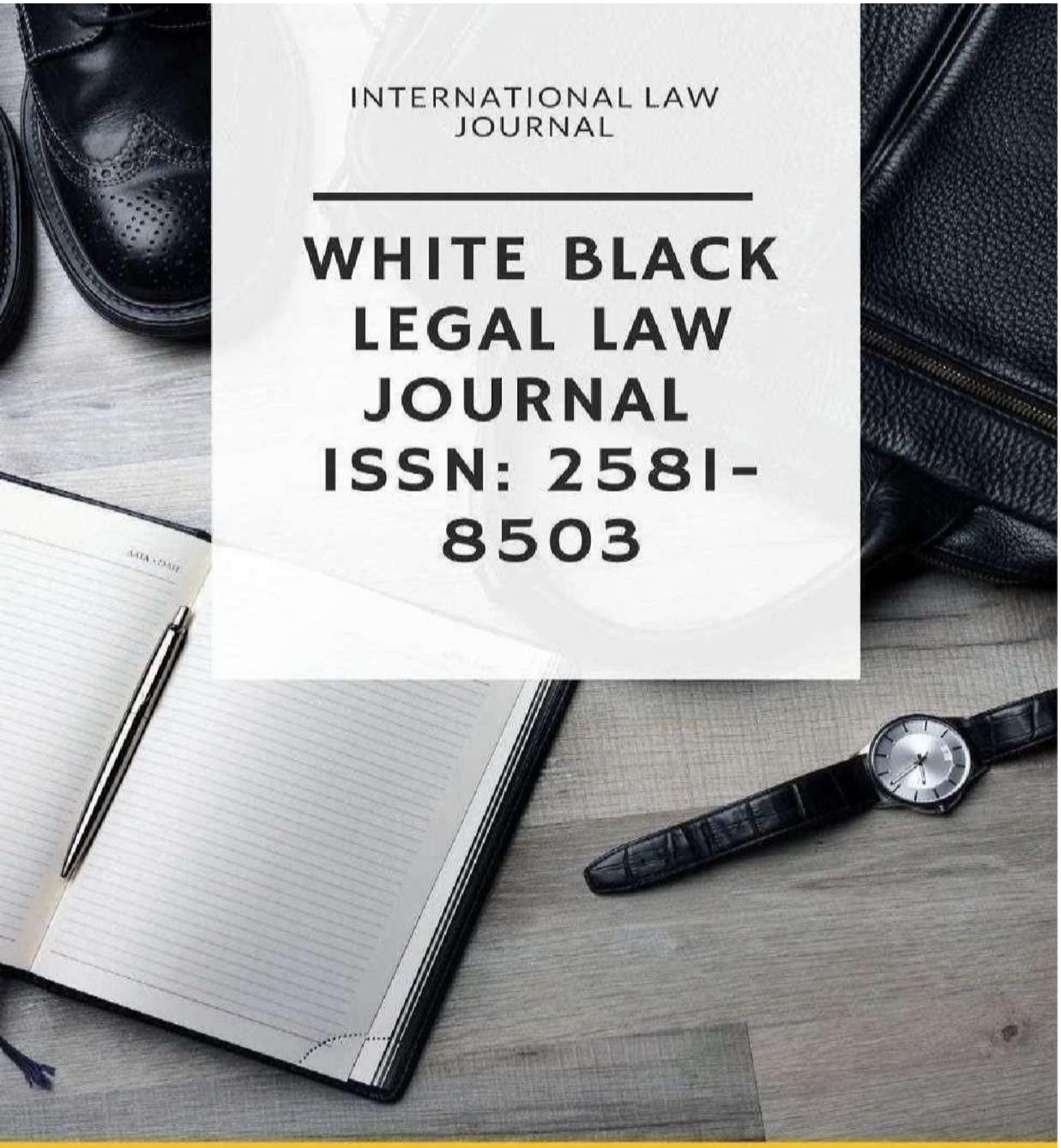

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THE LEGAL ACCOUNTABILITY OF STATES IN SPACE DEBRIS MANAGEMENT UNDER INTERNATIONAL SPACE LAW

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ABSTRACT

In the outer space, the rapid growth of human activities resulted in an increase in the accumulation of space debris, posing serious risks to the satellites, spacecraft, and the sustainable use of orbital environments and though there still exist international legal instruments like the Outer Space Treaty (1967) and the Liability Convention of (1972), now there is still remain a lack in the establishment of clear and enforceable mechanisms for ensuring state accountability in the space debris management and mitigation. This paper critically examines that how current treaties and soft-law instruments define, regulate, and restrict state responsibility. It analyses all the relevant international treaties, i.e., United Nations (UN) resolutions, and soft-law guidelines, including then the UN COPUOS Space Debris Mitigation Guidelines as well as the Inter-Agency Space Debris Coordination Committee (IADC) standards through the doctrinal legal methodology. A significant number of legal gaps have been outlined already like the absence of legally binding enforcement provisions, inconsistent national implementation and a regime of limited liability for debris management of space. While this paper draws a parallel from international environmental law, this study suggests regarding the principles to be codified, that is the polluter-pays principle and common but differentiated responsibility to strengthen the mechanism of global space management and governance. This research overall deals with ensuring effective legal accountability in space debris management by transforming current voluntary norms into a legally binding international regime for the long-term protection and sustainability of the outer space environment.

