

TRANSFORMING ARTICLE VI OF THE OUTER SPACE TREATY INTO AN EFFECTIVE MECHANISM OF SPACE DEBRIS MITIGATION

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ABSTRACT

The foundational treaties of space law currently do not provide for detailed regulation on space traffic management. This article will argue that, should a legally binding framework concerning space traffic management be enacted, it should be rooted within the wording of Article VI of the Outer Space Treaty (OST) combined with the insights of international environmental law (IEL). The provision, in its current form, imposes an imprecise obligation on States to authorise and continuously supervise non-governmental space activities under their jurisdiction to ensure compliance with the provisions of the Treaty and general international law. Using the precautionary approach, Article VI wording can be elaborated upon to set a minimum standard for authorisation and continuing supervision for States to adhere to: (1) a procedural requirement to conduct an environmental impact assessment (EIA) on all potential launch activities, and (2) a duty of cooperation and notification. Such procedural obligations aim to; harmonise State practice, collect more information about existing launch practices and their impact on creating space debris, and to guide States in codifying further substantive obligations.

1. INTRODUCTION

The contemporary commercialisation of the space industry has fuelled an increase of launch activities by private actors, and this has led to an overall, exponential increase in space objects polluting the Earth's orbit. As of 2021, ESA has reported 6,250 satellites in orbit, of which 3,500 are operational, a large increase from the mere 1,500 operational satellites that were present in 2015. [1] This trend will continue to grow with the launch of mega-constellations – in May 2019, for example, SpaceX launched the first 60 satellites of its Starlink constellation, with plans of launching a total of 12,000 satellites. [2] The numbers become more staggering when combined with the current space debris population as there are now estimated to be: 34,000 space objects

greater than 10cm, 900,000 objects between 1cm-10cm and 128,000 objects between 1mm-1cm. [3]

The increased space traffic coupled with the increased space debris population alone, will lead to “collision cascading,” also known as the “Kessler syndrome.” [4] A model of this phenomenon can be drawn from the Cosmos 2251 – Iridium 33 collision, that produced around 100,000 pieces of space debris of more than 1cm in diameter in the already crowded Lower Earth Orbit (LEO), most of which cannot be tracked. [5] Further, space debris fragments ‘travel at relative velocities approaching 18,000 miles per hour’ [6] that could penetrate and cripple functioning satellites. Collision cascading presents a broader environmental problem for the space-faring community: it would inevitably render large parts of the orbital zones inaccessible. [7]

The current regulatory framework is insufficient to effectively manage the increased space debris population. [8] The main treaties of space law were intended ‘primarily to facilitate access to and use of the space environment’ and although there are elements of environmental regulation, they do not attempt to provide broader, eco-centric protection of the space environment. [9] In the current *corpus juris spatialis*, only international soft law instruments, such as the COPOUS Guidelines on Debris Mitigation, explicitly address space debris mitigation but the voluntary implementation of these instruments has not proved enough to tackle the issue effectively. For this reason, there is an urgent need to codify obligations in the form of a Space Traffic Management Convention, as proposed in the 2018 IAA Study. [10]

This article will argue that, should a legally binding framework concerning Space Traffic Management (STM) be enacted, it should be rooted within the wording of Article VI of the Outer Space Treaty (OST) combined with the insights of international environmental law (IEL). This article will support this position based on two components as follows:

In Section 2, it will be demonstrated that Article VI OST should form the basis for any future system of space debris mitigation. This is because it establishes a broader mechanism for apportioning responsibility, and further liability, (Section 2.1) and a pre-emptive mechanism that encourages space debris mitigation (Section 2.2). In its current form, however, the provision is too vague to ensure effective space debris mitigation (Section 2.2.2). It follows that a future STM framework is necessary and that any such framework must elaborate upon the basic obligation contained in Article VI OST.

In Section 3, this article will proceed to illustrate *how* Article VI OST can be transformed into an effective mechanism for space debris mitigation for a future STM framework. Within international environmental law (IEL), the international community has increasingly responded to certain environmental threats by manifesting obligations in accordance with the precautionary principle. These obligations are often procedural in nature aimed at gathering information about the contributions of State activities and will therefore guide the codification of further substantive obligations (Section 3.1). These trends are applicable to the environmental problem of space debris (Section 3.2.). Therefore, it will be argued that, for Article VI OST to be transformed into an effective mechanism for STM, it should be complemented by two procedural obligations that will form the minimum standard necessary for effective space debris mitigation: (1) a procedural requirement to conduct an environmental impact assessment (EIA) on all potential launch activities, and (2) a procedural duty of cooperation and notification (Section 3.3).

