Space Law and Governance

By

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Table of Contents

Foreword

In an era where the stars are no longer just distant points of light but increasingly accessible frontiers for human activity, the discourse around space law and governance has moved from the periphery to the very centre of international relations and technological advancement. Commercial use of outer space today, offers enormous benefits that may potentially serve humanity in terms of fighting climate change, education, disaster mitigation, natural resource management and military operations.

As a teacher of Public Law, I have been witnessing a rapid pace of change from the initial state-led space race to the current landscape dominated by a vibrant mix of governmental agencies and innovative private enterprises. This evolution has brought with it unprecedented opportunities for scientific discovery, economic growth, and global connectivity. Yet, it has also introduced complex challenges, including the sustainable management of orbital resources, the ethical implications of extraterrestrial activities, and the imperative to prevent conflict in this new domain.

It is in this background that the book in hand "Space Law and Governance" offers an insightful and meticulously researched exploration of legal framework that underpin humanity's expansion into the cosmos. What sets this book apart is its comprehensive yet accessible approach. It masterfully navigates the historical foundations of space law, dissecting the landmark treaties that have shaped our understanding of outer space as a shared heritage, which under International law would be known as "Common Heritage of Mankind". More importantly, it courageously confronts the emerging issues that demand our immediate attention: the legal ambiguities surrounding space mining, the critical need for effective space traffic management,

the delicate balance between national security and peaceful use, and the profound ethical questions posed by human settlement beyond Earth. The integration of cutting-edge topics, such as the legal implications of AI and robotics in space, further solidifies its relevance for today's rapidly evolving environment.

"Space Law and Governance" is more than just a scholarly text; it is a vital guide for anyone seeking to understand and contribute to the responsible development of space. It underscores the undeniable truth that the future of outer space its peace, its sustainability, and its equitable utilization hinges on our collective ability to forge robust legal and governance mechanisms. This book is an essential read for policymakers crafting future regulations, legal experts navigating complex international disputes, industry leaders charting new commercial ventures, and indeed, for every citizen who looks up at the night sky and contemplates humanity's next great leap.

I commend the author for this timely and indispensable contribution to the field. It is my sincere hope that this book will inspire continued dialogue, foster greater international cooperation, and ultimately help steer humanity toward a future in space that is both prosperous and profoundly peaceful.

Prof. Amar Pal Singh
Vice Chancellor
Dr. Ram Manohar Lohiya
National Law University Lucknow

Preface

The boundless expanse of outer space, once the exclusive domain of science fiction and geopolitical ambition, has rapidly transformed into a vibrant arena of human endeavour. From the pioneering launches of the Cold War era to the burgeoning commercial ventures of today, humanity's reach beyond Earth has expanded exponentially, bringing with it unprecedented opportunities and complex challenges. As satellites proliferate, private companies venture into lunar exploration, and the prospect of extraterrestrial resource utilization becomes increasingly tangible, the need for a robust and adaptive legal framework governing these activities has never been more critical.

This book, "Space Law and Governance," embarks on a comprehensive journey through the intricate landscape of space jurisprudence. It is born from a recognition that the principles established in foundational treaties, while enduring, must continually evolve to address the dynamic realities of a new space age. We delve into the historical evolution of space law, tracing its philosophical roots and examining the landmark international instruments that have shaped its trajectory. From the foundational Outer Space Treaty to the nuanced discussions surrounding the Moon Agreement and the Artemis Accords, we explore the legal bedrock upon which all space activities rest.

Beyond the established norms, this work confronts the pressing contemporary issues that define the cutting edge of space law. We meticulously analyze the profound influence of the private sector, the burgeoning complexities of space mining and resource utilization, and the urgent imperative of space traffic management and orbital debris mitigation. The book also navigates the sensitive terrain of space militarization, the ethical considerations of human settlement

beyond Earth, and the transformative impact of emerging technologies like artificial intelligence and robotics on legal frameworks.

"Space Law and Governance" is designed to be an indispensable resource for policymakers, legal scholars, industry stakeholders, scientists, and anyone seeking a deeper understanding of humanity's legal and ethical responsibilities in the cosmos. It aims to foster a nuanced appreciation for the delicate balance required to promote innovation, ensure equitable access, and safeguard the long-term sustainability of outer space for generations to come.

