



Long Article

Space Debris: From the Womb to the Tomb

Avanti Deval¹ & Pallavi Kolarkar²

¹Symbiosis Law School, Pune ²Indian Law Society's ILS Law College, Pune

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Abstract: *Issues of space debris are not only harmful to the earth and outer space but also have other far-reaching results. In spite of the large perpetration rate, in outer space, the issue has not yet been successfully elucidated due to grey areas in the existing inadequate legal framework. These inadequacies thus prove to be detrimental to the overall functioning of objects in space. There is no denying that there exists a scarce legal framework with regard to the reduction in new space debris. Ambiguity regarding the accurate interpretation of certain terms thereby creating a legal lacuna for assigning liability has been noted and endeavored to remedy in the present study. Also, the thorough compliance with certain laws being merely a theoretical possibility due to the paucity of adequate sanctions has also been carefully studied.*

This paper aims to broach this inveterate subject and analyze the laws which encompass crucial aspects of mitigation, liability, detection, and applicability of solutions. Further, it seeks to propose suggestions like that of reasonable relaxation with regard to the requirement of consent of the launching state for the removal of space debris. Imperative and specific solutions like compulsory launching fees and 'implied ownership' are explained and suggested. Preventive and compensatory measures are elucidated inter alia. This paper adopts the doctrinal method of study to critically analyze, comment on, and magnify the legal aspects that need further consideration and analyses the efficacy of the existing space laws. This essay concludes by recommending in detail the future strategy to remedy the issue of space debris.

Keywords: *Space Debris, Remedial strategy, Space Laws, Mitigation, Liability.*

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1. Introduction

The latter part of the title ‘From the Womb to the Tomb’ summarizes a crucial understanding of a problem and the right approach to solve it. This understanding can be readily applied to the world of space debris. That is, if the issue of space debris is approached sooner than later, taking into consideration its impact on the Earth as well as on the outer space, a bout of panic for the future generations would be successfully absent. The creation of space debris resembles the lack of legal measures taken to avoid collisions and ensuring a systematic safety assessment process before a space launch. This present work elaborates on these critical aspects of space debris pollution.

Space collisions can be of two types; ‘an impact between two debris (non-functional) objects’ and ‘impacts between a debris object and a functioning satellite or a shuttle’. Staggering reminders to solve the space debris issue have come into light when fragments of space debris upon re-entry have fallen into water bodies¹ and on land in large chunks including contacts with humans². Considering the abovementioned facts, do we need a cataclysm to undertake a legal (and practical) action? Moreover, there is substantial doubt about the existing legal framework serving a critically important role in providing effective and clear solutions to the debris issue.

The foremost and commonly recognized criticism is with regard to the ambiguity and inadequacy of the legal definitions. Some key definitions are as clear as mud. *For example*, meaning of the term “non-functional”; scope of “damage causing party” in the context of affixing “absolute” or “fault-based liability”; definition of the term “fault”; standard of care for establishing negligence;³ ambit of compensable damages (direct/indirect); among other things, are either absent or alarmingly vague in the existing legal framework. This paper seeks to critically analyse these ambiguities and the negative impact of the same.

The situation remains further aggravated by the fact that damage to the outer space environment is also not spoken of in the Liability Convention. With regard to space debris detection, highly developed technologies which are not limited to a specific focal range are required. Though the current technology is insufficient to clear the outer space of debris, the urgency for remediation of space debris is far more alarming. This paper also seeks to lay out certain suggestions with regard to mitigation of this space debris issue.

¹ Sgobba Tommaso, ‘Space Debris Re-entries and Aviation Safety’ (*International Association for the Advancement of Space Safety*, 2013) <<http://iaassconference2013.space-safety.org>> accessed 10 July 2021

² Liu Alec, ‘Woman hit by space junk, lives to tell the tale’ (*Fox News*, 13 January 2015) <<https://www.foxnews.com/science/woman-hit-by-space-junk-lives-to-tell-the-tale>> accessed 17 July 2021

³ Howard A. Baker, ‘Space debris: Legal and Policy Implications’ (1989) 6 *Utrecht Studies in Air and Space law* 79

This paper will first throw light upon the evolution of space debris and proceed to magnifying the causes and consequences of the existence of space debris pollution. Further, it will conduct an enquiry on the legal aspects that need further consideration by the way of a critical analysis followed by a criticism of the same. Furthermore, the practical problems with respect to the liability (of states) and implementation (of laws) will be thoroughly addressed. As an idea without any action transforming into a regret is not the desired end goal, it is thus wise to strike while the iron is hot. In a nutshell, if all the spacefaring nations do not take measures to mitigate space debris, the day is not far when an astrophile will see fragments of debris instead of stars in the sky.

