SATELLITES TO SPACE TOURISM: EXPANDING HORIZONS OF SPACE LAW

Dr. Mousumi Kalita, Assistant Professor of Law, Faculty of Law, ICFAI University, Tripura

ABSTRACT

The legal environment around space activities is changing due to the quick development of satellite technology and the rise of space tourism. Space operations, which were formerly controlled by state-centric frameworks under international space law, are now more and more influenced by commercial innovation, private actors, and citizen involvement. This article explores the relationship between space tourism and satellites, emphasizing how satellites facilitate commercial human spaceflight through navigation, communication, safety, and regulatory control. It examines current international legal frameworks, including the Registration Convention, the Liability Convention, and the Outer Space Treaty, and assesses how well they handle contemporary issues raised by private space tourism endeavours. The article delves deeper into unresolved legal concerns such as space traffic management, insurance requirements, liability for space tourists, jurisdiction, and the long-term viability of orbital ecosystems. The report makes the case for modernizing and harmonizing space law to balance innovation, safety, and the peaceful use of space by evaluating both national and international regulatory methods. In the end, the growth of satellites and space travel marks a turning point for space law, necessitating flexible legal structures that can accommodate humanity's growing presence beyond Earth.

Keywords: Space Law; Satellites; Space Tourism; Commercial Spaceflight; Outer Space Treaty; Private Space Activities; Liability in Space; Space Governance; Emerging Technologies.

Objective of the Paper

- To examine how satellites play a technological role in space tourism, including orbital management, safety monitoring, communication, and navigation.
- To assess the suitability and sufficiency of current international space law instruments, such as the Registration Convention, Liability Convention, and Outer Space Treaty, in governing satellite-assisted space tourism.
- To evaluate the legal obligations and liabilities of public and commercial entities engaged in satellite operations that facilitate space travel.
- To assess the effects of national laws controlling commercial space operations on satellite-based space tourism businesses.
- To determine new legal issues resulting from the expansion of space tourism that are connected to data privacy, orbital congestion, space traffic management, and passenger safety.
- To draw attention to the ambiguities and regulatory inadequacies in the current space law pertaining to the use of satellites for commercial human spaceflight.

Introduction

The Dawn of a New Space Age

The "Dawn of the New Space Age" refers to an era highlighted by a rebirth of space exploration and commercialization, driven by private firms and technological improvements, following a period dominated by government-led missions. This new era is marked by improved accessibility, innovation, and an emphasis on sustainable development in space.

On October 4, 1957, the Soviet Union launched Sputnik 1, the first artificial satellite ever put into orbit, ushering in the Space Age. The Space Race between the US and the USSR began with this event, which resulted in significant advancements in science, technology, and politics.

Since scientists anticipated that solar activity cycles would be at their peak around that time, the International Council of Scientific Unions voted in 1952 to designate July 1, 1957, to December 31, 1958, as the International Geophysical Year (IGY). The council passed a resolution in October 1954 requesting that artificial satellites be launched to study the Earth's surface during the IGY.

The White House requested ideas from different government research institutes to carry out construction of the IGY's Earth-orbiting satellite in July 1955. The Vanguard proposal from the Naval Research Laboratory was selected in September 1955 to represent the United States in the IGY.

Everything changed with the launch of Sputnik. Sputnik was a technical marvel that surprised the American public and the rest of the planet. It was larger than the 3.5-pound payload Vanguard had planned. Furthermore, the public was concerned that the Soviet Union's capacity to launch satellites would also confer the ability to launch ballistic missiles capable of transporting nuclear weapons from Europe to the United States. The Soviets next launched Sputnik II on November 3 with a significantly heavier payload, which included a dog named Laika.

In response to the political uproar following the October launch of Sputnik I, the U.S. Defence Department authorized financing for a second U.S. satellite project. Wernher von Braun and his team at Army Redstone Arsenal started working on the Explorer project as a concurrent alternative to Vanguard.

The tide turned on January 31, 1958, when Explorer I was successfully launched by the United States. Named for lead investigator James Van Allen, this spacecraft carried a tiny scientific payload that ultimately led to the discovery of the magnetic radiation belts surrounding the Earth. As a successful ongoing series of small, practical spacecraft for science, the Explorer program went on.

Additionally, the National Aeronautics and Space Administration (NASA) was directly created because of the Sputnik launch. The National Aeronautics and Space Act (also referred to as the "Space Act") was passed by Congress in July 1958, establishing NASA from the National Advisory Committee for Aeronautics (NACA) and other government organizations on October 1, 1958[1].

[1] https://www.nasa.gov/history/sputnik/index.html.

Since the Union of Soviet Socialist Republics (U.S.S.R.) launched Sputnik, the first artificial satellite to orbit the Earth, on October 4, 1957, we humans have been exploring space. This took place during the Cold War, a time of intense animosity between the USSR and the US.