As we stand at the precipice of a new era of space exploration, marked by both immense promise and potential pitfalls, a collaborative and proactive legal approach is paramount. This book serves as a call to action, urging continuous international dialogue, the development of innovative legal solutions, and the establishment of cohesive governance mechanisms. Only through such concerted efforts can we ensure that outer space remains a domain of peaceful exploration, scientific discovery, and shared prosperity for all humankind.

Chapter 1

Introduction to Space Law and Governance

1.0 Introduction

The exploration and utilization of outer space have undergone a dramatic transformation over the past century, evolving from a domain solely controlled by national governments to an arena shaped by globalization, technological advancements, and increasing private sector involvement. Initially, space exploration was driven by intense geopolitical rivalries, particularly during the Cold War era, when the United States and the Soviet Union engaged in a space race that led to groundbreaking advancements in space technology[1]. This competition not only propelled humanity beyond Earth's atmosphere but also necessitated the creation of fundamental legal frameworks to govern space activities, prevent conflicts, and promote peaceful exploration.[2] Over time, the landscape of space activities expanded beyond government-led initiatives, encompassing private enterprises, international partnerships, and commercial ventures, thereby introducing new challenges and opportunities that demand a comprehensive and adaptive legal framework.[3]

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[1] Launius, R. D. (2018). *The History of Space Exploration: From the Ancient World to the Extraterrestrial Future.* Smithsonian Books

[2] United Nations Office for Outer Space Affairs (UNOOSA), *Treaties and Principles on Space Law*, 2021

[3] Jakhu, R, & Pelton, J. (2017), *Space Mining and Its Regulation.* SpringerJakhu, R., & Pelton, J. (2017), *Space Mining and Its Regulation.* Springer

With the advent of commercial space companies such as SpaceX, Blue Origin, Virgin Galactic, Skyroot, Next Planet Inc, etc., space exploration has entered a new phase marked by rapid innovation, reduced costs of access, and increasing commercialization.[4] Activities such as satellite deployment, space tourism, asteroid mining, and the potential colonization of celestial bodies have introduced complex legal, regulatory, and ethical concerns.[5] The necessity for a well-defined legal structure has become more pressing as humanity's presence in space grows, requiring clear guidelines for space governance, environmental sustainability, liability, and international cooperation[6]. A comprehensive legal framework must regulate space activities by setting enforceable guidelines for exploration, commercial ventures, and scientific research. Additionally, it must ensure the safety and sustainability of space operations by addressing issues such as space debris mitigation, environmental impact assessments, and responsible space traffic management to prevent overcrowding and collisions in orbit[7]. Given the increasing role of both governmental and private sectors, international cooperation is essential to foster peaceful collaboration, define liability and accountability for damages caused by space activities, and address ethical considerations surrounding resource utilization and ownership rights.[8]

Space law serves as the foundation for governing human activities in outer space, ensuring that exploration and utilization occur within

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[4] Musk, E. (2017), "Making Humans a Multiplanetary Species" *New Space*, 5(2), 46-61

[5] de Gouyon Matignon, L. (2019). *The Future of Space Exploration and Mining*, Springer

[6] Freeland, S. (2015), "The Regulation of Commercial Space Activities: Problems and Challenges." *McGill Institute of Air and Space Law Journal*, 40(1), 25-50

[7] European Space Agency (ESA), *Space Debris Mitigation Guidelines*, 2020.

[8] Hobe, S, Schmidt-Tedd, B., & Schrogl, K. U. (2017), *Cologne Commentary on Space Law*, Vol. 1-3, Carl Heymanns Verlag

a structured legal framework that upholds international legal principles.[9] The legal governance of space has continually evolved in response to advancements in technology, the growing presence of private sector players, and emerging security threats such as the militarization of space.[10] This chapter provides an in-depth analysis of the historical evolution of space law, tracing its development from the early days of space exploration to the modern era of commercial space activities. It examines the key international treaties and agreements that define the rights and responsibilities of nations and private entities in space, including the Outer Space Treaty of 1967[11], the Moon Agreement[12], the Liability Convention[13], and other significant legal instruments.