2. Evolution of Space Debris as an Issue

A longstanding accumulation and addition in space debris populace is indicated by science in a brutally honest way. There have been fragments of space debris exceeding twenty thousand recorded in the past 40 years and more than 8,000 still stay aloft.⁴ Space collisions can happen due to ‘an impact between two debris (non-functional) objects’ and ‘impacts between a debris object and a functioning satellite or a shuttle’.

The Kessler Syndrome indeed gives value to the puzzling nature of problems with respect to liability for damage caused in space. The Kessler Syndrome (though hypothetical) is a plausible and a commonly-dreaded situation.⁵ It refers to a situation of collision cascading leading to more self-generating collisions which would continue *ad infinitum*. This will result in an enhanced risk to the lives of astronauts and an unequalled pressure on neighbouring orbits. This also indicates the jeopardizing of essential aspects of daily life of humans which include satellite facilities like GPS, weather forecasting, space-based communications and so on.

In respect of the remediation of space environment, one may investigate the “precautionary principle”. The International Court of Justice has clarified that the precautionary principle doesn’t act “*as a reversal of the burden of proof*”.⁶ Principle 15 of the 1992 Rio Declaration⁷ describes its function as follows:

⁴ Sreemeena Sethu & Mandavi Singh, ‘Stuck in Space: The Growing Problem of Space Debris Pollution’ (2014) 2 UK Law Student Review 96

⁵ William Broad, ‘Orbiting Junk, Once a Nuisance, Is Now a Threat’ (*The New York Times*, 6 February 2007) <<https://www.nytimes.com/2007/02/06/science/space/06orbi.html>> accessed 24 July 2021

⁶ *Pulp Mills on the River Uruguay, Argentina v. Uruguay* ICJ GL No 135, [2006] ICJ Rep 113

⁷ Declaration of the UN Conference on Environment and Development (UNCED) 1992, UN Doc. A/CONF.151/26/Rev.1 Vol. 1

“In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

Hence, stalling the initiation of active debris removal from the Earth’s orbits will lead to a non-linear cost increase as large amounts of debris would have to be removed.⁸ Studies show that even an immediate cessation of satellite launches would not result in a safe space environment.⁹ It is thus a classic example where remedial action should begin sooner than later. The ever-growing volume of space debris has been graphically depicted below:¹⁰

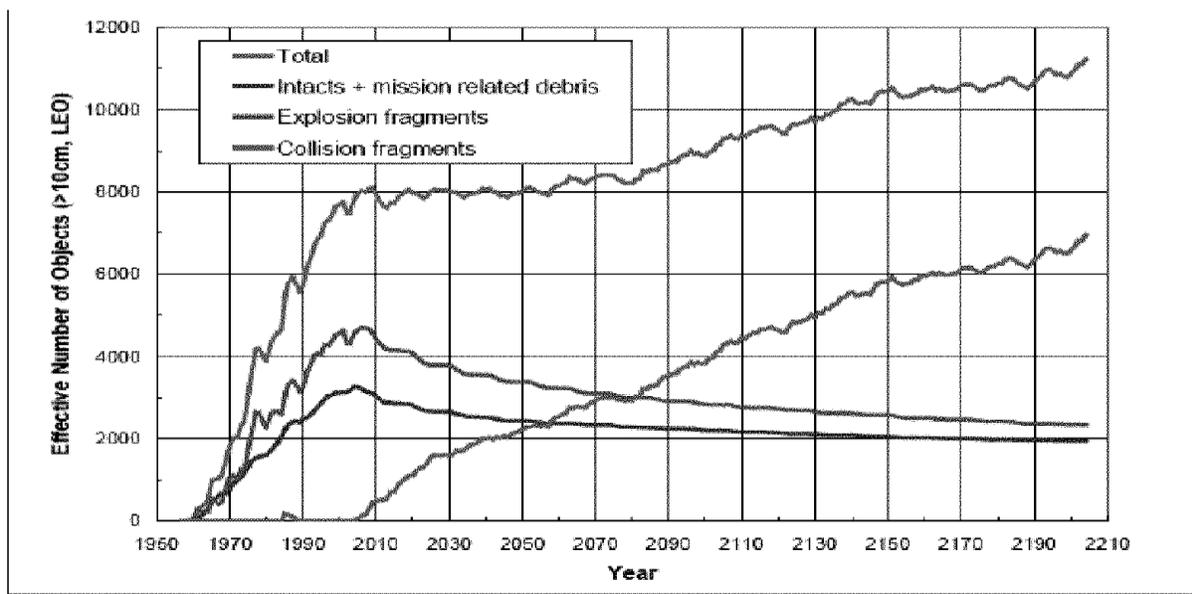


Fig. 1: Growing Volume of Space Debris

3. Space Debris Pollution: Causes and Consequences

The Low Earth Orbit (“LEO” *hereinafter*) and the Geostationary Earth Orbit (“GEO” *hereinafter*) are the most suitable orbits (amongst the four orbits around the Earth) where satellite operations take place.¹¹ The fallout of the atmospheric drag in the LEO is the eventual decay of satellites, such as the Soviet Union’s Sputnik 1.