KEYWORDS: Space, International law, Space Debris, Mitigation, India, EU, LEO, Satellites, Orbits, Spacecraft, Management ,Accountability, Outer space, UN COPUOS,

INTRODUCTION

The existence of millions of broken pieces of spacecraft, phases of rockets and tons of pieces of space debris[1] that are orbiting the Earth is making outer space overcrowded with junk. All these factors are making the outer space operations dangerous. From 1957, when Sputnik I[2] was launched, there has been varying levels of human activities in space ranging from mere scientific exploration to large-scale and lucrative operations. Consequently, an unintentional buildup of debris in space, which includes satellites, rocket components, and collision debris orbiting Earth. This ever- growing amount of junk poses serious threats to the safety regarding orbiting space and peaceful use of space. The issue was already foreseen back in the 1970s which is based on "Kessler Syndrome theory" particularly, now it has been worsened because of new mega-constellations and private satellite constellations, which have aggravated the situation, hence raising complex legal issues related to liability and environmental concerns across borders. While global conventions regarding outer space exists, such as the Outer Space Treaty of 1967[3], the Liability Convention adopted in 1972[4], and the Registration Convention adopted in 1975[5], these treaties refer to the general guidelines of actions and the conduct via all the nations, but they never addressess efforts regarding mitigation, removal of space debris, or making the actions binding. Moreover, UN-COPUOS[6] and IADC[7] guidelines, the soft laws as useful because of their broader recognition overall but there still remain just mere recommendations and have no legally binding force and to bring in light that the research at issue emphasizes an examination of the extent of legal accountability that nations have with regards to space debris of global space law, and at the same time, it tries to express clearly serious deficiencies within today's legal rules and then seek ways and methods towards enhancing these norms so as to offer genuine and enforceable accountability. Also, the scope aims to explore ways related to international responsibilities, national legislation, and technological advances and then to develop a sustainable and fruitful approach that is ethical

[1] United Nations General Assembly, *Report of the Committee on the Peaceful Uses of Outer Space* UN GAOR, 62nd sess, UN Doc A/62/20 (2007).
[2] Sputnik 1 (Union of Soviet Socialist Republics), first artificial Earth satellite, launched 4 October 1957.
[3] 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), opened for signature 27 January 1967, entered into force 10 October 1967.
[4] Convention on International Liability for Damage Caused by Space Objects (Liability Convention), opened for signature 29 March 1972, entered into force 1 September 1972.
[5] Convention on Registration of Objects Launched into Outer Space (Registration Convention), opened for signature 14 January 1975, entered into force 15 September 1976.
[6] United Nations Committee on the Peaceful Uses of Outer Space, *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* UN Doc A/62/20 (2007) annex
[7] Inter-Agency Space Debris Coordination Committee, *IADC Space Debris Mitigation Guidelines* (2007).

and moral within space.

LITERATURE REVIEW

The Outer Space Treaty (1967)[8] and Liability Convention (1972)[9] have assigned paramount roles in space activities to nations and made them liable for any damage caused by these space objects. Conversely, as discussed in more recent literature (for instance, Kuppusamy and Raj, 2025[10]; Bhardwaj and Kumar, 2025)[11], these conventions suffer from a lack of definition regarding the term 'space debris' and not about mega-constellations, private sector developments, and environmental impact. The method of fault finding and space collision as per the Liability Convention creates ambiguity on behalf of liability, and the convention's definition on 'damage' does not include either environmental impact or risk accumulation.

UN COPUOS[12] and IADC guidelines[13] constitute soft law and they recommend debris mitigation but still not obligate and thus have no enforcement capabilities. It would be very difficult for States to follow these guidelines. Various gaps have been identified within the literature as follows: there should be no ambiguity as regards liability for damages, there should be no debris removal facility that does not rely on state approval, and there should be applicable accountability for PSMs. The traditional tragedy of the commons continues as governments continue to preserve national sovereignty within collective sustainability.

It is argued that concepts from environmental law should be adopted within space law with a focus on enhancing responsibility, including polluter pays and shared but differentiated responsibility(Poonuganti, 2023[14]; Buchs & Bernauer, 2023[15]). Suggestions talks about expanding Liability Convention's scope on competence on environmental harm, developing an obligation for debris removal and testing either an incentive model with market components or

[8] Outer Space Treaty (n 3).
[9] Liability Convention (n 4).
[10] Akhil Kuppusamy K and Arun D Raj, 'Space Debris Mitigation Through Domestic Legislation' (2025) 5 *International Journal of Innovative Research and Legal Studies* 2044.
[11] Parul Bhardwaj and Bhupnesh Kumar, 'Liability and Responsibility for Space Debris: Who Pays for the Mess?' (2025) 26 *South Eastern European Journal of Public Health* 7219.
[12] United Nations Committee on the Peaceful Uses of Outer Space, *Space Debris Mitigation Guidelines* (n X) annex.
[13] Inter-Agency Space Debris Coordination Committee, *IADC Space Debris Mitigation Guidelines* (n X).
[14] S. Poonuganti, 'It's Raining Rockets: Heightening State Liability for Space Pollution' (2023) 23 *Chicago Journal of International Law* 490.
[15] Romain Buchs and Thomas Bernauer, 'Market-Based Instruments to Incentivize More Sustainable Practices in Outer Space' (2023) 60 *Current Opinion in Environmental Sustainability* 101247.

an international fund for compensation. There is an urgent need for greater environmental transparency to align law with the practice for a debris removal license.

