US-China Law Review, February 2024, Vol. 21, No. 2, 41-54
doi:10.17265/1548-6605/2024.02.001

Addressing the Liability Regime in the Space Convention: A Legal Reformation of the Concept of Damage and Its Application to Private Entities

Mohamed Abdelhamid, Guoyu Wang
Beijing Institute of Technology (BIT), Beijing, China

In recent decades, the exploration and utilization of space have seen significant transformations due to the increasing participation of non-governmental entities (NGEs), posing a challenge to conventional concepts of space governance and responsibility structures. The central concern in this dynamic environment pertains to the complex matter of assigning responsibility for harm inflicted by space objects, especially when the harm does not meet the criteria for compensable damage as outlined in the Convention on International Liability for Damage Caused by Space Objects. The Liability Convention, which serves as the principal legal framework regulating space operations, delineates a clear differentiation between absolute and conditional liability in relation to the responsibility for harm resulting from space objects. Nevertheless, this differentiation can give rise to ambiguities and possible deficiencies in safeguarding individuals affected by space mishaps, especially when the harm surpasses the conventional scope of physical damage to satellites or other celestial entities. This essay examines the difficulties presented by the existing liability framework in the field of space law, with a specific emphasis on the constraints of the Liability Convention in effectively dealing with increasing types of harm, including environmental harm, economic loss, and indirect harm. Additionally, it analyses several remedies to tackle these difficulties, such as broadening the scope of "damage", implementing a no-fault liability system, and creating a compensation fund. The study concludes by highlighting the necessity of a contemporary liability framework in space law that is more capable of dealing with the changing characteristics of space operations and the increasing prevalence of non-governmental entities (NGEs). To enhance the protection of victims of space accidents and preserve the long-term viability of space activities, the space law community should broaden the range of compensable harm and implement alternative liability mechanisms.

Keywords: space, activity, liability, damage, compensation, private entities, object

Introduction

The exploration and exploitation of outer space are transforming, with a shift towards non-governmental entities (NGEs) promoting innovation and participation. This challenges legal and regulatory frameworks, particularly in liability for space object damages (Sharmin, 2023).

Acknowledgement: I would like to thank my Professor Guoyu Wang for his efforts, support, and inspiration.
Mohamed Abdelhamid, Ph.D. candidate, School of Law, Beijing Institute of Technology (BIT), Beijing, China.
Guoyu Wang, Dean, Academy of Air, Space Policy and Law, Beijing Institute of Technology (BIT), Beijing, China.

The Convention on International Liability for Damage Caused by Space Objects (Liability Convention) represents the cornerstone of the legal regime governing the attribution of responsibility for harm inflicted by space operations. Established to navigate the complexities of space liability (Foster, 1973), the Convention delineates a binary schema of absolute and conditional liability, aimed at ensuring compensation for victims of space-related incidents. However, the rapid evolution of space activities and the diversification of actors involved have spotlighted the limitations of the Liability Convention, particularly its narrow conceptualization of "damage" and the mechanisms for its redress (Kehrer, 2019).

The Liability Convention's current framework, crafted in an era dominated by state actors, appears increasingly misaligned with the realities of today's space activities, characterized by the prominent role of NGEs. This misalignment raises profound questions about the adequacy of existing legal structures to accommodate the nuances of modern space exploration and to provide equitable protection for all stakeholders involved.

This paper endeavors to dissect the intricacies of the Liability Convention, critically examining its efficacy in addressing the broader spectrum of harms that may arise from contemporary space operations, including environmental degradation, economic disruptions, and indirect damages. Through a comprehensive analysis, this study proposes a constellation of legal reforms aimed at expanding the scope of compensable damage, introducing a no-fault liability system, and envisaging the creation of a compensation fund. These recommendations seek to forge a liability regime that is both responsive to the dynamics of modern space activities and attuned to the principles of justice and equity.

In charting a course towards the reformation of space liability laws, this paper underscores the imperative for a legal framework that transcends the traditional paradigms of responsibility and compensation, one that is capable of safeguarding the interests of a diverse array of space actors while fostering the sustainable and peaceful use of outer space. The evolution of space law, in tandem with the advent of NGEs in the cosmic arena, demands a forward-looking approach to liability that reflects the multifaceted nature of contemporary space endeavors and the shared aspirations of humanity in the vast expanse of the universe.

Navigating the Evolution of Space Liability

The journey into space began in 1957 when the Soviet Union launched the first artificial satellite from the Baikonur Cosmodrome in Kazakhstan (Abaideldinov, Kulikpayeva, & Shakhmova, 2014). Following this, the United Nations established the Committee on the Peaceful Uses of Outer Space (COPUOS) in 1958, a man was sent into space in 1961, and in 1969, a human first set foot on the Moon.[1] For many years, space exploration was predominantly the domain of nation-states due to the prohibitive costs and the potential military applications of space technology, a common concern during the Cold War era.[2] However, in 1984, the launch of the first commercial satellite marked a turning point, and since then, private enterprises have increasingly led the way in space exploration activities (Ziemblicki & Oralova, 2021).

