of a non-governmental entity originating from DPRK territory.[246]

F. The Appropriate State

The previous example of SpaceZ raises again the issue of who constitutes the appropriate State or States. In SpaceZ's example, the equitable solution to the appropriate State to provide authorization (and continuing supervision) is DPRK. In that example, DPRK is a launching State since the launch took place from its territory, and DPRK is the single registering State of the space object. If there can only be one "appropriate State" as some scholars argue, DPRK should be the appropriate State given it has likely enjoyed economic benefits from allowing the launch, it expects continued commercial benefits from SpaceZ's satellite, and it retains jurisdiction and control of the satellite. In short, DPRK, or any similarly situated State, should not enjoy the benefits of space activities without the burden of associated responsibilities. Canada, or any other similarly situated State without knowledge or reason to know of a non-governmental entity's space activities in another State, does not have requisite knowledge to trigger its corresponding international obligations. Unlike in the *Corfu Channel* case, where Albania had knowledge of dangerous mines in its territorial waters and

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[245] Registration Convention, *supra* note 142.

[246] It is an entirely separate matter as to whether the responsible State has the financial means to provide adequate reparations to the harmed State.

failed to warn the British, Canada had no knowledge or reason to know of its non-governmental entity's secret space activities in a foreign State.[247]

If more than one "appropriate State" is possible, then the obligation to authorize and supervise is incumbent upon all States who know or should know of relevant space activities. Failure to authorize or provide continuing supervision of non-governmental space activities cannot likely be excused by claiming that another State is more appropriate, if every relevant State is deemed an "appropriate State."[248] Even if multiple States with a responsibility for a non-governmental entities' space activity arrange for one State to authorize and/or supervise the space activity, the agreement does not divest the other State's or States' responsibility for the obligations.[249] Therefore, States should be cautious to ensure that if their non-governmental entities' space activities are authorized or supervised by another State, such authorization and supervision meets at least minimal standards to comply with international obligations.

G. Limitation on the Extent of Recovery

An internationally wrongful act triggers both State responsibility and a new international obligation upon the responsible State to make reparations for damage caused by the wrongful act.[250] Failing to authorize or provide continuing supervision as a basis for establishing fault does not necessarily mean that the extent of the responsible State's liability is unlimited. Instead, the extent of liability is directly related to the damage resulting from the wrongful act.[251] As such,

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[247] The example is simplistic to illustrate the key concepts. In reality, media coverage and corporate announcements for activities in most countries and involving significant companies would likely give a State reason to be aware of space activities by a State's non-governmental entity in other States. However, scenarios are possible where a State would have no reason to know of such activities until a space object is already in space or damage has occurred.

[248] Cheng, *Space Treaty Revisited*, *supra* note 146, at 14.

[249] *Id.*

[250] *See* Armstrong Cork Co., *supra* note 28, at 163; CRAWFORD, ILC ARTICLES, *supra* note 24, at 201.

[251] *See* Chorzów Factory, *supra* note 39, at 47; Armstrong Cork Co., *supra* note 28, at 163.

> "[t]he essential principle contained in the actual notion of an illegal act—a principle which seems to be established by international practice and in particular by the decisions of arbitral tribunals—is that reparation must, as far as possible, wipe-out all the consequences of the illegal act and re-establish the situation which would, in all probability, have existed if that act had not been committed."[252]

VI. CONCLUSION

This article represents an effort to provide greater understanding to fault-based liability in international space law. As the growth in space use and traffic increases, collisions between space objects will almost certainly occur. States and private entities alike should have better predictability to understand how liability may be assigned when damage is not determined through absolute liability. By understanding how liability would likely be apportioned, States can make better informed decisions regarding how to regulate the space activities of their non-governmental entities and apportion risk. Similarly, private actors and other parties with an interest in space activities can make better informed decisions related to the apportionment of financial obligations with greater fidelity regarding liability standards.

Despite the initial legal principles regarding liability for space activity being accepted nearly 60 years ago, and the subsequent *lex specialis* in 1972, fault-based liability standards remain unclear. The application of well-established principles in general international law supplies clarity. While the exact details of what is required to provide responsible authorization or continuing supervision likely depends on the circumstances of each case, wholly omitting effort to meet either of these obligations, or failing to fulfill the obligations with due diligence, is a wrongful act when the responsible State knows or should know that its duties are triggered. Such a wrongful act entails responsibility of the State, thereby adequately establishing fault and liability for damage resulting from the wrongful act.

Despite this article's focus on the obligations to authorize and supervise non-governmental entities' space activities, the same fault-based liability standards would apply to violating other

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[252] Chorzów Factory, *supra* note 39, at 47.

international obligations that cause damage in space. The particular circumstances of each case, including whether the relevant States are party to various space treaties, will impact the methods through which a harmed State may seek recovery. When fault-based standards are applicable, a lack of specificity in international space law alone does not mean such standards cannot be adequately determined. To add clarity, one should recall Bin Cheng's admonition that, "in pursuing any special interests in international law, it is essential to remain firmly attached to the discipline as a whole."[253] International law is rich with rules of customary international law, treaties and general principles within the international legal order to draw insight from. With the benefit of such insight and application of relevant principles, clarity can be distilled for a practical approach to fault-based liability in international space law.

[253] CHENG, INTERNATIONAL SPACE LAW, *supra* note 32, at viii.