In the short term, this elaboration of Article VI OST would encourage more States to engage in more responsible launch practices to mitigate the production of space debris and harmonise State practice to improve overall space security. In the long-term, this elaboration would be an effective mechanism for space debris mitigation by collecting more information about launch practices and their impact on creating space debris, to guide States to codify substantive mitigation standards within a STM framework. This approach may be challenged for assuming the establishment of a complex STM framework. Although, the argument for STM has received support in recent years, [11] previous attempts to codify such a framework have been unsuccessful with

many States reluctant to subscribe to further international law obligations.

2. A MECHANISM FOR SPACE DEBRIS MITIGATION: ARTICLE VI OF THE OUTER SPACE TREATY

Article VI is one of the key provisions of the OST that imposes two important obligations upon States: (1) an obligation to bear international responsibility for national activities in outer space, whether carried out by governmental or non-governmental entities, and (2) an obligation for the ‘appropriate State’ to authorise and continuously supervise private space activities.

This article will firstly explore how these obligations support space debris mitigation and then secondly their drawbacks, individual and combined, to effective space debris mitigation.

2.1. International Responsibility under Article VI OST

The first obligation of international responsibility under Article VI OST carries with it two important consequences that support space debris mitigation: (1) a wider scope of State responsibility and (2) liability.

2.1.1. Broader Scope of Responsibility

A unique feature of Article VI OST is that it codifies a broader scope of responsibility than that found in the customary ARSIWA. [12] To appreciate the importance of this attribute for the purpose of space debris mitigation, it is helpful to contrast the two scopes of State responsibility.

Under customary international law, State responsibility is triggered by an internationally wrongful act, i.e. the breach of an international obligation, that is attributable to the State. There are, however, only a limited number of circumstances in which attribution will be established for a breach of international law committed by a private actor: a defendant State must have exercised a certain level of ‘*control, direction or influence*’ over the private actor. [13] As the International Court of Justice (ICJ) reiterated in the *Bosnian Genocide* judgement, a State is ‘*responsible only for its own conduct, that is to say the conduct of persons acting, on whatever basis, on its behalf*’. [14] The onus of proving attribution under

international law is best demonstrated by the ICJ in the *Nicaragua* judgement, where it was held that the United States had not acted wrongfully, although they played a role in the financing, organising, training, supplying, equipping, and even in selecting the targets for a rebellion in breach of international law. [15]

This high threshold for attributing breaches of international law to the State would prevent States from being held responsible for a failure to ensure that private actors mitigate space debris. In the rapidly developing space industry that is becoming more heavily dominated by the private sector, States must hold international responsibility to ensure that private actors are acting in accordance with international law. This is because States hold the means to directly monitor and regulate launch practices in their territory.

On the other hand, Article VI OST imposes a wide scope of responsibility for ‘*national activities in outer space whether or not carried on by governmental agencies or by non-governmental entities.*’ This must be read in light of the provision as a whole, bearing in mind the requirement of authorisation and supervision by the ‘*appropriate State Party to the Treaty.*’ The consequence is that a State will bear international responsibility for a breach of international law of a private space activity under a State’s ‘*control, direction or influence*’ or ‘*authorisation and continuing supervision*’. [16] Importantly, the appropriate State cannot escape international responsibility by omitting to authorise and/or supervise, since it follows from Article VI OST that this immediately provokes that State’s responsibility.

2.1.2. Article VI OST Liability

Responsibility pursuant to Article VI OST does not only lead to regulatory responsibility, it will also lead to liability for any damage caused by the wrongful conduct. This is in line with the customary position in international law, as the Permanent Court of International Justice held in *Factory at Chorzow*, that ‘*the breach of an engagement involves an obligation to make reparation in an adequate form...and there is no necessity for this to be stated in the convention itself.*’ [17] Since the orthodox meaning of liability under international law is that of a duty to pay compensation, and compensation will be awarded should restitution no longer be available, State’s responsible for an internationally wrongful act will thus

be held liable for any damage caused by the wrongful conduct.

In the *corpus juris spatialis*, this position is perhaps conflicting with Article VII OST and the Liability Convention, which directly address the issue of liability for damage caused to another State. It has been argued that the effect of Article VII OST and the Liability Convention is to create an exclusive regime of liability, whereby responsibility under Article VI OST is only regulatory. [18] However, there are two reasons why this argument cannot be accepted.

Firstly, it ignores other, equally authentic, [19] language-versions of the OST that do not distinguish between the terms ‘responsibility’ and ‘liability.’ As Ricky J. Lee has noted, the French text makes use of the term “*responsabilité internationale*”, and the Spanish text of “*responsables internacionalmente*”, in both Article VI and VII OST. [20] Therefore, a reading of the English version of the OST cannot, on its own, be interpreted as overturning the customary position of liability for internationally wrongful conduct.

