Legal aspects of Active Debris Removal (ADR): regulation of ADR under international space law and the way forward for legal development

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3 Application of the Hard Law Pillar to Space Debris and ADR

The previous chapter outlined four legal issues relating to space debris and ADR, namely (1) whether States have an obligation under the current legal framework to mitigate and remediate space debris; (2) what is the potential liability for damage caused as a result of ADR operations; (3) whether States are allowed to remove space debris of another State; and (4) how the dual-use potential of ADR systems is addressed under the current framework.

This chapter aims to examine how the UN space treaties and general international law address the above four issues and whether there are legal gaps for their regulation. As noted in Chapter 1, the term "space debris" is not mentioned in the UN space treaties, as space debris was not a serious issue at the time when these treaties were concluded. However, the silence in the text of the UN space treaties on this matter does not mean that they do not apply to the regulation of space debris. These treaties lay the foundations for the orderly conduct of space activities and they contain provisions that are relevant to the issue of space debris.[1] Also, international law is applicable to space activities by virtue of Article III of the Outer Space Treaty, which also contains rules and principles that can apply to the governance of space debris.

Sections 3.1 to 3.4 will discuss, respectively, how the above four issues are regulated under the UN space treaties and general international law. Section 3.1 will discuss whether the current international legal framework for space activities imposes a duty upon States to mitigate and remove space debris. Section 3.2 will discuss the liability regime established in the UN space treaties, including whether and how this liability regime applies to damage caused by space debris, and how this regime may affect ADR activities. Section 3.3 will assess the jurisdiction and ownership over space objects and the potential legal and political ramifications if a State removes a debris object under the jurisdiction of another State without prior consent. Section 3.4 will discuss the restrictions posed by the current legal regime on military activities in outer space and how these restrictions are relevant to the use of ADR technologies. Section 3.5 will provide the conclusions of this chapter.

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1 Masson-Zwaan, T. L. (2017), Legal Aspects of Space Debris. In Bonnal, C., & McKnight, D. S. (Eds.). (2017). *IAA Situation Report on Space Debris* – 2016. International Academy of Astronautics, pp. 145-146.

3.1 *Issue 1*: Obligation of Debris Mitigation and Remediation

This section will address the question as to whether the hard law pillar of international space law imposes an obligation on States to mitigate and remediate space debris. Sections 3.1.1 and 3.1.2 will discuss the relevance of some fundamental principles in the Outer Space Treaty for the governance of space debris, namely the principle of the freedom of exploration and use of outer space and the province of all mankind principle and under Article I of the OST, as well as the non-appropriation principle under Article II of the OST. Section 3.1.3 will examine Article IX of the OST, which is the most environmentally relevant provision in the UN space treaties. It will assess the concept of "due regard" and its application to the reduction of space debris, discuss whether the creation of space debris can be regarded as "harmful contamination", and analyse the consultation mechanism in the event of potentially harmful interference with space activities of other States. As Article III of the OST provides that space activities should be carried out in accordance with international law, Section 3.1.4 will assess the principle of prevention, which is regarded as a cornerstone of international environmental law, and discuss the application of this principle to space debris. Finally, Section 3.1.5 will discuss the international responsibility of States for national space activities under Article VI of the OST, which can serve as a basis for States to develop national space legislation to transpose their treaty obligations into their national legal order.

3.1.1 The Freedom of Exploration and Use of Outer Space and the Province of All Mankind Principle

The international framework for the regulation of space activities set out in the UN space treaties can be characterised as "a system of freedoms and limitations".[2] The fundamental principle for the conduct of space activities is the freedom of exploration and use of outer space as enshrined in Article I paragraph 2 of the Outer Space Treaty:[3]

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

The ordinary meaning of "exploration" is "the activity of searching and finding out about something", and "use" means "to put something such

2 Popova, R., & Schaus, V. (2018). The Legal Framework for Space Debris Remediation as a Tool for Sustainability in Outer Space. *Aerospace*, *5*(2), 55, p. 6.

3 Viikari, L. (2008). *The Environmental Element in Space Law: Assessing the Present and Charting the Future.* Brill Nijhoff, p. 58.

as a tool, skill, or building to a particular purpose".[4] The two concepts are connected in that exploration can include a process to find out whether any subsequent use is possible.[5] As interpreted by Hobe, the term "use" should be understood broadly, meaning that "[a]ll kinds of activities that purport to make use of space in one way or another, including launching activities on Earth or the usage of satellites, may be covered by the legal regime of the use of outer space".[6] Therefore, in outer space, the "freedom to operate is the baseline rule".[7] This freedom is not unfettered but subject to restrictions under international law. Indeed, some restrictions are contained in paragraph 2 itself. The freedom should be exercised in accordance with the principle of equality, which can be interpreted as requiring States to take into account the opportunities of other States, especially the latecomers into the space field, to explore and use outer space. Also, space activities should be carried out in accordance with international law, which is further elaborated in Article III of the Outer Space Treaty. Moreover, since the freedom is granted to all States without discrimination of any kind, this right entails in itself an obligation to respect the enjoyment and exercise of the same freedom by others.[8]

A further qualification of the freedom of exploration and use of outer space can be found in Article I paragraph 1:

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

This provision reflects the preamble of the Outer Space Treaty and prescribes the overall purpose and nature of the use and exploration of outer space. As the concepts of "for the benefit and interests of all countries" and "province of all mankind" are not clearly defined in the Outer Space Treaty and subsequent space treaties, the specific meaning of these concepts is subject to interpretation. Masson-Zwaan submits that these concepts convey a general message that "the use of space should somehow benefit humankind".[9] Viikari submits that by establishing space activities as the province of all humankind and not of a single State, the provision "urges, albeit in a rather general way, responsible behavior on the part of all users of outer space".[10] Von der Dunk observes that these concepts could "serve

4 Cambridge Dictionary. Available at: <https://dictionary.cambridge.org/dictionary/english/>.
5 Hobe, S. (2009). Article I. In *CoCoSL Vol. 1*, Heymann, p. 34.
6 Hobe, ibid, p. 35.
7 Von der Dunk, F. G. (2015). International Space Law. In von der Dunk, F. G. & Tronchetti, F. (Eds.). *Handbook of Space Law*. Edward Elgar Publishing, p. 60.
8 Masson-Zwaan (2017), *supra* note 1, p. 140.
9 Ibid.
10 Viikari (2008), *supra* note 3, p. 59.

as a check (or at least the possibility of creating such checks) on unfettered unilateral usage of outer space to the detriment of all others".[11] These observations point to the direction that States should carry out their space activities in a reasonable manner, bearing in mind that they are neither the sole users of outer space nor the sole beneficiaries of the use of outer space.

As noted in a 2022 White Paper published by Working Group 1 of the Net Zero Space initiative, the general principles contained in Article I of the Outer Space Treaty are threatened by the dangerous growth of space debris, as this greatly jeopardises the potential of current and future generations to benefit from the use and exploration of outer space.[12] Therefore, it could be argued that the generation of space debris runs afoul of Article I of the OST because turning space into a junkyard is certainly not in the interest of all States, and the resulting congestion can hinder States from freely exploring and using outer space.[13] This is particularly so when considering that the growing amount of space debris puts at stake the long-term sustainability of outer space activities, and one may thus use Article I as a legal basis to argue that States should properly balance their interests and those of all others when undertaking space activities and make reasonable efforts to limit the creation of space debris. Yet, since according to the current technology level, the creation of space debris is not completely evitable in the course of space activities, it is difficult to derive from Article I a clear obligation to mitigate space debris.[14]

3.1.2 The Principle of Non-Appropriation of Outer Space

Article II of the Outer Space Treaty, which sets out the "non-appropriation" principle, is closely linked to the principles enshrined in Article I. It provides that:

> "Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."

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11 Von der Dunk (2015), *supra* note 7, p. 57.

12 Net Zero Space initiative Working Group 1 (Net Zero Space WG1). (November 2022). White Paper on "*Fostering Better and More Interoperable Norms: Comparing Existing Binding National Requirements Relating to Space Debris*" ("Net Zero Space WG1 White Paper"), p. 7. <https://www.netzerospaceinitiative.org/activities>. The Net Zero Space initiative will be discussed in more detail in Chapter 5 Section 5.1.4.

13 Gable, K. A. (2008). Rules Regarding Space Debris: Preventing a Tragedy of the Commons. *Proceedings of the Fiftieth Colloquium on the Law of Outer Space*, American Institute of Aeronautics and Astronautics (AIAA), p. 258. See also Jakhu, R. S. & Ahmad, M. T. (13 November 2017). The Outer Space Treaty and States' Obligation to Remove Space Debris: A US Perspective. *The Space Review*. <https://thespacereview.com/article/3370/1>.

14 Gable, ibid. See also Schladebach. (2013). Space Debris as a Legal Challenge. *Max Planck Yearbook of United Nations Law*, *17*(1), p. 69.

The primary intent of the non-appropriation principle is to reinforce Article I of the OST, in that the appropriation of (a part of) outer space by one State would encroach upon the freedom of other States to freely explore and use outer space and would go against the principle that space activities should be conducted for the benefit and in the interests of all countries.[15] As the proliferation of space debris undermines *de facto* the freedom to explore and use outer space, Force proposes that "occupation of an orbital position becomes appropriation when it is no longer being 'used' or capable of furthering a legitimate purpose".[16] Following this understanding, "indefinite non-use of space becomes appropriation when a space vehicle's useful life is ended".[17] Should this argument be upheld, States leaving defunct objects in orbit are under an obligation to remove them, otherwise this may constitute a breach of Article II of the OST. While this reading is advantageous to ADR advocates and can certainly be a direction for future legal development, it appears to go beyond the scope of what Article II prescribes.

As a matter of fact, "[a]ll objects will eventually be pulled back to Earth by friction with the Earth's atmosphere or by disturbances in the orbit", though the longer the distance between such object and the Earth is, the longer such process will take.[18] Therefore, although a non-functional object can occupy one orbital slot, it is not always the same orbital slot that such object resides in. Rather, defunct objects are "scrambling" gradually towards the Earth at varying speeds according to their orbital altitude. As such, Bittencourt Neto describes space debris as "ghost spaceships" drifting in outer space in a state of limbo and waiting for their fate: be it collided, fragmented, or finally re-entering the atmosphere.[19] Due to this constant change of orbital position, it is difficult to argue that a defunct space object has physically "appropriated" a certain orbit.

Moreover, as Freeland and Jakhu submit, "[w]hat the Outer Space Treaty prohibits is an 'appropriation by use' but not 'use' of outer space, which is guaranteed".[20] This is reflected in the formulation of Article II, which prohibits "national appropriation … by means of use or occupation". The term "use" in Article II must be considered in conjunction with Article I, which

15 Freeland, S. & Jakhu, R. (2009). Article II. In *CoCoSL Vol. 1*, p. 58.

16 Force, M. K. (2014). When the Nature and Duration of Space Becomes Appropriation: "Use" as a Legal Predicate for a State's Objection to Active Debris Removal. *Proceedings of the International Institute of Space Law 2013*, Eleven International Publishing, pp. 413-414.

17 Ibid, p. 419.

18 Masson-Zwaan, T. L. & Hofmann, M. (2019). *Introduction to Space Law*. Wolters Kluwer, p. 111.

19 Bittencourt Neto, O. de O. (2015). Chasing Ghost Spaceships: Law of Salvage as Applied to Space Debris. *Proceedings of the International Institute of Space Law 2014*, Eleven International Publishing, p. 153.

20 Freeland & Jakhu (2009), *supra* note 15, p. 58.

grants the freedom of use and exploration of outer space.[21] Read together, what Article II means is that "no amount of use of outer space will ever suffice to justify, from a legal viewpoint, a claim of" sovereignty over the whole or any part of outer space.[22] This reading is in line with the object and purpose of Article II, which, as reiterated by the US delegate to COPUOS in 1969, is to "prohibit a repetition of the race for the acquisition of national sovereignty over overseas territories" that developed in the past. Hence, the Outer Space Treaty "makes clear that no user of space may lay claim to, or seek to establish, national sovereignty over outer space".[23] In this sense, outer space is not subject to appropriation by way of use. The same reasoning is also applicable to occupation, which means that no amount of "occupation" of (a part of) outer space can justify an establishment of national sovereignty.[24] Creating a defunct object in the use of outer space does not mean that the State of registry has an intention to claim territorial jurisdiction or proprietary rights over a certain orbital spot. Should there be such an intention, the State concerned should at least use a spacecraft with the capability of station-keeping, instead of a debris object that is not controllable and decays naturally.

Considering that the continuous growth of space debris threatens the long-term sustainability of space activities, one may argue that Article II requires States "not to discard space debris to such an extent that outer space no longer can be used by all".[25] However, even this interpretation may encounter some difficulties in application, for the current space debris situation is not caused by any individual event but is the result of a cumulative process of human activities in outer space for over six decades. Therefore, although Article II sets forth a fundamental principle of space law prohibiting the establishment of sovereignty over outer space, it seems difficult to read from this Article a concrete obligation to mitigate and remove space debris.

3.1.3 Environmental Protection of Outer Space under the Outer Space Treaty

Article IX is the most fundamental article pertaining to environmental protection in the UN space treaties.[26] It consists of four sentences: the first two sentences codify several principles for carrying out activities in outer space, and the remaining two sentences deal with consultation in the event of potentially harmful interference.[27]

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21 Ibid, p. 53.
22 Ibid.
23 Ibid. Cited from Valters, E. N. (1970). Perspectives in the Emerging Law of Satellite Communications. *Stanford Journal of International Studies*, *5*, p. 66.
24 Ibid, p. 54.
25 Gable (2008), *supra* note 13, p. 259.
26 Marchisio, S. (2009). Article IX. In *CoCoSL Vol. 1*, p. 170.
27 Ibid.

3.1.3.1 International Cooperation and Due Regard

Sentence 1 of Article IX of the Outer Space Treaty provides that:

> "In the exploration and use of outer space, including the moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty."

This provision sets out two principles for the carrying out of space activities, namely the principle of international cooperation and the principle of due regard. The former principle has been further elaborated in the *Space Benefits Declaration*.[28] The second paragraph of this Declaration provides that:

> "States are free to determine all aspects of their participation in international cooperation in the exploration and use of outer space on an equitable and mutually acceptable basis. Contractual terms in such cooperative ventures should be fair and reasonable and they should be in full compliance with the legitimate rights and interests of the parties concerned, as, for example, with intellectual property rights."

This indicates that States are not under an obligation to enter into international cooperation but can freely determine their partners and means of cooperation on fair, equitable and mutually agreed conditions.[29] This principle could serve as a basis for States to conclude bilateral, multilateral, regional or global cooperative agreements and arrangements to remove dangerous debris objects out of congested orbital areas.

As to "due regard", the notion was first used in international air law, which imposes a duty of due diligence upon operators of State and military aircraft to ensure the safety of the navigation of civil aircraft.[30] The principle of due regard also appears in several provisions in the United Nations Convention on the Law of the Sea (UNCLOS).[31] For instance, Article 87(2) of the UNCLOS requires States to exercise their freedom of the high seas "with due regard for the interests of other States in their exercise of the freedom on the high seas". This general principle means that one State's exercise of its freedoms should avoid interfering with another State's enjoyment of its

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28 UN Doc. A/RES/51/122 (13 December 1996). Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries ("Space Benefits Declaration").

29 Salmeri, A. (2020). Developing and Managing Moon and Mars Settlements in Accordance with International Space Law. In *Proceedings of the 71st International Astronautical Congress 2020*. International Astronautical Federation, p. 6.

30 Marchisio (2009), *supra* note 26, p. 175.

31 United Nations Convention on the Law of the Sea (UNCLOS), adopted 10 December 1982, entered into force 16 November 1994, 1833 UNTS 3.

rights.[32] Similarly, in the space law context, the due regard principle functions as a limitation to the freedom of exploration and use of outer space granted under Article I of the OST.[33] The notion of "corresponding interests" denotes that there is no unfettered unilateral interest in outer space, which reflects the principle that the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all humankind.[34] In addition, the due regard principle can be interpreted in its context, which includes the rest of Article IX of the OST. A combined reading with the consultation clause in sentences 3 and 4 of Article IX implies that "due regard" means not to cause "potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space".[35] As such, the due regard principle requires States to make reasonable efforts to ensure that the exercise of their rights in outer space does not interfere with, or compromise the safety of, the space activities of other actors.[36]

In carrying out their space activities, a decisive interest of States consists in the interference-free exploration and use of outer space.[37] Since space debris poses risks of collision to space operations, the creation of space debris adversely affects the "corresponding interests" of all States.[38] Hence, the due regard principle can be read as imposing an obligation upon States to exercise due diligence and conduct space activities "with a certain standard of care, attention or observance" to limit the generation of space debris which may undermine the interests of other States.[39] As to the way to exercise "due diligence", reference can be made to the International Law Commission (ILC)'s *Draft Articles on the Prevention of Transboundary Harm from Hazardous Activities* of 2001 ("Draft Articles on Prevention").[40] This document has developed and explained the concept of "due diligence"

32 Schrijver, N. (2022). Chapter 15: Law of the Sea. In Rose, C. *et al*. *An Introduction to Public International Law*. Cambridge University Press, p. 311.

33 Marchisio (2009), *supra* note 26, p. 175.

34 Ibid, p. 176.

35 Byers, M., & Boley, A. (2023). *Who Owns Outer Space? International Law, Astrophysics, and the Sustainable Development of Space.* Cambridge University Press, p. 106.

36 Ibid, p. 175. Viikari (2008), *supra* note 3, p. 60. See also Marboe, I. (2012), The Importance of Guidelines and Codes of Conduct for Liability of States and Private Actors. In Marboe, I. (Ed.), *Soft Law in Outer Space: The Function of Non-binding Norms in International Space Law*, Böhlau Verlag, p. 137.

37 Stubbe, P. & Schrogl, K.-U. (2015). The Legal Significance of the COPUOS SDM Guidelines. In Hobe S., Schmidt-Tedd, B., & Schrogl K.-U. (Eds.). *Cologne Commentary on Space Law Vol. 3* ("CoCoSL Vol. 3"). Heymann, p. 646.