Furthermore, this chapter explores the roles of major national and international regulatory bodies that oversee space activities, including the United Nations Office for Outer Space Affairs (UNOOSA), the Committee on the Peaceful Uses of Outer Space (COPUOS), and leading space agencies such as NASA (United States), ESA (European Space Agency), ISRO (Indian Space Research Organisation), Roscosmos (Russia), CNSA (China National Space Administration), JAXA (Japan Aerospace Exploration Agency)[14], etc. These institutions play a crucial role in monitoring compliance with international space law,

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[9] United Nations, *The Outer Space Treaty of 1967*, UN General Assembly Resolution 2222 (XXI)

[10] Bowen, B. (2020). *War in Space: Strategy, Spacepower, Geopolitics.* Edinburgh University Press

[11] United Nations Office for Outer Space Affairs (UNOOSA), *Outer Space Treaty Overview*, 2022

[12] United Nations, *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, 1979.

[13] United Nations, *Convention on International Liability for Damage Caused by Space Objects*, 1972.

[14] NASA, *International Cooperation in Space Exploration*, 2023.

regulating private sector involvement, and addressing emerging legal challenges.

In addition to the existing regulatory framework, this chapter highlights the pressing challenges in space governance that require immediate and long-term legal solutions. These include the increasing problem of space debris and the need for sustainable space operations[15], the legal complexities surrounding resource exploitation and commercialization of celestial bodies[16], and the necessity for an effective space traffic management system to prevent orbital congestion[17]. Moreover, the militarization of space and related international security concerns pose significant challenges that must be addressed through legal frameworks and diplomatic negotiations[18].

By comprehensively examining these aspects, this chapter seeks to provide a deeper understanding of the complexities involved in space governance and the critical role of international legal instruments in facilitating sustainable and cooperative space exploration. As space activities continue to expand, the future of space law will depend on continuous international dialogue, the development of innovative legal solutions, and the establishment of collaborative governance mechanisms[19]. Ensuring that outer space remains a domain accessible, peaceful, and beneficial to all humankind will require a concerted effort by governments, regulatory bodies, private enterprises, and

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[15] Kessler, D. J., & Cour-Palais, B. G. (1978). "Collision Frequency of Artificial Satellites: The Creation of a Debris Belt." *Journal of Geophysical Research*, 83(A6), 2637-2646

[16] Scott, K. (2020). "Legal Challenges in Asteroid Mining" *Harvard Space Law Review*, 9(3), 120-145

[17] UNOOSA, *Guidelines for the Long-term Sustainability of Outer Space Activities*, 2019

[18] Moltz, J. C. (2019). *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests.* Stanford University Press

[19] Frans G. von der Dunk, *Handbook of Space Law* (Edward Elgar Publ'g 2021)

international organizations to create a dynamic and enforceable legal structure that balances technological progress, commercial interests, and global security imperatives.[20]

To address the multifaceted and rapidly evolving dimensions of space law, this book is structured into nine subsequent chapters that explore the evolution, structure, and future of space law in detail. Beginning with the historical development of international space law and the foundational treaties that shaped it, the chapters progress to analyze national policies, the rise of private actors, and the legal implications of space commercialization and resource utilization. Key topics such as orbital debris, militarization, human settlement beyond Earth, and the integration of emerging technologies like artificial intelligence and robotics are thoroughly examined. The final chapter contemplates future reforms and innovations in space governance, offering insights into the next generation of legal frameworks necessary for sustainable and cooperative space activities. Together, these chapters aim to equip readers with a nuanced understanding of the multifaceted legal, ethical, and policy challenges that will define humanity's future in outer space.