Secondly, the lack of reference to liability for internationally wrongful conduct under the Liability Convention must not necessarily lead to the conclusion that it was intended to exclude liability under Article VI OST. The principle of *lex specialis derogate legi generali* is only applicable where there exists an inconsistency between two rules of international law, or an intention that one is to exclude the other. [21] Yet neither can be said to exist in relation to the Liability Convention and Article VI OST. While there may be overlap, there exists no inconsistency: the former deals with liability for activities which are not in themselves wrongful; the latter with liability for internationally wrongful acts.

Further, such an interpretation would run contrary to the victim-oriented nature of the Liability Convention [22]; many of its provisions, in fact, encourage alternative methods of dispute resolution. It is therefore difficult to maintain an argument rebutting the ‘*strong presumption against the creation of a wholly self-contained regime.*’ [23] As a result, Article VI OST should be interpreted as upholding the customary principle of reparation, apportioning liability where a causal link is established. It results, therefore, that Article VI OST contains two important features that make it uniquely placed to address the mitigation of space debris:

1. Article VI OST creates a wide scope of State responsibility, ensuring that breaches of international law, in the course of space activities, are attributable to a State.
2. Such responsibility is not merely regulatory. It will lead to liability for damage caused by an internationally wrongful act and thus provides the necessary incentivisation to comply with international legal obligations, including possible obligations of space debris mitigation.

2.2. Authorisation and Continuing Supervision under Article VI OST

The second obligation that is codified by Article VI OST is that an appropriate State Party to the Treaty is responsible for authorising and continuously supervising the space activities of private actors. It operates in conjunction with the, above discussed, responsibility obligation to incentivise States to ensure that all space activities are regulated. A failure to do so will be caught by the broad scope of responsibility that Article VI OST sets and, potentially, liability.

It will be demonstrated that the wording of this provision is uniquely framed for pre-emptive action and may be used to encourage space debris mitigation. However, in its current state, the provision is ineffective due to its imprecise language and the lack of a minimum threshold for either authorising or supervising a launch activity.

2.2.1. An Existing mechanism for Space Debris mitigation?

The language of ‘authorisation and continuing supervision’ appears to create an empty obligation and relies on the discretion of States to choose the particular manner and standard for compliance. At a bare minimum, therefore, a State will be held responsible for an absolute omission to authorise and/or supervise a private space activity as the ‘appropriate State’. However for Article VI OST to effectively mitigate space debris, the provision must go further. There are thus two relevant questions: (1) Does Article VI OST go beyond the mere procedural checkbox, in the form of imposing a standard of due diligence? If so, (2) does the outer space legal regime impose an obligation of space debris mitigation?

The generally accepted answer to the former question is affirmative. As a substantive obligation, Article VI OST imposes a due diligence obligation for States to ensure that non-governmental entities comply with international law. [24] It is a duty of conduct, not result. This is supported by the language of the OST: Article VI OST requires States to ensure ‘*national activities are carried out in conformity with the [OST] provisions*’ and Article III OST declares that all space activities are to be carried out ‘*in accordance with international law.*’

Thus, a State would breach the due diligence obligation under Article VI OST by a partial omission to authorise and supervise, i.e. without taking appropriate steps to ensure compliance with international law. A straightforward example of such a breach would be a private space actor ‘X’ launching a space object that is carrying a nuclear weapon. The launch took place from, was subject to licensing in, and approved by State ‘Y.’ Although procedurally authorising ‘X,’ State ‘Y’ would not only be in breach of Article IV OST once the nuclear weapon enters the LEO, but it would also breach Article VI OST from the moment of launch.

The answer to the second question is more complex. The outer space legal regime is anthropocentric in nature. Nevertheless, the OST introduces many principles that could be interpreted as requiring States to consider and mitigate space debris such as: the principle of due regard, the principle of inter- and intra-generational equity, and the principle of international cooperation. [25] Space debris, as is known through the Kessler syndrome, threatens the very (safe) access to outer space upon which all other fundamental freedoms of the *corpus juris spatialis* rely. Moreover, the *corpus* of international environmental law requires States to ensure that activities within a State’s jurisdiction and/or control respect the environment of areas beyond national control. [26] This obligation is considered customary law and is thus made applicable to the outer space legal regime by virtue of Article III OST.

It follows that space law, at the very least, encourages States to undertake debris mitigation.

2.2.2. Or an Ineffective Mechanism for Space Debris Mitigation?

Notwithstanding the theoretical potential of Article VI OST, the imprecise language of ‘authorisation and

continuing supervision' fuels inconsistent State practice. Under Article VI OST, authorisation and continuing supervision is imparted to the 'appropriate State.' Not only is the term 'appropriate State' left undefined, the standard for authorising and supervising launch activities potentially encompasses all considerations, including space debris mitigation, and none of them. Without elaboration or harmonisation, the potential value of Article VI OST is significantly undermined as an existing mechanism for space debris mitigation.

