

Between Sea and Sky: Understanding Liability for Private and Commercial Space Operations

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Abstract: The legal framework for commercial space activities has been an emerging issue in recent decades. Understanding and addressing liability in space activities is crucial for the sustainable and responsible development of the commercial space industry, analogous to laying the foundation for a sturdy structure that can withstand the challenges of the ever-evolving space frontier. This article explores the concept of liability for private and commercial space launches and its importance in ensuring the safe and responsible operation of activities in space. Examining liability in *lex maritima* and commercial space law involves drawing parallels between the regulations governing both domains and uncovering potential opportunities for learning from existing legal frameworks. The analysis considers liability in various maritime zones, such as the territorial sea, high sea, and deep-sea bed, and draws comparisons to liability in the territory, space, and celestial body. It discusses the challenges and implications of addressing liability in space activities, including the allocation of liability, the protection of public safety, and the preservation of space as a shared resource.

Keywords: Outer Space Law, Comparative Law, Commercial Space Operation, Liability

1. Introduction

As Roscoe Pound once said, the ultimate degree of human control over the physical and internal aspects of human nature that men are now capable of, as well as the continual advancement of human capacities to ever-greater completion [1]. Human activities expand as technology takes humanity further into regions where no predecessors have ever set foot on, thus new regulations are required to control in ways individuals interact. Never before Tsiolkovsky had humans been able to envision a future of rockets and space stations, and they are gradually making such a dream come true [2]. The adventure into the arena of space law started in the early 20th century, followed by several monographs on how states ought to behave in outer space [3]. The first true milestone humans accomplished was when 1967 saw the signing of the Outer Space Treaty (OST), placing several key elements in the space law that are crucially essential in regulating human conduct in outer space [4,5]. Four subsequent conventions were also signed between 1968 and 1979 in the United Nations, expanding on the ideas found in OST.

The idea that only nations have the right to begin space operations is a cornerstone of modern space law. Consequently, they have the responsibility of making up for any harm inflicted against space objects, given that only states are granted the liberty to explore space [4]. The historical period

could be one of the reasons, owing to the tension between states makes it even idealistic for states to hope for peaceful co-existence [6]. Future development of space law can either adapt to new circumstances or develop under a state-centered paradigm.

There has been an increase in commercial launches in the last several years. Some affluent people are prepared to part with a sizeable amount for a respectable voyage to the outer regions of the atmosphere. In 2004, Virgin Galactic, a company owned by Richard Branson, revealed its intention to offer sub-orbital space trips to tourists, lasting 90 minutes and priced at \$200,000. These journeys would be facilitated by their spacecraft, SpaceShip Two, which would travel at three times the speed of sound [7]. There are also other space tourism agencies including but not limited to: Armadillo Aerospace, Bigelow Aerospace, Axion Aerospace, etc. All of which have insights and programs into future commercial space launches [8].

A few well-known instances involving the liability of satellites may be the infamous Russian COSMOS 954 crash into Canadian territory in 1978, which left radioactive debris strewn over a sizable portion of Canada [9].

To guarantee the safe and responsible operation of operations in space, it is important to understand liability for private and commercial space launches. The parallel between liability for commercial ships in maritime zones and liability in commercial space law provides valuable insights into the distinctions and regulations governing this liability. By examining the legal frameworks for liability in both domains, it becomes clear that understanding the *lex maritima* can serve as a useful foundation for comprehending liability in space. Therefore, exploring the liability of commercial ships in various maritime zones and drawing comparisons to commercial space law will shed light on the importance of addressing liability in space activities.

2. Overview of Commercial Space Law and Liability

2.1. Cardinal Treaties

The primary international agreement governing how nations and non-governmental organizations use and explore space is OST [4]. Article VI, which mandates that governments approve, oversee, and assure that their private persons' and enterprises' actions in space comply with international law, is one of the treaty's most important clauses. However, as the commercial space industry expands and gains new skills, such as asteroid mining, space tourism, and satellite servicing, there are more questions and difficulties with how to interpret and apply Article VI.