⁸ Bastida Virgili & H. Krag, ‘Strategies for Active Removal in LEO’ (2009) 5(1) ESA - 5th European Conference on Space Debris

⁹ Jan Helge Mey, ‘Space Debris Remediation’ (2012) 61 ZLW 251

¹⁰ ‘Inter-Agency Space Debris Coordination Committee Space Debris Mitigation Guidelines Update’ (45th Session of the Scientific and Technical Subcommittee United Nations Committee on the Peaceful Uses of Outer Space 2008)

<<https://orbitaldebris.jsc.nasa.gov/library/iadc-space-debris-guidelines-revision-2.pdf>> accessed 8 August 2021

¹¹ Michael Taylor, ‘Trashing the Solar System One Planet at a Time: Earth’s Orbital Debris Problem’ (2007) 20 Georgetown Environmental Law Review 53

Contrariwise, a GEO satellite persists in the orbit for longer periods due to the atmospheric drag being absent, such as USA's Vanguard 1 Satellite which still orbits in GEO since 1958.¹² It is contended here that it becomes imperative that the space debris in LEO should be a priority for states to remediate. The threat caused by space debris in LEO is more than that caused in GEO. This is primarily for the reason that the atmospheric drag is more in LEO and hence the threat of non-functional satellites falling back to earth and damaging persons or property is more.

3.1. The Creation of Space Debris

There have been instances wherein the mere collision of an inactive satellite with another active satellite resulted in the creation of massive amounts of space debris.¹³ These events have proven as a staggering reminder of the evolving issue of space debris.¹⁴ The creation of debris can take place through different ways and in different impact intensities too. Depending on the intensity of harm caused by debris, a rather higher intensity harm causing debris objects include harmful particulate matter ejected from the exhaust,¹⁵ disintegrated explosive bolts during upper stage launch, discarding of protective shields and other incidental hardware.¹⁶

Space accessories like thermal gloves which have floated out of the spacecraft¹⁷, cameras, micrometeoroid and orbital debris (MMOD) experiments¹⁸, greased gun leaks¹⁹, particles from explosion of fuel tanks²⁰ and spontaneous release of fragments from satellites²¹ have also been recorded in the past.

¹² Sreemeena Sethu (n 4)

¹³ Dr. T. S. Kelso, 'Iridium 33/Cosmos 2251 Collision' (*Celestrak*, 5 March 2009) <<http://celestrak.com/events/collision/>> accessed 14 August 2021

¹⁴ Maya Wei-Haas, 'Space Junk is a Huge Problem – and it's only Getting Bigger' (*National Geographic*, 25 April 2019) <<https://www.nationalgeographic.com/science/space/reference/space-junk/>> accessed 17 August 2021

¹⁵ 'Orbital Debris: A Technical Assessment' (*Committee on Space Debris National Research Council*, 1995) <<http://www.nap.edu/catalog/4765.html>> last accessed 23 August 2021

¹⁶ 'Orbiting Debris: A Space Environmental Problem' (*U.S. Congress, Office of Technology Assessment* September 1990) <<http://ota.fas.org/reports/9033.pdf>> accessed 15 August 2021

¹⁷ Loretta Hall, 'The History of Space Debris' (*Space Traffic Management Conference* 2014) <<https://commons.erau.edu>> accessed 28 November 2021

¹⁸ *Ibid*

¹⁹ James Sturcke, 'Astronaut loses tools during Spacewalk' (*The Guardian*, 19 November 2008) <<https://www.theguardian.com/technology/2008/nov/19/spacetechnology>> accessed 28 November 2021

²⁰ European Space Agency, 'Space Debris Mitigation: The Case for a Code of Conduct' (*Science Daily*, 22 April 2005) <<https://www.sciencedaily.com/releases/2005/04/050419110538.htm>> accessed 30 November 2021

²¹ 'New Debris Seen from Decommissioned Satellite with Nuclear Power Source' (*NASA*, January 2009) <<https://orbitaldebris.jsc.nasa.gov/quarterly-news/>> accessed 29 November 2021