With the launch of Sputnik, the Cold War entered a new arena: space. One less violent facet of the Cold War, the frequently fatal conflict between the US and the USSR, was the space race, a contest for prestige and spectacle. The project was an attempt to gain the support of possible nonaligned countries via soft power. The term "Third World" was used to refer to nonaligned countries; today, it is considered derogatory.[2]

The two countries have been vying for years to create intercontinental ballistic missiles (ICBMs), which are missiles that can transport nuclear warheads from one continent to another. The space race was started in the USSR by Sergei Korolev, a rocket designer who created the R7, the first ICBM. With the launch of Sputnik, this tournament gained international attention. The Sputnik satellite was launched on a R7 rocket and used a radio transmitter to emit audio beeps.

Once in orbit, Sputnik circled the planet once every ninety-six minutes. People all throughout the world realized Sputnik was indeed in orbit when they heard the radio beeps on the ground as the satellite went overhead. The U.S.S.R. outperformed the U.S. in space, which shocked the U.S.

Before successfully launching a satellite named Explorer into orbit on January 31, 1958, the United States made two unsuccessful attempts to do so. In order to perform scientific research, the explorer brought a number of instruments into space. A Geiger counter for cosmic ray detection was one of the instruments. This was for an experiment run by researcher James Van Allen, which demonstrated the existence of what are now known as the Van Allen radiation bands encircling Earth when combined with readings from subsequent satellites.

German rocket engineers who had previously created ballistic missiles for Nazi Germany made up a substantial portion of the crew that successfully launched the first American satellite. Wernher von Braun, who had spearheaded the development of Germany's V2 rocket, oversaw the German rocket experts that worked for the U.S. Army at the Redstone

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[2] https://education.nationalgeographic.org/resource/history-space-exploration.

Arsenal in Huntsville, Alabama. The more potent Jupiter C, or Juno, rocket was constructed by his team using the V2. Up until 1970, von Braun oversaw the Marshall Space Flight Center in Huntsville, Alabama, which was the centre of the American rocket program.

To enhance their rocket projects, the US and the USSR rushed to hire German rocket engineers and scientists at the end of World War II. Both countries were driven by the desire to advance their military technologies. Instead of working for the Soviets, von Braun and most of his top subordinates sought out American forces to surrender to. In what became known as Operation Paperclip, the German experts were moved to the United States along with some of their weapons and designs.[3]

The National Aeronautics and Space Administration (NASA), a new government organization, was created to oversee space exploration efforts in the United States. NASA took over the National Advisory Committee for Aeronautics (NACA) and a number of other military and research establishments, including the Army Ballistic Missile Agency (formerly known as the Redstone Arsenal) in Huntsville, Alabama, when it first started operations in October 1958.

The rocket family that would serve as the foundation for the initial successful launches and even the still-in-use Soyuz was based on Korolev's R7. Rival teams in the Soviet space program developed conflicting designs.

Von Braun's impact went well beyond the realm of space enthusiasts and rocket scientists. After appearing in three space-themed TV programs created by Disney in the middle of the 1950s, he rose to fame. In the meantime, von Braun's government mainly concealed the accomplishments and involvement of his Soviet colleague, Korolev.

Both Korolev and von Braun shared a desire and commitment to exploring space, even though their governments preferred using rocket technology for military applications.

Even though Korolev drove the Soviet Space program's early successes, he became a victim of one of Soviet Premier Josef Stalin's political purges and was recalled from prison to head the rocket development program in 1944. After learning of the United States' plan to launch an artificial satellite into space, it was Korolev who convinced and pushed the U.S.S.R.

[3] ibid

government to beat the U.S. in this endeavor, building the N1 rocket.

The U.S.S.R.'s win streak didn't end there. A month after Sputnik's launch, on November 3, 1957, the U.S.S.R. achieved an even more impressive space venture. This was Sputnik II, a satellite that carried a living creature, a dog named Laika.

The first human in space was Soviet cosmonaut Yuri Gagarin, who made one orbit around Earth on April 12, 1961, on a flight that lasted 108 minutes. A little more than three weeks later, NASA launched astronaut Alan Shepard into space, not on an orbital flight, but on a suborbital trajectory, a flight that goes into space but does not go all the way around Earth. Shepard's suborbital flight lasted just over 15 minutes.

Under Korolev's direction, the U.S.S.R. accomplished several space milestones before the United States, including the first artificial satellite, the first dog in space, and the first human in space. Luna 2, the first man-made object to land on the moon in 1959, was one of these landmarks. Soon after, Luna 3 was launched by the USSR. A second Soviet human mission orbited a cosmonaut around Earth for a whole day less than four months after Gagarin's 1961 voyage. Valentina Tereshkova became the first woman to travel to space when the U.S.S.R. launched the Vostok 6 mission and accomplished the first spacewalk[4].

To send a cosmonaut to the moon, Korolev was preparing the USSR. The space race's ultimate objective was to send a person to the moon. "I believe that this nation should commit itself to achieving the goal, before the decade is out, of landing a man on the moon and returning him safely to Earth," said U.S. President Robert F. Kennedy on May 25, three weeks after Shepard's flight, setting an ambitious goal for the country.

Through a program dubbed Project Gemini, NASA advanced John F. Kennedy's objective of a human landing on the moon in the 1960s. During this program, astronauts tested both their own endurance for extended spaceflight and the technology required for future trips to the moon.