An international agreement known as the Liability Convention of 1972 lays out the guidelines and processes for compensating for harm caused by space objects [10]. The Convention covers both functional and nonfunctional items, such as space trash, and defines a space object as anything launched into outer space, including its pieces. Additionally, the Convention recognizes launching states as the entities accountable for international obligations concerning any harm caused by their space objects, regardless of whether said objects are under the management of public or private enterprises. A key tool for guaranteeing nations' and commercial operators' accountability and responsibility in the emerging space age is the Liability Convention.

An international agreement known as the Rescue Agreement was ratified in 1967 and became operative in 1968 [11]. The primary goal of the Rescue Agreement is to guarantee that space objects that land outside of the launching state's territory are likewise returned or aided upon request, and that astronauts who experience any form of emergency or disaster in space be rescued and returned to their launching state. The Rescue Agreement further stipulates that nations, whether represented by governmental or non-governmental organizations, are internationally responsible for their national space operations and must refrain from interfering negatively with such activities. Commercial space

missions have been subject to the Rescue Agreement; this was the case in 2020 when a SpaceX spacecraft carrying two NASA astronauts landed in the Gulf of Mexico.

The Registration Convention governs the registration of items that nations or international organizations launch into space [12]. The Convention came into effect in 1976 after being approved by the UN General Assembly in 1974. It seeks to provide international guidelines and protocols on launching states' culpability for harm caused by space objects, as well as to give governments more tools and processes to aid in space object identification.

An international accord, referred to as the Moon Agreement, endeavors to govern the peaceful exploration and utilization of the Moon and other celestial bodies [13]. The agreement acknowledges the Moon and its natural endowments as part of the collective patrimony of humanity, to be harnessed for the benefit of all nations and peoples. For instance, it mandates that these operations respect international law and preserve the Moon's ecology and biodiversity. It further states that any constructions, installations, or equipment on the moon must be accessible for external examination and that any potentially dangerous interference or contamination must be prevented or reduced.

2.2. Literature Review

Paul B. Larsen argues that international treaties which aiming to govern collisions involving commercial spacecraft [14]. The Liability Convention, which applies more widely than Article VII of OST, holds operators severely liable for any damage space objects cause to aircraft or the ground. The apportionment of liability for damages beyond Earth's atmosphere and on land is akin to unraveling a cosmic puzzle, hinging on the adeptness of the responsible state or its licensed commercial operator to illuminate the path of culpability. Claimants may, therefore, choose not to abide by the treaty and pursue legal action directly in national courts against the accountable operator. He also talks about potential legal developments in the new space period, liability exposure, and various regimes managing responsibility.

In a compelling narrative, Charles Ellzey fervently argues that like a celestial body hurtling through the vast expanse of space, the responsibility for any collateral damage incurred on a global scale due to the launch of an object into space is comparable to an inescapable gravitational force, inexorably tethered to the State Party that orchestrated its ascent [15]. Article VII in OST goes into depth on this, while the Liability Convention goes into much more detail. Commercial launch activities must be regulated due to these international obligations, and in the US, commercial activities must be licensed by the Federal Aviation Administration and monitored by federal entities such as the US Air Force/US Space Force. Ultimately, the government of the launching state is responsible for retrieving fallen space objects rather than the non-governmental entity, should either party desire recovery.

Commercial space operators may be responsible for any harm resulting from their operations, elaborated by Elina Morozova and Alena Laurenava from Ellzey's same issue. But in accordance with the culpability Convention, States bear and assert culpability [16]. In this way, the only dangerous human activity domain where direct operators are not held liable is space operations. The rationale is that it was thought that only states would be able to carry out space operations. It follows that private actors' national space actions are presumed to be subject to international responsibility under Article VII of the OST. Launching items into space and providing launch facilities are two examples of these operations.

This article will venture into the same topic so often discussed as the above, yet from the perspective of comparison, between the similarities and differences. Such a venture could be a glimpse into the method of comparative law, which is a method used to study and analyze legal systems across different countries or jurisdictions. It entails comparing and contrasting different legal institutions, norms, and principles in order to comprehend how distinct legal systems operate and

interact with one another. Scholars can investigate the cultural, historical, and social elements that mold and impact the evolution of laws and legal establishments by contrasting legal systems.