There have been bygone avoidable acts of space debris too. These include the intentional acts of creating debris from the anti-satellite weapons tests (ASATs)²² conducted by the US and USSR, which produced more than five percent of the then catalogued orbital debris.²³ Another similar test conducted by China created debris which had spread throughout the satellite's orbit.²⁴

3.2. Direct contact of debris with Humans

The space debris has been observed to detrimentally affect humans and the environment on Earth. There have been numerous instances when the space debris upon re-entry was recorded to have fallen into water bodies²⁵ and at times on land²⁶ as well in large chunks. Instances where grave injury was caused to five Japanese sailors may also be cited.²⁷ There have been instances where space debris has come in physical contact with unaware individuals proving their experiences to be daunting.²⁸

4. Legal Enquiry: Critical Analysis of Legal Aspects that Need Further Consideration

The Convention on Registration of Objects Launched into Outer Space (Registration Convention)²⁹

This Treaty aids in identification of space object (which allegedly may be space debris), which thereafter becomes pertinent to affix liability on the launching state. It mandates launching states to register the concerned space object along with relevant information³⁰ such as “*basic orbital parameters and general function of the space object*” which is openly and fully accessible.³¹ Furthermore, in case identification of the harmful space object is not possible for a particular State Party, it may request a more capable State party to assist the identification and the latter State Party may agree to respond to such a request under “*equitable and reasonable*

²² David S.F. Portree, ‘Orbital Debris: A Chronology’ (NASA, January 1999) <<https://ntrs.nasa.gov/>> accessed 3 December 2021

²³ Loretta Hall (n 17)

²⁴ Weeden Brian, ‘2007 Chinese Anti-Satellite Test Fact Sheet’ (Secure World Foundation, 23 November 2010) <http://swfound.org/media/9550/chinese_asat_fact_sheet_updated> accessed 4 December 2021

²⁵ Sgobba Tommas (n 1)

²⁶ David S. F. Portree (n 22)

²⁷ ‘No one has yet been killed by Re-entering Space Junk’ (The Economist, 10 August 2019) <<https://www.economist.com/science-and-technology/2019/08/10/no-one-has-yet-been-killed-by-re-entering-space-junk>> accessed 5 December 2021

²⁸ Liu Alec, ‘Woman hit by space junk, lives to tell the tale’ (Fox News, 21 October 2011)

<<http://www.foxnews.com/scitech/2011/09/21/woman-gets-hit-by-space-junk-lives-to-tell-tale/>> accessed 7 December 2021

²⁹ Registration of Objects Launched into Outer Space (Registration Convention) 1975, 28 U.S.T.S. 695, 1023 U.N.T.S. 15

³⁰ Registration of Objects Launched into Outer Space (Registration Convention) 1975, art. IV

³¹ Registration of Objects Launched into Outer Space (Registration Convention) 1975, art. III

conditions”.³² This reflects the Convention’s intent to foster co-operation and mutual effort of State Parties in collectively fighting against the global issue of space debris.

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty)³³

It provides for preventive as well as compensatory measures. The former may be elucidated by the right of State Parties to call for consultations, in case there exists a cause to maintain that the nationals of the State Party calling the consultation, or any other State Party is about to indulge in a harmful space activity.³⁴ The latter is observed in accordance with the “*imposition of international liability for any damage caused by national activities of State Parties in Outer Space.*”³⁵

Convention on International Liability for Damage Caused by Space Objects³⁶

The Liability Convention is pertinent for two main reasons. Firstly, it is the only Convention which defines “damage” and secondly, it purports to provide further clarity on interpretation of liability under the international regime, which was not envisaged under the earlier Conventions. It includes damage to person as well as to property. While the former relates to “*loss of life, personal injury or impairment of health*”, the latter relates to that owned by “*persons (natural, juridical), States, International and Intergovernmental organizations*”. Furthermore, two types of liability are evidenced in this Convention. Whereas, absolute liability is imposed on “*launching states whose space objects cause damage on surface of earth or to aircrafts in flight*”,³⁷ fault-based liability is imposed when “*damage is caused elsewhere than on the surface of the Earth to space object(s) or to persons or property on board such a space object.*”³⁸ Moreover, “rapid and appropriate assistance” is required to be provided to the State Party if there exists evidence of “large scale danger to its human life” or serious interference to their living conditions due

³² Registration of Objects Launched into Outer Space (Registration Convention) 1975, art. VI

³³ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty) 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205

³⁴ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty) 1967, art. IX

³⁵ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty) 1967, art. VII

³⁶ Convention on International Liability for Damage Caused by Space Objects (Liability Convention) 1972, art. I(a)