Project Apollo, which took place between 1968 and 1972, succeeded Project Gemini in sending humans into orbit around the moon and to the lunar surface.

[4] ibid

Neil Armstrong became the first person to set foot on the moon when the United States launched the first astronauts there on Apollo11 in 1969. To learn more about the Moon, scientists continue to examine samples of rocks and lunar dust that astronauts obtained during the landing missions. The Soviet program started to deteriorate as the U.S. manned space program grew. Attempting to send a human to the moon caused internal conflict. The fact that Korolev died in 1966 following a botched surgery was possibly more significant. Both the Russian Federation and the United States maintain ongoing space projects today.

Early Space Law: The Legacy of the Outer Space Treaty (1967)

The Outer Space Treaty of 1967, which was created during the Cold War to guarantee the exploration and use of space for peaceful purposes and for the benefit of all nations, is the fundamental legal framework of international space law. It serves as the foundation for later space law agreements and forbids the deployment of weapons of mass destruction (WMD) in space, preventing an arms race.

With historic events including the first weather satellite launch in 1960, the first human in space (Yuri Gagarin, 1961), and the first moon landing (Neil Armstrong, 1969), the 1960s were a pivotal decade for space exploration.

The first of several international space accords, the Outer Space Treaty, was negotiated and ratified by the UN during this decade. The treaty established the framework for international space law and was ratified in 1967 by the three main spacefaring nations at the time: the US, the UK, and the former USSR.

Following the launch of Sputnik 1 in 1957, at the height of the Cold War, nations realized they needed a worldwide legal framework to handle the special potential and problems of space exploration, with the goal of ensuring "the use of outer space for peaceful purposes." The framework highlights international cooperation in space security and asserts that space exploration should benefit all people[5].

The Legal Subcommittee examined the Outer Space Treaty in 1966, and the General Assembly agreed that same year (resolution 2222 (XXI)). Despite a few new clauses, the Treaty was mostly based on the Declaration of Legal Principles Governing the Activities of States in

[5] https://www.un.org/en/peace-and-security/international-space-law-explained

the Exploration and Use of Outer Space, which the General Assembly had adopted in its resolution 1962 (XVIII) in 1963. The three depository governments—the United States, the United Kingdom, and the Russian Federation—opened the treaty for signature in January 1967, and it became operative in October of the same year. The following principles are part of the fundamental basis for international space law provided by the Outer Space Treaty:

The treaty lays out several fundamental guidelines that still apply to space operations[6]:

- The exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind.
- Outer space shall be free for exploration and use by all States.
- Outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.
- States shall not place nuclear weapons or other weapons of mass destruction in orbit or on celestial bodies or station them in outer space in any other manner.
- The Moon and other celestial bodies shall be used exclusively for peaceful purposes.
- Astronauts shall be regarded as the envoys of mankind.
- States shall be responsible for national space activities, whether carried out by governmental or non-governmental entities.
- States shall be liable for damage caused by their space objects; and
- States should avoid harmful contamination of space and celestial bodies.

Following are some other international space Treaties[7]

1967: The Outer Space Treaty: The cornerstone of international space law, the Outer Space Treaty, forbids the use of weapons of mass devastation in space, restricts the use of celestial bodies to peaceful purposes, and requires that space be freely explored for the benefit

[6] https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html
[7] Ibid

of all nations. The 17-article pact also holds countries accountable for harm caused by their space objects and prohibits claims of state sovereignty over celestial bodies or outer space. The pact has 115 parties as of March 2024, including all the main spacefaring states.

1968: The Rescue Agreement: Articles 5 and 8 of the Outer Space Treaty are expanded upon in the 1968 Rescue Agreement. It requires nations to do all within their power to save and help astronauts in need and get them back to their country of launch. Additionally, it states that nations must help retrieve and return space items that fall outside of the launching nation's borders upon request.

1972: The Liability Convention: Article 7 of the Outer Space Treaty is expanded upon in 1972 by the Liability Convention, which holds launching governments fully liable for harm their spacecraft due to aviation or the Earth's surface.

1976: The Registration Convention: Countries must register their orbiting space objects with the UN under the Registration Convention. Access to the data submitted by nations and international intergovernmental organizations is ensured by the UN Secretary-General's maintenance of this registry.

1984: The Moon Agreement: The Moon Agreement of 1984 forbids environmental disturbance and mandates that the Moon and other celestial bodies be used only for peaceful purposes. It proclaims the Moon and its natural resources to be the shared heritage of all people and mandates that nations notify the UN of the location and intent of any stations built on these bodies.

Technological developments made it necessary to create legal declarations and principles to uphold the previous treaties. These agreements, which were negotiated between 1982 and 1996, covered a wide range of technological topics, including nuclear power in space, space debris prevention, and television broadcasting.

Rarely will a treaty go into great detail about a technical issue. In addition to the treaties, COPUOS Member States more frequently create technical standards or guidelines. They are non-binding agreements that take on legal force after they are enacted nationally, Hoffmann says.