1. Conceptual and Legal Frameworks

Space debris[16], also known as space junk or orbital debris, is a general term for all those man-made objects orbiting Earth but no longer operable or functional. The list of these includes inoperative satellites, exhausted rocket stages, parts of the spacecraft, and fragments generated by the explosions or collisions.[17] For that matter, the fragments are broken down by their size and origin: big trackable debris (10 cm), small fragments (1–10 cm), and micrometre particles. Their origin can be traced to a lot of different sources such as regular operations-for instance, paint flakes and a rocket stage that has been used for the second time are left in orbit-an accidental break-up-for example, a fuel tank explosion and a battery catching fire in a satellite-a test conducted deliberately-for example, the anti-satellite weapon tests by China, India, the U.S., and Russia[18]-and collision in the orbit-for example, the Iridium- Cosmos crash scenario in 2009[19], which approximately 1,800 trackable fragments were the result of[20]. Commonly, the pieces of a dead satellite-that is, spacecraft that have come to the end of their useful life-fragments of things that have exploded or collided, and upper stages that have not been used anymore are the most common kinds of debris. The risk factors are heavily attached to how fast these pieces of debris are moving-for example, a 1-cm piece could, if it were faster than 7 km/s, slam through the outer shell of a satellite, thus creating a hole.[21]

1.1 Outer Space Treaty and the Liability Convention

The Outer Space Treaty (OST)[22] 1967 provides the first set of global regulations for any activities in space which includes, besides others, restriction of claiming celestial bodies, the permission of scientific investigation, and the stipulation that activities in the space must be in the interests of all the states (OST arts. I-II). OST assigns both the responsibilities and the

[16]Space Debris' (Encyclopaedia Britannica, 19 September 2025)
[17] The Aerospace Corporation, Space Debris 101
[18] European Society of International Law, 'Clearing up the Space Junk: On the Flaws and Potential of International Space Law to Tackle the Space Debris Problem
[19] Iridium Satellite LLC v. Cosmos-2251 Satellite Collision, Low Earth Orbit, 10 February 2009.
[20] NASA, *The Collision of Iridium 33 and Cosmos 2251: The Shape of Things to Come* (NASA Technical Reports Server, NTRS Document 20100002023, 2010).
[21] European Society of International Law, Clearing up the Space Junk' (n X).
[22] 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) 610 UNTS 205, opened for signature 27 January 1967, entered into force 10 October 1967.

liabilities to each State Party. According to Article VI, each State Party is responsible for activities of any state in outer space, meaning by either governmental or non-governmental (private) entities. Furthermore, it points out that the regulations regarding space activities by private entities must be present, and their work should be supervised by the relevant authorities. Under Article VII, States responsible for launching are internationally liable for damage caused by their respective space objects to other States or their nationals. The implication means they are solely liable in case any damage may come on Earth or into an aircraft, and only partly liable in case of damage happening in space where the country that causes the accident with a satellite or pieces of debris in orbit is the one that must pay for the damage to the property of the other country on Earth by using the satellite or debris. However, whenever the two satellites collide in outer space, Article VII and the Liability Convention (1972)[23] provide that the launch state needs to prove it was at fault-negligence-in case it is to be held responsible.[24]

In 1972, the Convention on International Liability for Damage Caused by objects in space elaborates more on the content of Article VII. It emphasizes that any state that launches a space object is unconditionally responsible for any harm to any aircraft in space or to the Earth caused by its own space objects adding onto which if the damage happens in such a place like an orbit and no fault is found, the launching state is not held liable[25]. The convention also gives a comprehensive explanation as of how the Claims Commissions have to receive applications for their consideration. However, only in Satellite Cosmos 954 crash in Canada v. The USSR[26] has been formally conducted under the convention of only a single major liability claim[27] and notably, both the Liability Convention and the OST[28] are provided for claims between states. Article VII directly points out that only a State should be responsible for the damage caused by another party of the State or its citizens, thus it will not be legally liable for any of the damage to its own citizens or property[29]. Although these treaties do not directly deal with debris, their provisions still stand for debris as space objects. According to OST, the bits and

[23] Convention on International Liability for Damage Caused by Space Objects (Liability Convention), opened for signature 29 March 1972, entered into force 1 September 1972.
[24] United Nations Office for Outer Space Affairs
[25] United Nations Office for Outer Space Affairs, (n X).
[26] Canada v. Union of Soviet Socialist Republics (Cosmos-954 Claim), Claim for Damages under the Convention on International Liability for Damage Caused by Space Objects, 18 January 1978; Settlement Agreement, 2 April 1981.
[27] Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, *Space Debris Mitigation and Remediation: Policy and Legal Challenges* (Conference Room Paper, Sixty-Fourth Session, UN Doc A/AC.105/C.2/CRP, 6 May 2025).
[28] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature 27 January 1967, entered into force 10 October 1967.
[29] Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, *Space Debris Mitigation and Remediation* (n X).