³⁷ Convention on International Liability for Damage Caused by Space Objects (Liability Convention) 1972, art. II

³⁸ Convention on International Liability for Damage Caused by Space Objects (Liability Convention) 1972, art. III

to damage caused by a space object.³⁹ All the State parties, but particularly the launching State are (is) liable to provide such assistance.⁴⁰

5. Criticism of the existing Legal Regime

Whereas, the provisions of the Registration Convention are noteworthy in a theoretical sense as it purports to identify the damage causing party on the basis of registration and implied ownership, the same are naturally not without practical limitations. It is quite difficult to identify the minute and at times microscopic components of the space object which may have dislodged as debris during the space activity or due to accidental collisions.⁴¹ Therefore, it is nearly impossible to accurately register all such debris so as to make the launching parties properly liable.

A criticism of the Outer Space Treaty, is that consultation is not allowed for activities by “nationals of another state party”. Moreover, the scope of this treaty is rather primitive and limited to ensuring co-existence of State parties in peaceful space exploration activities and therefore, the assessment of liability under this convention lacks clarity, which the liability convention was expected to resolve.

However, it is observed that the liability convention has failed to do so. The dichotomy of liability under the Convention, coupled with the ambiguity regarding the accurate interpretation of the term “cause of damage”, has created a legal lacuna making it harder to assign liability. *For example*, if State A’s space object collides with State B’s space object, and the latter causes harm in a State C on earth, irrespective of State B’s fault, it will be liable.⁴² On the other hand State A will be exonerated from any liability concerning damage caused to State C along with that to State B’s space object, unless fault is proven because the harm took place in outer space.⁴³ Such a provision does not seem quite equitable. Furthermore, not only is the definition of fault absent, but also the standard of care set forth for establishing negligence.⁴⁴ Moreover, damage to the outer space environment is also not spoken of in the Liability Convention.⁴⁵

³⁹ Convention on International Liability for Damage Caused by Space Objects (Liability Convention) 1972, Art. No. XXI.24, U.S.T. 2389, 961 U.N.T.S. 187.

⁴⁰ *Ibid*

⁴¹ Paul Larsen, ‘Solving the Space Debris Crisis’ (2018) 83 Journal of Air Law and Commerce 475

⁴² Kehrer, ‘Trevor Closing the Liability Loophole: The Liability Convention and the Future of Conflict in Space’ (2019) 20 Chicago Journal of International Law

⁴³ *Ibid*

⁴⁴ Howard A. Baker (n 3)

⁴⁵ N. Jasentuliyana, ‘Space Debris and International Law’ (1998) 26 Journal Space Law 139

6. Nature and Interpretation of Liability

With regard to the nature of liabilities, two pertinent types have been recognized so far. “Absolute liability” and “fault based” liability. Whereas the former is based on any breach of an international obligation and is irrespective of the intention of the State party in committing and/or preventing the same, the latter focuses on the wrongful intention or negligence as the case may be which has ultimately resulted in the said breach. The Outer Space Treaty revolves around the former type of liability, while the Liability Convention concerns itself with the latter.⁴⁶ Both these theories are naturally not without criticisms.

6.1. Need for alternate form of liability?

A common point of criticism to both these principles, is that they cannot be applied effectively, when the damage causing party cannot be ascertained and identified beyond reasonable doubt. In this context, it becomes pertinent to analyse other forms of liability which could be feasibly implemented. A recent theory in this regard is that of the market share liability principle, propounded by Mark. J. Sundahl,⁴⁷ which purports to recover damages from all such parties which are most likely involved in the concerned harmful activities.⁴⁸ Most importantly, the liability of each actor will be commensurate to the threat and not the damage caused by individual actors respectively.⁴⁹ Thus, this helps in remedying situations wherein the defendants lie indeterminate for various reasons and/or the relief is sought long after the damage was caused.⁵⁰

7. Problems in Implementation

Inadequate Legal Definitions

There are various issues and limitations of the current legal framework regarding mitigation of space debris and implementation thereof. The foremost and commonly recognized criticism is with regard to the ambiguity and inadequacy of the space debris’ legal definitions. According to the UNCOPOUS (United Nations Committee on Peaceful Use of Outer Space) guidelines,⁵¹ space debris is defined as “*all manmade objects including*

⁴⁶ Sylvia Maureen Williams, ‘Space Debris and International Law’ (1995) 38 Proceedings of the Colloquium on the Law of Outer Space 65

⁴⁷ Mark J Sundahl, ‘Unidentified Space Debris: The Case for a Market Share Liability Regime’ (2000) 24 Hastings International and Comparative Law Review 125-154