Some States *have* integrated a space debris mitigation standard with the requirement to authorise and continuously supervise their space activities. For example, Belgium's regulations on its space activities are found primarily in the 'Law of 17 September 2005 on Activities of Launching, Flight Operation or Guidance of Space Objects'. According to Article 4, private space activities require authorisation by "the Minister" and are required to be conducted in accordance with international law. Articles 7 and 8 specify that an applicant must attach a 'study of the impact on the environment' prior to authorisation, after the launch of a space object and/or during its operations. [27] Within the national legal system of Austria, the 'Outer Space Act 2011' lists conditions that must be met for the purpose of authorisation. Operators of space activities, for instance, are required to give due consideration to the internationally recognised guidelines for the mitigation of space debris and make appropriate provision for its recommendations. [28] These examples illustrate how requirements of authorisation and continuing supervision are inherently necessary for effective space debris mitigation. Furthermore, it demonstrates that regulating the potential production of space debris at the State-level may be effective because States can authorise and continuously supervise launch activities more directly.

Nevertheless, there are many other States, which have either not enacted a domestic, regulatory framework for space activities or have not included a standard for space debris mitigation measures that space activities must adhere to before a launch. Even in the Belgian 2005 legislation, illustrated above, the environment is only one factor in the pre-launch impact assessment to be considered by the Minister. There is no provision that requires a satisfactory outcome of the assessment to be a prerequisite to the decision of whether to grant a license. Without a harmonised standard for space debris mitigation measures to be implemented by States before

and during launch activities, the potential creation of space debris will remain unaddressed.

Accordingly, there are two conclusions to be drawn from the obligation of authorisation and continuing supervision under Article VI OST:

1. Article VI OST has the potential to provide for the necessary space debris mitigation by effectively creating a type of precautionary mechanism, which leads to State responsibility and liability should a State fail to take appropriate measures to mitigate the creation of space debris.
2. Article VI OST requires clarification and elaboration at the international level to effectively address space debris mitigation.

3. A FUTURE SPACE TRAFFIC MANAGEMENT REGIME

Space Traffic Management (STM) has been defined by the 2006 Cosmic Study on Space Traffic Management as 'the set of technical and regulatory provisions for promoting safe access into outer space, operations in outer space and return from outer space to Earth free from physical or radio-frequency interference'. [29] While STM refers to the mechanisms for international coordination of traffic in outer space, space debris mitigation would take up an essential position in such a framework. [30]

The 2018 IAA Study on STM sets out what such a Convention could look like. In short, it would consist of three pillars:

1. The Outer Space Convention, incorporating the fundamental principles of the existing *corpus juris spatialis*.
2. The Outer Space Traffic Rules, consisting of rules of technical nature, elaborating on and complementing, the general principles.
3. The Outer Space Traffic Technical Standards, including widely accepted standards that support licensing activities. [31]

The enactment of such a framework is, of course, an ambitious project. Previous attempts to establish a comprehensive STM regime have not succeeded 'either

because they were not yet appropriate for the political context of their time or because the international community was not ready yet to accept the impact and consequences of a given initiative.' [32] However, there have also been some promising developments that may provide the necessary push in favour of negotiating a STM framework. COPUOS has incorporated the topic of STM within its Legal Subcommittee agenda since 2016 and the United Nations is currently calling for States' views on the related issue of responsible behaviour in outer space to be submitted until May 2021. In fact, the 2018 IAA Study predicts that an STM framework could potentially be implemented within the next 15 years if the right steps are taken. [33]

The following Section 3 will illustrate *how* Article VI OST can be elaborated into an effective mechanism for space debris mitigation through 2 procedural, *precautionary* obligations: (1) a procedural requirement to conduct an EIA, and (2) a procedural duty of cooperation and notification. Translating this into the Outer Space Traffic Management Framework, proposed by the 2018 IAA study, Article VI OST would form part of the first layer, the 'Outer Space Convention', while the two procedural obligations complementing Article VI OST will fall under the second pillar of the 'Outer Space Traffic Rules'. These will furthermore guide the codification of rules under the third pillar, the 'Outer Space Traffic Technical Standards'.

3.1. The Precautionary Principle in Equivalent Regimes

International discourse of the precautionary principle began after various definitions were tested in a number of soft law statements in the 1980s, [34] such as the World Charter for Nature 1982 [35] and the Ministerial London Declaration 1987. [36] The precautionary principle *formula* emerged in the international arena as Principle 15 of the Rio Declaration on Environment and Development 1992. Principle 15 reads '*where there are threats of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*' [37] This now-canonical formulation of precaution in IEL has been incorporated into a growing number of 'hard' multilateral treaties, [38] ranging from the 1991 Bamako Convention, [39] to the 1995 Agreement Relating to Straddling Fish Stocks and Highly Migratory Fish Stocks. [40]