1.1 Historical Evolution of Space Law

The evolution of space law is deeply rooted in both ancient philosophies and modern geopolitical developments. Ancient Indian scriptures offer profound insights into celestial bodies, space exploration, and the ethical application of cosmic knowledge for the welfare of humanity. The *Rigveda*, one of the oldest known texts, describes the vastness of the universe, planetary movements, and celestial

[20] United Nations, *Global Governance of Outer Space Activities*, UN Space Report, 2024.

phenomena, illustrating an advanced understanding of astronomy and cosmology:

> *"Tribhūvanasyabhartā"* (Lord of the three worlds) and references to *antariksha* (outer space) reflect an awareness of cosmic realms and interplanetary domains, signifying an early recognition of celestial mechanics.[21]

The *Atharvaveda* further discusses planetary motions, star constellations, and the concept of an expanding universe, indicating that ancient Indian scholars possessed significant astronomical knowledge. The *Surya Siddhanta*, a classical Indian astronomical treatise, accurately calculated planetary orbits, eclipses, and time cycles, many of which closely align with modern astronomical findings.

1.1.1 Ancient Indian Texts and Spacecraft Concepts

The *Vaimānika Shastra*, attributed to Maharishi Bharadwaja, provides an intricate account of *Vimanas* – aerial vehicles with capabilities resembling modern aircraft and spacecraft. It describes various propulsion mechanisms, aerodynamics, and materials suitable for aerospace travel. Importantly, the text emphasizes that such technology should be used for peaceful purposes and human advancement, rather than warfare:

> *"Vimanas should be employed only for the betterment of mankind, and not for destructive purposes."*[22]

This principle aligns with contemporary space law, particularly the Outer Space Treaty (1967), which prohibits the militarization of space and encourages its peaceful use for the benefit of all humankind.

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[21] *Rigveda* 10.121.1 (Ralph T.H. Griffith trans., 1896)

[22] Maharishi Bharadwaja, *Vaimānika Shastra*ch. 1, verse 3 (G.R. Josyer ed., 1973).

1.1.2 Dharma and Ethical Space Governance

The Indian philosophical and legal system, rooted in the concept of *Dharma*, has long emphasized the ethical application of knowledge. The Manusmriti (*Laws of Manu*) and the Arthashastra by Chanakya advocate for responsible governance, ethical decision-making, and non-aggression:

> "Ahimsa paramo dharmah" (Non-violence is the highest duty)"[23]

This principle is particularly relevant to space law, which mandates international cooperation, peaceful exploration, and non-exploitative use of outer space. The Moon Agreement (1979), which asserts that celestial bodies should be used for the collective benefit of humanity, echoes these ancient ethical values.

1.1.3 Ancient Bharat's Influence on Modern Space Exploration

The mathematical and astronomical contributions of ancient Indian scholars like Aryabhata, Brahmagupta, and Bhaskara further reinforce Bharat's early engagement with space sciences. Aryabhata's work on planetary motion and heliocentric theory predates Copernicus by centuries, while Brahmagupta's calculations of gravity and planetary distances were groundbreaking for their time.

In contemporary space exploration, Bharat continues this legacy through the Indian Space Research Organisation (ISRO), which upholds principles of peaceful space utilization, international collaboration, and technological innovation for global welfare. ISRO's Chandrayaan and Mangalyaan missions align with the vision of responsible and ethical space exploration rooted in ancient Indian wisdom.

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[23] *Manusmriti* 6.92 (G. Bühler trans., 1886)

1.1.4 Cold War Era and the Modern Development of Space Law

While ancient Indian wisdom laid a philosophical and ethical foundation for space exploration, the evolution of space law in its modern form is deeply rooted in the geopolitical tensions of the Cold War era, a period that saw rapid advancements in space technology driven by the intense rivalry between the United States and the Soviet Union. This era marked the dawn of space exploration, with the successful launch of Sputnik 1 by the Soviet Union on October 4, 1957.[24] As the first artificial satellite to orbit Earth, Sputnik 1 signified a major milestone in human history, demonstrating the potential of space technology while simultaneously igniting concerns over the militarization of space and the need for regulatory oversight. The unprecedented nature of space activities raised numerous legal and diplomatic questions regarding sovereignty, jurisdiction, liability, and international cooperation, making the development of a structured legal framework an urgent necessity.[25]