pieces of a object in space should be considered as space objects because they are themselves considered space objects for liability. UNOOSA[30] claims that according to Registration Convention, and OST where a piece of debris can be owned by someone even if it is useful or working.[31] The law treats debris in the same way as intact satellites for example, even if a part of Satellite X belongs to State A whereas Earth on which the property that is damaged by the fragment is owned by State B, it is State A that is held liable. On the other hand, in case of damage in space, the fault of A should be determined by the victim State, which is pretty impossible as the tracking of debris paths and understanding the source of the collisions would be highly difficult. Now, while the OST and Liability Convention provides means to hold the states accountable, their fault-based system for any space accidents and their failure to address the losses to victims within their territory, meaning that in practice, leaving out the most incidents caused by space debris unaddressed.

1.2 UN COPUOS Guidelines and IADC Standards

Due to the few binding laws, the international community has rapidly relied mainly on soft-law norms to manage space debris. Adding into The UN Committee on the Peaceful Uses of Outer Space, CUPUOS[32], drafted Space Debris Mitigation Guidelines as voluntary standards which anyone can adopt. The first i.e., original edition came in 2007 and followed by the revised version in the year of 2010. The Inter-Agency Debris Coordination Committee,or IADC a coalition of different space agencies, issued regarding its mitigation[33] which they initially released their own mitigation guidelines in the year 2002 and updated it in 2007.Together both the IADC guidelines, which is the common ground among all the agencies of space, and the COPUOS versions recommend regarding the following best practices in producing spacecraft and missions in order to generate the least amount of debris possible, preventing the energy sources from exploding in orbit, keeping the risk of debris collision to the lowest and very minimum, and making sure that spacecraft must have proper end of life disposal. This could be by reentry in a controlled way or by moving them to graveyard orbits[34]. As an example, COPUOS Guideline 6 says, spacecraft and launch vehicle orbital stages in Low Earth Orbit (LEO)[35] after mission end should be removed from orbit in a controlled way; if this

[30] United Nations Office for Outer Space Affairs, Space Debris Mitigation Guidelines (UNOOSA, 2010).
[31] United Nations Office for Outer Space Affairs
[32] United Nations Committee on the Peaceful Uses of Outer Space, Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, UN Doc A/62/20 (2007).
[33]National Aeronautics and Space Administration, Orbital Debris Program Office
[34] United Nations Office for Outer Space Affairs (n X).
[35] United Nations Office for Outer Space Affairs, Space Debris and Space Traffic Management (UNOOSA, 2019).

is not possible, they should be disposed into orbits that avoid their long-term presence in LEO. Similarly, Guideline 7 says that satellites in GEO should be relocated to orbits beyond GEO, not left to drift through the GEO region.

The UN General Assembly-for example, GA res. 62/217 in 2007-has recognized these international standards as existing national practices and urged Member States to give immediate effect to these guidelines by their relavant national mechanisms. Many states have declared their intention to uphold their commitments. But, these guidelines of COPUOS/IADC are not binding in nature. Moreover no provisions exist for implementing them; rather, similar to the best practices instead of hard law and now while this is a voluntary framework, where not all are compliant in nature. It also presents the proof that the IADC guidelines which have kept their voluntary nature internationally, and that worldwide compliance, even the well known 25-year rule for LEO disposal, is still not sufficiently reached.

1.3 National Space Policies and Implementation Gaps

States are attempting to make efforts to incorporate debris mitigation into their national laws. However, they vary widely in their approach of execution, and enforcement is not always consistent for example, the FCC includes a condition that U.S.satellite operators agree to deorbit within five years end of their mission. NASA[36] and FAA[37] have been having safety rules for a long time that try to avoid orbital debris. The U.S. White House revealed a plan of National Orbital Debris Mitigation in 2022 where the multi-agency plan includes 44 activities aimed at enhancing the tracking, mitigation, and remediation of space[38] debris. While majority of space countries are also regulating similar rules in the said standard. Recently in 2025, the European Commission proposed a EU Space Act2025[39] in order to make the rules more consistent binding all launching operators to follow exact similar rules to EU territory, like improved tracking of space objects and actions in order to minimize space debris till it can, with the requirement of assessment of environmental impact whereas the act specifically states about the current existence of 13 different national approaches within the EU is a huge problem. The projects are even beginning to appear worldwide: India's space agency has set the goal for Debris Free Space Missions as its ambition, by 2030, that all the launches by India shall be free

[36] National Aeronautics and Space Administration, NASA Procedural Requirements for Limiting Orbital Debris(NPR 8715.6B, 2019).
[37] Mitigation of Orbital Debris, 47 CFR § 25.114(d)(14).
[38] United States Department of Commerce, Office of Space Commerce
[39] European Commission, Proposal for a Regulation on the Safety, Resilience and Sustainability of Space Activities in the European Union (EU Space Act), COM (2025) 335 final, 25 June 2025.