The precautionary principle has not yet received express confirmation before international judicial bodies that it represents a rule of customary international law. In fact, the ICJ, in the *Nuclear Test* cases, declined to evaluate the status of the precautionary principle in international law, responding that its legal status was uncertain. [41]

However, it has been acknowledged that the precautionary principle may be on its way to gaining such status. As early as 1995, Judge ad hoc Sir Geoffrey Palmer dissented in the *Nuclear Test* case, that '*the norm involved in the precautionary principle has developed rapidly and may now be a principle of customary international law.*' [42] The International Tribunal for the Law of the Sea (ITLOS) Chamber in the Advisory Opinion on *Responsibilities and Obligations in the Area* observed that with the growing incorporation of the principle into multilateral treaties, there is a '*trend towards making this approach part of customary international law.*' [43]

Further, the precautionary principle has been integrated into over 50 domestic legal systems across different legal cultures, [44] and has also been defended by domestic courts, often with reference to commentary from international judicial bodies. The Indian Supreme Court, in its landmark decision *Vellore Citizen Forum v Union of India 1996* went so far as to declare that the precautionary principle is '*already considered part of customary international law.*' [45] This demonstrates that, over the past two decades, the precautionary principle has become a norm across international law and its varying regimes, treaties and judicial forums. Therefore, the principle may be reasonably discussed in the context of the outer space legal regime, yet another branch of international law.

The following examples of the Law of the Sea and the Law of the Ozone Layer will demonstrate the practice of the precautionary principle and its associated procedural norms to conduct an EIA, and a duty of cooperation and notification.

3.1.1. Law of the Ozone Layer

The Vienna Convention for the Protection of the Ozone Layer 1985 is a framework agreement that, along with its further protocols, codified obligations targeted towards preventing further depletion of the ozone layer. It is a legally sophisticated and novel framework because it was

one of the first multilateral treaties to employ the precautionary principle with universal success. The preamble and Article 2(1) positions the instrument with a broad obligation for parties to take measures *'to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer.'* [46]

The precautionary principle was employed because the causal link between chlorofluorocarbons (CFC's) and the rapid depletion of the ozone layer was not fully understood, [47] and, more importantly, this scientific information would not be available for decades to come. It was, however, understood that there would be destructive repercussions to the international community from sunlight that was weakly filtered by a depleting ozone layer. For example, excessive ultra-violet radiation is dangerous to human health, to the Earth's ecosystem balance, and to the global warming of the Earth's atmosphere. This would impact, not only the current generation but also the health and sustainable development of future generations to come.

What obligations have manifested from the precautionary principle? Since the scientific understanding of ozone depletion was in its infancy and likely to evolve, the Vienna Convention *'needed to be flexible and capable of being adapted to accommodate new scientific assessments.'* [48] For this reason, the Convention heavily codifies procedural obligations for States to gather more information about potential ozone-depleting substances.

For example, the Convention creates an intelligence obligation for States to *'initiate and co-operate in, directly or through competent international bodies, the conduct of research and scientific assessments'* of ozone depleting substances, practices and processes that affect the ozone layer, and the biological effects from changes in the ozone layer. The horizontal obligations of the framework mirror the duty of cooperation and notification. Cooperation is codified *'by means of systematic observations, research and information exchange,'* [49] *'harmonising appropriate policies,'* [50] and in the development of the international, substantive, protocol regime. [51] This is facilitated by Articles 4, where States must cooperate to transfer alternative technologies and knowledge for systematic observations, and 5, where parties are to implement the acquired

information in pursuance of codifying substantive targets in the Protocols. As was evident in the Law of the Sea, these procedural obligations operate symbiotically to gather reliable and confirmed scientific information for the *international community* about a potentially harmful environmental problem.

The Vienna Convention is structured as an overarching framework, where the scientific information gathered is used to guide the codification of substantive obligations and targets in the Protocols to the Convention. For example, the Montreal Protocol governs the gradual elimination in the production and consumption of CFCs, Halons and hydrochlorofluorocarbons. Initially, the Protocol was anticipated to govern only 2 types of substances but, as the causes of ozone depletion were better understood through Convention research, the Protocol was extended to other related substances. [52] This demonstrates that the procedural norms associated with the precautionary principle are useful to effect substantive obligations directly and more accurately.

It has been confirmed that the duty to conduct an EIA is now part of customary international law and is therefore legally-binding on all States. The *Pulp Mills* judgment crystallised the duty for transboundary EIAs, [53] but also discussed the specific content of the right. Each State may determine the particular form of the EIA in its domestic legislation, but it must be conducted prior to the implementation of a project, have *'regard to the nature and magnitude of the proposed development and its likely adverse impact on the environment as well as the need to exercise due diligence.'* These limitations are important when combined with the *Responsibilities in the Area* judgment, which supports and extends the *Pulp Mills* discussion of EIA's to areas beyond national jurisdiction. [54]

Has the precautionary principle been successful in the Law of the Ozone Layer? The Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol are regarded as one of the most successful treaties in international law because it is the only treaty in history to have achieved universal ratification in 2009.