In response to these emerging challenges, the United Nations (UN) took a leading role in the establishment of legal mechanisms to regulate activities in outer space. Recognizing the potential for space exploration to either serve as a source of conflict or a field for peaceful international cooperation, the global community sought to prevent the militarization of space while ensuring equitable access to outer space resources.[26] To facilitate this objective, in 1959, the United Nations General Assembly (UNGA) established the Committee on the Peaceful Uses of Outer Space (COPUOS).[27] This specialized body was created to oversee

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[24] NASA History Office, *Sputnik and the Dawn of the Space Age*, available at: https://history.nasa.gov/sputnik.htm, United Nations Office for Outer Space Affairs (UNOOSA), "*History of Space Law,"*

[25] G.A. Res. 1348 (XIII), "*Question of the Peaceful Use of Outer Space*," December 13, 1958.

[26] Stephen Gorove, "*Developments in Space Law," American Journal of International Law*, vol. 58, no. 3, (1964): 795-809.

[27] United Nations General Assembly Resolution 1472 (XIV), "*International Co-*

discussions on space-related issues, develop regulatory principles, and draft treaties aimed at fostering responsible space exploration.

Over the following decades, COPUOS played an instrumental role in shaping the foundational legal framework governing outer space. Through extensive deliberations among member states, the committee formulated key principles to ensure that space remained a domain of peaceful exploration and scientific advancement, rather than a battle-ground for geopolitical conflicts[28]. This culminated in the drafting and adoption of several landmark international treaties and agreements that continue to serve as the backbone of space law today.

The Outer Space Treaty (OST) of 1967, regarded as the "Magna Carta" of space law, was one of the most significant achievements of early space law development.[29] It laid down fundamental principles such as the prohibition of sovereign claims over celestial bodies, the requirement that space exploration be conducted for the benefit of all humankind, and the explicit ban on placing nuclear weapons or other weapons of mass destruction in orbit[30]. The treaty set the stage for subsequent legal instruments, including the Rescue Agreement of 1968, the Liability Convention of 1972, the Registration Convention of 1976, and the Moon Agreement of 1979, each of which addressed specific aspects of space governance, from the rescue of astronauts to liability for damage caused by space activities.[31]

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operation in the Peaceful Uses of Outer Space," December 12, 1959

[28] Nandasiri Jasentuliyana, "*International Space Law and the United Nations,*" Kluwer Law International, 1999

[29] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 1967 (Outer Space Treaty)

[30] Christopher D. Johnson, "*The Outer Space Treaty at 50*," Secure World Foundation Report, 2017

[31] United Nations Treaties and Principles on Space Law, *UNOOSA*

As space technology evolved and space activities expanded beyond government-led missions, new legal challenges emerged, necessitating further discussions and adaptations to space law. The increasing involvement of private companies in space exploration, satellite deployment, and commercial ventures such as space tourism has introduced additional complexities that existing treaties did not fully anticipate[32]. Consequently, space law continues to evolve, with ongoing international discussions aimed at addressing modern challenges such as space debris mitigation, the commercialization of celestial bodies, and space traffic management.[33]

The historical development of space law demonstrates the International community's recognition of the necessity for a structured legal framework to govern space activities. From its origins in Cold War geopolitics to its expansion in the era of private space exploration, space law remains a dynamic and evolving field. As humanity continues to extend its reach beyond Earth, the role of international cooperation and regulatory mechanisms will be crucial in ensuring that space remains a domain of peaceful exploration, scientific discovery, and shared prosperity for all.[34]

1.2 Key Legal Instruments Governing Outer Space

The governance of outer space activities is primarily structured around a series of international treaties and agreements, collectively forming the foundation of space law. These legal instruments establish fundamental principles aimed at ensuring that outer space explo-

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[32] Frans G. von der Dunk, "*Commercial Space Activities: Trends and Challenges,"* Space Policy, vol. 24, no. 2 (2008): 78-87

[33] International Telecommunication Union (ITU), "Space Debris Mitigation Guidelines" 2007

[34] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), "The Future of Space Governance" 2023 Report

ration remains equitable, peaceful, and sustainable. Over the decades, developments in space technology and international relations have influenced the interpretation and implementation of these legal frameworks. Some of the treaties and conventions in the field are detailed in subsequent sections.