of debris. They also want other countries to follow suit. Also yet, many states still do not have any laws of space debris rather those usually refer to future missions which now according to UNOOSA, some of the states have decided to embed the principles for the mitigation of space debris into their national laws also these laws only cover with avoiding new debris; hence, hardly any laws exist which require the removal of already existing debris.[40] Here, most national regimes establish standards only for the end-of-life disposal-if voluntarily followed-and do nothing to clean up any space junk that has already accumulated. Additionally, several states that lack binding laws have decided to introduce non-binding license conditions or agency guidelines instead as even the most developed states have varying standards. This leads to an uneven landscape making it difficult to hold anyone accountable, and in the absence of any binding international rule requiring any action on pre-existing debris, states are largely free to choose whether or not to follow the guidelines. Moreover, there still remains loopholes in the state laws and in their enforcement.

2. Challenges in Enforcing Legal Accountability

One of the major problem is that the rules aimed mainly at mitigating debris are not strictly followed as laws for eg, both the COPUOS guidelines, IADC standards, and industry codes lacks the power that would give them the capacity to enforce compliance. They actually depend solely on the voluntary compliance of the parties involved. An analyst points out that guidelines like COPUOS or codes of conduct are soft law which cannot be enforced.

2.1 Non-Binding Nature of Soft Law Instruments

Voluntary adherence to guidelines, in practice, does not incur a legal penalty; it only carries the risk of disfavor by other states for a state or operator that decides not to follow a particular line of action. For example, the COPUOS guidelines explain that the ability of implementation belongs to each party and that there is a lack in mechanism of enforcement. While some of the countries have suggested for an international Code of Conduct that will not be having any legal binding force. In other words, those who are responsible for the space debris currently rely solely on their good will to follow the rules. States interested in launching at a low cost or performing risky activities are not subject to any direct punishment under international law if they decide not to make a contribution to debris mitigation because no legal obligation can be imposed on them. Carns (2017) says that in the past, the states have done only the least thing

[40]United Nations Office for Outer Space Affairs, (n X)

by merely watching the situation and following the voluntary guidelines rather than taking any active measures to solve the problem.[41] In order to create a large amount of space debris, China deliberately destroyed its defunct Fengyun-1C[42] weather satellite with the use of a missile in January 2007. This led to the largest debris field that followed, consisting of more than 2,000 fragments capable of being tracked and approximately 35,000 pieces with the size larger than 1 cm in total.[43] A number of international organizations UNOOSA and COPUOS among them denounced this move as reckless. China had declared about its intention to adhere to the guildelines of OST and the rules laid out in the Liability Convention[44]. As a matter of fact, there was no damages nor lawsuit probably because nobody was injured. That incident shows that: a) when there is an intentional creation of debris, this does not automatically make the owner liable to pay damages for them Liability Convention does not punish intentional destruction; and b) The most significant impact was political and reputational pressure.

In the 2009 case study of Iridium Cosmos collision[45] on February 10, 2009, a U.S. Iridium operational satellite collided with the] Russian Cosmos-2251[46] satellite in low Earth orbit(LEO) and the parts of each became pieces of junk in space. NASA estimated the collision resulted in more than 1,800 pieces of debris which is larger than 10 cm in length[47]. Under Article III of the Liability Convention based on fault in space, the U.S. could have held Russia liable. On the other hand, Russia could have accused the U.S. of both having control over their respective orbits. In reality, however, none of them filed a claim. China, quite surprisingly, filed a complaint against India for its 2019 ASAT tes[48]t a few years afterward. That was the first-ever claim. Nonetheless, no claims were filed against the Iridium-Cosmos incident. Both cases are examples that liability rules are not followed when there is debris. Hence, the fact that they are non-binding is a major problem.

2.2 Inconsistent National Space Legislation and Compliance

The diversity of national implementation is very much intertwined now while under Article VI

[41]United Nations Office for Outer Space Affairs,(n X)
[42] Fengyun-1C (People's Republic of China), intentional destruction of defunct meteorological satellite by anti-satellite missile test, Low Earth Orbit, 11 January 2007.
[43] David L. Talent, An Assessment of the Impact of the January 2007 Chinese ASAT Test on the LEO Environment (Oceanit, Texas Field Office, 5 Finetta Lane, Alvin, TX 77511).
[44] Convention on International Liability for Damage Caused by Space Objects, opened for signature 29 March 1972, entered into force 1 September 1972.
[45] Iridium Satellite LLC v. Cosmos-2251 Satellite Collision, Low Earth Orbit, 10 February 2009.
[46] Cosmos-2251 (Russian Federation), defunct military communications satellite, launched 1993, collision on 10 February 2009.
[47]Nicholas Johnson, The Collision of Iridium 33 and Cosmos 2251: The Shape of Things to Come (Conference Paper presented at the 60th International Astronautical Congress, Seoul, Republic of Korea, Oct. 16–19, 2009), NASA Johnson Space Center, Report No. JSC-CN-18971.
[48] Government of India, Mission Shakti: Anti-Satellite Weapon Test, 27 March 2019.

of the OST, the State from which a launch is conducted is responsible for authorizing and supervising space activities, there is no international system that ensures the same debris standards are adhered everywhere. Even some technologically advanced space-faring countries like in the United States, the European Union members, and Japan have explicit regulations or requirements for issuing licenses incorporating COPUOS/IADC guidelines.