⁴⁸ Mark A Geistfeldt, ‘The Doctrinal Unity of Alternative Liability and Market Share Liability’ (2006) 447 University of Pennsylvania Law Review 447

⁴⁹ Glen Robinson, ‘Multiple Causation in Tort Law: Reflections on the DES Cases’ (1982) 68 Virginia Law Review 713

⁵⁰ Sreemeena Sethu (n 4)

⁵¹ U.N. General Assembly on The International Cooperation in the Peaceful Uses of Outer Space, Res. 62/217 2008

fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional.”⁵² Here, the term non-functional could be interpreted in three different ways. Firstly, a space object which the concerned State has lost contact with, secondly, dead and no longer capable of functioning and yet is trackable, thirdly, a space object which is technically functional and trackable, but not in use by the launching State. Meaning of the term non-functional as per the third interpretation is yet a grey area in law.

Similarly, the Liability Convention,⁵³ lacks clarity in its definition of a “space object,” which, according to Article I(d), “*include[s] component parts of a space object as well as its launch vehicle and parts thereof*”.⁵⁴ Thus, it is unsettled whether objects that are entirely built-in space and were never launched come within the ambit of this definition. Thus, due to the unclear, non-binding and rather vague definitions of space object and space debris, it becomes even more difficult to affix liability or mitigate any damage caused.

Non-binding Nature

Another fallacy with regard to the existing regime is the non-binding nature of international guidelines. The best example is the ‘Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space’⁵⁵ which provides preventive as well as remedial measures for space debris and rules concerning affixing of liability on the damage causing parties. Naturally, thorough compliance remains a theoretical possibility due to the paucity of adequate sanctions. The situation is further aggravated by the fact that, there exists almost no jurisprudence regarding enforceable settlement procedures. Thus, these guidelines are at best merely voluntary and idealistic.

Technical limitations in Tracing Debris

Implementation of the existing international law on space debris becomes even more difficult for many other reasons. Tracing and supervising of the injury-causing debris easier said than done. Most of the currently used space debris tracking mechanisms are inadequate, because the debris which does not move through its radar scope is not detected allowing only intermittent tracking. In order to detect space debris continuously, highly developed tracking technologies which are not limited to specific focal range are required.

⁵² UNCOPUOS Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space 2007, Anx. UN doc. A/62/20.

⁵³ Convention on International Liability for Damage Caused by Space Objects (Liability Convention) 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187.

⁵⁴ Howard A. Baker (n 3)

⁵⁵ U.N. General Assembly on Outer Space Affairs, Res. 62/217 2008, U.N. Doc. A/RES/62/217

Inadequate provisions for Removal of Space Debris

While the Mitigation Guidelines provide for mitigation of space debris, they do not deal with “*remediation of the space environment*”.⁵⁶ This situation remains further aggravated by the fact that the launching state is required to consent to the removal of the space debris as per the Outer Space Treaty. Whereas, if this requirement (of consent), is reasonably relaxed then such a *modus vivendi* would aid in the space debris issue remediation; however, whether a party other than the launching state has a right to remove⁵⁷ the space object allegedly causing or composed of space debris, remains a grey area in law.

Rare Provisions for Reduction of New Debris

There exists a scarce legal framework with regard to reduction in new space debris. The only example would be Article IX of the Outer Space Treaty⁵⁸ which allow the member states to seek consultations regarding space projects which are likely to be detrimental to prospective/existing space programmes.

Increasing Private and Commercialized Space Activities

The application of the existing space treaties to private actors commercializing activities in outer space is unclear.⁵⁹ Large scale investments have occurred in private and commercial space activities since, the past three to four years. In 2017 itself, the financial investment in such projects has been observed to be close to 3.9 billion US. Dollars. In fact, companies like Space X, Blue Origin, and Virgin Galactic have been recorded to have made more successful launches than most State-owned bases.⁶⁰ However, this has increased the collisions in the already populated space and the risks of States indulging in cyber warfare tactics.⁶¹

⁵⁶ Dave Baiocchi & William Welsch IV, *Confronting Space Debris: Strategies and Warnings from Comparable Examples including Deepwater Horizon* (RAND 2010)

⁵⁷ Joseph Burke, ‘Convention on International Liability for Damage Caused by Space Objects’ (1984) 8 *Fordham International Law Journal* 255, 256

⁵⁸ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty) 1967, art. IX

⁵⁹ N. Jasentuliyana, ‘Space Debris and International Law’ (1998) 26 *Journal of Space Law* 139