Satellites and Communication: The First Legal Challenges

It is well acknowledged that telecommunications services and infrastructure are essential for a nation's socioeconomic and cultural advancement. Telecommunications "are an essential aspect of the national and international development process; they are not just the result of economic growth but also a prerequisite for overall development." A third of the world's population continues to increase their communications needs, but roughly two-thirds lack sufficient access to basic telecoms. This suggests that a significant global telecommunications expansion is required.

Consequently, the market for telecom services and equipment may be very large. Unquestionably, satellites are the most effective way to quickly expand telecommunications, especially for thin-route traffic, mobile, and broadcasting services. The use of satellites is and will continue to grow due to their special benefits. However, the availability of the two essential instruments for satellites—orbital positions and radio frequencies, or electromagnetic spectrum—will have a significant impact on the extent of that expansion.

In addition to increasing the likelihood of satellite interference, the growing reliance on satellites for military purposes and the rapidly growing number of commercial satellite operators' demand for geostationary orbital (GEO) slots and radio frequencies result in a shortage of available slots and spectrum. For instance, radio interference is now a significant issue that is only going to get worse. Military installations are becoming concerned about interference, and commercial satellite enterprises are experiencing trouble as a result of rising operating costs.[8]

The globe is commemorating the 50th anniversary of the space age's beginning in 2007, which has ushered in a new era with enormous promise for human advancement. At the same time, growing space activities are producing man-made space pollution, especially space debris, which raises the cost and risk of using outer space. Most people agree that space debris is a significant issue.2 Space debris fragments "move at speeds exceeding 22,000 miles per hour (or 35,000 kilometres per hour)." Even little debris can destroy a satellite or tear holes in a spacecraft at such high speeds.3There is no reliable defence against such catastrophic energy for any spacecraft. Anti-satellite (ASAT) test-generated space debris will be a serious threat to

[8] Jakhu Ram, "LEGAL ISSUES OF SATELLITETELECOMMUNICATIONS, THE GEOSTATIONARYORBIT, AND SPACE DEBRIS".

commercial and civilian spacecraft and may prevent everyone from accessing space. In this sense, it becomes essential.

In addition to more general issues of state sovereignty, culpability for damages, and national authorization of commercial space activities, the initial legal problems pertaining to satellites and communication mostly concerned radio frequency interference and the distribution of restricted orbital slots. With the advent of the space age, particularly with the 1957 launch of Sputnik, these difficulties surfaced.

Key early Legal Challenges include:

Radio Frequency Interference: Controlling the few available radio frequencies to avoid detrimental interference between various satellite systems and between satellite and terrestrial communication networks was one of the most pressing practical issues. To assure effective and non-interfering use, the International Telecommunication Union (ITU) came to play a crucial role in assigning the radio frequency spectrum and coordinating the use of geostationary orbital slots among governments.

Comparing "Province of all Mankind" with National Sovereignty: Fundamental problems concerning the boundaries between national airspace and outer space were brought up by the first satellite launches. Outer space is "not subject to national appropriation by claim of sovereignty" and should be used for the "benefit and in the advantage of all countries," according to the 1967 Outer Space Treaty, which treats it as a global common.

State Liability and Responsibility: It was first decided that states, whether they are run by governmental or non-governmental organizations, are internationally liable for all national space operations. This resulted in the Liability Convention of 1972, which stated that a launching state is fault-based liable for harm in space and completely liable for damage caused by its space objects on the surface of the Earth or to aircraft in flight.

Permission and Monitoring: National space laws and licensing regimes were developed because of the legal framework's requirement that states permit and regularly monitor the space operations of their private enterprises.

Data and Signal Regulation: As satellite technology developed to enable Earth observation and direct broadcasting, new problems with data privacy and the control of content sent across national borders (such as "landing rights" for satellite services in other nations) emerged.

The 1967 OST, which outlines the allocation regime for resources in the space domain, eventually solidified the legal ideas that formed the foundation of the international space law regime in the early 1960s. It is crucial to remember that this regime was implemented at the beginning of the space era, when there was a lot of ambiguity surrounding the possible future use of space. Because of this, the regime—despite Article IV—is generally permissive in scope, with a strong emphasis on developing general guidelines that can direct states' space operations in a way that lessens the likelihood of conflicts between and among state actors[9]. All resources in space are handled equally under the highly generalized allocation regime that results from the lack of differentiation between different resources, which is not without its drawbacks. The two main tenets of this regime—free access and non-appropriation—are found in the OST.

Article II OST, which declares that "Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means," contains the non-appropriation concept. Article II's meaning in relation to the exploitation of material resources on celestial bodies is a topic of intense debate (see, for example, de Man, 2016), but its application to orbital resources is far less contentious. This is because Article II's primary impact is to legally establish outer space as a global common, which essentially means that it exists outside of state borders. Therefore, although states may have jurisdiction over things, people, and activities in space, this jurisdiction is not "territorial" in nature (see generally Blount, 2007; von der Dunk, 2015). As a global common, space resources will be administered according to state-established rules of international law. As previously said, governments create regimes on an as-needed basis depending on the specific global commons and the resource in issue; there are no standard guidelines controlling the usage of resources in global commons. The section on coordination will cover these guidelines.