38 Blount P. J. (2019). On-Orbit Servicing and Active Debris Removal: Legal Aspects. In Nakarada Pecujlic, A., & Tugnoli, M. (Eds.). (2019). *Promoting Productive Cooperation Between Space Lawyers and Engineers*. IGI Global, p. 188.

39 Marchisio (2009), *supra* note 26, p. 175.

40 ILC. (2001). Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, with commentaries. *Yearbook of the International Law Commission, 2001*, vol. II, Part Two.

in some detail and its subject matter, i.e., the prevention of transboundary harm, is of direct relevance to the governance of space debris. The notion of "transboundary harm" is defined in the document as "harm caused in the territory of or in other places under the jurisdiction or control of a State other than the State of origin whether or not the States concerned share a common border".[41] The commentary to the Draft Articles on Prevention provides further elaboration on the meaning of "transboundary harm":

> "This definition includes, in addition to a typical scenario of an activity within a State with injurious effects on another State, activities conducted under the jurisdiction or control of a State, for example, on the high seas, with effects on the territory of another State or in places under its jurisdiction or control. It includes, for example, injurious impacts on ships or platforms of other States on the high seas as well."[42]

This elaboration indicates that transboundary harm includes the injurious effects caused by activities under the jurisdiction and control of one State to places under the jurisdiction and control of another State. As will be discussed later, Article VIII of the Outer Space Treaty provides that the State of registry retains jurisdiction and control over its space object. Hence, transboundary harm includes the injurious impacts caused by a spacecraft of one State to the spacecraft of another State, as they are under the jurisdiction and control of their respective registering States. In addition, outer space is expressly mentioned in the commentary to the Draft Articles on Prevention, which notes that in some instances, significant transboundary harm could occur when "there is no territorial link between a State and the activity [that causes the harm] such as, for example, activities taking place in outer space or on the high seas".[43] Therefore, the Draft Articles on Prevention are directly relevant to space activities.

The commentary to the Draft Articles on Prevention points out the dynamic character of due diligence:

> "What would be considered a reasonable standard of care or due diligence may change with time; what might be considered an appropriate and reasonable procedure, standard or rule at one point in time may not be considered as such at some point in the future. Hence, due diligence in ensuring safety requires a State to keep abreast of technological changes and scientific developments."[44]

The dynamic nature of the obligations to protect the environment is also reflected in the *Gabčíkovo-Nagymaros* judgment of the ICJ, where the Court

41 Art. 2(c), ibid.
42 Commentary to Art. 2, para. 9, ibid.
43 Commentary to Art. 1, para. 10, ibid.
44 Commentary to Art. 3, para. 11, ibid.

noted that "newly developed norms of environmental law are relevant for the implementation" of the Treaty concluded between Hungary and Slovakia in 1977 concerning the construction and operation of the Gabčíkovo-Nagymaros system of locks.[45] Similarly, the International Tribunal of the Law of the Sea (ITLOS) referred to "due diligence" as a "variable concept" which may change in light of new scientific and technological knowledge.[46] Following this line of reasoning, the duty of States to pay due regard to the rights and interests of others may also evolve with the advancement of space technologies. In the future, when reliable and cost-efficient ADR technologies become available, one may infer from the due regard principle a duty of States to actively remove their space debris from orbit in order to safeguard the corresponding interests of all States.[47]

The commentary to the Draft Articles on Prevention also notes that the economic and technical capabilities of the State concerned are factors to be taken into account in determining whether such State has fulfilled its obligation of due diligence.[48] Hence, the specific requirements imposed by the due regard principle upon a certain State should be determined in accordance with the specific circumstances of such State. Moreover, the required degree of care to exercise due diligence is proportionate to the degree of hazard involved, and therefore "[t]he standard of due diligence has to be more severe for the riskier activities".[49] As ADR activities generally involve higher risks than conventional space missions, under the due regard principle, States engaging in ADR operations should exercise a high degree of due diligence and take necessary measures to ensure that these operations are conducted in a way that does not endanger the spacecraft of other States.[50]

3.1.3.2 Avoidance of Harmful Contamination

Article IX Sentence 2 of the OST provides that:

> "States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose."

45 *Gabčíkovo-Nagymaros Project (Hungary/Slovakia), Judgment, I. C. J. Reports 1997*, para. 112.
46 *Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, para. 117.
47 Blount (2019), *supra* note 38, p. 188.
48 Commentary to Art. 3, paras. 12-14, Draft Articles on Prevention, *supra* note 40.
49 Commentary to Art. 3, paras. 11&18, ibid. See also *ITLOS Advisory Opinion of 2011*, *supra* note 46, para. 117.
50 Blount (2019), *supra* note 38, p. 183.

Sentence 2 addresses two sorts of contamination, namely forward contamination and backward contamination. As to backward contamination, only those "adverse changes in the environment of the Earth *resulting from the introduction of extraterrestrial matter*" are to be avoided. This qualification restricts its scope to pollution caused by foreign organisms or bacteriological substances which originate outside the Earth. Therefore, the re-entry of debris objects back to Earth would generally not be considered as a form of backward contamination in the context of Article IX of the OST due to their terrestrial origin.[51]

With regard to forward contamination, the term "harmful contamination" is not specified in the UN space treaties and many questions are left unanswered. In particular, a key question is what constitutes "contamination" and whether this concept includes space debris, a term not addressed in any of the UN space treaties. If the answer is affirmative, then to what extent should the creation of space debris be deemed as "harmful"? It should be recalled that due to their high speed in orbit, even a tiny piece of debris can potentially threaten space missions. The early consideration of the issue of contamination in COPUOS suggests that emphasis was placed on biological, chemical and radioactive contamination.[52] This is reflected in the 1959 Report of COPUOS where the Committee highlighted that "certain activities related to lunar and planetary impacts might result in biological, chemical, and radiation contamination" and recommended the continuation of studies to "minimize the adverse effects of possible biological, radiological, and chemical contamination".[53] The term "contamination" is also used in some space-related instruments in the context of biological and radioactive contamination. Sentence 2 of Article IX of the OST is expressly referred to in the Committee on Space Research (COSPAR) Policy on Planetary Protection as the basis for an international standard on procedures to avoid organic-constituent and biological contamination in space exploration.[54] The Nuclear Power Sources Principles of 1992 provide that the design and use of space objects with nuclear power sources on board shall "ensure with high reliability that radioactive material does not cause a significant contamination of outer space".[55]

While it is clear that the term "contamination" includes biological, chemi-

51 Stubbe, P. (2017). *State Accountability for Space Debris: A Legal Study of Responsibility for Polluting the Space Environment and Liability for Damage Caused by Space Debris*. Brill, p. 147.

52 Marchisio (2009), *supra* note 26, p. 171.

53 UN Doc. A/4141 (14 July 1959). Report of the Ad Hoc COPUOS, p. 47. See also Marchisio, ibid.

54 COSPAR. (2021). *COSPAR Policy on Planetary Protection.* Approved by the COSPAR Bureau on 3 June 2021, p. 1. <https://cosparhq.cnes.fr/scientific-structure/panels/panel-on-planetary-protection-ppp/>.

55 UNGA Resolution 47/68 of 14 December 1992, *The Principles Relevant to the Use of Nuclear Power Sources in Outer Space*, Principle 3.

cal and radioactive contamination, the question is whether this term is confined to these forms of contamination, or whether it is broad enough to also cover the generation of space debris. The Outer Space Treaty does not provide a clear answer and the issue is contested among scholars. Some scholars argue that "harmful contamination" refers only to the introduction of biological, chemical and radioactive substances into outer space.[56] Some scholars raise a question mark by stressing the vagueness of the terms used in the provision and the lack of guidance on their meanings.[57] Other scholars submit that the term should be read broadly and cover space debris because they have adverse impacts on space activities.[58]

To answer this question, it is important to interpret the term "harmful contamination" in light of the object and purpose of Article IX. As observed by Cheng, "[t]he purpose which Article IX serves may be illustrated by the United States Project West Ford, which consisted in launching into orbit a belt of tiny dipoles (needles) around the earth".[59] This implies that contamination can extend to "the mere introduction of physical material into space".[60] In addition, during the drafting process of Article IX of the Outer Space Treaty, the delegation of the Soviet Union stated that:

> "The entire draft Treaty was based on the idea of co-operation among all States. That meant, inter alia, that States must refrain from any experiment likely to interfere with the space activities of other States; *article VIII* covered that contingency by establishing machinery for consultation, and also provided that States should avoid harmful contamination."[61]

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56 Reynolds, G. H. & Merges, R. P. (Eds.). *Outer Space: Problems of Law and Policy*. 2nd ed., Westview Press, 1998, p. 209. Citing from Stubbe, P. (2010). Common But Differentiated Responsibilities for Space Debris – New Impetus for a Legal Appraisal of Outer Space Pollution. *ESPI*, *31*, p. 7. Wheeler, J. (2014). Space debris: The legal issues. *Royal Aeronautical Society*: "Space debris is not normally classed as 'harmful contamination'; the phrase being usually construed as biological or radioactive contamination." <https://www.aerosociety.com/news/space-debris-the-legal-issues>.

57 Viikari (2008), *supra* note 3, p. 60: "the OST fails to give guidance in determining the meaning of both 'harmful contamination' and 'adverse change in the environment'."

58 Marchisio (2009), *supra* note 26, pp. 176-177: "The definition of harmful contamination appears to be a broad concept, covering all possible kinds, forms or instances of harmful interference in outer space, deliberate or unintentional alike. […] In this sense, space debris are a form of harmful contamination." Stubbe & Schrogl (2015), *supra* note 37, p. 645: "Art. IX sentence 2 OST should […] be construed as prohibiting the introduction of undesired, man-made objects into outer space. This also covers space debris, which are man-made objects that have lost their function." Alby, F., Alwes, D., Anselmo, L., Baccini, H., Bonnal, C., Crowther, R., Flury, W., Jehn, R., Klinkrad, H., Portelli, C., & Tremayne-Smith, R. (2004). The European space debris safety and mitigation standard. *Advances in Space Research*, *34*(5), pp. 1260-1261.

59 Cheng, B. (1997). *Studies in International Space Law*. Oxford University Press, pp. 256-257.

60 Stubbe & Schrogl (2015), *supra* note 37, p. 645.

61 UN Doc. A/AC.105/C.2/SR.57 (12 July 1966). COPUOS LSC Summary Record - 5th Session, 57th Meeting, p. 12, emphasis added.

The "*article VIII*" mentioned in the above statement refers to the draft article proposed by the Soviet Union on the avoidance of harmful contamination of outer space, which was later incorporated into Article IX of the Outer Space Treaty. This indicates that the underlying intention of the harmful contamination provision is to avoid interfering with the space activities of others. In addition, the perception of outer space as a scientific laboratory that needs to be protected from contamination for the purpose of future scientific missions – the so called "sci-lab perception" – is perceived as having permeated the drafting process of the Outer Space Treaty and especially Article IX.[62] In accordance with this sci-lab perception, the aim of the due regard principle is to preserve outer space as an area that can be freely explored and used by all. The purpose of avoiding harmful interference and preserving outer space for future use can only be upheld if Article IX is interpreted in an evolutive manner, as new forms of interference and new threats to space sustainability can emerge with the development of space technologies. Since space debris represents a critical threat to the current and future use of outer space, all the above considerations point to the direction that the inclusion of space debris into the scope of "contamination" is in line with the purpose of Article IX.

An important question is whether the ordinary meaning of the term "contamination" is broad enough to cover physical substances like space debris, as treaty interpretation cannot go beyond the ordinary meaning of the term to be interpreted. The word "contamination" is defined in the Merriam-Webster Dictionary as "a process of contaminating: a state of being contaminated".[63] The definition of the word "contaminate" includes, *inter alia*, "to make unfit for use by the introduction of unwholesome or undesirable elements".[64] The creation of space debris can be regarded as the introduction of undesirable elements into outer space as they serve no useful purposes, and in this sense space debris "contaminates" the space environment.

As Gable submits, the term "contamination" can be broadly read as including the "deposition of space debris", and there is indeed "nothing to suggest that such a reading necessarily would be improper".[65] Evidence in this regard can be found in the US Safety Drinking Water Act, where the term "contamination" refers to "any physical, chemical, biological, or radiological substance or matter in water", and physical contamination includes "sediments".[66] While this evidence is admittedly remote from

62 Stubbe & Schrogl (2015), *supra* note 37, pp. 644-645.
63 See <https://www.merriam-webster.com/>.
64 Ibid.
65 Gable (2008), *supra* note 13, p. 259.
66 US Environmental Protection Agency. Types of Drinking Water Contaminants. <https://www.epa.gov/ccl/types-drinking-water-contaminants>.

space and comes from domestic legislation, it shows that hazardous physical substances can be covered under the ordinary meaning of the term "contamination". Therefore, while the dimensions of the space debris problem might not have been anticipated, or even contemplated, by the drafters of the Outer Space Treaty, the term "contamination" is a generic term that is broad enough to include physical contamination like space debris. This understanding is in line with the purpose of Article IX of the OST to avoid the introduction of materials into space that can interfere with the space activities of other States. This purpose provides room for an evolutive interpretation of the term "contamination", which can thus include the generation of space debris, something that might not be foreseen by the Treaty drafters but is now becoming a critical source of interference in outer space.

If space debris can be regarded as a form of "contamination", the next question is where the threshold of harmfulness lies. In other words, when would the generation of space debris be considered "harmful"? Hobe submits that "the definitional decision to limit 'space debris' to things that are in Earth orbit or re-entering the Earth's atmosphere might be relevant with respect to the qualification of 'harmful'".[67] As debris orbiting the Earth constitutes the most pressing issue to be dealt with, this kind of space debris could be considered the most "harmful" in comparison with debris generated in other areas of outer space. In addition, like the interpretation of the due regard principle, the meaning of harmfulness should be ascertained in the context of the rest of Article IX. Reading it in conjunction with the due regard principle, Stubbe submits that the contamination of space must be regarded as harmful when it "reaches a level that threatens the usability of outer space and therefore disregards the interests of other states".[68] Based on the sci-lab perception, Baker contends that the obligation to avoid harmful contamination was not intended to protect the outer space environment *per se* but only to avoid interference of one activity with another.[69] This argument can be supported by reading it in the context of sentences 3 and 4 of Article IX, where the obligation to undertake or the right to request international consultation is triggered in the event of potentially harmful interference. This also leads to an understanding that activities interfering with the current and future use of outer space can be regarded as "harmful".[70] In the absence of specific criteria, the determination of "harmfulness" has to be made on a case-by-case basis, taking all the relevant circumstances into

67 Hobe, S. (2012). Environmental Protection in Outer Space: Where We Stand and What is Needed to Make Progress with regard to the Problem of Space Debris. *Indian Journal of Law and Technology*, *8*(1), p. 5.

68 Stubbe, P. (2017). *State Accountability for Space Debris: A Legal Study of Responsibility for Polluting the Space Environment and Liability for Damage Caused by Space Debris*. Brill, p. 158.

69 Baker, H. A. (1987). Protection of the Outer Space Environment: History and Analysis of Article IX of the Outer Space Treaty. *Annals of Air and Space Law*, *12*, p. 163.

70 Ibid, p. 167.

account, including the amount and location of space debris created and the associated risks.

While the "harmful contamination" clause can arguably apply to space debris, it should be noted that the clause only requires States to "avoid" harmful contamination and to adopt "appropriate measures" to this end "where necessary". Therefore, this requirement "is at best an obligation of effort rather than an obligation of result, of *trying* in good faith rather than being *obliged* to avoid any contamination".[71] In other words, "[a]voidance may be the intent; it need not be the result", which thereby allows for "harmful contamination by default".[72] Hence, if a State has made reasonable efforts to mitigate space debris in carrying out space activities, the requirement to avoid harmful contamination would not be regarded as having been violated even when these activities ultimately create space debris. As the terms "appropriate" and "necessary" are not further defined in the Outer Space Treaty, the determination of what measures should be taken and when to take measures are largely left to the discretion of the State conducting potentially harmful space activities.[73]

In short, through teleological and evolutive interpretation, the creation of space debris can be regarded as a form of "contamination" in the context of Article IX. Such contamination is harmful if the generation of space debris threatens the long-term usability of outer space. However, the vague terms used in this provision make it difficult to verify whether there is a violation. Therefore, as Gable observes, "[w]ithout a more definite delineation, […] one could not use this provision to require and enforce measures of space debris mitigation".[74]

3.1.3.3 Appropriate International Consultation

Sentences 3 and 4 of Article IX provide a mechanism of consultation with regard to the avoidance of potentially harmful interference in outer space:[75]

> "If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A

71 Von der Dunk, F. G. (2010). Too-Close Encounters of the Third Party Kind: Will the Liability Convention Stand the Test of the Cosmos 2251-Iridium 33 Collision?. *Proceedings of the International Institute of Space Law 2009*, Eleven International Publishing, p. 205.
72 Baker (1987), *supra* note 69, p. 168.
73 Viikari (2008), *supra* note 3, p. 60.
74 Gable (2008), *supra* note 13, p. 259.
75 Marchisio (2009), *supra* note 26, p. 179.

> State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the moon and other celestial bodies, may request consultation concerning the activity or experiment."

The two sentences deal with, respectively, the obligation of the State conducting potentially harmful activities to undertake appropriate international consultations before proceeding with such activities, and the right of the potentially affected State to request consultation. The prevalent understanding of "consultation" is that the term involves "asking an opinion on, or common examination of, a specific problem".[76] Appropriate international consultation and information exchange could enable the States concerned to assess the potential risk of interference and to undertake responsive measures to mitigate such risk, such as to avoid a collision in space through effective coordination. Therefore, while the consultation clause "aims not to protect the environment per se but merely to safeguard other states' space activities", it may create a *de facto* spill-over effect for the protection of the space environment.[77]

The consultation clause provides a legal basis for States to share concerns and seek coordination. However, the practical value of the consultation clause may be compromised by its lack of specificity. The clause does neither set out procedures for consultation nor lay down dispute settlement mechanisms for disagreements arising therefrom.[78] It does not require the consultation to achieve any concrete result, nor does it expressly oblige the State concerned to effectively take into account any such result when eventually performing the planned activity.[79] In addition, the potentially affected State does not have a right of veto to bar the planned space activity.[80] As observed by Viikari, due to the ambiguity of the consultation clause, States are not particularly eager to consult with each other about their planned space activities, at least not when there are no direct deleterious impacts expected.[81] In fact, the provisions relating to consultation have seldom been directly used and invoked.