The 20th century witnessed a remarkable surge in space exploration initiatives, propelled by technological advancements and fueled by the desire to unravel the mysteries of the cosmos. Early space missions, spearheaded

[1] https://history.state.gov/milestones/1953-1960/sputnik, accessed on 24th March, 2024
[2] https://www.history.com/topics/cold-war/space-race, accessed on 24th March, 2024.

by governments, laid the foundation for a new era of human endeavor in space.[3] Over the past five decades, the space industry has undergone a significant transformation, with private enterprises emerging as the forefront of space exploration, previously dominated by governmental entities.[4] Despite this shift, existing legal frameworks have struggled to evolve correspondingly, inadequately addressing potential conflicts that may arise. Consequent to the conditions previously described, NASA decommissioned its space shuttle fleet in 2010, resorting temporarily to the utilization of Russian Soyuz rockets prior to initiating collaborations with private sector spaceflight providers (Meyer, 2010). In 2012, the National Aeronautics and Space Administration (NASA) formalized a contractual relationship with Space Exploration Technologies Corp. (SpaceX), committing $1.6 billion towards the procurement of logistical support and supply deliveries to the International Space Station (ISS) (Albert, 2014).

However, this burgeoning activity also raised concerns about the potential risks and hazards associated with space activities. The possibility of damage to property, persons, or the environment from space objects became a pressing concern (Belobrajdic, Melone, & Diaz-Artiles, 2021). The uncontrolled reentry of space debris or the collision of spacecraft could pose significant risks to Earth's inhabitants and infrastructure. Therefore, it was crucial to establish a legal framework that would address the issue of liability for damage caused by space objects (Marie-Valentine, 2021). The concept of liability for damage caused by space objects was first introduced in the early days of space exploration. In 1957, the United Nations General Assembly adopted a resolution calling for the development of international rules to govern space activities (Joyner, 1981). This resolution led to the creation of the Committee on the Peaceful Uses of Outer Space (COPUOS), which has been the primary forum for international negotiations on space law ever since.[5] In 1963, COPUOS established a Working Group to study liability for space objects (Kuźniar-Kwiatek, 2023). The Working Group met for several years and considered a number of different proposals. In 1967, COPUOS submitted a draft convention on liability to the General Assembly for consideration (Myszona-Kostrzewa, 2023, pp. 1-6).

The Convention entered into force in 1972 and as of 1 January 2021, 98 States have ratified the Liability Convention[6], 19 have signed but not ratified and four international intergovernmental organizations (the European Space Agency, the European Organization for the Exploitation of Meteorological Satellites, the Intersputnik International Organization of Space Communications, and the European Telecommunications Satellite Organization) have declared their acceptance of the rights and obligations provided for in the Agreement[7]. The primary purpose of the Liability Convention is to ensure that victims of damage caused by space objects are compensated for their losses (Schmalenbach, 2022). The Convention also seeks to deter harmful space activities by imposing liability on launching states for their space objects (Poonuganti, 2022). However, for many years, the exploration and utilization of outer space were exclusively the domain of governments (Dineen, 2022). The high costs associated with space missions and the perceived threat of militarization during the Cold War era had effectively discouraged private sector involvement (Moltz, 2011). However, in 1984, the

[3] https://www.nasa.gov/learning-resources/for-kids-and-students/what-is-nasa-grades-5-8/, accessed on 24th March, 2024.
[4] https://www.nasa.gov/specials/60counting/spaceflight.html, accessed on 24th March, 2024.
[5] https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html.
[6] Convention on International Liability for Damage Caused by Space Objects pmbl., Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187.
[7] https://treaties.un.org/pages/showdetails.aspx?objid=08000002801098c7.

launch of the first commercial satellite marked a turning point, signaling the gradual shift of leadership in space activities from governments to private companies. As private companies assume a greater role in space activities, questions arise about the adequacy of existing liability frameworks and the need for adaptations (Denis, Alary, Pasco, Pisot, Texier, & Toulza, 2020).

Liability encompasses the legal duty to provide compensation to a third party for injuries incurred subsequent to an event leading to damage (Cheng, 1995). In the realm of international law, liability typically emerges from the conduct of ultra-hazardous yet legally permissible activities, such as space exploration endeavors, which, while not inherently illegal, possess the capacity to inflict damage (Bedjaoui, 1987). Usually, to determine liability, The Convention distinguishes between *absolute liability* which the launching State is absolutely liable for damage caused by its space object on the surface of the Earth or to aircraft in flight (Article II) (Murphy, 1994), and *conditional liability* which the launching State is only liable for damage caused by its space object to a space object of another launching State or to persons or property on board such a space object (Article III). In this case, the launching State must prove that the damage was not due to its fault or the fault of persons for whom it is responsible.[8] It's necessary to show that one's actions caused harm. So, the mention of "fault" in Article III of the Liability Convention can seem confusing. In fact, the term "fault" in this area of international law leads to a lot of confusion over its meaning and use (Dennerley, 2018). Typically, liability regimes are categorized into two types: no-fault and fault-based (Goldberg & Zipursky, 2016). The no-fault system, also known as strict liability, focuses solely on the existence of a cause-and-effect relationship, where causation and damage are the primary considerations, and the notion of fault is not taken into account (Dennerley, 2018). An efficacious elucidation of the operational mechanics of fault, tailored to the specific objective at hand, remains enigmatic, as the modus operandi of fault lacks clarity. In seeking elucidation within the interpretative realm, recourse to the contextual framework provided by the Liability Convention is warranted. Notably, the Outer Space Treaty, serving as the foundational framework convention underpinning the operational scope of the Liability Convention, assumes pivotal significance in this analytical endeavor. This treaty, encapsulating fundamental principles and norms derived from customary international law, constitutes a primary resource for navigating the legal terrain pertinent to outer space activities (Smith, 2015, pp. 554-617). The unclear or ambiguous language found in Article III of the Liability Convention necessitates the application of other pertinent international law rules as outlined in Article 31and 32 of the Vienna Convention on the Law of Treaties (VCLT). This means that relevant rules of customary international law, which are recognized as evidence of widespread practice accepted as law, must be applied to address these ambiguities[9].