Article I OST's open access policy complements the non-appropriation principle. According to this article, "All States should have the freedom to explore and utilize outer space, including the moon and other celestial bodies, without any form of discrimination, on an equal footing and in compliance with international law." The utilization of space is distributed across

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[9] Blount P.J, "Legal Issues Related to Satellite Orbit"

all states by this provision. The term "use" is crucial since it suggests that governments do have the authority to take use of space resources. As a result, all nations have unfettered access to resources, which are components of space. This access shall be granted based on "equality," according to the following clause. Here, equality relates to the concept of non-discrimination, which holds that all states have an equal right to acquire these resources, rather than equal allocation[10]. The use of space "shall be carried out for the benefit and in the interests of all countries," according to Article I. This puts some responsibility on the states to make sure that space uses result in "benefits" for everyone, but it stops short of a formal benefit sharing regime wherein an actor's gains are distributed to all states. Resolution 51/122 of the UN General Assembly, which affirms that "States are free to select all aspects of their engagement in international cooperation," provided confirmation of this (United Nations General Assembly, 1996).

Liability in Outer Space: Who Bears Responsibility for Accidents?

According to the 1972 Convention on International Liability for Damage Caused by Space Objects, the state that launches a space object bears primary responsibility for any harm it does. Liability is based on fault for damage that occurs in space and can be absolute for damage to aircraft or on Earth. Every state that takes part in a joint launch is accountable both jointly and severally.

Who has responsibility for mishaps?

The state of launch: The nation that launches an object into space is held internationally responsible for any harm the object causes to planes in flight or to the Earth's surface. Liability for space damage: Due to its negligence, the launching state is responsible for any harm its space objects cause in space.

combined launches: Any damage resulting from the combined launch of a space object by two or more states is their joint and several liability. This implies that any one of the launching states may be sued for the entire sum of damages. What does this entail for private individuals and businesses? National accountability: All space activities, even those carried out by private businesses, must be authorized and overseen by a nation. State-to-state claims are required: Under the Liability Convention, a state must file a claim for damages against another

[10] Id

state. In contrast, individuals or businesses may file direct lawsuits against one another in national legal systems.

There are several issues with liability for damages in the space industry. First, identifying the most suitable (or even any) accountable entity or entities can already be difficult. This is partially because of the flaws in the international law of space's legal framework. The five U.N. space accords were drawn up in the 1960s and 1970s, when it was difficult to envision the demands of the contemporary space industry. Determining the cause of damages that occur in space—possibly tens of thousands of kilometers away from Earth—can [11]likewise be challenging. The fact that several "launching states" may be equally liable for compensation under the 1972 Convention on International Liability for Damage Caused by Space Objects (henceforth referred to as the Liability Convention)[12] may cause further issues.

The current international regulation of responsibility in space activities presents several issues from an economic perspective. One of these is that, in accordance with the Liability Convention, multiple "launching states" may be involved in a single harmful incident, each of which is equally accountable for damages. Insurance coverage may overlap as a result. Clearly, "too much" insurance is typically preferable than none, at least from the victim's perspective. However, this is not at all ideal from the perspective of insurance markets. Furthermore, the convention's broad definition of a launching state may lead to unfair liability consequences.

Liability issues in the space industry are numerous and encompass a range of legal and policy facets. While some are more recent, others have known each other for decades. Many of them have one thing in common: they center on issues of great economic significance. These are the main topics of this essay. The essay will first briefly discuss why an enhanced liability system is becoming increasingly necessary from an economic standpoint in the pages that follow space industry. Next, the flaws of the current international liability regime for space operations are evaluated. After that, the article will move on to the topic of nuclear liability, which might be used as a template for a better liability system for the space industry[13].

The current international regulation of responsibility in space activities presents a

[11] Convention on International Liability for Damage Caused by Space Objects, Nov. 29, 1971, 961 U.N.T.S. 187
[12] The term "launching state" includes "(i) A State which launches or procures the launching of a space object; (ii) A State from whose territory or facility a space object is launched". See Convention on International Liability for Damage Caused by Space Objects, art. I.c
[13] Vikkari Lotta "A New Liability Regime for the Space Sector – an Economic Imperative Economic Imperative".

number of issues from an economic perspective. One of these is that, in accordance with the Liability Convention, multiple "launching states" may be involved in a single harmful incident, each of which is equally accountable for damages. Insurance coverage may overlap as a result. Clearly, "too much" insurance is typically preferable than none, at least from the victim's perspective. However, this is not at all ideal from the perspective of insurance markets.

Furthermore, the convention's broad definition of a launching state may lead to unfair liability consequences. However, the definition is still ambiguous enough to make it difficult to determine whether states qualify as liable launching states in many situations. Furthermore, the potential harm caused by space operations surpasses the ability of any one spacefaring company to compensate. Damage can be significant, especially if nuclear power sources are used.

For example, radioactive materials from defunct satellites can have catastrophic effects if they fall into the atmosphere and reach heavily populated parts of the Earth. Absolute and limitless liability (as now defined by the Liability Convention for damage occurring on Earth) would directly increase the costs of space activities and hence restrict the growth of the space sector, even in the case of less serious incidents. Additionally, it can make activities that are intrinsically dangerous uninsurable. Furthermore, from the standpoint of space-faring entities, the victims' secure position may occasionally be unduly powerful.