The ambiguity of the consultation clause could be remedied by reading the clause in the context of the rest of Article IX. The consultation clause is

76 Masson-Zwaan & Hofmann (2019), *supra* note 18, p. 21.
77 Viikari (2008), *supra* note 3, pp. 60-61.
78 Baker (1987), *supra* note 69, p. 169.
79 Viikari (2008), *supra* note 3, p. 61.
80 Viikari, ibid. In fact, the consultation provision is a compromise between the proponents of the possibility of veto in the event of potentially harmful interference and those States unwilling to accept a veto to their space activities. *See* Baker (1987), *supra* note 69, p. 155.
81 Viikari, ibid.

closely linked to the principles of due regard and international cooperation, in that undertaking international consultation "offers good faith evidence that states are taking the interests of other states into account and, by so doing, promotes international cooperation".[82] Therefore, a perfunctory approach towards consultation could be regarded as a failure to pay due regard to the interests of other States. Moreover, by referring to the *pacta sunt servanda* principle,[83] one can argue that States are required to undertake consultation in good faith and to make reasonable efforts to reduce potentially harmful interference. As stated in the ICJ's *Nuclear Tests* judgment:

> "One of the basic principles governing the creation and performance of legal obligations, whatever their source, is the principle of good faith. Trust and confidence are inherent in international co-operation, in particular in an age when this co-operation in many fields is becoming increasingly essential."[84]

This statement is particularly pertinent to the governance of outer space, where the inhospitable but fragile orbital environment, the high risk and heavy investment involved in space activities, and the growing dependence of humankind on space infrastructures, all call for appropriate consultation and coordination where needed to minimise the risk of harmful interference with other activities in outer space. Hence, the consultation clause should not be understood as providing "a mere formality which the State of origin has to go through with no real intention of reaching a solution acceptable to the other State".[85] In light of the good faith principle, "if the requesting state could demonstrate that potentially harmful interference would result from the proposed activity", the State planning and conducting such activity shall respond timely and properly to such request.[86] It would be difficult for a State to contend that it has complied with the consultation provisions if it undertakes activities that have been proven risky without prior consultation or proceeds with potentially harmful activities regardless of the consultation requests and results.

As noted by the COPUOS Legal Subcommittee (LSC), the space environment is "becoming increasingly complex and congested, owing to the growing number of objects in outer space, the diversification of actors in outer space and the increase in space activities".[87] The growing population of objects surrounding the Earth will make the consultation clause more important in the future, as there will be an increasing need for space

82 Baker (1987), *supra* note 69, p. 148.
83 Article 26, 1969 VCLT: "Every treaty in force is binding upon the parties to it and must be performed by them in good faith."
84 *Nuclear Tests (Australia v. France), Judgment, I.C.J. Reports 1974*, p. 253, para. 46.
85 Marchisio (2009), *supra* note 26, p. 180.
86 Baker (1987), *supra* note 69, pp. 164-165.
87 UN Doc. A/AC.105/1243 (24 June 2021). Report of the COPUOS Legal Subcommittee on its sixtieth session, para. 194.

operators to coordinate their activities for collision avoidance. Moreover, as Viikari submits, consultation and cooperation are particularly important when introducing new types of space activities whose consequences are as yet unclear.[88] Since ADR operations involve an inherent high risk of collision, there is a higher likelihood of harmful interference. Hence, States engaging in ADR operations should consult more actively with the potentially affected States. Meanwhile, the removal of a debris object under foreign jurisdiction could be regarded as "harmful interference" by the State of registry of such object. Therefore, the seeking and granting of consent for removal could be conducted through "appropriate international consultation" between the States concerned under Article IX of the OST.

3.1.4 Application of International Environmental Law to Space Debris

Article III of the Outer Space Treaty provides that States should carry out space activities in accordance with international law. This affirms the application of general international law, including international environmental law, to outer space.[89] In this sense, the principle of prevention, which functions as "the cornerstone of international environmental law",[90] is of relevance to the regulation of space debris. This principle can be traced back to the well-established Roman law maxim *sic utere tuo ut alienum non laedas* (use your own property in such a way that you do not injure that of other people), initially as a principle guiding the activities of individual citizens.[91] The principle was referred to in the *Corfu Channel* case, where the ICJ articulated the existence of certain general and well-recognised principles, including the principle that States should not "allow knowingly [their] territory to be used for acts contrary to the rights of other States".[92]

Specific to the context of environmental protection, a landmark case is the 1941 *Trail Smelter* arbitration, where the arbitral tribunal held that "under the principles of international law […] no State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence."[93] The principle of prevention was later embodied in Principle 21

88 Viikari (2008), *supra* note 3, p. 60.
89 Masson-Zwaan (2017), *supra* note 1, p. 141.
90 Dam-de Jong, D. A. (2022). Chapter 16: International Environmental Law. In Rose, C. *et al*. *An Introduction to Public International Law*. Cambridge University Press, p. 324. Sands, P., Peel, J., Fabra, A., & Mackenzie, R. (2018). *Principles of International Environmental Law.* 4th ed., Cambridge University Press, p. 201.
91 Viikari (2008), *supra* note 3, p. 150.
92 *Corfu Channel case, Judgment of April 9th, 1949: I.C.J. Reports 1949*, p. 22.
93 *Trail Smelter Arbitration (United States v. Canada)*, Arbitral Award (11 March 1941), Reports of International Arbitral Awards (RIAA), Vol. III, p. 1965.

of the *Declaration of the United Nations Conference on the Human Environment* of 1972 ("Stockholm Declaration"):[94]

> "States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."

Principle 21 of the Stockholm Declaration was reaffirmed in Principle 2 of the 1992 *Rio Declaration on Environment and Development* ("Rio Declaration").[95] The aim of Principle 21/2 is to establish a balance between "two fundamental objectives pulling opposing directions", namely the sovereign right of States over their natural resources and their responsibility to avoid environmental damage.[96] Compared to the formulation of the principle of prevention in the *Trail Smelter* arbitration, Principle 21/2 added an important element to this principle.[97] Whereas in the *Trail Smelter* dispute the arbitral tribunal referred exclusively to environmental damage caused to the territory of other States, Principle 21/2 extends the responsibility of States to avoid causing environmental damage "in areas beyond the limits of national jurisdiction". As outer space is an area beyond the jurisdiction of any State pursuant to Article II of the OST, the principle of prevention can apply to the protection of the outer space environment. The customary status of this principle was confirmed by the ICJ in the 1996 *Nuclear Weapons* advisory opinion:

> "The existence of the general obligation of States to ensure that activities within their jurisdiction and control respect the environment of other States or of areas beyond national control is now part of the corpus of international law relating to the environment."[98]

Although Principle 21/2 does not expressly stipulate a particular threshold of harm, it is commonly accepted today that the principle of prevention only concerns the prevention of harm that exceeds a minimum threshold.[99] The roots of this qualification can be traced back to the *Trail Smelter* award,

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94 Declaration of the United Nations Conference on the Human Environment, Stockholm, 16 June 1972, UN Doc. A/CONF.48/14/Rev. 1.

95 Rio Declaration on Environment and Development, Rio de Janeiro, 13 June 1992, UN Doc. A/CONF.151/26.

96 Sands *et al*. (2018), *supra* note 90, p. 201.

97 Dam-de Jong (2022), *supra* note 90, p. 324.

98 *Legality of the Threat or Use of Nuclear Weapons*, *Advisory Opinion*, *I. C. J. Reports 1996*, para. 29.

99 Brunnée, J. (2021). Harm Prevention. In: Rajamani, L., & Peel, J. *The Oxford Handbook of International Environmental Law*. 2nd ed., Oxford University Press, p. 272. Dam-de Jong (2022), *supra* note 90, p. 335.

which used the word "serious consequence".[100] This threshold is generally considered to be damage that may be qualified as "significant", defined by the ILC as "something more than 'detectable' but need not be at the level of 'serious' or 'substantial'".[101] The existence of the threshold of significance was affirmed by the ICJ in the *Pulp Mills*[102] and the *Costa Rica/Nicaragua*[103] judgments. As noted by the ILC, the term "significant" "is not without ambiguity and a determination has to be made in each specific case".[104] More specifically, the assessment of the "significance" of transboundary harm "involves more factual considerations than legal determination" and has to be made on a case-by-case basis, with account taken of the circumstances of a particular case and the period in which such determination is made. [105]

It should be further noted that the principle of prevention does not impose an obligation of result but an obligation of conduct. As such, the principle is not regarded as violated even if transboundary environmental harm actually occurs, insofar as the State concerned has taken all reasonable measures to prevent such harm.[106] This is affirmed by the ICJ in the *Pulp Mills* judgment where the Court pointed out that "the principle of prevention, as a customary rule, has its origins in the due diligence that is required of a State in its territory".[107] The Court further stated that:

> "A State is thus obliged to use all the means at its disposal in order to avoid activities which take place in its territory, or in any area under its jurisdiction, causing significant damage to the environment of another State."[108]

Therefore, the principle of prevention can be understood as imposing an obligation upon States to act with due diligence in order to avoid causing significant transboundary harm. Like the determination of "harmful" con-

100 *Trail Smelter* arbitration, *supra* note 93.

101 Commentary to Art. 2 of the Draft Articles on Prevention, *supra* note 40, para. 4. See also ILC. Draft Principles on Protection of the Environment in relation to Armed Conflicts, with commentaries: "the obligation of prevention in customary international environmental law […] only applies to harm above a certain threshold, most often indicated as 'significant harm". *Yearbook of the International Law Commission* (2022), vol. II, Part two.

102 *Pulp Mills on the River Uruguay (Argentina v. Uruguay), Judgment, I.C.J. Reports 2010*, para. 104.

103 *Certain Activities Carried Out by Nicaragua in the Border Area (Costa Rica* v. *Nicaragua)* and *Construction of a Road in Costa Rica along the San Juan River (Nicaragua* v. *Costa Rica), Judgment, I.C.J. Reports 2015*, para. 118.

104 Ibid.

105 Commentary to Art. 2 of the Draft Articles on Prevention, *supra* note 40, paras. 4 & 7.

106 Dupuy, P.-M., & Viñuales, J. E. (2018). *International Environmental Law.* 2nd ed., Cambridge University Press, p. 64. Dam-de Jong (2022), *supra* note 90, p. 335.

107 *Pulp Mills* judgment, *supra* note 102, para. 101.

108 Ibid. This statement was later reiterated in the *Costa Rica/Nicaragua* judgment. See *Costa Rica/Nicaragua* judgment, *supra* note 103, para. 104.

tamination under Article IX of the OST, there is currently no clear criterion on what constitutes "significant" environmental harm in outer space in the context of the principle of prevention. As such, the assessment of "significance" could involve the consideration of a number of factual elements such as the number of the debris created, the mass of the debris, and the orbital area where the debris is located. The IADC is currently performing work to set metrics for defining a sustainable space environment, and the release of this formula will help to provide "a quantitative interpretation of the space environment status and forecasts".[109] In addition, the Space Sustainability Rating (SSR) system, which uses a series of carefully devised metrics to assess the level of sustainability of space missions and operations, can also provide a useful point of reference for the determination of significance.[110]

3.1.5 State Responsibility for National Space Activities

With the growing participation of the private sector in space activities, especially since the start of the New Space era in 2019, there is a growing need to effectively regulate private activities in outer space to ensure that these activities are carried out in an orderly manner in compliance with the requirements under international space law. The regulation of the space activities of private entities is addressed in Article VI of the Outer Space Treaty, which provides that:

> "States Parties to the Treaty shall 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, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty."

The wording of this provision, which appeared for the first time in the 1963 *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space* ("Declaration of Legal Principles"),[111] emerged as a compromise formula reached between the US and the Soviet Union. The Soviet Union wanted to reserve space activities "solely and exclusively" for States, while the US, which at that time had already plans for private space activities, did not wish to close the door for private entities to access outer space.[112] The formulation of Article VI reconciles these two competing interests, which paves the way for private entities to conduct space activities side by side with the public actors, while stipulating that States should assume international responsibility for space activities carried on by their

109 IADC. (2023). IADC Report on the Status of the Space Debris Environment. IADC-23-01, p. 23.
110 The SSR system will be discussed in more detail in Chapter 4.
111 UN Res. 1962 (XVIII) of 13 Dec. 1963.
112 Gerhard, M. (2009). Article VI. In *CoCoSL Vol. 1*, *supra* note 5, p. 105.

private entities.[113] As such, the compromise is that the involvement of private entities in space activities is not precluded insofar as they are covered under the umbrella of the international responsibility of States.[114]

As States bear international responsibility for national space activities carried out by both governmental agencies and non-governmental entities, Article VI establishes a *lex specialis* to the general rule of attribution under international law for non-governmental space activities.[115] Under international law, "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".[116] In contrast, the conduct of private persons or entities is generally not attributable to the State, "both with a view to limiting responsibility to conduct which engages the State as an organization, and also so as to recognize the autonomy of persons acting on their own account and not at the instigation of a public authority".[117] Different from this general rule, under the "space-specific attribution rule" enshrined in the first half of Article VI sentence 1 of the Outer Space Treaty, the conduct of private entities in carrying out outer space activities is attributable to the State like that of governmental agencies.[118] As Cheng observes:

> "This is where Article VI is not merely innovatory. It is almost revolutionary. Under it, it appears that States have assumed direct State responsibility for non-governmental national space activities. This means that every thing that is done by such non-governmental entities is deemed to be an act imputable to the State as if it were its own act, for which it bears direct responsibility. Thus a breach of whatever provision of the Space Treaty by such a non-governmental entity involves immediately the State's direct responsibility, as if it were a breach by the State itself. State responsibility occurs the moment the breach is committed,

113 Ibid, pp. 105-106. Kopal, V. (2008). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. Available on the UN website: <https://legal.un.org/avl/ha/tos/tos.html>.

114 Von der Dunk, F. G. (2011). The Origins of Authorisation: Article VI of the Outer Space Treaty and International Space Law. *Space, Cyber, and Telecommunications Law Program Faculty Publications*, *69*, p. 6.

115 Stubbe (2017), *supra* note 68, p. 97.

116 See ILC. (2001). Draft Articles on Responsibility of States for Internationally Wrongful Acts (ARSIWA), with commentaries. Text adopted by the ILC at its fifty-third session, in 2001, and submitted to the General Assembly as a part of the Commission's report covering the work of that session (A/56/10), commentary to ARSIWA Chapter II, para. 2.

117 Ibid, paras. 2-3. It should be noted that a State may be held responsible for an omission when they should have acted under international law, such as to take necessary measures to prevent private entities under their jurisdiction from undertaking certain activities, but failed to act as the law so requires. In these situations, the State concerned is responsible for its own behaviour, i.e., failure to act. See ibid, para. 4.

118 Stubbe (2017), *supra* note 68, p. 97. As noted by the ILC, "[t]o show that conduct is attributable to the State says nothing, as such, about the legality or otherwise of that conduct". See ibid, para. 4.

> and not when the State is seen to have failed in its duty to prevent, suppress or repress such a breach."[119]

In other words, States assume international responsibility not only for their governmental space activities but also for those carried out by private entities. The international responsibility for the latter activities is further elaborated in Sentence 2 of Article VI, which provides that:

> "The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty."

Read in conjunction with Sentence 1, this provision requires States to perform their duty of authorisation and continuous supervision of private space activities in a manner that serves the purpose of assuring that these activities are carried out in conformity with international law.[120] As such, Article VI is often seen as a rationale for States to adopt national space legislation, as a way to implement their obligations under international space law in their national legal order.[121] By virtue of this provision, international obligations imposed on States such as the requirements to pay due regard to the activities of others and to avoid harmful contamination of outer space, can find their way to the national level and bind private entities. According to the national space law database maintained by UNOOSA, there are over forty countries that have enacted their national laws and regulations relating to the exploration and use of outer space.[122] It should be noted that Article VI does not expressly require States to establish national space legislation, and States may resort to other means to authorise and continuously supervise private activities in outer space, such as by doing so on an *ad hoc* basis through administrative procedures.[123] Yet, setting up a licensing regime under national law for the regulation of private space activities represents the easiest way to implement the obligation of authorisation and continuing supervision.[124] This method also has the advantage of providing regulatory certainty and predictability to private space operators.

Like for other space activities, States have international responsibility to authorise and continuously supervise ADR activities of private entities and to ensure that these activities are carried out in conformity with interna-

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119 Cheng, B. (1998). Article VI of the 1967 Space Treaty Revisited – 'International Responsibility', 'National Activities', and 'The Appropriate State'. *Journal of Space Law*, *26*(1), p. 15.