⁶⁰ Rich McCormick, ‘SpaceX Plans to Launch First Internet-Providing Satellites in 2019’ (*The Verge*, 4 May 2017) <<https://www.theverge.com/2017/5/4/15539934/spacex-satellite-internet-launch-2019>> accessed 16 December 2021

⁶¹ Brian Kennedy & Mark Strauss, ‘Many in U.S. Have Confidence in What Private Space Companies Will Accomplish’ (*Pew Research Center*, 22 June 2018) <<https://www.pewresearch.org/fact-tank/2018/06/22/many-in-u-s-have-confidence-in-what-private-space-companies-will-accomplish/>> accessed 19 December 2021

Scope of Damages remains Unclear

It remains ambiguous whether indirect damages including but not limited to moral and/or mental are considered compensable under the liability convention.⁶² The issue regarding the ambit of damage under the Liability Convention arose in the Kosmos 954 case in 1978. The facts of the case were such that a satellite owned by Soviet hurled down on Canadian land. While this land was unoccupied when the incident occurred and did not lead to any damage and/or destruction to/of persons or property as such, a large-scale radio-active debris got dumped due to the satellite's fall in Canada. Thus, Canada prayed for compensation to cover the costs of clean-up of this radio-active waste.⁶³ But, since the terms of the Convention were not adequate to supply the meaning of damage, it was scarcely pleaded and rarely taken notice of.⁶⁴

8. Conclusion and Suggestions

It is concluded that *firstly*, there is a lack of binding and uniform laws pertaining to mitigation and removal of space debris; *secondly*, that the existing laws on the issue are quite outdated and replete with ambiguities and lacunas; and *lastly*, that the various factors such as high cost requirement, condition precedent of consent of launching party for removal of space debris and, absence of strict procedures for registration, pre-check compliances etc. have further complicated the issue of space debris. The findings and results pertaining to each of these concerns have been summarized briefly hereinafter and an attempt has been made to complement each of them with certain viable solutions respectively.

It is observed that there is a lack of binding guidelines across different stages of the space activities. It is suggested that standard practices are adopted multilaterally which provide for preventive measures even in the inceptive and developmental stage of the programmes. This will aid in avoiding and/or minimizing debris releases, accidental explosions, hazardous collisions. Moreover, developing uniform binding rules regarding remedial measures to dispose of space hardware after launch is also pertinent.

It is discerned that the legal frameworks have rarely been amended ever since their inception. It is strongly suggested that State Parties embark upon doing so in the immediate future so as to clarify, modify, and supplement the existing ambiguous and rather inadequate stance on space debris. This recommendation may

⁶² Carl Christol, 'International Liability for Damage Caused by Space Objects' (1980) 74 American Journal of International Law 346

⁶³ Joseph A. Burke, 'Convention on International Liability for Damage Caused by Space Objects: Definition and Determination of Damages After the Cosmos 954 Incident' (1984) 8 Fordham International Law Journal 255, 256

⁶⁴ Kehrer (n 42)

be supported primarily by three reasons. *Firstly*, that the technology and law, both have undergone tremendous developments in the past 40 years, thereby, naturally implying the need to update the enforcement mechanisms. *Secondly*, that the drafters of the treaties themselves anticipated the need for such amendments and the same is evidenced through articles XXVI (periodic review after 10 years or 5 years on request of one-third of the parties), XXV (acceptance of amendments by majority), XXIII (re-affirm, supplement, or extend provisions) of the Liability Convention. *Thirdly*, that if there is more clarity and understanding of the legal framework, then the chances of accountability of damage causing parties and adoption of precautionary measures are most likely to increase.

One of the primary difficulties in protection of satellites in the geo-stationary orbit which could in turn aid in reduction and remediation of space debris, is the high-cost technology required. It is suggested that a compulsory launching fee is imposed and an effective multilateral agreement is drawn up with that regard.

As per the Outer Space Treaty, a State party is not allowed to interfere with another State's property in space. Thus, even after a space object has been recognized and identified as damage causing space debris, it can only be removed by the launching party or after procuring its consent. It is suggested, that in the interests of effective and faster resolution of space debris which is an alarming global issue, the condition precedent of consent is relaxed equitably and reasonably on a case-to-case basis.

However, if such a suggestion is sought to be incorporated, it is pertinent to advocate a caveat here. Wrongful interference with space objects of another State in order to misuse its sensitive data and technologies under the garb of space debris remediation is indeed a dangerous possibility. Therefore, complimentary to the above-mentioned suggestion, it is recommended that a binding and well-phrased legal framework is drafted in this regard which ensures that the States' individual security interests are balanced with the persistent need to clean the space environment.