Militarization vs. Peaceful Use: Security Dimensions of Space Law

The responsibility Convention provides a fault responsibility scheme for losses that occur in space. There are many legal and economic issues with this approach, which eventually call for a more workable responsibility framework. When it comes to space-related mishaps, the current system can cause extremely significant damage. It can be difficult to allocate obligations among the several states involved, and it may even result in unjust or somewhat random conclusions.

Additionally, the Liability Convention's standards for calculating compensation are quite vague, as is the characterization of damages that require compensation. Furthermore, the current international space liability regime does not cover damage to the environment of the global commons, any activity involving a mere risk of damage, or harm to citizens of the launching state or foreign nationals taking part in space operation. It may be impossible to establish the blame and/or the necessary causality, even in rather clear examples of compensable damage.

International treaties, agreements, decisions of the United Nations General Assembly, and rules and regulations of international bodies make up the complex structure of space law that governs activity in space. The Outer Space Treaty (OST) of 1967 and other important agreements will be examined to lay out the worldwide legal foundation of space law. Beyond this legal framework, the research investigates the militarization of space, examining the relationship between space law and the changing military operations occurring in space.

Five international treaties and five sets of rules governing space make up the core legal foundation of space law. The UN Committee for Peaceful Uses of Outer Space (UNCOPUS) papers and resolutions of the UN General Assembly (UNGA) also function as auxiliary tools for interpreting and implementing these principles and treaties. Space law also includes elements of customary international law (Xinmin, 2014)[14].

The 1967 Outer Space Treaty (OST), the foundational legal document sometimes referred to as the "Magna Carta of space," serves as the foundation for the current system (Johnson-Freese & Burbach 2019). Importantly, the OST requires parties to use the Moon and other celestial bodies for peaceful purposes. However, because space technology can be used for both military and civilian purposes, the term "peaceful purposes" is ambiguous (Johnson-Freese & Burbach 2019)[15].

Additionally, the treaty forbids the stationing of nuclear weapons or other WMDs in orbit, on the Moon, or on other celestial bodies. Notably, the OST expressly forbids the testing or use of WMDs, except for the Moon and other solid bodies, where no state has shown a desire to do so. However, it does not forbid the weaponization of space. This may be related to the fact that the treaty forbids claims of sovereignty over the Moon, requires representatives of other states to have unrestricted access to space installations and vehicles, and holds states accountable for harm caused by objects launched from their territory.

India has been showcasing its strong belief in the enormous potential of using space for peaceful purposes through a variety of space-based services and applications for social and

[14] Gloria Bertasini & Cecilia Rosa Yanez, “Legal Dimensions of the Militarization of Space: An Examination of International Space Law”
[15] ibid

national goals. India has been actively involved in the creation of several international treaties pertaining to space law in UN committees. Since the UN treaties on space law do not specifically prohibit such applications, India and most other countries have been employing space systems for national security objectives.

However, India is adamantly against any attempt to launch weapons into space or to test unconventional weapons there because doing so would constantly endanger all space systems, whether they are used for military or civilian objectives. India is keeping a close eye on global events and the efforts of a few nations to create legislation to stop any space arms race. At the proper moment, suitable actions would be taken without jeopardizing our country's interests[16].

The commercialization of space has completely changed the industry, transforming it from a domain controlled by governmental organizations into a vibrant marketplace propelled by private investment and innovation. This change has led to much lower launch costs, more space access, and the development of new business ventures like tourism, satellite services, and future resource extraction.

Commercialization of Space: Private Players Enter the Arena

The commercialization of space represents a dramatic change from the conventional government-led approach (such as NASA and ISRO) to one in which private businesses play a major role. Driven by an entrepreneurial spirit and an emphasis on profitability and innovation, this "New Space" period has fundamentally changed the space industry.

Important Private Participants and Activities

Through a variety of initiatives, large private corporations are spearheading this change:

SpaceX: With its emphasis on reusable rocket technology (Falcon 9 and Falcon Heavy), SpaceX (founded by Elon Musk) has transformed the industry and significantly lowered launch costs. Additionally, SpaceX runs the Starlink satellite network for worldwide broadband internet and offers NASA crew and cargo transportation services to the International

[16] Government Of India Ministry Of Space Lok Sabha Unstarred Question No. 369 Answered On 23.02.2011

Space Station (ISS). Deep space trips to the Moon and Mars are the goal of the Starship program[17].

Blue Origin: Jeff Bezos founded Blue Origin, which is creating reusable launch vehicles, such as the future New Glenn rocket for orbital missions and the New Shepard rocket for suborbital space tourism and scientific research. Additionally, Blue Origin works with NASA on lunar lander programs.

Virgin Galactic: Virgin Galactic, founded by Richard Branson, aims to make space tourism a reality by providing passengers with a unique view of Earth and the experience of weightlessness through suborbital flights utilizing its SpaceShipTwo aircraft.

Rocket Lab: With its Electron rocket, Rocket Lab specializes in offering frequent and affordable launch services for small satellites.

Axiom Space: With plans to construct a commercial space station in Low Earth Orbit (LEO), Axiom Space is a pioneer in the private space station industry.