The Cosmos 954 incident marked a seminal moment in the annals of space exploration, representing the inaugural instance wherein a sovereign state lodged a claim against another for damages resultant from space objects (Schick, 1961). This precedent-setting case broached the critical question of which jurisdiction's laws, the claimant state's, or the launching state's, ought to adjudicate the nature of the damages incurred (Choudhury, 2021).

---

[8] https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html.
[9] Statute of the International Court of Justice 1945, 59 Stat. 1031, Art. 38(1)(b).

Within this legal conundrum, the role of international customary laws emerged as pivotal, given the absence of universally established norms pertaining to liability within the global legal framework (Marakani, 2023). The Trial Smelter case[10] is an international landmark case dealing with sulphur dioxide pollution. The decision in the Corfu Channel case sets a precedent for a broad obligation of due diligence pertaining to a state's territory. However, it is noted that there are more specific primary rules that mandate due diligence obligations, which are customized to particular circumstances (Coco & de Souza Dias, 2021).

In the adjudication of fault within the frameworks of fault liability and risk liability, judicial bodies have construed the notion of "fault" through the lens of strict liability. In establishing liability, these courts have consistently opted for a strict liability approach, notwithstanding the absence of causation for the resultant damages. This judicial tendency overlooks the examination of risk-based liability in the context of determining "fault". Risk-based liability refers to scenarios wherein, despite the absence of direct fault, a party becomes liable due to the inherent risks posed to another party, thereby placing them at risk. Based on above mentioned loopholes, it is observed that The Liability Convention's current approach is seen as weak, and its main rule is mainly about being careful or doing due diligence (Kehrer, 2019).

Redefining Damage in Space Activities

According to the Liability Convention, "damage" is defined as loss of life, personal injury, or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations. This definition encompasses a broad range of potential harms resulting from the activities of space objects, whether these occur on the surface of the Earth, in the airspace, or in outer space itself (Sylkina, Dosymbekova, Tusupova, & Abdrakhmanova, 2014).

However, the Convention's narrow definition of "damage" has been criticized for failing to address emerging forms of damage that are increasingly relevant in the context of space activities; it is limited to physical damage to space objects and persons or property on Earth or in air[11]. The Convention is clearly designed with a focus on protecting and supporting the victims (Hurwitz, 1992, p. 264). However, This narrow approach raises concerns in light of the growing recognition of the potential for space activities to cause harm outside of the traditional physical realm, for example *environmental damage* where space activities can generate debris that poses a threat to the environment, disrupting ecosystems and harming wildlife (Tou, 2008), *economic loss* where space activities can disrupt critical infrastructure and economic activities on Earth, such as satellite-based communication or navigation systems, and *indirect damage* where Space accidents can trigger a chain of events leading to indirect damage, such as loss of revenue due to interruption of business operations (Klomp, 2016). The Liability Convention's limited scope of compensable damage may not cover such indirect losses. These emerging forms of damage underscore the need to expand the scope of compensable damage under the Liability Convention. A modernized liability regime would better reflect the evolving nature of space activities and provide victims with a more comprehensive range of protections (Jayaraman, Chandrasekhar, & Rao, 1997).

[10] United States v. Canada (Trial Smelter case).
[11] Liability Convention Art. I.

The Legal Gaps Derived From the Lack of Definitions and Clauses on the Launch and Return of Space Objects

The Convention applies to the damage caused by a space object on the surface of the Earth, to aircraft in flight, or elsewhere than on the surface of the Earth to a space object of another launching state or to persons or property on board such space object (Amalia, 2020). However, the Convention does not apply to damage caused by the launch or return of a space object into outer space or to damage caused by a space object that has become inert.[12]

The exclusion of these activities from the scope of the Liability Convention can be attributed to several factors, including the sovereignty of the State and the limited scope of damage, as the main concern when drafting the Convention was the possibility of damage to Earth as a result of falling space objects.[13] It was said that launch and return operations, which occur within the territory of the State, fall under its sovereign control and are unlikely to affect other states and their citizens (Gorove, 1970). It should not be subject to international liability claims; this exception is intended to protect launching states from liability for damage that occurs during the normal course of launch or return operations (United Nations, 2001, pp. 31-33). For example, if a space object explodes during launch, the launching state would not be liable for damage caused by the explosion if the explosion was due to an unavoidable defect in the space object or if the exploding space object was not under the control of the launching state.[14] This principle also extends to situations where a space object, having become inert or no longer operative, causes damage without being under the direct control of the launching state.