In this illuminating discourse, this article embark upon a celestial voyage to juxtapose the intricate tapestries of maritime and cosmic jurisprudence. Like intrepid navigators charting uncharted waters, this article delve into the depths of legal realms, unfurling the compass of comparison to unravel the enigmatic interplay between terrestrial territories, boundless expanses of space, and the ethereal allure of celestial bodies. In terms of resource use and sovereignty, these are equivalent to the territorial sea, high sea, and deep-sea bed. States, however, are entitled to full sovereignty over their territory, including its air and sea borders, as well as compensation for any injury they may cause. While for high sea and outer space, no sovereignty can be executed owing to the fact that no state has the right to govern but only certain rights to use. Yet consequences can arise from commercial operations if such operations cause severe incidents. The deep-sea bed is also a cutting-edge topic, where humans are extracting more and more components that are beneficial for human production.

3. Liability of Commercial Ships

3.1. Territorial Sea

Within the confines of the territorial sea, the onus of liability pertaining to commercial ships is subject to the jurisdiction and sovereignty of the coastal states, akin to the intricate interplay of celestial bodies within the cosmic expanse, where the regulatory authority of coastal states acts as the gravitational force that governs the movement and conduct of commercial vessels. These states have the authority to enforce laws and regulations within a certain distance from their coastlines. In terms of liability, coastal states may hold commercial ships accountable for any damages, accidents, or violations that occur within their territorial sea. However, it is important to consider the implications and limitations of liability in the territorial sea context of commercial shipping. This includes the challenges of enforcing liability across different jurisdictions, the potential conflicts of laws, and the need for international cooperation to ensure consistent standards of liability for commercial ships.

Under the circumstance of an oil spill, which is a typical incident involving commercial liability between a company and the state, it is a great example of contamination and compensation. The liability of an oil spill in another state's territorial sea is governed by international conventions and national laws. The subject of legal responsibility for marine oil spills is adequately opined under the International Convention on legal responsibility for Oil Pollution Damage (CLC) [17].

According to Jessie Elizabeth Shifalo, et al., unless it is demonstrated that the management or charterer was responsible for the spill via deliberate misconduct, the CLC holds the registered owner of a vessel civilly accountable [18]. The flag state's obligation, as enshrined in the United Nations Convention on the Law of the Sea (UNCLOS), is akin to a guiding star illuminating the legal seascape. Moreover, the United States Code § 1321 further delineates the responsibility of vessel owners or operators in the event of oil spills, similar to a legal net cast to hold accountable those responsible for environmental harm. It states that the owner or operator of a vessel from which oil is discharged in violation of the law may have liabilities, and the United States Government may also have rights against any third party whose actions may have caused or contributed to the discharge of oil or hazardous substance. As a result, therefore, international agreements, domestic legislation, and the particulars of the spill all affect who is liable for an oil leak that occurs within the territorial sea of another state.

In the domain of maritime jurisprudence, an unmistakable dichotomy emerges between the dominion of the flag state and the port state, akin to the contrasting landscapes painted by different authors in the vast tapestry of literature. The flag state, much like the author of a literary work, holds the power of registration and control over the commercial vessel, while the port state, akin to the

discerning critic, exercises authority over the vessel's compliance with international maritime regulations [19]. The Liability Convention of 1972 distinguished the term "Launching State", which is also the state under which the satellite is registered, according to the Registration Convention of 1974. Both concepts are identical in the sense of resorting liability between states and companies. The incident of COSMOS 954 mentioned no doubt resembles the contamination by the oil spill in the territorial sea. However, the pollution unleashed on the land of Canada was not caused by merchant spacecraft therefore there will not be a distinction between the liability of the Soviet state and the company who launched it. However, in most cases of oil spills, the liability shall be divided between the flag state and the entity that committed the incident under the instruction of the flag state, indicating the future possibility of division of liability between the launching state's government and the company launching it.