There have been some obstacles to implementing the Protocol and the Convention at the State level such as *'in the illegal trade in controlled substances, in the management of the large stockpiles of controlled substances, and in the elimination of certain substances,*

such as methyl bromide, carbon tetrachloride, and the HCFCs.’ [55] In spite of this, from a scientific perspective, the precautionary principle has been effective in not only preventing further depletion of the ozone layer but also reversing the effects of ozone-depleting substances. According to the latest UN study, the ozone holes are healing at a rate of 1- 3% a decade and will have completely vanished in the northern hemisphere by the 2030s and the southern hemisphere by the 2060s. [56]

Two conclusions may be drawn from the use of the precautionary principle within the Law of the Ozone Layer:

1. The precautionary principle is invoked where full scientific certainty about an environmental problem is not yet available to the international community, but neglecting the harm could hold devastating consequences for sustainable development.
2. Procedural norms support the precautionary principle because they are flexible to State capabilities and effectively gather information for codifying further substantive obligations.

3.1.2. Law of the Sea

Marine environmental problems often present a legal difficulty to codify adequate solutions for. This is because they are often afflicted with polycentric and cumulative causes, from *‘different substances discharged from multiple mobile and stationed sources,’* [57] which makes it difficult to apportion legal responsibility to any particular State. Marine environmental protections have thus broadly shifted their emphasis from command-and-control obligations to more holistic and precautionary measures that focus on intelligence gathering about State activities and their environmental effects. [58] Substantive standards are, in turn, prescribed from the scientific information gathered and are therefore catered towards a particular type of environmental problem.

The United Nations Convention on the Law of the Sea (UNCLOS) contains broad precautionary provisions that targets activities that are potentially and significantly harmful to the environment of other States and the High Seas. [59] They are phrased as a safety net to encompass

environmental harms that may be yet unknown to the international and scientific community, and therefore place focus on procedural norms that help States to *determine* potential harms of future activities. For example, Article 206 UNCLOS incorporates a broad duty to conduct an EIA *‘where States have reasonable grounds for believing that planned activities under their jurisdiction or control may cause substantial pollution of or significant and harmful changes to the marine environment.’*

Within the Law of the Sea regime, the fundamental duty to conduct an EIA and the duty of notification and cooperation are procedural obligations that complement each other. Article 206 UNCLOS continues to establish an obligation for States to disseminate these environmental assessment reports in accordance with Article 205, *‘to provide such reports at appropriate intervals to the competent international organisations, which should make them available to all States.’*

The precautionary principle, and its associated procedural norms, have been upheld and facilitated as mechanisms for marine environmental protection by the ITLOS, on all 4 occasions that the question of its validity has been presented. In the *Responsibilities in the Area* judgment, the ITLOS identified direct obligations of sponsoring States under the Convention and under the general international law obligation of due diligence, one of which was the *‘obligation to apply a precautionary approach...and the obligation to conduct environmental impact assessments.’* [60] This is significant because the Chamber supported extending the precautionary principle to deep sea mining activities that threatened environmental harm to the seabed of the *Area*, where no State holds sole territorial jurisdiction. Furthermore, the ITLOS has supported the fundamental duty of cooperation and notification as a precautionary mechanism. In the *Southern Bluefin Tuna* judgment, the Tribunal granted provisional measures that were aimed at resuming negotiations between the parties towards a new agreement – one that included renewed catch levels of southern bluefin tuna and a set of conservation measures. [61]

Has the precautionary principle been successful within the Law of the Sea? It may be argued that the precautionary principle and its procedural norms have not been fully embraced. For example, the duty to conduct an EIA under UNCLOS is not entirely

prescriptive. The provision *'does not specify the factors to be considered in evaluating the effects of proposed activities, ...the treatment of applicable international standards,'* or require that affected States receive timely information from these environmental assessments. [62] However, it would be inaccurate to view the precautionary, procedural obligations as a futile mechanism for environmental protection. Rather, the flexibility afforded to States as to the exact format and parameters of an EIA has encouraged more States to ratify treaties that include provisions to protect the marine environment. This is important because more scientific information can be gathered in order to confidently guide the codification of further substantive obligations.

For instance, scientific assessments revealed that certain fish stocks were being over-exploited by the international community, but it was difficult to determine which States and activities were the cause because the fish stocks were those that migrated between international law jurisdictions. [63] This encouraged negotiations for the *1995 Agreement Relating to Straddling Fish Stocks and Highly Migratory Fish Stocks*, which was designed to codify both procedural standards for data collection [64] and substantive conservation measures for a list of species. Article 5(b) of the Agreement requires conservation measures to be adapted on the best scientific evidence available and designed to *'maintain or restore fish stocks at levels capable of producing maximum sustainable yield.'* This demonstrates that the procedural norms attached to the precautionary principle are effective because they yield important information that may guide the type of substantive obligations necessary to combat an environmental problem, and the standard at which they are set.