120 Ibid.

121 Masson-Zwaan & Hofmann (2019), *supra* note 18, p. 20.

122 See UNOOSA. National Space Law Database. <https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/index.html>.

123 Gerhard, M. (2009). Article VI. In *CoCoSL Vol. 1*, p. 119.

124 Masson-Zwaan, T. L. (2023). Widening the Horizons of Outer Space Law. Doctoral Thesis at Leiden University, *Meijers-reeks*, p. 11.

tional law. An example of the authorisation for private ADR activities is the licence granted by the UK Space Agency to the ELSA-d mission in March 2021, which sets a leading precedent for licensing future missions involving complex RPO in space, such as ADR.[125] The ELSA-d mission is commanded and controlled by Astroscale UK from a mission operations centre located in Harwell, UK.[126] This falls within the scope of the UK Space Industry Act of 2018, which applies to, among others, space activities carried out in the UK, including "operating a space object".[127] Therefore, a UK licence is required for the ELSA-d mission. As part of the licence application, Astroscale UK provided information to the UK Space Agency regarding the following subjects:

1. ELSA-d mission description and overview
2. Servicer and client spacecraft descriptions and orbital parameters
3. Safety and mission assurance
4. Debris mitigation
5. Deorbit, passivation, and re-entry hazards".[128]

It can be seen that mission safety and space debris mitigation are important elements for consideration in the licensing process. In particular, as ADR operations involve in general a higher risk of collision than other space activities, a clear process has been established for the ELSA-d mission to avoid collisions between the servicer and client spacecraft, as well as between them and space objects of other parties.[129]

As the ELSA-d spacecraft needs to communicate with several US earth stations, a request for authorisation has also been made to the US Federal Communications Commission (FCC) which regulates the use of radio frequency for space activities.[130] A "description of the design and operational strategies that will be used to mitigate orbital debris" is required for the application.[131] The FCC's rules provide that for non-US-licensed space stations, this requirement "can be satisfied by demonstrating that debris mitigation plans for the space station(s) for which U.S. market access is requested are subject to direct and effective regulatory oversight by the national licensing authority".[132] As the ELSA-d mission has already been licensed by the UK,

125 Astroscale. (12 March 2021). ELSA-d Mission Licence Approved by UK Space Agency. <https://astroscale.com/elsa-d-mission-licence-approved-by-uk-space-agency/>.
126 FCC Report: ELSA-d CONOPS and Debris Mitigation Overview ("ELSA-d CONOPS Report"), p. 1. <https://fcc.report/IBFS/SES-STA-INTR2020-00086/2166969.pdf>.
127 Sec. 1, UK Space Industry Act. The Act received Royal Assent on 15 March 2018. <https://www.legislation.gov.uk/ukpga/2018/5/contents/enacted>.
128 ELSA-d CONOPS Report, *supra* note 126, p. 1.
129 Ibid, p. 11.
130 FCC International Bureau. (29 September 2020). Commission Request regarding Astroscale ELSA-d mission. <https://fcc.report/IBFS/SES-STA-20200113-00043/2729900>.
131 47 Code of Federal Regulations (CFR) § 25.114(d)(14).
132 47 CFR § 25.114(d)(14)(v).

in November 2021 the FCC authorised the communications of US earth stations with the ELSA-d spacecraft, after having evaluated its application.[133]

The ELSA-d case exemplifies the application of Article VI of the Outer Space Treaty in practice where the UK authorises an ADR technology demonstration mission through its licensing regime. In view of the complexity of ADR operations and the high risks involved, it would be beneficial for States to establish national guidelines to enhance the safety of ADR activities, and the US and Japan have already taken some initiatives in this regard.[134] Meanwhile, with more States engaging in ADR activities, it would be advisable for States to adopt guidelines at the international level so as to ensure consistency among different national guidelines. As shown in the ELSA-d case, an ADR operation may possibly require the authorisation of more than one State. Harmonised standards could facilitate the mutual recognition of licences among States, and a streamlined process would alleviate the administrative burdens of private entities in the application for authorisation.

3.2 *Issue 2*: International Liability for Damage Caused by Space Objects

This section will address the liability regime under current international space law and discuss how this regime may impact ADR activities. Article VII of the Outer Space Treaty establishes a general rule of liability for damage caused by space objects:

> "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."

As space activities are inherently dangerous, imposing liability for damage inflicted by space activities is the counterpart of the enjoyment of the freedom to explore and use outer space granted under Article I of the OST.[135] In this sense, the rationale for imposing liability on the States involved in the launch of a space object for damage caused by such object to other States is "the interest of the international community in securing a reliable State liability regime to respond to the ultra-hazardous activities of launching States".[136]

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133 FCC. (8 August 2022). Facilitating Capabilities for In-space Servicing, Assembly, and Manufacturing. FCC 22-66, para. 5. <https://docs.fcc.gov/public/attachments/FCC-22-66A1.pdf>.

134 This will be discussed in more detail in Chapter 5 Section 5.2.

135 Kerrest, A. & Smith, L. J. (2009). Article VII. In *CoCoSL Vol. 1*, p. 130

136 Ibid, p. 129.

The general principle of liability under Article VII of the Outer Space Treaty has been elaborated in the Liability Convention, which establishes two separate patterns of liability, namely absolute liability and fault-based liability. The former applies to damage caused by a space object on the surface of the Earth or to aircraft in flight, and the latter applies to damage caused in outer space.[137] The rationale for distinguishing between absolute and fault-based liability according to the location of the damage caused is the degree of involvement in ultra-hazardous activities.[138] Entities carrying out space activities are regarded as having accepted the high risks associated with the operation of a spacecraft and are therefore on a more or less equal footing for risk sharing.[139] In contrast, uninvolved third parties on the ground cannot be regarded as having accepted such risks, which thus deserve special protection.[140]

For the establishment of liability, the injured State needs to prove the existence of "damage", defined in the Liability Convention as "loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations".[141] This definition speaks only of personal and property damage and does not mention damage to the space environment. As observed by Masson-Zwaan:

> "It is not clear whether this definition includes harm to the extra-terrestrial environment per se, without harm to persons or property. Environmental pollution may cause harm to persons or property; but then it would be the 'secondary' damage to persons or property resulting from the 'primary' damage to the environment that gives rise to compensation under the Convention".[142]

When there is no such "secondary" damage, it is generally understood that damage caused to the space environment per se does not give rise to liability under the Liability Convention. Hence, an entity creating space debris need not worry much about the risks of liability exposure, insofar as there is no subsequent damage caused to the property or persons of another State.[143] In this sense, the Liability Convention does not provide a strong incentive for States to limit the creation of space debris in the course of their space activities.

Under the Liability Convention, liability for damage caused by a space object is attributed to the "launching State" of such object, which is defined

137 Arts. II & III, Liability Convention.
138 Stubbe & Schrogl (2015), *supra* note 37, p. 647.
139 Ibid. See also Marboe (2012), *supra* note 36, p. 124. Masson-Zwaan & Hofmann (2019), *supra* note 18, pp. 27-28.
140 Ibid.
141 Art. I(a), Liability Convention.
142 Masson-Zwaan (2017), *supra* note 1, p. 142.
143 Viikari (2008), *supra* note 3, p. 69.

in the Convention as "(i) A State which launches or procures the launching of a space object; (ii) A State from whose territory or facility a space object is launched".[144] The liability regime is State-centered, meaning that a claim for compensation can only be presented to the launching State and not to a private entity.[145] Also, only States may present a claim, and private entities have no direct course of action under the Liability Convention but depend on their national States to present a claim for them.[146]

Wherever the location of damage, the Liability Convention is only applicable to damage caused by "space object". Accordingly, whether the Liability Convention can apply to damage caused by space debris depends on whether space debris is covered under the term "space object". Therefore, Section 3.2.1 will assess the relation between the terms "space object" and "space debris". Sections 3.2.2 and 3.2.3 will then discuss the two separate liability patterns established under the Liability Convention, namely absolute liability for damage caused on the ground and fault-based liability for damage caused in outer space. This will be followed by a discussion in Section 3.2.4 on the liability for knock-on collisions, i.e., situations where the debris created in a collision subsequently causes damage to third parties. Finally, Section 3.2.5 will address how the current liability regime may affect ADR activities.

3.2.1 Relation Between "Space Object" and "Space Debris"

The term "space debris" is neither mentioned nor defined in the UN space treaties, which use the operative terminology "space object". According to Article I (d) of the Liability Convention, the latter term "includes component parts of a space object as well as its launch vehicle and parts thereof". The same definition has been adopted in Article I(b) of the Registration Convention. This definition is "silent as to when, if at all, a space object or its component or fragmented parts, ceases to be a 'space object'.[147] In other words, the question is whether a space object can cease to exist and if so, when does this happen? It should be noted that each object launched into outer space will ultimately become non-functional after it has served its intended mission. In fact, some objects, such as rocket stages, are only designed to function till they reach a certain altitude, and will thus become non-functional shortly after launch. However, in terms of collision risks, non-functional objects, i.e., space debris, are no less dangerous than active satellites, especially when considering that they do not have manoeuvrabil-

144 Art. I(c), Liability Convention.
145 Art. IX, ibid.
146 Art. VIII, ibid. Masson-Zwaan (2017), *supra* note 1, p. 142.
147 Chatterjee, J. (2015). Legal Issues relating to Unauthorised Space Debris Remediation. *Proceedings of the International Institute of Space Law 2014*, Eleven International Publishing, p. 17.

ity to avoid collisions and that the majority of them are difficult or impossible to be tracked and dodged due to their small sizes.

The silence on functionality in the definition of "space object" implies that a space object does not lose its status when it becomes non-functional. As Froehlich notes, "[w]hile the UN space treaties make clear that space objects include also their component parts, none of them see functionality as relevant in defining a space object".[148] Reading otherwise would lead to an unreasonable and absurd result, for a State could avoid its liability for damage caused by its non-functional object by simply claiming that such object had already ceased to function before the damage occurred. Therefore, a non-functional artificial object in orbit should be regarded simultaneously as a "space object" in the context of the UN space treaties and a piece of "space debris" as per the IADC/COPUOS definition.[149] Hence, as Masson-Zwaan submits, "an inactive satellite or even a lost screwdriver should logically still be regarded as (a component part of) a space object for which responsibility remains with the launching State and which can give rise to liability of the launching state, if damage occurs".[150]

The next question is that for the qualification as "space object", whether a distinction should be made between intact debris objects such as defunct orbital stages and debris fragments. Some scholars argue that the concept of space object (and its component parts) "is not broad enough to encompass all classes of space debris", which covers "[i]nactive satellites, rocket motors and other operational debris", but does not include "fragments and microparticular matter".[151] The opposite view is that when a space object is fragmented into pieces, these fragments can be treated as "component parts" of the original object and should thus still be regarded as "space objects".[152] This dissertation advocates the latter view. The dictionary meaning of "component part" is "something (as a building or part of a building) that cannot be removed without substantial damage to itself or to the immovable

148 Froehlich, A. (2019). The Right to (Anticipatory) Self-Defence in Outer Space to Reduce Space Debris. In Froehlich, A. (Ed.). *Space Security and Legal Aspects of Active Debris Removal*, Springer, p. 74.

149 Su, J. (2016). Active Debris Removal: Potential Legal Barriers and Possible Ways Forward. *Journal of East Asia and International Law*, *9*(2), p. 408.

150 Masson-Zwaan (2017), *supra* note 1, p. 142.

151 Kim, Y., Popova, R., Schaus, V., Rossi, A., Alessi, E. M., Colombo, C., Gkolias, I., & Tsiganis, K. (31 January 2019). Proposal for Improved Mitigation Procedures and Guidelines. European Commission Horizon 2020: The Revolutionary Design of Spacecraft through Holistic Integration of Future Technologies - ReDSHIFT. Deliverable 2.4 "*Proposal for Improved Mitigation Procedures and Guidelines*", p. 10.

152 Cheng (1997), *supra* note 59, p. 506. Mudge, A. G. (2022). Incentivizing 'Active Debris Removal' Following the Failure of Mitigation Measures to Solve the Space Debris Problem: Current Challenges and Future Strategies. *Air Force Law Review*, *82*(1), p. 120. Chung, G. (2019). Jurisdiction and Control Aspects of Space Debris Removal. In Froehlich, A. (Ed.). *Space Security and Legal Aspects of Active Debris Removal*, Springer, p. 35.

property to which it is attached",[153] or "something determined in relation to something that includes it".[154] Therefore, it is possible to regard something released or detached from a spacecraft as the latter's "component part". In addition, since the amount of debris fragments substantially outnumbers that of intact space objects, accidental collisions are more likely to be caused by the former than the latter.[155] Hence, excluding debris fragments from the scope of "space object" would run contrary to the victim-oriented spirit of the Liability Convention, which is reflected in its preamble recognising "the need to elaborate effective international rules and procedures concerning liability for damage caused by space objects and to ensure, in particular, the prompt payment under the terms of this Convention of a full and equitable measure of compensation to victims of such damage". Such exclusion could even disincentivise States from minimising the risk of post-mission break-ups of their space objects, for after these break-ups, States would be exonerated from their liability for the subsequent damage caused by the debris fragments. A further justification for the inclusion of debris fragments into the scope of "space object" can be found in Article IV of the Liability Convention, which will be addressed in Section 3.2.4 below.

While the definition of the term "space object" is commented by some scholars as a "circular definition" which "fails to define the term 'space object' exhaustively while merely providing a vague inclusive boundary for the term",[156] it is this very character that suggests that any piece of space debris can be subsumed under the scope of this term. It is important to note that the purpose of defining the term "space object" is to establish liability for damage caused by a space object. Therefore, the phrase "'space object' includes the component parts of a space object" in the definition will only make practical sense when a component part is somehow detached or broken off from the original object and becomes a *distinct* object on its own. This is because before such separation, any damage caused by the component part would be directly attributed to the original object. For instance, a solar panel of a satellite is beyond doubt a "component part" of such satellite. However, when being an integral part of the satellite, any damage caused by the solar panel to other space objects through collision will evidently not be considered as damage caused by the solar panel, but by the satellite itself. It is only after the solar panel is detached from the satellite, whether as an intact item due to a loose screw, or as a broken part due to the disintegration of the satellite, that the term "component part" is activated and such solar panel becomes capable of causing damage as

153 Merriam-Webster Dictionary: <https://www.merriam-webster.com/legal/component%20part>.

154 The Free Dictionary: <https://www.thefreedictionary.com/component+part>.

155 ESA. (Last updated 12 September 2023). Space Debris by the Numbers. <https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers>

156 Chatterjee (2015), *supra* note 147, p. 17. Popova & Schaus (2018), *supra* note 2, p. 10.

a "space object" from a legal point of view. It is possible that such solar panel may later be disintegrated into more "component parts", and so forth. Therefore, it is reasonable to regard any debris piece detached from its parent body as a "space object" in view of the circular nature of the definition of this term.

Based on the above analysis, it can be concluded that the inclusion of non-functional satellites and rockets as well as debris fragments which have separated from these objects within the scope of "space object" is in line with both the definition of "space object" and the victim-oriented spirit of the Liability Convention. As articulated by Perek, "space debris are space objects which terminated their functions or fragmented from their parent bodies".[157] As such, space debris should be regarded as a subset of space objects under international space law. Hence, the Liability Convention can apply to damage caused by space debris.

3.2.2 Absolute Liability for Damage Caused on the Ground

Article II of the Liability Convention provides for a regime of absolute liability:

> "A launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the Earth or to aircraft in flight."

Under this Article, for a claim of compensation, the injured State has to prove the existence of damage, identify the space object causing damage, and establish the causality between the damage and the space object concerned. The first and only time the Liability Convention has been invoked thus far concerns damage caused on the surface of the Earth by the re-entry of Cosmos 954, and the dispute did not go to an international court but was settled through negotiations between Canada and the Soviet Union.[158]

For ADR operations, Article II could be relevant in situations where the target debris object is de-orbited and re-enters into Earth's atmosphere. By mission design, the removal spacecraft may be disposed of together with the de-orbited target debris object as a combined stack, or it can re-boost

157 Perek, L. (2005). Ex Factor Sequitur Lex: Facts which Merit Reflection in Space Law in Particular with Regard to Registration and Space Debris Mitigation. In Benkö, M., & Schrogl, K. U. (Eds.). *Space Law: Current Problems and Perspectives for Future Regulation*. Eleven International Publishing, p. 41. See also Frigoli, M. (2019). Between Active Debris Removal and Space-Based Weapons: A Comprehensive Legal Approach. In Froehlich, A. (Ed.). *Space Security and Legal Aspects of Active Debris Removal*, *16*, Springer, p. 74: "A broad interpretation of the term 'space object' could arguably include 'space debris', considering that both space objects at the end of the their life-time and orbital fragments of the same are space debris".

158 See Chapter 2 Section 2.2.3 *infra*.

into a higher orbit to remove another debris object. In the latter case, the de-orbited debris object may re-enter in an uncontrolled fashion, for it does not have any propellant to adjust its trajectory. If the de-orbited debris survives re-entry and crashes into an aircraft in flight or causes damage to persons or property on the ground, the launching State of such object would be absolutely liable for the damage caused. Therefore, the re-entry risk and the potential liability exposure are issues to be considered by States engaging in ADR activities in the contemplation of post-mission disposal strategies.

3.2.3 Fault-Based Liability for Damage Caused in Outer Space

Article III of the Liability Convention provides for a fault-base liability regime:

> "In the event of damage being caused elsewhere than on the surface of the Earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible."

The phrase "elsewhere than on the surface of the Earth" is generally understood as meaning outer space.[159] To establish liability for damage caused by a space object, the victim State needs to prove "fault" of the launching State or of persons for whom the latter State is responsible. However, the Liability Convention does not define "fault" or provide a standard of care for the determination of "fault". According to the *Max Planck Encyclopedia of Public International Law*, "fault" is used to describe "a set of blameworthy psychological attitudes of the author of an act or an omission".[160] Such attitudes consist "either in the fact that the author of the act, or omission, albeit without intention or wish to cause an unlawful event, consciously conducts himself differently from the way which could avoid the event – *culpa* in its various degrees – or in the fact that the author foresees the unlawful events and facts – or omits an act – in order to cause it (*dolus*)".[161] On the basis of this definition, von der Dunk submits that "a 'fault' presumes a *choice* for the person at fault, a choice between at least two options of 'conduct', where that person whether by 'intention' or 'negligence' chose an option (that is by flawed 'judgment') leading to the harm concerned, where choosing another

159 As observed by Smith and Kerrest, the use of this phrase instead of directly referring to outer space in Article III is to avoid gaps in its application with regard to Article II of the Liability Convention. For instance, a collision between an ascending space object which has not reached outer space and a re-entering space object will fall under Article III. See Smith, L. J. & Kerrest, A. (2013). Article III (Fault Liability) LIAB. In Hobe S., Schmidt-Tedd, B., & Schrogl K.-U. (Eds.). *Cologne Commentary on Space Law Vol. 2* ("CoCoSL Vol. 2"). Heymann, p. 132.