1.2.1 The Outer Space Treaty (1967):

1.2.1.1 Cornerstone of International Space Law

The Treaty on *Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, commonly known as the Outer Space Treaty (OST), serves as the foundational legal framework for international space law. Adopted by the United Nations General Assembly in 1966 and entering into force on October 10, 1967, the treaty has been ratified by over 110 nations and signed by several others[35].

Key Principles and Provisions

a. **Freedom of Exploration and Use**

Outer space is designated as the province of all humankind and must be utilized for the collective benefit of humanity. No nation may restrict another from exploring or utilizing outer space, provided such activities comply with international law prevailing on the subject matter. This principle is enshrined in Article 1 of the Outer Space Treaty (1967).[36]

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[35] United Nations Office for Outer Space Affairs, (1967), *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)*

[36] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205, available at https://20092017.state.gov/t/isn/5181.htm.

b. **Non-Appropriation Principle**

The treaty explicitly prohibits national appropriation of outer space, including celestial bodies such as the Moon and Mars, by any means, including sovereignty claims, occupation, or unilateral declarations of ownership.

c. **Peaceful Purposes and Prohibition of Weapons of Mass Destruction**

States are obligated to conduct space activities exclusively for peaceful purposes. The treaty expressly prohibits the placement of nuclear weapons or any other weapons of mass destruction (WMDs) in Earth's orbit, on celestial bodies, or in outer space.

d. **State Responsibility for National Space Activities**

Governments bear international responsibility for all space activities carried out under their jurisdiction, including those conducted by private entities and commercial organizations. States must ensure that such activities adhere to treaty obligations.

e. **Liability for Damage**

Under the treaty, states assume international liability for any damage caused by their space objects to another country, entity, or individual. This provision establishes accountability for space related incidents.

f. **International Cooperation and Assistance in Outer Space**

The Outer Space Treaty (OST) serves as the foundation for international space law, ensuring that space exploration remains peaceful, cooperative, and beneficial for all humankind. Article IX and Article V of the treaty emphasize the responsibility of nations to prevent harm in space and assist astronauts in distress.

g. **Preventing Harmful Contamination (Clause 1.6.1)**

- Countries must ensure that their space activities do not contaminate celestial bodies (like the Moon or Mars) or disrupt the space environment.
- This includes preventing biological contamination (e.g., bacteria from Earth) and physical damage (e.g., space debris).
- Space agencies follow guidelines, such as those set by the Committee on Space Research (COSPAR), to minimize contamination risks.

h. **Assisting Astronauts in Distress (Clause 1.6.2)**

- The treaty requires nations to help astronauts from any country if they are in distress, whether in space, upon re-entry, or after landing in a foreign territory.
- This reflects humanitarian principles, reinforcing that space exploration should prioritize safety and cooperation over political differences.
- The Rescue Agreement of 1968, an extension of the OST, further details obligations to rescue and return astronauts safely.

As the legal bedrock of space governance, the Outer Space Treaty continues to guide international cooperation, ensuring the equitable, responsible, and peaceful utilization of outer space for present and future generations.[37]

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[37] United Nations Office for Outer Space Affairs (UNOOSA), "*Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*" https://www.unoosa.org, NASA. "*The Outer Space Treaty of 1967,* "https://www.nasa.gov, International Institute of Space Law (IISL), *"Principles of Space Law*" https://www.iislweb.org

1.2.2 The Liability Convention (1972)

The Convention on International Liability for Damage Caused by Space Objects, commonly referred to as the Liability Convention, is a landmark treaty in international space law. It was adopted by the United Nations General Assembly on November 29, 1971, and officially entered into force on September 1, 1972. This convention builds upon the liability principles outlined in the 1967 Outer Space Treaty, creating a comprehensive legal framework for addressing damages caused by space objects. The primary purpose of the treaty is to establish clear legal and procedural mechanisms through which injured parties can claim compensation for damages resulting from space-related activities.

The Liability Convention applies to damage caused by space objects, a term that includes satellites, spacecraft, launch vehicles, and other artificial objects launched into outer space. The convention regulates the liability of launching states, defined as:

- The state that launches a space object,
- The state that procures the launch of a space object,
- The state from whose territory or facility space object is launched.