This lacuna may be resolved to a certain extent with another approach, *i.e.*, if registration is considered as implied ownership. As a result, at least the small pieces of debris which could not have been registered due to practical limitations, or others which were simply never registered, could legally be removed by third parties without acquiring any consent from the concerned launching party.

It is contended that the provisions regarding pre-launch compliance checks and penal impositions are inadequate or even largely absent in the existing international regime. It is suggested that inspiration is derived from provisions relating to certain national organizations of States such as the Federal Aviation

Administration of the U.S.A.⁶⁵ Accordingly, it is suggested that strict assessment regarding safety of the launch system is undertaken. In case of non-compliance of set standards, it is contended that permission for the space activity itself or its continuance in case non-compliance is observed at a later stage is not granted or revoked as the case may be. It is also suggested that apart from liability to compensate for damage, penal liabilities such as exemplary fines are also imposed.

An interesting analogy has been drawn between the Law of the Sea and the current Space Law. This analogy reveals a demonstration of the inadequacies of the current Space Laws. It assumes the astronauts being the 'sailors of outer space' and their satellites being their 'ships'; whereas during war at the sea, according to the customary law, a state takes upon itself the ownership and charge of the ship which it controls, *via capture*.⁶⁶ According to the 'U.N. Convention on the Law of the Sea', parties (pirates) who capture ships for private purposes are subject to penalties and these pirate ships are termed to be 'under pirate control'.⁶⁷ Hence, it can be understood from the law of the sea that ownership shouldn't be the causal factor for the harm that is caused. The responsibility for harm should instead stream from 'control'. This downright well-grounded nature of liability due to harm does not find a place in the law of space. This calls for a review and amendment in the Liability Convention as the states shouldn't be held responsible for the damage done by their satellite long after they have lost control over it (here, control vests either with another state, or the launching state's satellite has been hit by another active/non-active space object resulting in loss of control).

The inevitable nature of the creation of debris and its absolute prevention is certainly a dilemma. As mitigation of debris in space is not binding, it ultimately rests upon the consensus of the nation's *vis-à-vis* liability, rights to remove space debris, penalties, and following international guidelines. This, however, shouldn't be much of an elongated process as the Earth needs remediation sooner than later.⁶⁸

Recently, there has been a glimmer of hope for the space debris issue. *Firstly*, wooden satellites have started to be built due to wood's very nature of burning up while re-entering the Earth's atmosphere without any

⁶⁵ The United States of America - UNOOSA Compendium of Space Debris Mitigation Standards Adopted by States and International Organizations, 9 47 U.S.C., sec. 309

⁶⁶ Donald R. Rothwal., *The Oxford Handbook of the Law of the Sea* (1st edn. OUP 2015)

⁶⁷ United Nations Convention on the Law of the Sea 1982, 1833 U.N.T.S. 397, art. 101–05

⁶⁸ Stephen Hobe, 'International Space Law in its First Half Century' (2011) 53 International Institute of Space Law 30

harmful emissions.⁶⁹ *Secondly*, a contract has been signed for the purposes of executing the first debris removal mission.⁷⁰ *Thirdly*, options like space whips, giant magnets, harpoons, or nets⁷¹ are explored.

There also needs to be present a more refined and dependable assessment system for those flight missions which have astronauts on board. This would not only lessen the probability of accidental collisions of two spacecrafts, but also would prove beneficial to the debris mitigation process.

In order to support and enforce the abovementioned solutions, new and refined legal frameworks including “A Code of Customary International Law”, “A Reformed Fault-based Liability System”, “A Compensation/Liability Fund”, and “A Market-share Liability System” should be formed.

Prospective amendments in outer space law shouldn't hinder the advancement in space activities. Instead, they should be able to expunge uncertainty and rather, state clearly what should be integrated and executed in order to protect the probable victims. If the key definitions are well-understood and are clearly interpretable, the outer space actors can be better accounted.

After all, it should be *de rigueur* to implement and abide by the existing space laws to indorse safety and security on and beyond Earth.

⁶⁹ Justin Harper, 'Japan developing wooden satellites to cut Space Junk' (*BBC News*, 29 December 2020) <<https://www.bbc.com/news/business-55463366>> accessed 22 December 2021

⁷⁰ Andrew Parsonson, 'ESA signs Contract for first Space Debris Removal Mission' (*Space News*, 2 December 2020) <<https://spacenews.com/clearspace-contract-signed/>> accessed 26 December 2021

⁷¹ Loren Grush, 'Satellite uses giant net to practice capturing Space Junk' (*The Verge*, 19 September 2018) <<https://www.theverge.com/2018/9/19/17878218/space-junk-remove-debris-net-harpoon-collisions>> accessed 30 December 2021