Generally, the U.S. regulators FAA, FCC[49], NOAA[50] - requires operators to submit plans for how they will handle their debris as a condition of issuing a license. For example, the FCC requires that a new satellite licensee demonstrate compliance with the U.S. debris rules, which is inclusive of a five-year plan for the satellite to dispose after the end of the mission. Actually, even FAA launch licensing has regulations on debris. As per the U.S. legislations, licenses for commercial launch and operation are therefore interlinked with compliance to debris mitigation rules. Hence, both the EU and ESA have the official debris rules in line where the EU Space Strategy which mainly focuses on making a sustainable space followed by which in the year of 2024, the European Council initiated the Space Sustainability Act[51], which does not only limits on the operators of launches but also the information already shared. In consequence, ESA updated its Space Debris Mitigation Policy and Requirements in the year 2023 where the new policy has thus shortened LEO disposal time from 25 years to 5 years and raised the probability of disposal after the mission[52]to 90%. Now besides that ESA should be ready for passivation i.e., fuel depletion in order to avoid collision with other space objects in space. States of France and the UK which have certain debris licensing regulations that corresponds to these standards while some countries of Europe have their own local directives to follow however, the implementation is mainly done either through ESA or licenses of their domestic nations.Japan Aerospace Exploration Agency[53] (JAXA) and the Japan government have finally arrive at a mutual understanding thatdeals with rules and regulation of space debris, now the agency JAXA, has a Space Debris Mitigation Standard, which dictates that satellites of Japan should not give rise to an explosion in orbit and should produce as less debris as possible -for example by deorbiting or going to the graveyard orbits[54]. Japan is a member of the IADC and ISS[55]

[49] Mitigation of Orbital Debris, 47 CFR § 25.114(d)(14).
[50] United States Department of Commerce, Space Policy Directive-3: National Space Traffic Management Policy, 21 June 2018.
[51] European Commission, EU Space Strategy for Security and Defence, JOIN (2023) 9 final.
[52]European Space Agency, New Space Debris Mitigation Policy and Requirements in Effect
[53] Japan Aerospace Exploration Agency, JAXA Space Debris Mitigation Standard(JAXA-JMR-003E, revised edn 2021).
[54] United Nations Office for Outer Space Affairs, 'India and Space Debris'
[55] Inter-Agency Space Debris Coordination Committee, IADC Protection Manual for the International Space Station (ISS), (IADC Doc No. IADC-04-03, revised edn).

debris coordination groups. Under the Japanese Space Activities Act the government has to give its green light to every launch, including environmental reviews, and in practice debris mitigation is enacted when a licence is given. The rules put a lot of emphasis on the avoidance of collisions and the getting rid of things at the end of life. Japan also announced recently they would be establishing legal and regulatory frameworks for active debris removal authorizations starting in 2024.

India does not have a comprehensive space law as yet, but still there are instances when the Indian Space Research Organisation shows zero tolerance for space junk. The ISRO's Space Debris Mitigation Requirements compliant with UN/IADC standards require rocket stages to be neutralized and satellites to be returned back to the Earth's atmosphere. For example, ISRO will be opening the upper-stage fuel tank and tell the operators to move the GEO satellites to a higher orbit after life India has taken a pledge to change green itself in the last few years, an example being that it signed up to international guidelines, perhaps the newl anticipated Indian Commercial Space Laws, may consider these types of activities as a part of normal and usual licensing procedures. There are several ways how national systems can tie in with licensing in order to ensure debris rules. If an operator fails to comply with debris rulesfollowed by the violation, they might be denied of the permission to carry out their activities or penalized. As in 2021, the U.S. FCC fined a satellite company for $150,000 penalty for violation of rules related to space debris management. For now, the level of enforcement is a bit limited, thus varying from different country to country depending upon their capacity. [56]

Of all these schemes, the compliance burden falls ultimately on private entities satellite operators and launch service providers but they must be supervised by the state. Article VI of the OST is clear on the issue where it is clearly the state’s responsibility to ensure that they comply with debris-related regulations through domestic legislation. Practically when comes to reality the state becomes indirectly responsible as it is held accountable for its states internationally and utilizes license conditions to hold them accountable if they are not compliant. If states adopt rigorous, small-scale national rules and there are no enforceable binding international abligations then, they still cause a lot of interference.