160 Palmisano, G. (2007). Fault. *Max Planck Encyclopedia of Public International Law*, para. 5.

161 Ibid.

option would not have led to such harm".[162] Hence, if a State wilfully uses its space object to cause damage to a satellite of another State, the former State can presumably be held at fault.

However, in the absence of an established standard of care, it is difficult to prove "negligence" for damage caused in outer space. This difficulty can be illustrated in the accidental collision between American Iridium-33 and Russian defunct Cosmos 2251, the first-ever collision between two intact satellites in outer space.[163] Since neither Russia nor the US claimed compensation for the damage caused by this collision, the Liability Convention missed a chance to be tested and clarified.[164] Still, one may wonder which State would be held liable for the accident, if this were to be decided before an international court. As to Russia, while leaving a defunct satellite adrift in orbit in an uncontrolled fashion can beyond doubt pose risks to other space objects, Cosmos 2251 ceased to function well before the adoption of any international instruments recommending post-mission disposal measures. Therefore, Russia may argue that it should not be held at fault for not de-orbiting Cosmos 2251 and that Iridium should move its satellite to avoid the collision because Cosmos 2251 was a derelict satellite incapable of manoeuvring.[165] Meanwhile, since Iridium, the owner of Iridium 33, was incorporated and headquartered in the US, should the US be blamed for the collision? It should be noted that even the US space surveillance network, which is generally regarded as the most advanced space tracking system, could not precisely predict the occurrence of this collision.[166] In fact, even if the conjunction risk could be estimated, Iridium could still contend that it is not obliged to perform CAMs because the current space debris mitigation guidelines only recommend operators to "consider" CAMs when "available orbital data indicate a potential collision", and should therefore not be held faulty for the accident.[167]

The 2009 accident shows that on top of the ambiguity of the term "fault", factual elements such as the availability and reliability of orbital data for the calculation of collision risk can also complicate the task of establishing fault. It has been noted that different sources of information about the orbital

162 Von der Dunk (2010), *supra* note 71, p. 203.
163 See Chapter 2 Section 2.2.1 *infra*.
164 The reason for the absence of formal claims for compensation might be that the accident did not result in substantial economic damage on either side: Cosmos 2251 was already a defunct satellite before the collision and Iridium had a spare satellite to replace Iridium 33 so there was barely any interruption in service provision to its clients. See von der Dunk (2010), *supra* note 71, p. 204. Masson-Zwaan & Hofmann (2019), *supra* note 18, p. 28.
165 Listner, M. (2012). Iridium 33 and Cosmos 2251 three years later: where are we now?. *The Space Review*. <https://thespacereview.com/article/2023/1>.
166 Von der Dunk (2010), *supra* note 71, p. 204.
167 Listner, M. (2012), *supra* note 165.

location of space objects are not always in agreement.[168] This could lead to diverging results of conjunction assessment and calculation of collision risks. Finally, the lack of virtual possibility to conduct on-site investigations also makes it difficult to look for the "real" causes of the accidents.[169] The accuracy of orbital data will likely be enhanced through the advancement of space monitoring technologies. The development of soft law can also facilitate data communication by providing recommendations on achieving uniformity in the sharing of information, such as the harmonisation of standard units for basic orbital parameters.[170] While technological advancement may contribute to the ascertainment of fault from an evidentiary perspective, such advancement cannot solve the problem regarding the ambiguity of "fault" for the application of the Liability Convention. This problem could appear again in the context of Article IV of the Liability Convention, which applies to situations where space debris created by a collision between two space objects subsequently causes damage to a third party. This Article will be discussed in the next section.

3.2.4 Liability for Damage Caused by Knock-on Collisions

The aforementioned collision between Iridium 33 and Cosmos 2251 occurred in 2009 at an orbital altitude of 790 km, which is an area heavily used by communications satellites.[171] The large amount of debris created as a result of this collision might trigger a chain of collisions because of the physical characteristics of outer space.[172] In fact, shortly after the collision, a NASA Earth observation satellite had to conduct a collision avoidance manoeuvre to dodge debris resulting from the collision.[173] In addition, the ISS has performed several manoeuvres to reduce collision risk with fragmentation debris from the 2009 accident, and in some instances the ISS crew sheltered in the Soyuz spacecraft docked to the ISS as a precaution.[174] If the debris generated in the 2009 collision causes further damage to a third party, this would bring into play Article IV of the Liability Convention.

The liability patterns under Article IV accord with the patterns established

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168 Palmroth, M., Tapio, J., Soucek, A., Perrels, A., Jah, M., Lönnqvist, M., Nikulainen, M., Piaulokaite, V., Seppälä, T., & Virtanen, J. (2021). Toward Sustainable Use of Space: Economic, Technological, and Legal Perspectives. *Space Policy*, *57*, 101428, pp. 7-8.

169 Von der Dunk (2010), *supra* note 71, p. 205.

170 Sec. 2(a), UN Doc. A/RES/62/101 (10 January 2008). Recommendations on enhancing the practice of States and international intergovernmental organizations in registering space objects.

171 Masson-Zwaan, T. L. (2009), Space law and the satellite collision of 10 February 2009, *COSPAR's Information Bulletin: Space Research Today*, *174*, p. 9.

172 Ibid.

173 Johnson (2009), *supra* note 38, p. 10.

174 NASA Orbital Debris Program Office. (2012). Increase in ISS Debris Avoidance Maneuvers. In *Orbital Debris Quarterly News*, *16*(2), pp. 1-2.

in Articles II and III of the Liability Convention which depend on the location of damage. Article IV(1) reads:

> "In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, and of damage thereby being caused to a third State or to its natural or juridical persons, the first two States shall be jointly and severally liable to the third State, to the extent indicated by the following:
> a. If the damage has been caused to the third State on the surface of the Earth or to aircraft in flight, their liability to the third State shall be absolute;
> b. If the damage has been caused to a space object of the third State or to persons or property on board that space object elsewhere than on the surface of the Earth, their liability to the third State shall be based on the fault of either of the first two States or on the fault of persons for whom either is responsible."[175]

Article IV affirms the understanding that debris fragments can be subsumed under the term "space object", for it applies to a situation where two objects collide and the debris resulting from the collision causes damage to a third State. Therefore, an interpretation excluding debris fragments from the scope of "space object" would lead to an absurd result, for there is no good reason to explain why damage caused by debris fragments generated as a result of a collision can trigger the application of the Liability Convention by virtue of Article IV, while that caused by debris fragments generated by other means such as an accidental explosion resulting from residual fuel cannot. Hence, a contextual reading indicates that debris fragments should still be regarded as "space objects".

The provision that the first two States involved in a collision are "jointly and severally liable" to the third State means that the third State may present a claim to each or both of them for the entire compensation due under the Liability Convention.[176] This, again, reflects the victim-oriented spirit of the Liability Convention. The third State does not need to identify which space object caused the damage but needs only to establish that the damage incurred was caused by a space object that was involved in the initial collision event.[177] The burden of compensation for the damage should be apportioned between the first two States in accordance with the extent to which they were at fault.[178] If the degree of fault attributable to them cannot be established, the burden of compensation should be apportioned equally between them.[179]

175 Article IV(1), Liability Convention.
176 Article IV(2), ibid.
177 Smith, L. J. & Kerrest, A. (2013). Article IV (Damage Caused Jointly by Two or More Space Objects/Third Party Liability) LIAB. In *CoCoSL Vol. 2*, p. 139.
178 Article IV(2), Liability Convention.
179 Ibid.

3.2.5 Implications of the Liability Regime for ADR Activities

The problem with the current liability regime for space activities is that it fails to create a favourable environment for ADR. As noted by Mudge, this regime disincentivises ADR when it comes to both the States creating space debris and the States wishing to carry out ADR operations.[180] As to debris-creating States, leaving space debris in orbit may incur potential liability if their space debris later causes damage to other space objects. However, to establish the liability of the debris-creating State, the victim State needs to identify the "launching State" of the debris involved, prove the existence of damage falling under the definition of "damage" contained in the Liability Convention, establish the causal link between the debris and the damage caused, and prove "fault" on the part of the launching State.[181] Specifically, the lack of a specific standard of fault, coupled with the difficulty of collecting evidence due to the remoteness of outer space, "will make the burden of proof quite heavy" for the claimant State.[182] This is perhaps one of the reasons why no claim for liability has ever been brought under the Liability Convention for damage caused in outer space, even though collisions have occurred.[183] In view of the complexity of holding a launching State liable for the damage its space debris causes, the current fault-based liability regime for damage caused in space does not provide a strong incentive for States to avoid or limit the generation of space debris. Rather, since absolute liability applies to damage caused on the surface of the Earth, States may be more inclined to leave their large and massive debris objects in space than to de-orbit them, for it may involve even greater risk of liability if these objects survive re-entry and cause damage on the ground.

At the same time, the Liability Convention may disincentivise States interested in ADR from undertaking ADR efforts. As noted in Chapter 2, ADR operations are inherently risky activities as collisions may occur and cause more debris if things go wrong. The debris fragments generated by collisions may cause further damage to other space objects. In addition, the frequent alteration of orbits in ADR operations results in a higher risk of collision with other space objects, which may also lead to knock-on collisions. Without knowing what "fault" means, States engaging in space activities are uncertain about how to avoid or reduce the risk of being held at fault.[184] Facing this uncertainty, States would be discouraged from removing either their own debris or space debris of other States on a for-hire basis.[185]

180 Mudge (2022), *supra* note 152, p. 91.
181 Masson-Zwaan (2009), *supra* note 171, pp. 7-8.
182 Masson-Zwaan & Hofmann (2019), *supra* note 18, p. 28.
183 Ibid.
184 Masson-Zwaan (2023), *supra* note 124, p. 224.
185 Mudge (2022), *supra* note 152, pp. 131-132.

In sum, the ambiguity surrounding the meaning of "fault" could raise liability concerns and thus constitute a legal hurdle for ADR activities. Under the current liability regime, States may tend to "ignore their space debris and leave it on-orbit" rather than to actively remove them from space.[186] Hence, to promote efforts to actively and safely remove space debris, it is necessary to clarify the meaning of "fault" for the establishment of liability for damage caused in outer space. How soft law may contribute to filling the gap of ambiguity in the current liability regime of space law will be discussed in Chapter 4.

3.3 *Issue 3*: Prior Consent as a Prerequisite for the Removal of Debris under Foreign Jurisdiction

This section will discuss the sovereign and ownership rights over space objects. Section 3.3.1 will discuss the jurisdiction and control retained by the State of registry over its space object, as well as the ownership right of objects launched into space, as set out in Article VIII of the Outer Space Treaty. As Article VIII of the OST has been elaborated in the Registration Convention, the rules of registration of space objects set forth in the latter Convention will be addressed in Section 3.3.2. As the jurisdiction and control over space objects may constitute an obstacle to debris removal, such as in situations where the State of registry fails to remove its dangerous debris object and also refuses to grant permission to others to do so, a question arises as to whether there are any legal grounds to justify non-consensual removal. Therefore, Section 3.3.3 will discuss some circumstances under general international law that may provide a defence for the non-consensual removal of space objects under foreign jurisdiction when certain conditions are met. Finally, the potential implications of non-consensual removal to international peace and security will be assessed in Section 3.3.4.

3.3.1 Jurisdiction, Control, and Ownership Regarding Space Objects

This section will discuss the question as to whether a State may remove a piece of space debris under the jurisdiction of another State. This issue is addressed in Article VIII of the Outer Space Treaty. The first sentence of this Article provides that:

> "A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body."

Jurisdiction, as an aspect of State sovereignty, "refers to a state's competence under international law to regulate the conduct of natural and juridical

186 Ibid, p. 131.

persons".[187] The notion of regulation embraces the exercise of all governmental authorities including legislative, executive and juridical.[188] Hence, Article VIII of the Outer Space Treaty affirms the power of States to enact and enforce law in relation to space objects carried on their registries.[189] Control means "the exclusive right and the actual possibility to supervise the activities of a space object" and any personnel thereof.[190] The whole concept of "jurisdiction and control" should not be read separately but as one block: "jurisdiction should induce control, and control should be based on jurisdiction".[191] Critically, the competence to "control" a space object is more than a technical capability.[192] Hence, a State's jurisdiction and control over its registered space object continues even if its technical control over such object is lost.[193] This can be understood by looking at the two dimensions of State sovereignty, an internal one and an external one. The internal dimension refers to the highest authority of a State to regulate its domestic affairs, and the external one indicates that a State cannot be submitted to the authority of another State without its consent, as all States are legally equal under international law.[194] Accordingly, the right of jurisdiction and control means not only a State's power to regulate and supervise its space object but also its competence to preclude other States from manipulating, capturing or relocating such object without its permission.

Article VIII speaks of "object launched into outer space" without adding further qualification, and it does not prescribe any temporal factor limiting the retention of a State's jurisdiction and control over its registered space object.[195] This implies that a State can continue to exercise jurisdiction and control over its registered space object even after such object loses functionality. In other words, "jurisdiction over a space object is not affected if and when it eventually becomes space debris".[196] This reading is in line with the foregoing analysis that the exercise of jurisdiction and control does not

187 Crawford, J., & Brownlie, I. (2019). *Brownlie's Principles of Public International Law*, 9th ed., Oxford University Press, p. 440. For a general discussion on the notions of "sovereignty" and "jurisdiction" in international law see e.g., Truxal, S. (2017). *Economic and Environmental Regulation of International Aviation: From Inter-national to Global Governance*. New York: Routledge, pp. 35-49.

188 Ibid.

189 Schmidt-Tedd, B. & Mick, S. (2009). Article VIII. In *CoCoSL Vol. 1*, p. 157.

190 Ibid.

191 Ibid. See also Lafferranderie, G. (2005). Jurisdiction and Control of Space Objects and the Case of an International Intergovernmental Organisation (ESA). *German Journal of Air and Space Law (ZLW)*, *54*, p. 231.

192 Schmidt-Tedd & Mick (2009), ibid.

193 Mudge (2022), *supra* note 152, p. 124.

194 Van den Driest, S. (2022). Chapter 3: Subjects, Statehood, and Self-Determination. In Rose, C. *et al*. *An Introduction to Public International Law*. Cambridge University Press, p. 42.

195 Chung (2019), *supra* note 152, p. 33. See also Viikari (2008), *supra* note 3, p. 82: "Article VIII of the Outer Space Treaty assigns the jurisdiction, control and ownership of a space object to the state of registration for an indeterminate period of time […]".

196 Bittencourt Neto (2015), *supra* note 19, p. 160.

depend on the actual capability of technical control. In addition, while the expression "object launched into outer space" is not specifically defined in the Outer Space Treaty, the expression is used interchangeably with the term "space object" in the Registration Convention, which defines the latter term in the same way as the Liability Convention. A contextual reading of these treaties indicates that jurisdiction and control can extend also to debris fragments, meaning that States possess sovereign control over the fragments of their formerly intact space objects.[197] Reading otherwise would be asymmetric to the allocation and determination of responsibility and liability under the current legal regime, as the launching State can still be held liable for damage caused by its debris fragments.[198]

As a space object remains under the jurisdiction and control of the State of registry in perpetuity, any attempt by another State to remove that object without the express consent of the State of registry could be seen as illegal interference with such object and a breach of sovereignty. Hence, if a State wants to remove a certain debris object, it can only legally do so if it has jurisdiction and control over that object or with prior permission from the State on whose registry such object is carried.[199] In other words, as a report published by the US National Research Council (NRC) notes, "[n]o state has the legal authority to remove a debris object from space without the express consent of the object's state of registry".[200] The Report further states that "[a]bsent formal diplomatic engagement with other nations, the United States would be limited to retrieving only objects on its own registry."[201] Similarly, a statement of the Group of 77 and China at the 60th session of the LSC of COPUOS expresses the view that "no object should be removed without prior consent or authorization of the Registering State".[202] Accordingly, the consent of the registering State should be considered a "must-have" for the removal of debris under its jurisdiction.

197 Mudge (2022), *supra* note 152, p. 126. Frigoli (2019), *supra* note 157, p. 58: "the registering State retains jurisdiction and control and ownership of the space object even if it is blown up into thousands of debris."

198 Su (2016), *supra* note 149, p. 408. See also Soucek, A. (2016). Legal and Practical Considerations of Registering Constellations and Space Debris. *IISL/ECSL Symposium on "40 years of entry into force of the Registration Convention: Today's practical issues*, p. 12.

199 UN Doc. A/AC.105/C.1/2012/CRP.16 (27 January 2012). Active Debris Removal — An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space: A Report of the International Interdisciplinary Congress on Space Debris Remediation and On-Orbit Satellite Servicing, p. 32.

200 NRC. (2011). *Limiting Future Collision Risk to Spacecraft: An Assessment of NASA's Meteoroid and Orbital Debris Programs* ("NRC Report of 2011"). The National Academies Press, p. 84. <https://nap.nationalacademies.org/catalog/13244/limiting-future-collision-risk-to-spacecraft-an-assessment-of-nasas>.

201 Ibid.

202 G-77 and China Statement during the 60th Session of the Legal Subcommittee of the UN COPUOS (2021), p. 5. <https://www.unoosa.org/documents/pdf/copuos/lsc/2021/statements/item_3_5_6a_6b_8_10_11_13_14_G77_China_ver.1_31_May_AM_LegalSC_280521.pdf>.

The use of the term "retain" in the provision suggests that it is not the act of registering that confers jurisdiction and control.[203] Hence, when a space object has not been registered, it does not mean that no State can exercise jurisdiction and control over such object. It should be noted that neither Article VIII of the Outer Space Treaty nor the Registration Convention which elaborates this Article prescribes a specific time limit for registration. Therefore, although it would be desirable for States to register their space objects immediately after a successful launch, there is no consistent State practice in this regard.[204] In the absence of specific timing, it can happen that a space object is not registered simply because this has not yet been done. In that scenario, it would be unreasonable to say that such an unregistered object is not subject to the jurisdiction of any State and can, as a corollary, be removed by any State without the need of prior permission. In the event of non-registration, other factors that demonstrate a link between a State and a certain space object, such as the act of launching and ownership, may become highly relevant in determining which State has jurisdiction and control over the unregistered object.[205]

At the same time, although registration does not in itself create jurisdiction and control, it confirms which State is entitled to exercise jurisdiction and control over a certain space object. As submitted by Chung, the act of registration "would offer better protection to the State of registry and its registered space object (or its debris) under international space law", which represents "the most compelling incentive for registration".[206] Therefore, it is beneficial for States to register their space objects in a timely manner as this can provide legal certainty to them. In addition, although there is no specific timing, States are obliged under the general principle of *pacta sunt servanda* to perform their treaty obligations in good faith. Therefore, for parties to the Registration Convention, not registering their space objects within a reasonable period may be regarded as a failure to fulfil their obligation of registration.