With the proliferation of private entities in space, the frequency and complexity of launch and return activities have increased. The potential for accidents and resulting damage, both within and beyond State borders, also increases. The exclusion creates a potential accountability gap. If launch or return activities cause damage beyond State borders, victims may lack legal recourse for compensation (Anderson, Nelson, Omido, & Rigby, 2023, pp. 1-2). The exclusion of launch and return activities from the Liability Convention presents a gap in the legal framework governing space activities. As space exploration becomes more complex and diverse, addressing this gap becomes increasingly important. Carefully considering the potential risks, limitations of the current regime, and proposed solutions is crucial to ensure a balance between responsible space exploration and fair compensation for victims of space accidents. Only by adopting a forward-thinking approach can we guarantee the sustainable and equitable development of the space frontier.[15]

Shifting Paradigms in Space Liability From State Accountability to Private Sector Engagement

In the last 50 years, the space sector has seen remarkable changes, transitioning from a domain led by government agencies to one where private companies are now leading the charge in space exploration.[16] Despite this shift, existing legal frameworks have struggled to evolve correspondingly, inadequately addressing potential

[12] https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html.
[13] https://link.springer.com/chapter/10.1007/978-3-031-13264-3.
[14] https://mansors.com/blog/liability-for-damage-caused-by-space-objects.
[15] https://www.wired.com/2016/02/space-is-cold-vast-and-deadly-humans-will-explore-it-anyway/.
[16] https://thunderbird.asu.edu/thought-leadership/insights/moving-beyond-launch-realizing-benefits-new-space-economy.

conflicts that may arise. The current state of space law, characterized by outdated multinational treaties, attributes liability exclusively to states, even for activities conducted by private companies.[17] This approach appears increasingly misaligned with the realities of contemporary space activities and the principles observed in other domains of international law, such as aviation and maritime law (Ziemblicki & Oralova, 2021). There is a consensus among most scholars that using national tort law to address damages resulting from space activities represents an inappropriate resolution (Beck, 2009). Despite the potential for serious jurisdictional issues, this approach might be necessary. On the international stage, only nations are held accountable for damages caused by their companies, making the liability of private firm's subject to domestic law (Abrams, 2013). National legislation varies in its treatment of liability for private entities. As established in 1988 within the United States, companies operating in the space sector are typically responsible for damages not exceeding $500 million. Beyond this threshold, liability transitions to the federal government, which assumes responsibility for damages up to $1.5 billion, with adjustments for inflation considered. Should damages surpass this limit, liability reverts to the companies in question, in countries like China, Russia, and Europe, the initial financial threshold for liability is significantly lower, and there is no third threshold. Such discrepancies can lead to a phenomenon known as "forum shopping", where companies might seek out jurisdictions with the least stringent regulatory frameworks. This practice is reflected in the phenomenon of "flags of convenience" within the international maritime law regime. It is important to note that these regulations are domestic in nature, and on the international stage, liability is solely attributed to the state. However, this raises a pertinent question: Given that private companies operate with the objective of generating profit and serve other private entities, why should states bear liability for their activities (Albert, 2014)? It has been previously highlighted that, in contrast to space-related activities, international air and maritime legal frameworks do not encompass the doctrine that sovereign states are accountable for the conduct of private entities (Yuan, 2021).

Several European nations, namely France, Belgium, Germany, Sweden, and the UK, have implemented "reimbursement/indemnification clauses" with the aim of striking a balance between meeting their international liability commitments and abstaining from financial responsibility for space-related damages in instances where they were not directly involved in the space operations conducted by private entities. These clauses often explicitly cite Article VII of the Outer Space Treaty and the Liability Convention as foundational legal frameworks guiding their approach (de Rozavel & von der Dunk, 2011). The overarching framework empowers a state to assert a claim against a space activities operator for reimbursement of compensation disbursed by the state pursuant to international law for damages inflicted by private space assets. For instance, Article 14 of France's "LOI no 2008-518 du 3 juin 2008 relative aux opérations spatiales" (commonly known as the French Space Operations Act) delineates comprehensive regulations concerning indemnification across various scenarios of space operation-induced damages. This includes provisions ensuring that "the Government refrains from pursuing indemnification claims if the damage results from a space object employed as part of an operation authorized in accordance with the provisions of the present Act and arising from actions directed towards governmental interests." (Clerc & Mariez, 2008, pp. 453-470).

[17] https://www.wilsoncenter.org/article/global-legal-landscape-space-who-writes-rules-final-frontier.

Presently, China does not possess specific legislative or regulatory structures designed to expressly govern damages incurred in outer space. Nonetheless, pertinent segments of the extant general national legislation may be leveraged in the context of incidents occurring in space. An illustrative example of this is the clauses found within the Civil Code of the People's Republic of China, which was ratified by the National People's Congress of China in 2020, henceforth referred to as the Civil Code (Wang & Ma, 2023). When considering the application of fault liability, a fundamental principle within the Civil Code to disputes arising from space tort, whether domestic or involving foreign elements, it becomes relevant due to the absence of explicit provisions for absolute liability in the context of space tort within the Civil Code. Should fault liability stand as the sole principle applicable to space tort cases, it poses significant challenges in aligning the tenets of Chinese national law with those of international law (Cheng, 1997).