A space object may have multiple launching states, in which case all involved states bear joint and several liabilities for damages under the convention.

Key Provisions:

a. **Absolute Liability for Damage on Earth and to Aircraft in Flight**

One of the most significant aspects of the convention is the absolute liability imposed on launching states for damage caused by their space objects on the Earth's surface or to aircraft in flight. This means that:

- A launching state is automatically liable for any damage caused by its space object, irrespective of whether the state was at fault.
- The injured party is not required to prove negligence or wrongful intent.
- The liability is unlimited in principle, ensuring full compensation for affected parties.

This provision ensures that nations and private entities affected by falling debris, crashes, or other space-related accidents can receive compensation without the burden of proving fault.

b. **Fault-Based Liability for Damage in Outer Space**

In contrast, if a space object causes damage to another space object or its personnel in outer space, liability is determined based on fault. In such cases:

- The affected state must prove that the launching state was responsible for the damage due to negligence or wrongful action.
- If a space object collides with another in orbit, the party at fault is required to compensate the injured party.
- This approach recognizes the complexities of space operations, where unforeseen accidents may occur due to space debris, mechanical failures, or external forces.

c. **Claims and Compensation Mechanisms**

The Liability Convention provides a structured process for filing claims and seeking compensation:

i. **Filing a Claim:**

- Only a state (not an individual or private entity) may bring a claim against a launching state.
- The claim must be filed within one year from the date the damage occurred or was discovered.
- The claim must be presented through diplomatic channels or via the United Nations Secretary-General.

ii. **Resolution Mechanisms:**

- The convention encourages parties to resolve disputes through diplomatic negotiations first.
- If diplomatic efforts fail, the parties may establish a Claims Commission, an independent body tasked with adjudicating the dispute.
- The Claims Commission's decision may be either binding or advisory, depending on the prior agreement between the involved states.

d. **Relevance and Future Implications**

The 1972 Liability Convention is a cornerstone of international space law, playing a crucial role in ensuring accountability in space activities amid the increasing commercialization of space exploration, including satellite launches, space tourism, and asteroid mining. By establishing clear liability rules, the treaty provides legal certainty for states and private actors, helping to mitigate risks associated with space operations. It imposes absolute liability for Earth-based damages and fault-based liability for damages in outer space, striking a balance between ensuring compensation for affected parties and recognizing the technical challenges of space exploration.

Furthermore, the convention sets a precedent for future legal frameworks addressing emerging challenges such as space debris manage-

ment and liability for private space missions. As space activities become more complex and international cooperation expands, the Liability Convention continues to serve as a foundational treaty, ensuring fairness, responsibility, and compensation in the event of damage caused by space objects. Its principles remain vital in shaping responsible and sustainable space activities as humanity ventures further into the cosmos.[38]

1.2.3 The Registration Convention (1976)

The Convention on Registration of Objects Launched into Outer Space (commonly referred to as the Registration Convention) was adopted by the United Nations General Assembly (UNGA) in 1974 through Resolution 3235 (XXIX) and officially entered into force on September 15, 1976. This treaty was developed as part of the broader framework of international space law to enhance transparency, accountability, and cooperation among nations engaged in space activities. It builds upon the principles established in the Outer Space Treaty (1967) and the Liability Convention (1972) by creating a standardized system for documenting space objects launched into orbit or beyond.

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[38] United Nations, *Convention on International Liability for Damage Caused by Space Objects*, 1972, United Nations Office for Outer Space Affairs (UNOOSA), *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, 1967., Cheng, B., *Studies in International Space Law*, Oxford University Press, 1997, pp. 245-250., Lyall, F., & Larsen, P.B., *Space Law: A Treatise*, Ashgate, 2009, p. 331., United Nations, *Liability Convention*, Article I., Hobe, S., *Pioneering Space: Law and Policy Issues*, Springer, 2015, p. 87., UNOOSA, *The Liability Convention and its Role in Space Law*, 2018., Gabrynowicz, J., *Space Law: Past, Present, and Future*, Routledge, 2019, p. 120., Cheng, B., *General Principles of Space Law*, Oxford University Press, 2005, p. 310., Hobe, S., *Introduction to Space Law*, 3rd ed., Kluwer Law International, 2013, p. 211., Lyall & Larsen, *Space Law: A Treatise*, p. 335., Freeland, S., *Emerging Issues in Space Law*, Cambridge University Press, 2018, p. 149., United Nations, *Liability Convention*, Article IX., Cheng, B., *Studies in International Space Law*, p. 258.