Article VIII Sentence 2 addresses the ownership of space object:

> "Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth."

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203 Masson-Zwaan & Hofmann (2019), *supra* note 18, p. 32.

204 Ibid.

205 Ibid. See also Jakhu, R. S., & Pelton, J. N. (Eds.). (2017). *Global Space Governance: an international study*. Cham: Springer, p. 344. Frigoli (2019), *supra* note 157, p. 56: "Ownership of a space object is a determining factor in identifying which state can exercise jurisdiction and control."

206 Chung (2019), *supra* note 152, pp. 37-38.

While a property is generally deemed as *res nullius* when its owner is no longer in a position to or has no intention to recover it, which entitles whoever finds it to lay claim to it, this is not the case in outer space.[207] Ownership of a space object is generally considered as perpetual since it is not affected by the location of such object under Article VIII of the OST.[208] Hence, "a space object continues to be owned by its owner(s) even if outwardly it appears to be uncontrolled and/or non-functional",[209] and even when the object has been fragmented into hundreds of space debris.[210] The argument can be supported by reading Article VIII of the Outer Space Treaty in the context of the Rescue Agreement, which complements Article VIII by prescribing the rights and obligations of all States Parties regarding the recovery and return of space objects that fall back to Earth outside the territory of the launching State.[211] It is likely that a falling object may be disintegrated and fragmented during the re-entry process, and the obligation to return suggests that ownership would still be attached to such object in spite of the disintegration.[212] As noted in a report published by the Organisation for Economic Co-operation and Development (OECD) in 2020, the UN space treaties "establish a strong property ownership regime of 'space objects'", under which "no nation may salvage, or otherwise collect, the space objects of other nations that are in space without the formal consent of the object's registered national owner".[213]

3.3.2 Registration of Space Objects

While Article VIII of the Outer Space Treaty affirms a jurisdictional link between a space object and the State on whose registry such object is carried, it does not impose an obligation on States to register its space object.[214] Neither does Article VIII specify which State should register an object launched into outer space or how a registration is to be made. These issues are addressed in the Registration Convention, which elaborates on Article VIII of the Outer Space Treaty. As set in its preamble, the purpose of the Registration Convention is to "provide for States Parties additional means

207 UN Doc. A/AC.105/C.1/2012/CRP.16 (2012), *supra* note 199, p, 31.
208 Frigoli (2019), *supra* note 157, p. 56. See also Force, M. K. (2016). Active Space Debris Removal: When Consent Is Not an Option. *The Air & Space Lawyer*, *29*(3), pp. 10-11.
209 UN Doc. A/AC.105/C.1/2012/CRP.16 (2012), *supra* note 199, p, 31.
210 Frigoli (2019), *supra* note 157, p. 56. See also Tallis, J. (2015). Remediating Space Debris: Legal and Technical Barriers. *Strategic Studies Quarterly*, *9*(1), p. 91: "Anything put into space remains the property of the entity that launched it — even if that property explodes into 5,000 pieces."
211 Art. 5, Rescue Agreement. See also UN Doc. A/AC.105/C.1/2012/CRP.16 (2012), *supra* note 199, p. 31.
212 Ibid.
213 Undseth, M., Jolly, C., & Olivari, M. (2020). Space Sustainability: The Economics of Space Debris in Perspective, *OECD Science, Technology and Industry Policy Papers*, No. 87, OECD Publishing, p. 33.
214 Ibid, p. 31.

and procedures to assist in the identification of space objects".[215] As such, the Registration Convention operates in conjunction with the Liability Convention to identify the potentially liable State(s) for damage caused by space objects.[216]

Article II(1) of the Registration Convention provides that:

> "When a space object is launched into Earth orbit or beyond, the launching State shall register the space object by means of an entry in an appropriate registry which it shall maintain. Each launching State shall inform the Secretary General of the United Nations of the establishment of such a registry."[217]

This provision establishes a duty for States to establish and maintain an appropriate national registry of space objects. Under this provision, only a State qualified as "launching State" can register a space object in its national registry. The term "launching State" is defined in the Registration Convention the same way as in the Liability Convention, which refers to a "State which launches or procures the launching of a space object", and a "State from whose territory or facility a space object is launched".[218] When there is more than one launching State, they should jointly determine which one of them will register the space object in its national registry, and this State is referred to in the Registration Convention as the "State of registry".[219] Since States are only required to register space objects that are "launched into Earth orbit or beyond", there is no obligation to register objects that fail to reach orbit or spacecraft carrying out suborbital flight.[220]

Alongside the national registry, Article III of the Registration Convention asks the UN Secretary-General to maintain an international register of space objects.[221] This international register differs from the aforementioned national registry in that "registering a space object with the international register held by the Secretary-General of the United Nations does not play any role in allocating jurisdiction and control over that object".[222] In addition, while the Registration Convention leaves it to the State of registry to determine the contents of its national registry and the conditions under

215 Masson-Zwaan (2017), *supra* note 1, p. 142.
216 Viikari (2008), *supra* note 3, p. 75.
217 Art. II(1), Registration Convention.
218 Article I(a), ibid.
219 Art. I(c), ibid.
220 Schmidt-Tedd, B., Malysheva, N. R., Stelmakh, O. S., Tennen, L. I., & Bohlmann. U. M. (2013). Article II (National Registries/Registration Obligation) REG. In *CoCoSL Vol. 2*, p. 252.
221 Art. III(1), Registration Convention.
222 A/AC.105/C.2/2012/CRP.11 (2012). Responses to the Set of Questions Provided by the Chair of the Working Group on the Status and Application of the Five United Nations Treaties on Outer Space: Belgium, p. 4, para. 6(d).

which such registry is maintained,[223] it stipulates more specific requirements on the information to be recorded in the international registry. Article IV(1) of the Registration Convention provides that:

> "Each State of registry shall furnish to the Secretary-General of the United Nations, as soon as practicable, the following information concerning each space object carried on its registry:
> (a) Name of launching State or States;
> (b) An appropriate designator of the space object or its registration number;
> (c) Date and territory or location of launch;
> (d) Basic orbital parameters, including
> i. Nodal period;
> ii. Inclinations;
> iii. Apogee;
> iv. Perigee;
> (e) General function of the space object."

Besides the above information, the Registration Convention also provides that each State of registry may, from time to time, provide additional information to the UN Secretary-General concerning its registered space objects.[224] Furthermore, each State of registry shall notify the UN Secretary-General, to the greatest extent feasible and as soon as practicable, of its registered space objects which have been but no longer are in earth orbit.[225]

It has been noted that the information required to be provided is "vague and general", for while this is useful in identifying the launching State of a space object and the basic orbital parameters of such object at the time of registration, it is "not sufficient to allow for the object to be tracked with any precision, nor located in orbit at a future date".[226] As a result, the identification of specific objects in orbit is largely left to the space situational awareness (SSA) systems that track objects in space and maintain catalogues of their positions.[227] These catalogues do not have any legal effects attached to registration, but they constitute a useful source of data complementary to the information contained in the international register.[228]

The US currently maintains the most complete catalogue of space objects, while other States and international organisations such as China, Russia

223 Ar. II(3), Registration Convention.
224 Art. IV(2), ibid.
225 Art. IV(3), ibid.
226 Masson-Zwaan (2017), *supra* note 1, p. 143. Weeden, B. (2011). Overview of the Legal and Policy Challenges of Orbital Debris Removal. *Space Policy*, *27*(1), p. 41.
227 Weeden (2011), ibid.
228 Schmidt-Tedd & Mick (2009), *supra* note 189, p. 155.

and the EU have also developed their SSA capabilities.[229] Therefore, if a State intends to remove a debris object beyond its jurisdiction, it may use its own catalogue or request assistance from other States with SSA systems to "tag" such object to a specific launch event in order to ascertain its origin and identify the potential launching State.[230] Article VI of the Registration Convention could serve as a legal basis to request assistance:

> "Where the application of the provisions of this Convention has not enabled a State Party to identify a space object which has caused damage to it or to any of its natural or juridical persons, or which may be of a hazardous or deleterious nature, other States Parties, including in particular States possessing space monitoring and tracking facilities, shall respond to the greatest extent feasible to a request by that State Party, or transmitted through the Secretary-General on its behalf, for assistance under equitable and reasonable conditions in the identification of the object."

When a space debris object poses a substantial risk to the safety of space operations or to the long-term sustainability of the space environment, such as a massive derelict rocket body with a high risk of collision or explosion, it can be said that such object is of "a hazardous or deleterious nature", and the above Article VI could thus be applied in this case. When such object can be linked to a certain launch event, the State contemplating its removal may consult the international register maintained by the UN Secretary-General to ascertain the State of registry. In practice, this can be done by visiting the "Online Index of Objects Launched into Outer Space" published on the website of UNOOSA.[231] Once the identity of the State of registry is ascertained, the contemplating State may request approval from it for the debris removal.

3.3.3 Circumstances Precluding Wrongfulness and Non-Consensual ADR

The foregoing analysis indicates that States are entitled to clean up their own debris, but they can only remove a debris object under foreign jurisdiction with the authorisation of the State of registry of such object. This provision does not constitute a legal hurdle when ADR operations are conducted "on a 'for hire' (consensual) basis", namely when the State of registry agrees or even procures the removal services.[232] Under international law, consent by

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229 Schrogl, K. U., Jorgenson, C., Robinson, J., & Soucek, A. (2018). Space Traffic Management: Towards a Roadmap for Implementation. *International Academy of Astronautics (IAA) June 2018*, pp. 96-98. For instance, the EU Space Surveillance and Tracking (EU SST), which has been in operation since 2016, provide data, information and services on space objects that orbit around the Earth. For more information see: <https://www.eusst.eu/>.

230 Weeden (2011), *supra* note 226, p. 41.

231 The online index is available at: <https://www.unoosa.org/oosa/osoindex/search-ng.jspx?lf_id=>.

232 Force (2014), *supra* note 16, p. 408.

one State to the commission of a given act by another State precludes the wrongfulness of such act in relation to the former State, provided that the consent is valid and to the extent that the act remains within the limit of the consent given.[233] Therefore, valid consent by the State of registry could justify the removal of a space object under its jurisdiction by another State, insofar as the removal operation remains within the limits of the consent given.

Meanwhile, if the State of registry of a dangerous space object neither consents to the removal of such object nor takes necessary initiatives to reduce the associated risks, Article VIII of the Outer Space Treaty could represent an obstacle for ADR operation.[234] Pursuant to this Article, States may be held internationally accountable for the non-consensual removal of space objects under the jurisdiction of other States.[235] Meanwhile, in the international legal field, lawbreakers are sometimes "excused for their actions because of the unusual circumstances they found themselves in".[236] In the context of non-consensual removal, the circumstances of *distress* and *necessity* are considered to be of the greatest potential relevance that may be invoked by the wrongdoing State to preclude the wrongfulness of its actions.[237] These two circumstances will be discussed in Sections 3.3.3.1 and 3.3.3.2 below.

3.3.3.1 Distress

The wrongfulness of an act of a State not in conformity with its international obligations can be precluded if the author of the act in question has no other reasonable way, in a situation of distress, of saving the author's life or the lives of other persons under the author's care.[238] As noted by the ILC, cases of distress involve mostly aircraft making emergency landings or ships entering ports in the territory of another State in a situation of emergency, such as under the stress of weather or following mechanical or navigational failure.[239]

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233 Art. 20, Draft articles on Responsibility of States for Internationally Wrongful Acts (ARSIWA), with commentaries. Text adopted by the International Law Commission at its fifty-third session, in 2001, and submitted to the General Assembly as a part of the Commission's report covering the work of that session (A/56/10). See also Chatterjee (2015), *supra* note 147, p. 27.

234 Bittencourt Neto (2015), *supra* note 19, p. 158.

235 Frigoli (2019), *supra* note 157, p. 58.

236 Byers & Boley (2023), *supra* note 35, p. 241.

237 Arts. 24 & 25, ARSIWA, *supra* note 233. In ARSIWA, the circumstance of "consent" is also listed as a circumstance precluding wrongfulness of an unlawful conduct. However, as noted by some scholars, whether it is appropriate to include consent in the secondary rule of international law is debatable. See e.g., Crawford & Brownlie (2019), *supra* note 187, p. 547: consent "seem[s] more akin to 'primary' rules, which define the content of obligations than to 'secondary' ones".

238 Art. 24, ARSIWA.

239 Commentary to Art. 24 of ARSIWA, para. 2.

Mirroring the cases involving aircraft and ships, a distress in space could be a situation where a crewed spacecraft encounters a serious anomaly which threatens the lives of the persons onboard. To save their lives, these persons may, for instance, seek shelter in a spacecraft of another State without prior permission and invoke the situation of distress as a justification. In the 2013 film Gravity, an American astronaut entered the Chinese Space Station and used the Chinese Shenzhou spacecraft to return to Earth after a life-threatening accident caused by a cloud of space debris.[240] This can be regarded as a circumstance of distress and the potential wrongfulness of getting onboard the spaceship of another State without prior permission could therefore be precluded.

The plea of distress requires that there is "no other reasonable way" to save the lives of the people in distress.[241] It seems difficult to conceive a scenario where a certain space object has to be removed in order to save the lives of astronauts. The practice of the ISS in the event of close conjunctions is to conduct CAMs and to shelter the astronauts onboard in an escape vessel according to the risk level.[242] Reference can further be made to the rules of the road to avoid collisions in space contained in the *Best Practices for the Sustainability of Space Operations* released by the Space Safety Coalition (SSC) in 2023.[243] Evidently, in the event of a high-risk conjunction between a crewed spacecraft and a *non-manoeuvrable* spacecraft, the suggested rule is that the crewed spacecraft should move.[244] Meanwhile, it is noteworthy that even when a high-risk conjunction involves a crewed spacecraft and a *manoeuvrable* non-crewed spacecraft, it is still the crewed spacecraft that should move unless otherwise arranged.[245] The underlying rationale is that "human safety is of paramount importance, crewed spacecraft often prefer to 'give way' (meaning to take evasive manoeuvring action), preferring to retain the highest levels of support and control over threat mitigation scenarios".[246] In other words, it is considered a safer option for the crewed spacecraft to manoeuvre for collision avoidance. In this sense, a possible situation that might satisfy the "no other reasonable way" condition could be that a crewed spacecraft has somehow lost its manoeuvrability and an ADR spacecraft happens to be available to remove in a timely manner a debris object threatening the crewed spacecraft.

240 Gravity (2013 film). Wikipedia. <https://en.wikipedia.org/wiki>.
241 Art. 24(1), ARSIWA.
242 NASA. (26 May 2021). Space Debris and Human Spaceflight. <https://www.nasa.gov/mission_pages/station/news/orbital_debris.html>.
243 SSC. *Best Practices for the Sustainability of Space Operations*, initially published in 2019 and updated in 2023. <https://spacesafety.org/best-practices/>.
244 Ibid, p. 15.
245 Ibid.
246 Ibid, p. 16.

3.3.3.2 *Necessity*

The state of necessity applies to situations where acting in a manner not in compliance with an international obligation of the responsible State is the only way to safeguard an essential interest against a grave and imminent peril.[247] In the *Gabčíkovo-Nagymaros* case, the ICJ considered the state of necessity as "a ground recognized by customary international law for precluding the wrongfulness of an act not in conformity with an international obligation".[248] By examining the work of the ILC, the Court identified five conditions that must be cumulatively satisfied for the invocation of necessary:[249]

(1) it must have been occasioned by an "essential interest";
(2) that interest must have been threatened by a "grave and imminent peril";
(3) the act being challenged must have been the "only means" of safeguarding that interest;
(4) the act must not have "seriously impair[ed] an essential interest" of the State towards which the obligation existed; and
(5) the State which is the author of that act must not have contributed to the occurrence of the state of necessity.

As to the first condition, "essential interest" can be the interests of a State, of a group of States, and of the international community as a whole. Therefore, a State may claim that its "essential interest" is at stake because its space asset vital to its national security is threatened by another space object. In the *Gabčíkovo-Nagymaros* case, the ICJ stated that "the concerns expressed by Hungary for its natural environment in the region affected by the Gabčíkovo-Nagymaros Project related to an 'essential interest' of that State".[250] The court also cited its statement in the *Nuclear Weapons* advisory opinion that "the environment is not an abstraction but closely related to the well-being of humankind, including generations unborn".[251] As humankind is becoming increasingly dependent on space infrastructures, the preservation of the usability and stability of the orbital environment can be regarded as an "essential interest" to be safeguarded.

To satisfy the second condition, the interest must be threatened by a "grave and imminent peril". Reference can be made to the statement of the ICJ in the *Gabčíkovo-Nagymaros* case:

> "The word "peril" certainly evokes the idea of 'risk'; that is precisely what distinguishes 'peril' from material damage. But a state of necessity could not

247 Art. 25, ARSIWA.
248 ICJ *Gabčíkovo-Nagymaros Project* judgment, *supra* note 45, p. 40, para. 51.
249 Ibid, pp. 40-41, para. 52.
250 Ibid, p. 41, para. 53.
251 Ibid. ICJ *Nuclear Weapons* advisory opinion, *supra* note 98, para. 29.