2.3 Limited liability in Space Debris

It is nearly impossible to identify a single party to blame for damage from debris, even without preventive measures and the OST/Liability Convention acts as a guide to who bears the costs after a disaster, but it does not spell out how to gather evidence or file claims. As noted, for

[56] United Nations Office for Outer Space Affairs (n X).

damage on Earth or to aircraft, the launching state is fully liable; for in-orbit damage, liability is only partial. Yet proving claims in court is exceedingly hard, locating the debris's origin is often impossible - small pieces move fast and fresh fragments from a crash multiply, making recovery difficult. So when a collision occurs between two satellites, both launched by different countries, figuring out who is responsible then becomes technically and legally complex as there remains no clear authority that can instantly identify who is at fault for any crashes in space, unlike terrestrial torts. The Space Liability Convention provides for a Claims Commission consists of representatives from the claimant and respondent states, but such commissions have met only once, in 1978, the case of Cosmos 954. A large number of potential claims are still pending legal actions that are unlikely to be pursued.

The actual issue with the Liability Convention is that it requires payment to be made from one state to another state for property or personal damage, but not to private individuals. If debris of State A's debris falls onto State B and injured people or damaged property, State A isobliged to compensate State B according to the Article II (absolute liability), whereas if A's falling debris harms an A's citizen on its own territory, the Convention does not bind any liability on A to pay to its own citizen; domestic law or insurance therefore replaces international space law. In reality, victims outside of their borders have remedies under the treaty, whereas victims within their own borders do not. Some commentators have observed that the foreign victims can access to international remedies, but local victims cannot. Thirdly, concept of liability may not fit very well with issue of space debris removal, it would be a case of mismatch, as the launching state always is the one who holds the space objects in its custody forever, meanwhile some third party is cleaning the debris without consent. The United Nations Office for Outer Space Affairs UNOOSA, which states that the debris should not be considered as abandoned property; the launched state still retains property rights for eternity. Therefore, a state or institution cannot take any debris without the consent to for cleaning it up or face the consequences of violating someone's right to property. According to space law, debris is state owned property, and in case of cleaning without the consent might cause a legal trouble. Lastly, although an accident may result from space debris, enforcing liability and accountability across borders is difficult.[57].The case of Cosmos 954, in 1978 the USSR's nuclear -powered satellite that scattered radioactive debris over Canada and that incident led to a single compensation agreement where the USSR paid Canada about $3 million but took a long time to settle the issue due to the diplomacy there.

[57] United Nations Office for Outer Space Affairs, (n X).

3. Binding Legal Regime

3.1 International Environmental Law

Outer space is also known as "global commons" and is often compared to the high seas where the use of one party can negatively impact the other parties involved. Environmental law has clear rules for such situations such as, the rule of no-harm of the customary international law which requires states to make sure that their activities does not cause any major harm to other states environment. Article IX[58] of the OST with the interests of all other States requires to perform such activities in order to avoid harmful contamination of space; however the central focus of Article IX is either biological or chemical contamination, as the no-harm clause includes debris pollution, as debris itself is considered as a form of pollution in space.[59]Regarding the space policy, environmental law can be a source of it and one such rule is the precautionary principle, which is explicitly mentioned under Rio Declaration[60], the Montreal Protocol[61], and numerous other environmental law instruments. Mainly it urges states to take preventive measures against pollution caused by debris regarding the degree or gravity of pollution. Given that there are numerous objects in orbit floating with incomplete tracking information, the high probability of just a single collision calls for a precautionary action similar to the one to prevent any tipping points of climate. Now in the same way as both the principle- no-harm or due diligence principles require that the launch actors carefully evaluate the risks of debris and steps regarding the mitigation.

Historically, the United States(US), Russia (former USSR), and recently China has been the proactive leading contributors to space debris who emphasizes the need of it but still not all states have generated as much debris. A fair regime might mean these spacefaring leaders bear a larger share of cleanup work. Historical COPUOS language on a distributive approach-peaceful uses of outer space should benefit all states irrespective of levels of economic or scientific development-in other words, new spacefaring nations with fewer satellites and less resultant debris would not be burdened at the same rate as long-established space powers. Linked to proportional contributions to the problem, a differentiated approach could tie cleanup

[58] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, art IX, opened for signature 27 January 1967, entered into force 10 October 1967.
[59] Yannick Radi, 'Clearing up the Space Junk – On the Flaws and Potential of International Space Law to Tackle the Space Debris Problem' (2023) 12 *ESIL Reflections* (Issue 2).
[60] Rio Declaration on Environment and Development, UN Doc A/CONF.151/26 (Vol I) (1992).
[61] Montreal Protocol on Substances that Deplete the Ozone Layer, adopted 16 September 1987, entered into force 1 January 1989.

costs or responsibilities. Proposals including market-share liability and tiered fee systems have been put forward as mechanisms by which states might pay in proportion to the number of active space objects they own.