Relativity Space: To increase production speed and efficiency, Relativity Space is creating 3D-printed rockets and engines.

One of the few countries in the globe to rule the space arena is India. India has accomplished a remarkable feat in space exploration for a developing country. India makes up barely 2% of the world's space economy, despite being a space-faring nation. India's space industry accomplishments lag behind those of nations like the United States and China, which contribute more to the $447 billion global space economy. India's space industry is largely under government control, which explains why it only has a little portion of the world's space economy.[18]

Through its national space agency, ISRO (Indian Space Research Organisation), which operates under the auspices of the Indian Department of Space, the Indian space program,

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[17] https://www.google.com/search?q=6.

[18] Rabindra Jhunjhunwala†, Roshnek Dhalla and Dnyaneshwari Chincholikar, “FDI in Space: India Opens its Space Arena to Foreign Investment” Cite as: 2022 SCC OnLine Blog Exp 23...https://www.scconline.com/blog/post/2022/03/16/fdi-in-space-india-opens-its-space-arena-to-foreign-investment/

which was initiated in the 1960s, has changed the space domain. ISRO has operated and regulated space activities for almost 50 years under the Department of Space administration. Private businesses' engagement has been hindered by the statutory bodies' acquisition of total control over the Indian space sector. Recognising the value of working with private foreign companies, the Indian government has declared its plan to allow foreign direct investment in the country's space industry.[19]

IN-SPACE will be the organization in charge of facilitating foreign investment in the space sector and will offer a one-stop shop for international firms to access the Indian space industry in order to guarantee successful cooperation between Indian and foreign players. Investing in the Indian space domain has many advantages for international investors:...

Cost-effective: In comparison to its competitors like NASA, India has far lower operating costs for establishing bases and launching spacecraft. The statement made by Indian Prime Minister Narendra Modi about the Indian expedition to Mars costing less than the entire budget of the Hollywood film Gravity perfectly captures the affordable character of Indian space ambitions.

Outstanding success rate: Currently ranked as the sixth largest space agency globally, ISRO has an outstanding success rate. By successfully launching roughly 342 (three hundred and forty-two) foreign satellites from more than 34 (thirty-four) countries, India has established a reputation for itself.

Innovative equipment: ISRO has state-of-the-art equipment and is working with private companies to launch SSLVs (small satellite launch vehicles). This will give international companies more opportunities to collaborate with the Indian space industry.

Liberalized space sector: ISRO has developed solid ties with many businesses over the years, which will help international companies looking to establish operations in India.

Space Tourism: From Fiction to legal Reality

From being a topic of science fiction, space tourism has developed into a real economic sector led by private firms like Virgin Galactic, SpaceX, and Blue Origin. Due to the fact that

[19] Ibid

current international space law, which was mainly created for state-led missions, is frequently insufficient for private commercial endeavors, this shift has required the creation of new legal and regulatory frameworks.

Space tourism, which was formerly limited to the world of vivid fantasies and science fiction books, is now more than just a pipe dream. It's quickly becoming a concrete reality. This blog explores this innovative journey, tracing its beginnings and examining its developing present and bright future. Civilians are now able to enter a domain that was previously only accessible to elite astronauts and cosmonauts, which represents a fundamental change in how mankind perceives and enters the last frontier. At this critical juncture, anyone with the aspiration and resources to pursue the stars might find the pull of orbit, not just the select few.

Indeed, the creators of science fiction sowed the seeds of space tourism. In addition to envisioning everyday space flight, Arthur C. Clarke's "2001: A Space Odyssey" and other classics also alluded to the potential for advanced space stations and extraterrestrial contacts. The public was captivated by these stories, which paved the way for aspirations in the real world.

With government-led space initiatives, space exploration started to move from fiction to reality. The space race of the Cold War era, which was mostly between the US and the USSR, produced historic accomplishments like the Apollo moon landing and satellite launches. These late 20th-century turning points established the fundamental technology and body of knowledge for upcoming space travel.

The field of space exploration experienced a dramatic change as the twenty-first century got underway. The traditional realm of government agencies was challenged by the emergence of private corporations as major participants. Businesses like SpaceX, created by Elon Musk in 2002, and Blue Origin, founded by Jeff Bezos in 2000, started making significant investments in creating new, more affordable means to access space.[20] This change represented a shift away from nationalistic and scientific endeavors and towards a wider range of objectives, such as private exploration and commercial tourism.

The International Space Station (ISS), an international cooperative project, was also

[20] https://www.drishtiias.com/blog/space-tourism-from-sci-fi-dreams-to-reality

developed during this time. The International Space Station (ISS) is a symbol of global cooperation in space as well as a center for scientific study.

Technological developments have also been quite important. The cost of sending payloads into space has significantly decreased because to reusable rocket technology, which SpaceX pioneered with their Falcon rockets. Space tourism is becoming more viable than ever thanks to the development of spacecraft like Boeing's Starliner and SpaceX's Dragon.