> exist without a 'peril' duly established at the relevant point in time; the mere apprehension of a possible 'peril' could not suffice in that respect. […] a 'peril' appearing in the long term might be held to be 'imminent' as soon as it is established, at the relevant point in time, that the realization of that peril, however far off it might be, is not thereby any less certain and inevitable."[252]

Accordingly, a merely apprehended or contingent peril is not sufficient.[253] Rather, the state of necessity requires the peril to be "clearly established on the basis of the evidence reasonably available at the time".[254] Therefore, a State seeking to invoke the state of necessity to justify its unauthorised removal of a debris object under foreign jurisdiction must prove the actual risk posed by such object to the essential interest concerned. This may be difficult when the essential interest to be safeguarded is the stability of the orbital environment, for this is mostly threatened by the accumulation of space debris generated in the over six decades of space activities rather than a single debris creation event. One possible scenario may be that a massive debris object is likely to be subject to a catastrophic fragmentation which could seriously threaten the long-term usability of a certain orbital area. In that scenario, the State invoking necessity may need to prove the risk magnitude, i.e., the risk of collision and the severity if such risk materialises.

The third condition requires that the conduct in question must be the only way to safeguard the essential interest.[255] This condition cannot be met even when other available means are more costly or less convenient.[256] This condition is difficult to prove when an operational spacecraft is threatened by approaching debris, as such spacecraft could simply conduct CAMs to reduce the risk, though this may consume additional propellant.[257] Meanwhile, the plea of necessity may be established in scenarios where a highly hazardous debris object threatening the space environment is removed without prior consent, provided that the risk of such object is clearly established and its removal is proven to be the only way to mitigate the risk. As noted by Popova and Schaus, the growing congestion in Earth orbit will probably induce the occurrence of accidents in outer space, and it is thus conceivable that the state of necessity might gain more relevance in the future and play a role in servicing as a ground for ADR operations.[258]

The fourth condition requires that the act in question does not seriously impair an essential interest of the State(s) towards which the obligation

252 ICJ *Gabčíkovo-Nagymaros Project* judgment, *supra* note 45, p. 42, para. 54.
253 Commentary to Art. 25 of ARSIWA, para. 16.
254 Ibid.
255 Art. 25(1)(a), ARSIWA.
256 Commentary to Art. 25 of ARSIWA, para. 15.
257 Wang, G. (2014). The Jurisdiction of Space Debris and the Legal Basis of Active Space Debris Removal. *Journal of Beijing Institute of Technology (Social Sciences Edition)*, *16*(6), p. 108.
258 Popova & Schaus (2018), *supra* note 2, p. 9.

exists, or of the international community as a whole.[259] In other words, necessity cannot justify an action by one State that causes serious harm to other States. When it comes to an unauthorised ADR operation, the State invoking necessity may assert that there are no substantial interests impaired as the target debris object is no longer functional. Meanwhile, the State of registry of such object may argue that the non-consensual removal has seriously impaired its essential interest because the object concerned contains sensitive data and thus involves national security interests.[260] In the end, the judges adjudicating the dispute may need to make "a reasonable assessment of the competing interests" involved.[261]

Finally, according to the fifth condition, the state of necessity cannot be relied on if the State invoking necessity has contributed to the situation of necessity.[262] Therefore, a State that has deliberately put its space assets in peril cannot later resort to the state of necessity to preclude the wrongfulness of its unlawful acts to safeguard these assets.

In sum, the circumstances precluding wrongfulness provide certain legal grounds for one State to remove space debris under the jurisdiction of other States, on the condition that the removing State acts within the ambit of these circumstances. When a valid consent is given by the State of registry, the State engaging in ADR activities should operate within the limits of such consent. In the absence of consent, circumstances such as distress and necessity may justify some "self-help" actions and preclude the wrongfulness of unauthorised ADR, provided that the pre-defined conditions for the invocation of these circumstances have been fulfilled. Specifically, the plea of distress is subject to the condition that there are "no other reasonable ways" of saving lives, and the circumstance of necessity is applicable only when acting in a manner not in conformity with international law is "the only way" of safeguarding an essential interest. These conditions denote the exceptional character of these two circumstances.[263]

3.3.4 Security Risks of Non-Consensual ADR

While the circumstances precluding wrongfulness represent legal tools at the disposal of ADR advocates,[264] any non-consensual ADR operations targeting objects under foreign jurisdiction should be conducted with caution due to the potential implications of these operations. This is because an unauthorised removal may lead to tension and conflicts, especially when

259 Art. 25(1)(b), ARSIWA.
260 See Section 3.3.4 *infra*.
261 Commentary to Art. 25 of ARSIWA, para. 17.
262 Art. 25(2)(b), ARSIWA.
263 Commentary to Art. 24 of ARSIWA, para. 6. Commentary to Art. 25 of ARSIWA, para. 1.
264 Force (2014), *supra* note 16, p. 418.

the target for removal is of technical and military sensitivity, which could threaten international peace and security. Specifically, it has been noted that "the space security nexus to jurisdiction and control over space objects continues *ad infinitum*", and therefore "circumventing the provisions of the existing regime that establish jurisdiction and control in the State of registry may have negative consequences for space security".[265] The interests underlying the jurisdictional link between a State and its space object are articulated in the NRC Report of 2011:

> "The question of whether or not a particular object is to be removed from space as 'debris' will be scrutinized through a strong filter of national interests and security. The legal principle that forbids one nation from taking the space object of another has deep roots: it goes back to the early days of the Cold War era when the USSR and the United States wanted to deny each other a facile excuse to seize one another's satellites in order to engage in reverse engineering. The Cold War is over, but the acute sensitivity regarding satellite technology remains."[266]

As space objects may remain technically and strategically sensitive even after they become non-functional following mission completion, it can be in the interest of States to protect these objects from arbitrary capture or removal of other States to avoid the divulgence of sensitive and classified information. Hence, as observed by Hall, "any unauthorized attempt on the part of one state covertly or overtly to salvage or remove inactive 'abandoned' spacecraft of another state from orbit will trigger international incidents and, possibly, military conflict".[267]

With regard to the security risks involved in a non-consensual ADR, reference can be further made to the UNSG Report of 2021.[268] The Report contains the views of States on the following three issues and a consolidated summary of these views:

1. "[E]xisting and potential threats and security risks to space systems, including those arising from actions, activities or systems in outer space or on Earth";
2. "[A]ctions and activities that could be considered responsible, irresponsible or threatening in outer space and their potential impact on international security";
3. "[F]urther development and implementation of norms, rules and principles of responsible behaviours and on the reduction of the risks of misunderstanding and miscalculations with respect to outer space".[269]

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265 UN Doc. A/AC.105/C.1/2012/CRP.16 (2012), *supra* note 199, p. 33.
266 NRC (2011), *supra* note 200, p. 85.
267 Hall, R. C. (1967). Comments on Salvage and Removal of Man-Made Objects from Outer Space. *Journal of Air Law and Commerce*, *33*(2), p. 288.
268 UN Doc. A/76/77 (13 July 2021), Report of the UN Secretary-General on Reducing space threats through norms, rules and principles of responsible behaviours.
269 Ibid, p. 1.

All these issues address the need for consent of the State of registry for the performance of RPO to approach its space objects. Since RPO are in general part of an ADR mission, the views regarding RPO can apply *a fortiori* to ADR activities.

As to the *first* issue, the UNSG Report of 2021 states that:

> "Rendezvous and proximity operations, if carried out without advance notification, coordination or consent, could be interpreted as a threat or hostile act. The State whose satellite was the object of such a close approach would be unable to know the intent of the manoeuvring satellite."[270]

For the *second* issue, the UNSG Report enumerates a series of actions and activities that could be considered as responsible and irresponsible. Examples of responsible behaviours proposed by States include, among others: "Notification of manoeuvres and of rendezvous and proximity operations, including in order to coordinate operations, to avoid potential misunderstandings or to seek consent."[271] In contrast, RPO "that are carried out without sufficient transparency or prior communication, without consent or without cooperation, [or] that make contact without permission" can be regarded as irresponsible behaviour.[272]

Finally, with regard to the further development of rules and standards for RPO within the context of the *third* issue, the UNSG Report of 2021 outlines three possible elements including, *inter alia*:

> "Carry out [RPO] in an open and transparent manner, including by requiring prior consent before approaching the satellite of another State."[273]

It can be seen from the above consolidated views that the need for prior consent is underlined in the context of all these three issues, and RPO without prior consent may lead to misunderstandings and security concerns. The issue of ADR is addressed more explicitly in the replies submitted by some States. In particular, France expresses the view that:

> "Rendezvous operations, including active debris removal, pose a high risk to the space objects being approached. When consent has not been obtained for a rendezvous operation, such an operation may, under certain circumstances, be interpreted by the targeted State as an attack aimed at destroying or causing the loss of control of the space object being approached or inspected. Therefore, France considers that such operations should be subject to the prior and explicit consent of the relevant State."[274]

270 Ibid, p. 7, para. 16.
271 Ibid, p. 8, para. 18(b).
272 Ibid, p. 10, para. 19(f).
273 Ibid, p. 15, para. 36(a).
274 Ibid, p. 42.

It can be said that States share a common understanding that non-consensual ADR operations may be perceived as a threatening or even hostile action. Hence, even in scenarios where the conditions of invoking the circumstances for precluding wrongfulness may be satisfied, the benefits that can be gained from a non-consensual ADR operation should be properly weighed and balanced against the potential risk of tensions and conflicts that could be triggered by such operation.[275] States may raise these circumstances to the State of registry in the process of consultation and negotiation undertaken pursuant to Article IX of the Outer Space Treaty, so as to request the State of registry to either remove the debris itself or to grant permission for removal. If the consultation fails to achieve a concrete result and non-consensual removal is considered as imperative, the State engaging in such operation should take reasonable measures to minimise the risk of unwanted escalation. In any event, non-consensual removal, even when justifiable, is advisable to be treated as a careful exception.

Ideally, if States could conclude an international agreement specifying the conditions of non-consensual ADR, many legal issues and uncertainties associated with this kind of operations can be solved. However, in view of the diverging levels of strategic and military sensitivity of space objects, States may want to determine the granting of consent for removal on a case-by-case basis. Therefore, the development of commonly accepted conditions for ADR operations without the need for prior consent can be challenging, as States generally consider the unauthorised approaching to their space objects as a potentially threatening action, let alone capturing and removing them. Another challenge is how to ensure that these conditions are not abused for hostile purposes in order to assuage States that their national security interests would not be undermined. In view of these difficulties, it appears that a more feasible way forward for the development of space law to surmount the hurdle of jurisdiction and control would be to facilitate the happening of ADR operations on a consensual basis.

3.4 *Issue 4*: Legal Restrictions on the Use of ADR Technologies

Section 3.4 will discuss the rules and principles regulating the dual-use capabilities of ADR technologies. As mentioned in Chapter 2, ADR technologies have an inherent dual-use nature, meaning that they can be used both to remove a debris object from space and to destroy an active satellite of a potential adversary. In light of this potential, this section will assess the limitations posed by the current international legal regime on the use of ADR technologies. Section 3.4.1 will discuss the prohibition to place in orbit around the Earth nuclear weapons and weapons of mass destruction under Article IV(1) of the Outer Space Treaty and whether the deployment

275 Force (2014), *supra* note 16, p. 410.

of ADR systems in space may violate this provision. Section 3.4.2 will assess the relevance of the prohibition on the threat or use of force and the right of self-defence under the UN Charter to ADR activities.

3.4.1 Prohibition to Place Weapons of Mass Destruction in Outer Space

Article IV(1) of the Outer Space Treaty prohibits States from placing in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, installing such weapons on celestial bodies, or stationing such weapons in outer space in any other manner. As the provision is silent on any weapons other than those indicated above, the placement of conventional weapons in Earth orbit is not banned by this article.[276] The Outer Space Treaty does not define the term "weapon", and there is no internationally agreed definition of what a space weapon is. The difficulty of establishing a commonly accepted definition lies largely in the fact that many space mechanisms have the potential to be used for hostile actions if their operators so intend. According to the US, "[a]ll satellites with manoeuvring capabilities, if launched into the proper orbit, could technically be used to attempt to collide with another satellite, even if not optimized to do so".[277] Similarly, Germany notes that "a significant number of space objects can, to a varying degree, be used to target, disable or even destroy objects in space – even when not designed for such purposes originally."[278] The dual-use nature of many space objects complicates the task of determining whether these objects should be regarded as weapons. Because of this difficulty, the discussions on reducing space threats currently follow a behaviour-based approach, which focuses on how space activities are conducted, as distinct from a capabilities-based approach, which focuses on the capabilities of space objects.[279] Therefore, like many other space objects of dual-use nature, a removal spacecraft should not be regarded as a space weapon simply because of its potential capability to destroy another satellite, and what matters most is how such spacecraft is used.

The terms "nuclear weapons" and "weapons of mass destruction" are also not defined in the Outer Space Treaty. Since in the formulation of Article IV of the OST, "*any other* kinds of weapons of mass destruction" are prohibited alongside "nuclear weapons", weapons of mass destruction should be understood as referring to those weapons with a destructive power comparable with nuclear weapons.[280] In its 1996 *Nuclear Weapons* advisory opin-

276 Masson-Zwaan & Hofmann (2019), *supra* note 18, pp. 18-19.
277 A/76/77 (2021), *supra* note 268, p. 97.
278 A/AC.294/2022/WP.6 (5 May 2022), Responsible behaviours as a practical contribution to the prevention of an arms race in outer space and to strengthening the international frameworks on space security: Submitted by Germany, para. 13.
279 See Chapter 5 Section 5.4.1 *infra*.
280 Schrogl, K.-U. & Neumann, J. (2009). Article IV. In *CoCoSL Vol. 1*, p. 76.

ion, the ICJ referred to the term "nuclear weapons" as "explosive devices whose energy results from the fusion or fission of the atom".[281] As to the meaning of "weapons of mass destruction", the UN General Assembly referred to this term in its resolution 32/84(B) of 1977 as "atomic explosive weapons, radioactive material weapons, lethal chemical and biological weapons, and any weapons developed in the future which might have characteristics comparable in destructive effect to those of the atomic bomb or other weapons mentioned above".[282] It follows that weapons of mass destruction should be understood as weapons that can cause a magnitude of catastrophe similar to that of atomic explosions.[283] According to the study of Dobos and Prazak, even if ADR systems could be used for hostile purposes, "the technology of the ADR system is probably not practical for the conduct of massive anti-satellite (ASAT) attacks if developed in a scope proposed by the supporters of active debris mitigation".[284] Therefore, a spacecraft designed to perform ADR missions and used for this purpose should not be regarded as a *weapon*, nor as a weapon of *mass destruction*.

As to the restrictions on the use of removal spacecraft, reference can be further made to the preamble of the Outer Space Treaty, which recognises "the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes". The notion of "peaceful" is commonly understood as meaning "non-aggressive".[285] This interpretation is congruent with the fact that the current legal regime does not completely rule out military activities and that space has been used for military purposes such as reconnaissance since the dawn of the space age.[286] In this sense, the use of a removal spacecraft for non-aggressive purposes, including removing one's own debris or removing a debris object under the jurisdiction of another State on a consensual basis, should be regarded as a form of peaceful use of outer space. This argument can be supported by referring to Article II of the Convention for Establishment of a European Space Agency, which provides that the purpose of ESA "shall be to provide for, and to promote, for exclusively peaceful purposes, cooperation among European States in space research and technology and their space applications".[287] Similarly, China's national space policy issued in 2022 affirms that "China upholds the principle of exploration and utilization of

281 ICJ *Nuclear Weapons* advisory opinion, *supra* note 98, para. 35.

282 UN Doc. A/RES/32/84-B (12 December 1977). Prohibition of the development and manufacture of new types of weapons of mass destruction and new systems of such weapons.

283 Carus, W. S. (2012). *Defining "Weapons of Mass Destruction"*. Center for the Study of Weapons of Mass Destruction, Occasional Paper 8, pp. 11-14.

284 Dobos, B., & Prazak, J. (2019). To Clear or to Eliminate? Active Debris Removal Systems as Antisatellite Weapons. *Space Policy*, *47*, p. 222.

285 Lyall, F., & Larsen, P. B. (2017). *Space Law: A Treatise*. 2nd ed., Routledge, p. 496.

286 Blount (2019), *supra* note 38, p. 181. See also Blount, P. J. (2019). Chapter 5: Peaceful Uses of Outer Space. In Masson-Zwaan & Hofmann (2019), *supra* note 18, pp. 67-68.

287 ESA. ESA's Purpose. <https://www.esa.int/About_Us/Corporate_news/ESA_s_Purpose>.

outer space for peaceful purposes".[288] As both ESA and China emphasise the peaceful purposes of their space activities, their engagement in ADR missions indicates an understanding that ADR activities conform to the peaceful principle. Hence, as Blount submits, "there is no legal prohibition that disallows the deployment and use of [ADR] technologies for peaceful purposes".[289]

In sum, the placement of removal spacecraft in orbit around the Earth and the use of such spacecraft for the purpose of removing space debris on a consensual basis are allowed under the Outer Space Treaty. The use of ADR technologies for the remediation of space debris also conforms to the principle of peaceful purposes of the Outer Space Treaty. As mentioned earlier, Article III of the Outer Space Treaty affirms the application of international law to space activities. Specifically, Article III requires space activities to be carried out "in accordance with international law, including the Charter of the United Nations ("UN Charter"),[290] "in the interest of maintaining international peace and security and promoting international co-operation and understanding". The explicit reference to the UN Charter and to the maintenance of international peace and security indicates the intention of the drafters of the Outer Space Treaty to make the rules and principles related to security matters under international law applicable to outer space.[291] In this regard, Articles 2(4) and 51 of the UN Charter are of particular relevance: the former prohibits the threat or use of force, and the latter recognises the rights of individual and collective self-defence.[292] The next section will discuss the limitations imposed by these two Articles on the use of ADR technologies.

3.4.2 The Prohibition on the Threat or Use of Force and the Right of Self-Defence

Article 2(4) of the UN Charter prescribes a general prohibition on the threat or use of force:

> "All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations."

288 State Council Information Office of China. (January 2022). *China's Space Program: A 2021 Perspective*. The text of the policy is available at: <https://www.cnsa.gov.cn/english/n6465645/n6465648/c6813088/content.html>.