Yet beware of one particular difference between the jurisdiction of states regarding the liability of oil spills in the territorial sea and satellite contaminations in the territory, which is whether states have full rights to juristic or not. States only have jurisdiction in respect of certain specific matters, according to Article 21 of UNCLOS, which includes navigation, pipeline and cable protection, fisheries, pollution control, scientific research, and regulations pertaining to customs, finances, immigration, and hygienic conditions [20,21]. Conversely, governments, by the rights given by the international law, unquestionably possess complete jurisdictional rights over their own area. This discrepancy stems from the idea of innocent passage and the "internal economy" theory, which held that the law of the coastal state applied only to actions taken by foreign ships that had an impact outside of the ship. governments that receive a fallen satellite are required under Outer Space Law to return the item, although there are no set time constraints, which gives governments a significant deal of latitude.

3.2. High Sea

The concept of High Sea is mentioned Article 1 of the High Sea Convention [22]. But now that the EEZ and the idea of archipelagic water have emerged, this definition has to be updated [20]. All states, both colossal and petite, have access to the high sea without hinderance physically or mentally, hence no state has the right to assert sovereignty over it [22]. As stated in Article 1 of OST, such a concept also applies to space, where sovereignty is not possible [4]. Since both are seen as part of humanity's shared history, they are not governed by the sovereignty or laws of any one state but rather are a part of the global community. Both are also subject to the principle of peaceful use, which prohibits any military or hostile activities in these areas and requires cooperation and coordination among states and other actors. However, the High Sea is more accessible and exploitable than outer space, which requires advanced technology and resources to enter and operate. This creates different challenges and opportunities for international law in terms of ensuring equitable access, benefit-sharing, environmental protection, and dispute settlement in these domains.

UNCLOS governs a merchant ship's responsibility especially when it comes to high seas operations. As it is stated in UNCLOS, a ship's liability for damage or loss to other ships, people, or property is governed by international collision regulations and any applicable international conventions, such as the International Convention on Civil Liability for Oil Pollution Damage (CLC) and the International Convention for the Safety of Life at Sea (SOLAS). Furthermore, the rules and regulations of the ship's flag state may also apply to the responsibility of its ships at sea. It's crucial to remember that a commercial ship's obligation might be complicated and include several legal regimes.

One of the most well-known principles derived from incidents that occurred in the High Sea is the Lotus Principle, which was first mentioned in the Lotus Decision. The Lotus Decision is the international court decision on the Lotus Case, how, in 1927, a Turkish ship and a French ship clashed

on the high seas. Questions are raised regarding whether states can exercise jurisdiction over crimes committed towards their compatriots. The Lotus Principle means the assertion of states' freedom to act when absence of a restrictive law is found [23]. It is, however, considered obsolete to exercise the Lotus Principle on liability dispute on the high sea, for the flag state principles are applied to most of the jurisdiction, indicating that states cannot apply their jurisdiction rights only because no particular rule of law prohibits them to do so, but for the fact that it is registered and licensed to do so. There is a remaining disagreement on whether the Lotus principle can be applied to liability cases that happen in the realm of outer space where no principle of sovereignty is implemented. Employing the Lotus Principle could be one major step toward the state's jurisdiction on unregistered space objects. Unregistered space objects were never a legal concern until the controversial launch of experimental satellites by Swarm Technologies, which is a great example of future illegal launches and unregistered satellites, concerning a start-up aiming to enable communications over space for the "Internet of things", unveiling a potential for government or company to launch unregistered spacecraft and the rule of law behind it [24]. Apart from unregistered launches, it is also possible to launch unregistered objects within the same launch as the registered ones, disguised as debris. The Lotus Principle enables states to exert their rights to juristic owing to the fact that no particular rule of law prohibits them from doing so.

3.3. The International Sea Bed Area

Like modern-day adventurers, those who embark upon this audacious voyage are driven by a potent combination of curiosity, ambition, and the allure of untold riches. They navigate uncharted waters, both literal and metaphorical, in search of the elusive treasures that lie hidden beneath the waves. In this subaquatic realm, the allure of the exotic is palpable. The ocean floor, a tapestry of unexplored wonders, holds within its grasp an array of treasures waiting to be unveiled. The manganese nodules, like precious gems scattered across a celestial canvas, beckon the explorers with their enigmatic charm. Their iridescent hues and intricate formations hint at the untold stories that lie dormant within their metallic core.