Example of Cases Related to the Space Liability Convention

Often, parties involved in space-related incidents opt for alternative dispute resolution methods like negotiations or mediation, avoiding formal legal claims under the Convention (Hertzfeld & Timothy, 2013, pp. 133-134). In 1978, the world held its breath as the Soviet Satellite Cosmos 954, carrying a nuclear reactor on board, re-entered Earth's atmosphere and crashed in Canada. The incident, though thankfully resulting in no immediate casualties, sent shockwaves due to the potential for radioactive contamination. The wreckage scattered debris across a vast area, prompting extensive cleanup efforts and crucial raising questions about liability. Canada, directly affected by the crash, engaged in discussions with the Soviet Union. The discussions centered around the applicability of the Liability Convention, the presence of nuclear material onboard Cosmos 954 added a layer of complexity and heightened concerns.[18]

Under the Liability Convention, the Soviet Union was liable for the damage caused by Cosmos 954 on the territory of Canada, a non-launching state. The Soviet Union initially denied liability, arguing that the accident was due to an unavoidable technical malfunction. However, after negotiations, the Soviet Union agreed to pay Canada $3 million, a fraction of the $6 million Canada spent on cleanup operations. While the settlement reached between Canada and the Soviet Union resulted in the latter providing $3 million in compensation, it wasn't explicitly linked to the Liability Convention.[19]

This ambiguity reflects the challenges in applying existing legal frameworks to complex situations involving spacefaring technology and potential transboundary harm. The Cosmos 954 incident remains a stark reminder of the risks associated with space activities and the need for robust international cooperation to ensure accountability and address evolving challenges. This incident highlighted the complexities associated with determining and compensating for environmental damage and cleanup costs.[20] The settlement process revealed the challenges in quantifying damage and negotiating compensation, especially for incidents involving hazardous materials. As a result, there is some uncertainty about whether the Liability Convention can provide adequate protection for

[18] https://www.cbc.ca/arts/operation-morning-light-podcast-soviet-satellite-exploded-traditional-dene-land-1.6650994.
[19] https://www.jaxa.jp/library/space_law/chapter_3/3-2-2-1_e.html.
[20] https://cjil.uchicago.edu/print-archive/its-raining-rockets-heightening-state-liability-space-pollution.

victims of environmental damage from space activities. It is possible that States may need to develop additional legal mechanisms to address such damage.[21]

In 1996, a French satellite, SPOT 4, was struck by debris from the Chinese satellite Fengyun 1C, which had exploded in orbit. The debris caused damage to SPOT 4, after negotiations, China agreed to pay France $22 million in compensation for the damage caused to SPOT 4. The SPOT 4 incident highlighted the growing risk of space debris, and it reaffirmed the importance of the Liability Convention in ensuring that launching States are held accountable for the damage caused by their space activities.[22] In 1996, a private company called Arianespace launched an Ariane 5 rocket from Kourou, French Guiana. The rocket exploded just 37 seconds after liftoff, scattering debris over the Atlantic Ocean. The debris damaged several fishing boats, but no one was injured.[23]

The Liability Convention did not apply to the Ariane 5 Flight 501 incident because Arianespace is a private company, not a State. However, Arianespace did agree to pay compensation to the owners of the damaged fishing boats. While these cases didn't necessarily translate into formal claims under the Liability Convention, they demonstrate situations where its applicability was considered due to the nature of the incidents and potential damages in 2007, the United States government launched the UARS (Upper Atmosphere Research Satellite) into space. In 2011, UARS decayed and reentered Earth's atmosphere, scattering debris over the Pacific Ocean. The government of Tonga, a Polynesian kingdom located in the South Pacific, claimed that the debris from UARS had caused damage to its fishing boats and tuna stocks.

The United States government initially denied liability, arguing that the accident was due to the natural degradation of UARS as it orbited Earth. However, after negotiations, the United States agreed to pay Tonga $300,000 in compensation for the damage caused by the debris (FindLaw, 2018). This was the second time that a launching State had been held liable for damage caused by a space object under the Liability Convention. The UARS incident again highlighted the need for launching States to take all reasonable precautions to prevent their space objects from causing damage. It also showed that the Liability Convention can be an effective mechanism for holding launching States accountable for the damage caused by their space activities (Robinson, 2010, pp. 27-52).