289 Blount (2019), *supra* note 38, p. 182.

290 Charter of the United Nations, adopted 26 June 1945, entered into force 24 October 1945, 1 UNTS XVI.

291 Azcárate Ortega, A., & Lagos Koller, H. (2023). The Open-Ended Working Group on Reducing Space Threats Through Norms, Rules and Principles of Responsible Behaviours: The Journey So Far, and the Road Ahead. *Air and Space Law*, *48*(Special), p. 22.

292 Masson-Zwaan (2017), *supra* note 1, p. 140.

Besides being enshrined in the UN Charter, the prohibition of use of force is also a rule of customary international law, binding also the very few States that are not parties to the UN Charter.[293] Article 2(4) prohibits not only the use but also the *threat* of force. However, in practice, it is not uncommon for political or military leaders of States to express threats to use force against other States, and such threats do not necessarily constitute a breach of Article 2(4).[294] Threats are generally not regarded as a violation of Article 2(4) to the extent that they remain "political rhetoric of a general nature", unless they become "sufficiently specific".[295] As such, it may amount to a "threat of force" under Article 2(4) when, for instance, a State threatens to use its removal spacecraft to capture or destroy a specific military satellite of another State.

Article 2(4) prohibits the threat or use of force "against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations". The Purposes of the UN are enshrined in Article 1 of the UN Charter, which includes to "maintain international peace and security".[296] To this end, States should "take effective collective measures for the prevention and removal of threats to the peace, and for the suppression of acts of aggression or other breaches of the peace".[297] The requirement to maintain peace accords with space law since "a central goal of the regime is the maintenance of international peace and security".[298] The use of dual-use technologies for hostile purposes can be destabilising, which may lead to tensions and conflicts in outer space. Therefore, pursuant to Article 2(4) of the UN Charter, States should refrain from using or threatening to use ADR systems for forcible actions against other States, including to impinge on the rights of other States to explore and use outer space by interfering with their space activities.[299]

The lawful exercise of the right of self-defence as enshrined in Article 51 of the UN Charter constitutes an exception to the prohibition on the use of force.[300] Article 51 provides that nothing in the Charter "shall impair the inherent right of individual or collective self-defence if an armed attack occurs against a Member of the United Nations, until the Security Council has taken measures necessary to maintain international peace and security". For a self-defence to be warranted, it must be taken in response

293 Blokker, N. M. & Dam-de Jong, D. A. (2022). Chapter 11: Law on the Use of Force. In Rose, C. *et al*. *An Introduction to Public International Law*. Cambridge University Press, p. 216.
294 Ibid.
295 Ibid.
296 Art. 1(1), the UN Charter.
297 Ibid.
298 Blount (2019), *supra* note 38, p. 182.
299 Ibid.
300 ICJ *Nuclear Weapons* advisory opinion, *supra* note 98, para. 38.

to an "armed attack".[301] In the *Nicaragua* judgment, the ICJ distinguished "the most grave forms of the use of force (those constituting an armed attack) from other less grave forms".[302] The Court further stated that the "scales and effects" are to be considered when assessing whether a certain act constitutes an "armed attack", as distinct from other less grave forcible actions such as a mere frontier incident carried out by regular armed forces.[303] Accordingly, not every use of force necessarily amounts to an armed attack, and only the latter entitles a State to resort to self-defence under Article 51 of the UN Charter.[304] However, it should be noted that there is "no clear watermark for distinguishing armed attacks from uses of force", and the determination has to be made by taking all the relevant facts and circumstances of each specific case into account.[305]

Although it is not expressly stipulated in Article 51 of the UN Charter, every lawful exercise of the right of self-defence must meet the conditions of necessity and proportionality.[306] As stated by the ICJ in the *Nicaragua* judgment, there is a "specific rule whereby self-defence would warrant only measures which are proportional to the armed attack and necessary to respond to it, a rule well established in customary international law".[307] The customary status of the principles of necessity and proportionality was also affirmed by the ICJ in the *Nuclear Weapons* advisory opinion and in the *Oil Platforms* judgment.[308] Necessity is generally understood as meaning that the victim State has no other reasonable option in the circumstances than to resort to forceful actions to defeat the armed attack.[309] This does not require the use of force to be the only available means to respond to an armed attack but that non-forceful measures are insufficient to address the situation.[310] Proportionality requires that the scope, duration, intensity and effects of the defensive response correspond to the original armed attack.[311]

As the inherent right of self-defence is enshrined in the UN Charter and has

301 Ibid.
302 *Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America). Merits, Judgment. I.C.J. Reports 1986*, p. 101, para. 191.
303 Ibid, p. 103, para. 195.
304 Schmitt, M. N. (2017). *Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations*. Cambridge University Press, p. 341. Sarah, M. (2014). The Legality and Implications of Intentional Interference with Commercial Communication Satellite Signals. *International Law Studies*, *90*, p. 171.
305 Blokker & Dam-de Jong (2022), *supra* note 293, p. 224.
306 Ibid, p. 225.
307 ICJ *Nicaragua* judgment, *supra* note 302, paras. 176 & 194.
308 ICJ *Nuclear Weapons* advisory opinion, *supra* note 98, para. 41. *Oil Platforms (Islamic Republic of Iran v. United States of America), Judgment, I. C. J. Reports 2003*, paras. 43, 73-74, & 76.
309 Crawford, J., & Brownlie, I. (2019). *Brownlie's Principles of Public International Law*. 9th ed., Oxford University Press, p. 722. Schmitt (2017), *supra* note 304, p. 348.
310 Schmitt (2017), ibid, pp. 348-349.
311 Brownlie & Crawford (2019), *supra* note 309, p. 722. Schmitt (2017), ibid, p. 349.

been affirmed by the ICJ, it is applicable in outer space by virtue of Article III of the Outer Space Treaty. As observed by Zhao and Jiang, there is no international law denying the existence of the right of self-defence in outer space, and any denial of such right would put States in a disadvantaged position to safeguard their national security and other essential interests in space.[312] Moreover, the existence of the right of self-defence in the space domain has been explicitly affirmed in national and international policy documents issued by some Western States. The US National Space Policy of 2020 states that the US "will continue to use space for national security activities, including for the exercise of the inherent right of self-defence".[313] The North Atlantic Treaty Organization (NATO)'s overarching Space Policy also addresses expressly the threat to space assets and the issue of space-related self-defence.[314] In particular, the Policy states that:

> "At the 2021 Brussels Summit, Allies agreed that attacks to, from, or within space present a clear challenge to the security of the Alliance […]. Such attacks could lead to the invocation of Article 5. A decision as to when such attacks would lead to the invocation of Article 5 would be taken by the North Atlantic Council on a case-by-case basis".[315]

Article 5 is the cardinal provision of the North Atlantic Treaty, which sets out the principle of collective defence in response to an attack against one or more NATO members.[316] Attacks to and within space can be conducted by using direct-ascent and co-orbital anti-satellite systems to damage the space assets of other States.[317] Attacks can also be from space to Earth by using jammers, lasers and projectiles ejected from orbit to damage targets on the ground.[318] The use of removal spacecraft for hostile purposes can

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312 Zhao, Y., & Jiang, S. (2019). Armed Conflict in Outer Space: Legal Concept, Practice and Future Regulatory Regime. *Space Policy*, *48*, p. 54.

313 US. (9 December 2020). *National Space Policy of the United States of America*, p. 3. Available at: <https://www.faa.gov/sites/faa.gov/files/2022-04/National_Space_Policy.pdf>.

314 NATO. (17 January 2022). *NATO's overarching Space Policy*. Available at: <https://www.nato.int/cps/en/natohq/official_texts_190862.htm?selectedLocale=en>.

315 Ibid, para .12. Article 5 of the North Atlantic Treaty, which sets out the principle of collective defence, is the cardinal provision of the Treaty. It provides that if a NATO member is the victim of an armed attack, each and every NATO member will consider this armed attack as against all members, and will take necessary actions to assist the member attacked "in exercise of the right of individual or collective self-defence recognized by Article 51 of the Charter of the United Nations … including the use of armed force". See NATO. (14 April 2021). Collective Defence – Article 5. <https://www.nato.int/cps/en/natohq/topics_110496.htm>.

316 NATO. (2 September 2022). Founding Treaty. <https://www.nato.int/cps/en/natohq/topics_67656.htm>.

317 Mutschler, M. M. (2010). Keeping Space Safe: Towards a Long-Term Strategy to Arms Control in Space. *Peace Research Institute Frankfurt (PRIF) Report*, *98*, p. 5.

318 Cohen, R. S. (28 May 2020). What's a Space Weapon? The Answer Can Be Complicated. *Air & Space Force Magazine*. <https://www.airandspaceforces.com/whats-a-space-weapon-the-answer-can-be-complicated/>.

be characterised as a threat *within* space and may potentially trigger the exercise of self-defence by NATO.

As the destructive effects of these different types of space-related threats vary, the methods taken and their intensity can be factual elements to be considered when assessing the "scale and effects" of a certain forcible act. For instance, the use of high-end kinetic capabilities against a substantial amount of space assets, such as a constellation of navigation or communication satellites, is more likely to surpass the threshold of armed attack than the use of low-end jamming which only causes temporary and reversible effects. This does not mean that signal jamming cannot constitute an armed attack. As noted by the ICJ in its *Nuclear Weapons* advisory opinion, neither Article 2(4) nor Article 51 of the UN Charter refers to specific weapons, and thus these provisions "apply to any use of force, regardless of the weapons employed".[319] Therefore, the use of non-kinetic systems, such as cyber-attack and satellite signal interference can also rise to "use of force" and "armed attack" if its scale and effects reach the requisite threshold of intensity.[320]

In sum, under international law, the removal spacecraft should in principle not be used for aggressive actions such as destroying satellites of other States, though it may be used in an exercise of the right of self-defence in response to an armed attack. One question to consider is whether the right of self-defence can serve as a legal ground for the removal of a debris object of another State without prior consent. This will require the existence of an armed attack in the first place. A potential scenario could be that a State somehow creates or releases space debris with an aim to cause damage to the space assets of another State, and the intensity of such hostile action crosses the gravity threshold of armed attack. In that event, the victim State, if its technology so allows, may remove the incoming space debris to safeguard its space assets, to the extent that this constitutes a necessary and proportional response to such attack.

3.4.3 Lack of Specific Rules to Address Dual-Use Concerns

The discussion in this section shows that removal spacecraft designed and used for the purpose of space debris remediation should not be regarded as "weapons" or "weapons of mass destruction" in outer space. As such, deployment and use of removal spacecraft in orbit around the Earth does not constitute a violation of the Outer Space Treaty. In the meantime, international law imposes restrictions on the use of removal spacecraft. Pursuant to the prohibition on the threat or use of force in international relations under the UN Charter, the threat or use of removal spacecraft for aggressive

319 ICJ *Nuclear Weapons* advisory opinion, *supra* note 98, para. 39.
320 Schmitt (2017), *supra* note 304, p. 339 et seq. Sarah (2014), *supra* note 304, pp. 171-172.

actions against other States is prohibited, although States are entitled to use such spacecraft to respond to an armed attack under certain conditions.

Meanwhile, the legality of deploying and using removal spacecraft for ADR operations does not mark the end of the analysis.[321] As mentioned in Chapter 2, owing to their dual-use potential, even when ADR operations are conducted solely for benign purposes, such as the removal of one's own hazardous objects from congested orbits, these operations could still be mistaken as embodying a hostile intention. Therefore, while the current legal regime imposes limitations on the use of ADR technologies for forcible actions, it does not specifically address how ADR activities should be carried out in a way to reduce the potential security concerns arising from the dual-use potential of ADR technologies.

3.5 Chapter Conclusion

This chapter aimed to answer the questions of how the hard law pillar of international space law applies to the four issues relating to the governance of ADR and whether there exist regulatory gaps. An examination of the rules and principles under the UN space treaties and general international law shows that these rules and principles lay down the fundamental legal framework for space activities including ADR. Yet, they do not specifically address the issue of space debris, and there are legal gaps for the regulation of each of the four issues, which will be summarised below.

As to *Issue 1*, The UN space treaties and general international law do not impose upon States an explicit obligation to mitigate and remove space debris. As a baseline, according to the Outer Space Treaty, States have the right to freely explore and use outer space, to the extent not prohibited by international law. Space debris is a side effect of the exercise of such freedom. With the growth of space debris and the increase of actors and activities in outer space, the issue of space debris is becoming a threat to the operational safety and long-term sustainability of outer space, which raises a need to regulate the creation of space debris. The current international legal framework for space activities contains some general provisions that are relevant in this regard, but they are not precise enough to effectively oblige States to tackle this problem. More specifically, the Outer Space Treaty provides that space activities should be carried out for the benefit and in the interests of all countries, and that outer space is not subject to national appropriation by any State. In addition, States should conduct space activities with due regard to the rights and interests of other States, should avoid harmful contamination of outer space, and should undertake appropriate

321 Blount (2019), *supra* note 38, p. 182.

international consultation in the event of potentially harmful interference. Pursuant to the principle of prevention under international environmental law, States should prevent the causing of significant environmental harm to areas beyond the jurisdiction of any State, including outer space. All these are applicable rules for regulating the behaviours of States in carrying out space activities, but the vagueness of their terms and formulation makes it difficult to verify whether a certain debris generation event constitutes a breach of the relevant principles and rules. This is further complicated by the fact that current technology does not enable a complete avoidance of space debris in the course of space activities. These legal and factual factors make it difficult to draw from these general provisions a clear duty to mitigate and even remove space debris. Therefore, it would be difficult to rely solely on these general rules and principles to hold a State accountable for the space debris it creates, which probably explains why the Outer Space Treaty has seldom been invoked to condemn debris generation events as violations. As Masson-Zwaan observes: "There is an increasing amount of space debris, while no clear obligation exists to clear it up".[322] Since the projected run-away growth of space debris puts the future use of outer space at stake, more efforts are needed to supplement the current hard law pillar of space law. To address the space debris problem, the international community has adopted several non-legally binding instruments to mitigate the creation of space debris and preserve the long-term sustainability of outer space activities. What steps have been taken and whether they are sufficient to tackle the space debris problem will be discussed in the next chapter.

As to *Issue 2*, the current liability regime established in the UN space treaties applies to damage caused by space objects. Through treaty interpretation, especially in light of the victim-oriented spirit of the Liability Convention, it can be concluded that space debris, including both defunct spacecraft and debris fragments, falls within the scope of "space object". Therefore, a launching State may be held liable for the damage caused by the space debris it creates to the persons or property of another State. Absolute liability applies to damage caused on the ground, which is intended to provide better protection to third parties not involved in space activities. Fault-based liability applies to damage caused in outer space. The Liability Convention does not provide a definition or standard of care for the determination of fault, which could make it difficult for the victim State to establish liability of the launching States for damage caused in outer space. As such, the Liability Convention does not provide a strong motivation for States to mitigate or remove space debris, for leaving debris in orbit does not necessarily give rise to liability. On the contrary, the Liability Convention may disincentivise ADR operations. In view of the inherent risk

322 Masson-Zwaan, T. L. (30 April 2021). Still No Obligation to Clear up Space Debris. Available at: <https://www.universiteitleiden.nl/en/news/2021/04/tanja-masson-zwaan-still-no-obligation-to-clear-up-space-debris>.

involved in these operations, States engaging in ADR may be concerned about their risk of liability exposure when something goes wrong in these operations, especially when considering that the meaning of "fault" remains ambiguous. In other words, States are uncertain about how they may plan and execute their ADR operations in such a manner to reduce the risk of being held at "fault" if these operations cause damage in outer space, which could discourage States from engaging in ADR operations. To enhance legal certainty and mission safety for ADR operations, guidelines for ADR operations should be developed. The relevance of soft-law instruments for the determination of "fault", and the industry-led initiatives to develop guidelines and recommended practices for the design and operations of ADR missions will be addressed in the next chapter.

As to *Issue 3*, the State of registry retains jurisdiction and control over its space object pursuant to Article VIII of the OST. As satellites and rocket stages do not lose their legal status of "space object" when they become non-functional, the removal of a decommissioned object from outer space can only be carried out either by the State of registry itself or by another State with the express consent of the State of registry. Non-consensual removal would constitute a violation of Article VIII of the OST. There are some circumstances that may be invoked to preclude the wrongfulness of non-consensual removal under certain conditions, but they must be used with caution because this could raise international conflicts. Even defunct space objects can contain sensitive information, and the removal of these objects without the consent of their States of registry may be regarded as a hostile and even threatening act. To reduce the risk of unwanted escalation, ADR operations should be carried out on a consensual basis, and the future direction for legal development should thus be to facilitate the seeking and granting of approval and the entry into cooperative arrangements for debris removal.

As to *Issue 4*, Article IV(1) of the Outer Space Treaty prohibits the placement of nuclear weapons and weapons of mass destruction in outer space. There is no legally binding definition of what constitutes a weapon in space, and the dual-use potential of many space systems makes it difficult to draw a clear line between weapons and non-weapons in outer space according to their capabilities. ADR mechanisms should not be considered as weapons when they are used for peaceful purposes, namely to remove debris from orbit in conformity with international law. Pursuant to the UN Charter, States are also prohibited from using, or threatening to use, ADR systems for forcible actions against other States. An exception to the prohibition on the use of force is the right of self-defence, which can only be lawfully exercised in response to an armed attack, and in accordance with the principle of necessity and proportionality. While the current legal regime imposes some restrictions on the use of ADR mechanisms for aggressive actions, the use of such mechanisms for peaceful purposes may still raise security con-

cerns due to their dual-use potential. Therefore, it is essential to ensure that ADR activities are carried out in a manner that reduces the risks of dual-use concerns. In this regard, Transparency and Confidence-Building Measures (TCBMs) are particularly relevant as the implementation of these measures can reduce or even eliminate misunderstandings and miscalculations. The relevance of TCBMs to ADR will be discussed in the next chapter.

In sum, although the hard law pillar of international space law contains some basic provisions to address the four issues outlined in Chapter 2, it does not provide sufficient answers to the governance of these issues. The next chapter will turn to the soft law pillar of space law to see whether and to what extent it contributes to filling the regulatory gaps in the hard law pillar.