The primary aim of the convention is to ensure effective tracking and identification of space objects by establishing a system for the mandatory registration of space objects, facilitating the exchange of information regarding space objects between states and the United Nations Office for Outer Space Affairs (UNOOSA), and promoting accountability and jurisdictional clarity in case of disputes or liability issues arising from space activities. The convention obligates each launching state to register every space object it sends into orbit or beyond. A launching state is defined as a state that launches or procures the launch of a space object or a state from whose territory or facility a space object is launched. If multiple states qualify as launching states, they must decide among themselves which one will be responsible for the registration.

1.2.3.1 National and International Registry Systems

Each contracting state is required to establish and maintain a national registry of all space objects launched under its jurisdiction. The launching state must also submit relevant information to the United Nations Secretary-General, who oversees the international registry of space objects.

1.2.3.2 Information Disclosure Requirements

The registration must include specific details about the space object, such as:

a) Name and identifier of the space object.
b) Launching state(s) responsible for the launch.
c) Date and location of the launch (including launch facility).
d) Orbital parameters, including nodal period, inclination, apogee, and perigee.
e) General function or purpose of the space object.

If there are significant modifications or changes to the orbital parameters, states are encouraged to update their registry accordingly.

The United Nations plays a crucial role in fostering international cooperation in space activities, ensuring transparency and accountability through its registry of space objects, maintained and published by the Secretary-General. This registry serves as a public document, allowing states and organizations to track space objects, thereby promoting responsible conduct in outer space. Additionally, international conventions under the UN framework encourage collaboration among nations, particularly in addressing legal disputes or risks posed by space objects, such as damage or interference with other missions. By facilitating dialogue and cooperation, the UN helps uphold the principles of peaceful and sustainable space exploration

1.2.3.3 Significance and Impact of the Registration Convention

a. **Enhanced Space Governance:**

The convention strengthens legal frameworks for regulating space activities and provides a clear record of space assets, minimizing disputes over jurisdiction and ownership.

b. **Liability and Damage Resolution:**

Maintaining a comprehensive registry helps in identifying responsible parties in cases of space debris, satellite collisions, or damages caused by falling space objects.

c. **Transparency and Trust in Space Operations:**

The obligation to disclose information ensures that space-faring nations operate openly and responsibly, preventing secrecy in military or commercial space activities.

d. **Space Traffic Management and Sustainability:**

As the number of satellites and space missions continues to grow, the convention plays a crucial role in tracking and managing orbital congestion, reducing the risks of space debris and potential conflicts.

e. **Challenges and Limitations**

Despite its significance, the Registration Convention faces certain challenges in modern space governance:

- **Non-compliance and Gaps in Reporting:** Some countries fail to register all space objects, especially small satellites and private-sector launches.
- **Limited Enforcement Mechanism:** There are no strict penalties for non-compliance, making it difficult to enforce adherence.
- **Rise of Private Space Entities:** With private companies like SpaceX, Blue Origin, and OneWeb playing a dominant role in space launches, new mechanisms are needed to ensure corporate compliance with the registration process.

The Registration Convention (1976) remains a cornerstone of international space law, ensuring that space objects are documented and traceable, thereby reducing legal uncertainties in outer space activities. However, with the increasing complexity of space operations, there is a growing need to modernize the treaty to address emerging challenges such as commercial space ventures, mega-constellations of satellites, and space traffic management. Strengthening compliance mechanisms and encouraging wider participation will be essential in maintaining peaceful, responsible, and sustainable use of outer space.[39]

[39] United Nations General Assembly, Resolution 3235 (XXIX), Convention on Registration of Objects Launched into Outer Space, 1974, Treaty on Principles Governing the Activities of States in the Exploration and Use of