The Long March 5B is a variant of China's largest rocket, was launched in late April 2021. The specific mission involving the Long March 5B rocket in 2021 was to deliver part of China's Tiangong Space Station into orbit.[24] This mission was a key component of China's ambitious space exploration program, which aims to establish a modular space station and conduct manned space flights. After successfully placing its payload into orbit, the core stage of the rocket began an uncontrolled descent back to Earth.[25] Due to its size and the speed at which it was traveling, not all parts of the rocket were expected to burn up in the atmosphere, the core stage eventually re-entered the Earth's atmosphere and fell into the Indian Ocean near the Maldives on May 9, 2021. Fortunately, there were no reports of injury or damage from falling debris, raising concerns about potential damage if debris were to land in populated areas. This incident highlighted gaps in the regulation of space debris

[21] https://link.springer.com/chapter/10.1007/978-3-031-13264-3_11.
[22] https://www.sciencedirect.com/topics/earth-and-planetary-sciences/french-satellite.
[23] https://www.sciencedirect.com/topics/earth-and-planetary-sciences/french-satellite.
[24] https://spacenews.com/china-rolls-out-long-march-5b-rocket-for-space-station-launch/.
[25] https://spacenews.com/china-rolls-out-long-march-5b-rocket-for-space-station-launch/.

and the need for stricter norms and guidelines to prevent similar occurrences in the future.[26] The incident serves as a poignant reminder of the challenges posed by space debris and the importance of responsible spacefaring practices. It underscores the need for comprehensive international norms and regulations to address the safety, sustainability, and environmental impact of space activities.[27]

Conclusions and Recommendations

To modernize the liability regime for space activities, a comprehensive approach that addresses the nuanced challenges and opportunities of contemporary and future space endeavors is needed. The following policy recommendations aim to bridge the existing gaps in the Liability Convention, foster international cooperation, and ensure a balanced approach that accommodates the interests of all stakeholders, including states and non-governmental entities (NGEs). These policy recommendations aim to create a liability regime that is adaptable, equitable, and conducive to the sustainable and peaceful use of outer space. By addressing the current gaps and anticipating future challenges, the international community can ensure that space activities continue to benefit humanity as a whole.

Several proposals have been put forward to address the limitations of the Liability Convention's scope of compensable damage, for applying the Convention to private entities,

- Expanding the definition of "damage". The definition of "damage" could be broadened to include environmental damage, economic loss, and indirect damage. This would recognize the broader impact of space activities and provide more comprehensive compensation to victims, in fair ways that do not particularly affect emerging space states and small private entities because of the potential financial burden of expanded commitments, and may require international support or capacity-building mechanisms to ensure equitable access to space.
- Introduce a no-fault liability regime for specific categories of space activities, especially those involving significant risks to global commons, such as Earth orbit and lunar environments. This regime would allow for compensation without the need to prove fault, streamlining the process for addressing damages and ensuring timely support for victims, and would shift the burden of proof from the claimant to the launching State, making it easier for victims to obtain compensation. This would provide victims with greater certainty and reduce the need to prove fault, which can be a complex and challenging endeavor.
- Interpretative approach. The Convention's existing provisions can be interpreted more broadly to encompass damage caused during launch and return within certain circumstances.
- Amendment to the Convention. A more substantial solution involves amending the Convention to explicitly include launch and return activities within its scope of application.
- Expand the scope of the Convention to include private entities. The current Liability Convention only applies to damage caused by space objects launched by States. However, as private companies become more involved in space activities, there is a growing need to extend the scope of the Convention to include private entities. This could be done by adding a new provision to the Convention that explicitly states that private entities

[26] https://medium.com/the-aerospace-corporation/another-uncontrolled-chinese-rocket-body-is-plummeting-to-earth-questions-bf6c7af3d500.
[27] https://medium.com/the-aerospace-corporation/another-uncontrolled-chinese-rocket-body-is-plummeting-to-earth-questions-bf6c7af3d500.

are also subject to its liability regime. Alternatively, the Convention could be amended to define "launching State" to include private entities that launch space objects.

- Establish a system of registration for private entities that launch space objects. Currently, there is no requirement for private entities that launch space objects to register them with any international organization. This makes it difficult to track and identify the entities responsible for space objects, and it makes it more difficult to hold them accountable for damage they cause. And it would help to ensure that they are identified and that they are aware of their liability obligations under the Convention. It would also make it easier to track the ownership and operation of space objects, which could help to reduce the risk of accidents and damage.
- Establish a mechanism for resolving disputes between private entities and victims of space accidents. The current Liability Convention does not provide a specific mechanism for resolving disputes between private entities and victims of space accidents. This could result in lengthy and costly litigation, which could discourage victims from seeking compensation. It could be established through an international tribunal or through a system of arbitration. This would help to ensure that victims have a fair and efficient way to seek compensation for the damage they have suffered.
- Develop guidelines for the conduct of private space activities. AS private companies become more involved in space activities, it is important to develop guidelines for their conduct. These guidelines should address issues such as safety, environmental protection, and liability. It could be undertaken by international organizations such as the United Nations Office for Outer Space Affairs (UNOOSA) or by a consortium of States. These guidelines could be adopted as voluntary standards or as binding regulations.
- Implement Mandatory Insurance Requirements for NGEs involved in space activities to carry insurance that covers potential liabilities under the expanded definition of damage. The insurance requirements should be scalable based on the risk profile of the activity, promoting responsible behavior while not stifling innovation and commercial participation in space exploration. Mandatory insurance could impose a significant financial burden on new and smaller entities, potentially inhibiting their entry into the space sector. To mitigate such economic challenges, a tiered insurance requirement could be introduced, allowing for premiums that reflect the scale of operations and associated risks, thus offering a more accessible entry point for emerging space nations and startups.
- Establish an international compensation fund financed through contributions from states and NGEs based on their level of space activity and the associated risk profile. This fund would serve as a mechanism to compensate victims of space activities, complementing individual insurance schemes and providing an additional layer of financial security. Likewise, contributions to a compensation fund should be scaled according to the economic capabilities of nations and the risk profile of entities' space activities, ensuring that no disproportionate financial burden falls on emerging space actors. Additionally, the establishment of international funds or assistance programs aimed at capacity-building in emerging space nations could offset some of these economic challenges, facilitating technology transfer, knowledge sharing, and regulatory support. This approach not only addresses the immediate economic concerns related to the proposed legal reforms but also promotes a more inclusive and sustainable global space community, encouraging innovation and participation across a broader spectrum of nations and entities.
- Strengthen international cooperation and capacity-building, and encourage the formation of an international