There are two conclusions to be drawn from the use of the precautionary principle within the Law of the Sea:

1. The lack of full scientific certainty about an environmental problem, and the possibility that such certainty will not be foreseeably attained, should not necessarily bar the international community from codifying the precautionary principle into a multilateral treaty framework.
2. The procedural duty to conduct an EIA and the duty of notification and cooperation are effective and flexible to guide the further

codification of appropriate substantive obligations for environmental protection.

3.2. Elaborating Article VI OST wording into a Mechanism for Space Debris Mitigation

Is the precautionary principle applicable to the problem of space debris? The precautionary principle follows environmental problems that have not had the fortune of time to conclude causation with absolute scientific certainty, but the implications of regulatory neglect will be vast and devastating to the international community. Some academics have posited that the precautionary principle may not be relevant to the problem of space debris because there exists plausible scientific evidence for its harm. [65] Nonetheless, *'while there is scientific evidence on the harmful effect of space debris on human assets in space, the harmful impact of space debris on the outer space environment [itself] is shrouded in scientific uncertainty.'* [66] For example, it is difficult to determine the exact source of a piece of space debris, whether from *'explosions creating fragments (e.g. deliberate explosions as part of space weapons testing), deterioration of active and inactive payloads, spent rocket thrusters, and other material produced by the operation of spacecraft.'* [67] Much of space debris is too small to even be tracked by radars on Earth, thus determining their exact source is even more challenging.

Further, space debris is likely to pose 'vast and devastating' consequences for the international community. Space debris travels at incredible velocities in orbit, and therefore causes significant damage to other space objects when they collide. [68] In the short-term, this may not only render a space object inoperable but may also pose a significant threat to humans stationed on a spacecraft. [69] The effects of such collisions will also have a long-term effect on the outer space environment because it will render outer space potentially inaccessible to future generations. [70] A continuing cycle of collisions will produce more debris fragments that may proceed to collide with a further object and so forth: the Cosmos 2251 - Iridium 33 collision alone produced more than 100,000 pieces of space debris of more than 1cm in diameter and each piece is a potential future collision for the space-faring community. [71] In addition, the higher the altitude of a fragment, the longer it will likely remain in orbit before re-entering the Earth's atmosphere. For example, a piece of debris orbiting at an altitude of 1,000km could take over a thousand years to re-enter.

The majority of space debris orbits in the Earth's geostationary orbit at an altitude of 36,000km and will thus remain there for millions of years to come. Without any regulatory action taken, the rate of collisions will exceed the rate at which the fragments it produces will re-enter the Earth's atmosphere, and therefore threaten the free access of outer space and the sustainable development of future generations. [72]

The environmental problem of space debris is largely shrouded in scientific uncertainty and poses many devastating consequences for the international community, both in the short and long-term. Accordingly, the extension of the precautionary principle to the environmental problem of space debris would not necessarily entail a radical change in international space law, *'but rather resemble a natural evolution of law in accordance with the trends set by environmental law sensu largo.'* [73]

The previous discussion can thus be assembled into a single conclusion as follows: a future framework of STM should be rooted in Article VI OST wording that has been elaborated upon in reliance on the precautionary principle in two ways. Firstly, the *'authorisation and continuing supervision'* obligation of Article VI OST can be more precisely defined by invoking the precautionary principle and its associated procedural norms. Secondly, the *'appropriate State party to the Treaty'* could be more precisely defined as the State in the best position at *that* moment to assert direct and immediate jurisdiction over a launch operation.

3.2.1. Defining the *'authorisation and continuing supervision'* Obligation

The two procedural norms may be translated to the environmental problem of space debris within the legal regime of outer space as follows. The duty to conduct an EIA under Article VI wording would oblige States to identify and assess the potential impacts of proposed launch activities that are of an ultra-hazardous nature. [74] This would form part of the necessary requisite to *authorising* a launch operation into outer space and may also be necessary to conduct *during* a launch operation, such as where significant changes are made to a satellite's orbital path that had not been assessed prior. IEL and customary international law has established some general criteria that a EIA must satisfy, namely that an EIA must: (1) be conducted prior to implementation

of a project, (2) continuously monitor the effects of a project on the environment, and (3) have regard for the nature and magnitude for the proposed development. [75] States remain free to determine the specific content of the EIA, and this matches the pre-emptive and flexible wording of Article VI OST.