The International Seabed Authority (ISA) and a State Party to UNCLOS must sponsor and authorize all mineral exploration and exploitation operations, including deep sea bed mining [25]. The ISA is responsible for making sure that deep sea mining is carried out in compliance with the rules and guidelines that the ISA has approved, including fair distribution of financial gains and efficient preservation of the marine ecosystem. Nevertheless, the ISA is unable to determine appropriate standards to reduce the likelihood of endangering the marine ecosystem as the environmental effects of deep-sea mining are still not completely known [26]. A rising number of nations have stated that they will not approve of any mining without a moratorium, prompting calls for a cautious halt or outright ban on deep sea mining on the international seabed. A complete responsibility scheme is necessary to provide environmental protection and international governance in the context of deep-sea mining, as it involves several parties such as the ISA, contractors, and supporting nations.

Analogous to the intricate realm of deep-sea excavation, the realm of commercial space mining presents an array of intricate liability quandaries and arduous challenges in the arduous endeavor of extracting precious resources from asteroids and other celestial entities. These multifaceted predicaments encompass the perilous specter of mishaps, the far-reaching repercussions of resource exploitation on the delicate celestial ecosystem, and the labyrinthine legal entanglements that ensue.

Presently, the Space Act, as it applies to the United States, allows commercial space companies to participate in activities that can endanger non-launch participants. The corporation bears full liability for any damages that fall below \$500 million. However, the government will compensate the business

for losses up to around \$3 billion if they exceed that level; any damages above that would be the business's liability [27].

States are required by law to avoid hazardous contamination both on Earth and in space, as evidenced by the Moon Agreement and the OST. [28]. It might be challenging to prove culpability for harm done to the space environment as opposed to the Earth, though, due to the special characteristics of resource extraction from space.

It might not always be appropriate to hold companies accountable for hazards that arise from producing items in space since those risks might not be recognized or predictable. When producers only have assets in space or when businesses operating in space have limited resources, enforcement may also present difficulties.

The Liability Convention implicates government responsibility for the activities of those operating in space, but it is unclear whether it stands today is sufficient to address the potential for accidents arising from commercial space mining activities [29]. The Moon Treaty, a controversial child of the OST, has been rendered an outcast by the three major acceded to it, which makes it binding international law. However, the status of private property rights in space mining remains uncertain.

The profound enigma surrounding the legal infrastructure for the exploitation of lunar and other celestial resources may be encapsulated within the confines of the Liability Convention, a legally binding treaty that shackles the sovereignty of nations, restraining their pursuit of indemnification for any incurred harm. In order to sue the United States for damages, foreign commercial mining corporations must convince their governments or another nation, which is still dependant on other political factors. Furthermore, since the Liability Convention came into effect in 1972, no liability claims have been filed under it [30].

Looking back to deep sea-bed mining, several solutions can be suggested. In order to facilitate communication and allow firms to sue for damages independently of the state, new players such as the ISA can be formed to mediate at a supernational level. Such actors could be derived from ad hoc committees in the United States and merged into certain authorities legitimized by international law.

4. Conclusions

It is crucial to comprehend responsibility for both private and commercial space launches in order to conduct space operations in a safe and responsible manner. Important insights into the rules and differences controlling responsibility in space may be obtained by comparing liability. Because both fields have fundamental concepts about the necessity for international collaboration, resource protection, and the distribution of obligation to avert harm. Creating and implementing thorough liability frameworks is essential as commercial space activities grow in order to guarantee safety, responsibility, and the responsible advancement of space ventures.

In addition to the current understanding of liability for private and commercial space launches, there is a need to explore the future possibilities of this research. As the space industry evolves, there may be a need for a more comprehensive and tailored approach to address the unique characteristics and risks associated with space launches. The future of liability research in space may involve examining the implications of commercial space tourism. It will be necessary to set up responsibility frameworks to safeguard space visitors' safety and wellbeing as more businesses, like SpaceX and Blue Origin, begin to provide space tourism experiences. Studies in this field can aid in the creation of guidelines and standards that guarantee the ethical performance of space tourism operations and handle any potential liability concerns.

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