body under the auspices of the United Nations to oversee the implementation of these recommendations, facilitate dialogue among stakeholders, and provide technical assistance to countries and non-governmental organizations. This body will also work to harmonize national regulations on space liability and promote best practices in space safety and sustainability.

- Interim measures for States and NGEs. Until the proposed amendments and policies are adopted, states and NGEs should adhere to voluntary guidelines that embrace the principles of transparency, responsibility, and cooperation in space activities. These guidelines could include measures such as sharing information on space operations, engaging in collaborative space traffic management initiatives, and conducting environmental impact assessments for missions. Greater cooperation could help to ensure that space activities are conducted in a safe, responsible, and sustainable manner. It could also help to address the growing challenges posed by space debris and other environmental threats.

References

Abaideldinov, Y. M., Kulikpayeva, M. Z., & Shakhmova, A. (2014). The Republic of Kazakhstan cooperation with the Russian Federation and other countries of the world in the field of outer space. *Life Science Journal, 11*(5), 491-498.

Abrams, B. (2013). First contact: Establishing jurisdiction over activities in outer space. *Ga. J. Int'l & Comp. L., 42*, 797-824.

Albert, C. (2014). Liability in international law and the ramifications on commercial space launches and space tourism. *Loy. LA Int'l & Comp. L. Rev., 36*, 233.

Amalia, R. (2020). State obligations related to the launch of objects into outer space under international law. *Lampung Journal of International Law, 2*(2), 99-108.

Anderson, J., Nelson, T. G., Omido, A., & Rigby, A. (2023). *Private sector space projects take off: Leaving legal unknowns in their contrail*s. Skadden, Arps, Slate: Meagher & Flom LLP. Retrieved from https://www.skadden.com/insights/publications/2023/12/2024-insights/other-regulatory-developments/private-sector-space-projects-take-off/pfd

Beck, B. (2009). The next, small step for mankind: Fixing the inadequacies of the international space law treaty regime to accommodate the modern space flight industry. *Alb. LJ Sci. & Tech., 19*, 30.

Bedjaoui, M. (1987). Responsibility of states: Fault and strict liability. *Encyclopedia of Disputes Installment, 10*, 358-362.

Belobrajdic, B., Melone, K., & Diaz-Artiles, A. (2021). Planetary extravehicular activity (EVA) risk mitigation strategies for long-duration space missions. *NPJ Microgravity, 7*, 16. Retrieved from https://www.nature.com/articles/s41526-021-00144-w

Cheng, B. (1995). International responsibility and liability for launch activities. *Air & Space L., 20*, 297.

Cheng, B. (1997). *Studies in international space law*. Oxford: Oxford University Press.

Choudhury, P. R. (2021). *Issues relating to application of intellectual property rights in space activities: A legal analysis*. Montréal: McGill University.

Clerc, P., & Mariez, J. (2008). Unofficial translation of France's LOI no 2008-518 du 3 juin 2008 relative aux operations spatiales. *J. Space Law, 34*, 453-470.

Coco, A., & de Souza Dias, T. (2021). "Cyber due diligence": A patchwork of protective obligations in international law. *European Journal of International Law, 32*(3), 771-806.

De Rozavel, A. K., & von der Dunk, F. G. (2011). Liability and insurance in the context of national authorisation. In *National space legislation in Europe: Issues of authorisation of private space activities in the light of developments in European Space Cooperation* (pp. 125-161). Leiden, The Netherlands: Martinus Nijhoff Publishers.

Denis, G., Alary, D., Pasco, X., Pisot, N., Texier, D., & Toulza, S. (2020). From new space to big space How commercial space dream is becoming a reality. *Acta Astronautica, 166*, 431-443. Retrieved from https://www.sciencedirect.com/science/article/pii/S0094576519313451

Dennerley, J. A. (2018) State liability for space object collisions: The proper interpretation of "fault" for the purposes of international space law. *European Journal of International Law, 29*(1), 281-301. Retrieved from https://doi.org/10.1093/ejil/chy003

Dineen, M. (2022). For the betterment of all mankind: Claiming the benefits of outer space through intellectual property rights. *Hastings Sci. & Tech. LJ., 13*, 73.

FindLaw. (2018). Recovery of natural resource damages under comprehensive general liability policies. Retrieved from https://corporate.findlaw.com/law-library/recovery-of-natural-resource-damages-under-comprehensive-general.html

Foster, W. F. (1973). The convention on international liability for damage caused by space objects. *Canadian Yearbook of International Law/Annuaire canadien de droit international*, *10*, 137-185.