The duty of cooperation and notification may also be translated to the outer space legal regime in order to mitigate the production of space debris, in a number of ways. IEL has demonstrated that this duty complements the duty to conduct an EIA to circulate important scientific information to a potentially affected State. For the purposes of debris mitigation, such information exchange may include the location, size and the potential orbital paths of space debris as necessary for other States to become aware of potential collisions and to take appropriate response measures. [76] Currently, the Registration Convention codifies a brief obligation of international data sharing, *'but it is intermittent and not reliably accomplished where space debris is concerned.'* [77] Instead, this procedural duty will help States to *'continually supervise'* their space activities and their effects on the outer space environment and other States, and therefore actively mitigate the risk of potential collisions.

The duty of cooperation and notification could be translated more broadly as an obligation that encourages State parties to cooperate with each other and codify substantive mitigation measures for STM. This ensures that the international space-faring community is actively working towards setting technical standards for the third pillar of Outer Space Traffic Rules. This broader vision of this duty also complements the duty to conduct an EIA because the scientific information gathered may be used to guide substantive standards for space debris mitigation, and further to update such measures according to new scientific findings.

3.2.2 Defining the *'appropriate State Party to the Treaty'*.

The term *'appropriate State Party'* as employed in the OST is also imprecisely defined because it leaves two important questions unanswered. Firstly, what criteria should be employed to determine the *'appropriate State'*? Secondly, can there be more than a single *'appropriate State'*?

This article argues that the ‘appropriate State’ should be seen as the State in the best position to assert direct and immediate jurisdiction to authorise and supervise a private actor’s space activities at any given time of the operation. This criterion provides much needed legal certainty, and ensures that the appropriate State is factually capable of discharging the elaborated obligation of authorisation and continuing supervision.

The criterion employed mirrors the test set out by Ricky J. Lee. [78] Nevertheless, it clarifies that, whilst there can only be one ‘appropriate State’ at any given time, that State may change during a satellite’s operational lifetime depending on the operation’s circumstances. Translated for the purposes of space debris mitigation, authorisation should be carried out by the State exercising territorial jurisdiction over the launch, and supervision by the State exercising such jurisdiction over the company’s headquarters or mission-control centre.

3.3. An Article VI Metamorphosis into an Effective Mechanism for Space Debris Mitigation.

This article has proposed a metamorphosis of the current interpretation of Article VI OST from a largely imprecise provision, to a mechanism that can be used to ensure States actively mitigate the production of space debris during launch operations. But would such a mechanism be effective in mitigating the production of space debris?

A transformed Article VI provision would be effective to mitigate the production of space debris in 3 primary ways. Firstly, attaching a procedural obligation to conduct an EIA prior to authorising, and further *during*, launch operations, encourages States to gather more scientific information and certainty about the health of outer space and the impact of particular space activities on the creation of space debris. More accurate scientific information will also be gathered because it is prescribed to the State that may assert the most direct jurisdiction, as a more precise definition of ‘appropriate State’ would lend itself to.

Secondly, the accumulation of scientific information will lead to improved space security and dialogue. The duty of cooperation and notification ensures that scientific information, such as the potential collision paths of space debris, is given to potentially affected States to be able to take appropriate action. Accordingly, States would be cooperating to reduce the probability of collisions with

space debris and slow the rate of cascading collisions that would inevitably affect the space operations of all States. This would improve the space security of the whole international community.

Thirdly, the proposed elaboration of Article VI creates a *harmonised*, minimum standard for space debris mitigation. Attaching 2 procedural obligations to the obligation of authorisation and continuing supervision creates a legally certain standard for States to follow. A harmonised standard for space debris mitigation is also beneficial to the international space community in the long-term because States may be held accountable to this renewed standard.

4. CONCLUSION

To conclude, the wording of Article VI OST should be included in a future STM framework because it establishes a broader mechanism for apportioning responsibility, and further liability, and a pre-emptive mechanism that encourages space debris mitigation. In its current form, the language of Article VI contains imprecise language to ensure effective space debris mitigation at the State level. Therefore, this article proposes to elaborate the provision in two ways, using the precautionary principle that has seen increasing support from the international community.

Firstly, the ‘authorisation and continuing supervision’ obligation must be elaborated into two procedural obligations that form a minimum standard for States to adhere to: (1) a requirement to conduct an EIA on all potential, ultra-hazardous launch activities, and (2) a duty of cooperation and notification. Secondly, the ‘*appropriate State Party to the Treaty*’ should be defined as the State in the best position at any time to assert direct and immediate jurisdiction over a launch operation.

Translating this into a future Outer Space Traffic Management Framework, as proposed by the 2018 IAA study, Article VI OST would form part of the first pillar, the ‘Outer Space Convention’, while the two procedural obligations complementing Article VI OST will fall under the second pillar of the ‘Outer Space Traffic Rules’. These will furthermore guide the codification of rules under the third pillar, the ‘Outer Space Traffic Technical Standards’. This transformation of Article VI OST aims to guide States to improving space security both in the short and long-term.

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