3.2 The Polluter-Pays Principle and Differentiated Responsibility

The polluter-pays principle, a common principle in environmental law, applies to outer space which means that those causing pollution must pay for cleanup or restoration of the resulting damage. If space debris is defined as pollution of outer space, PPP offers a sound legal principle for demanding active debris-removal programs. In practice, however, PPP may look very different from its theoretical form. For instance, launching states could be made to pay fees or bonds to offset cleanup expenses. Several have suggested a deposit-refund scheme similar to a bottle bill, in which each launch is subject to a refundable deposit to be used for remediation of debris in space. This would shift liability from a post-occurrence model -paying after harm has occurred to a pre-occurrence model -prepaying for expected debris costs.[62]

Support for soft-law approaches continues like space insurance has been proposed via the International Code of Conduct for Outer Space Activities, a non-binding instrument, and enforcement funds have been discussed in the G20 and the United Nations. More importantly, PPP espouses COPUOS's framing of outer space as a common heritage: while treaty language rarely invokes pollution in outer space, the common-resource framing presumes that degradation of the space environment ought to be borne by its authors. Also it poses distributional concerns: if the fees are set too high, access might be deterred for the smallest states. It is here that differentiated responsibility becomes relevant. A binding regime would have to include provisions reflecting state capability and historic contribution, perhaps including a graduated liability system reflecting historic levels of pollution.

3.3 Binding Global Framework

Holding the responsible parties accountable, requires a new global treaty with universal consent, there is an urgent need for a single and comprehensive regime for debris in space where such a treaty would oblige states-or their associate bodies of organisations-to provide for how they will dispose of debris and satellites at the end of their lives, to clean up sites of collision, and to manage debris under activities which is licensed. A convention has been

[62] Sraavya Poonuganti, 'It's Raining Rockets: Heightening State Liability for Space Pollution' (2023) 23 *Chicago Journal of International Law* 490.

proposed - Space Debris Liability Convention, which goes beyond the current Liability Convention by providing more details of duties related to the generation of spacedebris. Till date there is no such international instrument that has been created, though there is still argument going within the COPUOS while the political considerations may hinder in the approval of treaty which mainly involves the reallocation of power and resources while the move toward active debris removal has gained some attention, with efforts of public-private, such as the FOREVER[63] mission of Japan and testing the technologies of ADR -Astroscale's,. Still there are some legal issues regarding ADR i.e., the debris under OST of Article VIII[64] remains the property in particular, the state that is launching any satellite or object in space meaning that the removal requires the consent of the owner party in case of the remover is violating any ownership or prohibitions of appropriation in any form. There has been a huge debate over the issue of salvage rights where some experts arguing that after a sufficient period of orbital residency, debris becomes abandoned property which thus can be recovered while others maintain that strict consent which should be followed. In 2015 a student's note of Chicago Journal of International Law and Policy[65] advocating the abandonment of trash for easier cleanup reflecting this lingering dispute. As the emergence of STM arises, the aim is to avoid collisions and safe operations; both state and private actors are undertaking related measures for this purpose, for example, the U.S. Space Policy Directive-3 (2018)[66] which gave NOAA[67] the task to manage space traffic coordination and at the same time, the European Union has released statements on licensing procedures of risk of collision. The space environmental treaty would still allow the UN or COPUOS to have the authority and monitor the conformity for example by requesting the debris report and identifying the violators who would be punished accordingly.

4. Conclusion

The current international space law regime does not impose any effective accountablility on states with regard to space debris management which is the central issue. Treaties currently

[63] Japan Aerospace Exploration Agency, Commercial Removal of Debris Demonstration (CRD2) / FOREVER Mission (JAXA, Japan).
[64] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, art VIII, opened for signature 27 January 1967, entered into force 10 October 1967.
[65] Cleaning Up Space Debris: The Case for Treating Orbital Debris as Abandoned Property' (2015) 16 *Chicago Journal of International Law* 649.
[66] U.S. Space Policy Directive-3, National Space Traffic Management Policy, 21 June 2018.
[67] United States Department of Commerce, Space Policy Directive-3: National Space Traffic Management Policy, (21 June 2018).

existing particularly both the Outer Space Treaty and the Liability Convention establish the liability for damage caused by the objects but still fail to establish clear and enforceable obligation for prevention of debris or removal in space actively. These laws were drafted when the long term environmental consequences of space activities were not clear so they have significant regulatory gaps in the contemporary orbital environments. In reality the space debris management is mainly based on non binding guidelines technical standards and voluntary best practices and which are developed by both national and international organisations while these measures contribute to awareness and coordination, their soft laws nature limits uniform implementation and permits the states to prioritise the interest of the nation over collective sustainability of orbit. This leads to the drawback which is further given by the different national laws that poorly regulate the private sector or fail to impose the debris removal obligations clearly in the requirement of supervision. In consequence to which the accountability remains highly reactive and thus concentrates on the compensation rather than proactive protection of the environment. As a matter of fact, space debris is the transboundary and a cumulative problem governing outer space through fragmented or voluntary measures would not be an effective solution rather it must instead be treated as a shared domain that demands collective responsibility. In international environment laws: the duty to prevent harm the precautionary principle and the polluter pays principle could provide a consistent normative basis for enhancing state obligations in this. However these principles need to be formally recognised as binding space law instruments in order to be effective. So, it is very important to have a legally binding International treaty either by means of a separate space debris agreement, a protocol to the existing treaties or a well-developed compliance mechanism and such a arrangement would make it clear what constitutes responsibility to align national practices and set enforceable standards for release limitation and for the removal of debris in space if however there is no such move towards binding accountability the question of whether the Earth's orbital environment will continue to be sustainable and safe for use will remain uncertain, there will be long term risks to both the present and future activities in the space.