Goldberg, J. C. P., & Zipursky, B. C. (2016). The strict liability in fault and the fault in strict liability. *Fordham L. Rev.*, *85*, 743.

Gorove, S. (1970). The recovery and return of objects launched into outer space: A legal analysis and interpretation. *The International Lawyer*, *4*(4), 682-694.

Hertzfeld, H. R., & Timothy, G. (2013). Binding arbitration as an effective means of dispute settlement for accidents in outer space. Retrieved from https://www.elevenjournals.com/tijdschrift/iisl/2013/2%20Settlement%20of%20Space-Related%20Disputes/IISL_2013_056_002_001.pdf

Hurwitz, B. A. (1992). *State liability for outer space activities in accordance with the 1972 convention on international liability for damage caused by space objects*. Netherlands: Springer.

Jayaraman, V., Chandrasekhar, M. G., & Rao, U. R. (1997). Managing the natural disasters from space technology inputs. *Acta Astronautica*, *40*(2-8), 291-325. Retrieved from https://www.sciencedirect.com/science/article/pii/S009457659700101X

Joyner, C. C. (1981). UN General Assembly resolutions and international law: rethinking the contemporary dynamics of norm-creation. *Cal. W. Int'l LJ.*, *11*, 445.

Kehrer, T. (2019). Closing the liability loophole: The liability convention and the future of conflict in space. *Chi. J. Int'l L.*, *20*, 178.

Klomp. (2016). *Economic development and natural disasters: A satellite data analysis*. Retrieved from https://www.sciencedirect.com/science/article/pii/S0959378015300650

Kuźniar-Kwiatek, D. (2023). The concept of long-term sustainability of outer space activities and the international responsibility of states for space activities. *Studia Iuridica*, *97*, 112-125.

Marakani, P. (2023). An analysis to determine fault under the liability convention 1972. *International Journal of Legal Developments and Allied Issues*, *9*(1), 82-89.

Marie-Valentine. (2021). *Collision risk from space debris Current status challenges and response strategies*. Retrieved from https://spacewatch.global/wp-content/uploads/2021/07/IRGC-2021.-Collision-risk-from-space-debris-Current-status-challenges-and-response-strategies.pdf

Meyer, Z. (2010). Private commercialization of space in an international regime: A proposal for a space district. *Nw. J. Int'l L. & Bus.*, *30*, 241.

Moltz, J. (2011). *The politics of space security: Strategic restraint and the pursuit of national interests*. Stanford: Stanford University Press.

Murphy, S. D. (1994). Prospective liability regimes for the transboundary movement of hazardous wastes. *The American Journal of International Law*, *88*(1), 24-75. Retrieved from https://doi.org/10.2307/2204021

Myszona-Kostrzewa, K. (2023). Some legal aspects of international liability for damage caused by malfunctioning of satellite navigation systems. Retrieved from https://www.ceeol.com/search/article-detail?id=1193715/PDF

Poonuganti, S. (2022). It's raining rockets: Heightening state liability for space pollution. *Chi. J. Int'l L.*, *23*, 490.

Robinson, J. (2010). *The role of transparency and confidence-building measures in advancing space security*. Wien: European Space Policy Institute. Retrieved from https://www.files.ethz.ch/isn/124827/ESPI_Report_28_online.pdf

Schick, F. B. (1961). Space law and space politics. *International & Comparative Law Quarterly*, *10*(4), 681-706.

Schmalenbach, K. (2022). Convention on international liability for damage caused by space objects. In *Corporate liability for transboundary environmental harm: An international and transnational perspective* (pp. 523-536). Cham: Springer International Publishing.

Sharmin, F. (2023). China's increasing space power and India-China orbital competitions: Implications in the Indo-Pacific with a focus on South Asia. *Journal of Indo-Pacific Affairs*, *6*(8), 53-73.

Smith, L. J. (2015). Legal aspects of satellite navigation. In *Handbook of space law* (pp. 554-617). Northampton, MA: Edward Elgar Publishing.

Sylkina, S. M., Dosymbekova, M. S., Tusupova, A. Z., & Abdrakhmanova, E. S. (2014). Legal analysis of the convention on International liability for damage caused by space objects (March 29, 1972). *Life Science Journal*, *11*, 264-266.

Tou, X. (2008). The transboundary movement of harmful wastes and the transformation of traditional state responsibility. *Macquarie Journal of International & Comparative International Law*, *5*(1), 97-110.

United Nations. (2001). Draft articles on responsibility of states for internationally wrongful acts, with commentaries. Retrieved from https://legal.un.org/ilc/texts/instruments/english/commentaries/9_6_2001.pdf

Wang, G. Y., & Ma, X. (2023). Liability and patent protection for space activities in China. In *Oxford research encyclopedia of planetary science*. Oxford: Oxford University Press.

Yuan, A. (2021). Filling the vacuum: Adapting international space law to meet the pressures created by private space enterprises. *Denv. J. Int'l L. & Pol'y, 49*, 27.

Ziemblicki, B., & Oralova, Y. (2021). Private entities in outer space activities: Liability regime reconsidered. *Space Policy, 56*, 101427.