Traditional aerospace has also shown increasing interest during this time. businesses like Lockheed Martin and Boeing, as well as more recent entrants like Virgin Galactic, owned by Richard Branson. These businesses are investigating various space tourism concepts, such as orbital flights and suborbital experiences, to broaden the scope and reach of space travel for both commercial businesses and the public.[21]

Space Tourism's Present Situation

Significant advancements in space tourism have occurred recently, most notably thanks to the efforts of businesses like Virgin Galactic, SpaceX, and Blue Origin. Under the direction of visionary businessman Elon Musk, SpaceX has played a significant role in this new phase of space exploration. Beyond simple tourism, Musk's lofty vision for space travel encompasses a future in which humans become a multiplanetary species. Space travel is now much more affordable because of SpaceX's developments in reusable rocket technology, which are exemplified by the Falcon and Starship rockets.

Space tourism has entered a new phase, particularly with SpaceX's Crew Dragon missions to the International Space Station. Although their main purpose is to transport astronauts, these flights have made it possible for private citizens to travel to space. The corporation will play a major role in determining the future of space tourism, as seen by its plans for lunar expeditions and perhaps trips to Mars. Suborbital flights, which currently provide civilians a sight of Earth from space, are only the beginning.

These endeavors are far more than amusement rides; they are the first steps towards a broader future in which space will serve as a new arena for recreation, science, and exploration.

[21] Ibid

Effects on the Economy

With major economic benefits anticipated, space tourism is starting to emerge as a potentially profitable sector. By 2030, the space tourism industry may be worth $3 billion a year, according to a UBS estimate. Increased investments and technological developments that make space travel more accessible and inexpensive are the main drivers of this rise.

The industry has significant potential to create jobs. According to a Space Foundation survey, the worldwide employment in the space industry, which includes tourism, increased by 5.7% in 2019 to about 423,000 workers. This number is anticipated to increase as space tourism expands, providing opportunities in a variety of industries, from engineering and aerospace to hospitality and customer service.

Property Rights and Space Mining: The Debate over Ownership Beyond Earth

Since the Outer Space Treaty (OST) forbids national acquisition of celestial bodies but says nothing about private ownership of harvested materials, the discussion over space mining property rights focusses on the current lack of clear legal frameworks. The fundamental conflict is between encouraging commercial innovation and avoiding a "space gold rush" in which big organizations predominate, and the advantages are not distributed fairly. To address the issues of resource ownership, use, and conflict potential, new international accords and governance frameworks have been called for.

There are important resources in space. These give governments, businesspeople, and investors a strong incentive to pursue space exploration and settlement. Valuable elements including neodymium, scandium, yttrium, iridium, platinum, and palladium—the majority of which are uncommon on Earth—are known to be abundant in asteroids. Harvesting these minerals from space may be able to justify even extremely expensive mining expeditions due to their great value. With the goal of mining asteroids, Google leaders Larry Page and Eric Schmidt recently founded and funded Planetary Resources.

In a similar vein, Microsoft millionaire Naveen Jain established Moon Express, which says it will begin using robots to mine the moon as early as next year. In the meantime, the Texas-based Shackleton Energy Company is now soliciting money for their plan to extract ice in Shackleton Crater at the lunar south pole in order to supply fuel for planetary missions[22]. Of course, the fundamental space travel technology required for off-planet development has been around for a number of decades; after all, the United States did land a man on the moon in 1969. Additionally, new developments in spacefaring technology, such as the SpaceX Falcon Heavy rocket, promise to lower the cost of moving people and products into and out of space.

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At a cost of $120 million, this new rocket will deliver roughly fifty metric tons of payload to low-Earth orbit, enabling material to be transported to space for roughly a thousand dollars per pound, significantly less than the tens of thousands of dollars per pound that technologies like NASA's retired space shuttle cost to transport cargo. Additionally, the cost of putting products into orbit will probably decrease significantly if SpaceX or another business is able to reach the objective of partial or complete reusability, particularly if additional companies enter the market.

The absence of a well-defined legal framework for acknowledging property rights in

[22] Rand Simberg, "Property Rights in Space", https://www.thenewatlantis.com
[23] ibid

space under current U.S. and international law has hindered space settlement despite technological advancements and the allure of valuable resources. As moon samples returned to Earth on both U.S. and Soviet flights (the latter robotically) have been exchanged for other tokens of value, there is a small amount of globally recognised legal precedence for maintaining ownership of minerals obtained in space.

However, it is more difficult to truly own the area of the heavenly body from which the minerals are extracted, as in a regular mining claim. Raising money to develop land or extract its resources is challenging, if not impossible, without legally recognized rights to purchase, own, and sell titled property. Since property rights have long been seen as one of the cornerstones of wealth in the modern world, their absence in space can be partially explained by the circumstances surrounding the development of international law in the early space age.

Environmental Concerns: Regulating Space Debris and Orbital Pollution

The long-term viability of space operations is seriously threatened by the buildup of space debris and orbital pollution, both economically and environmentally. Non-binding international standards make up most of the current regulation, which is widely viewed as insufficient for controlling the increasing congestion, especially from commercial mega-constellations.

The main issue is the exponential growth in debris, which raises the possibility of collisions and the Kessler Syndrome, a potential cascade effect in which collisions produce additional debris, making some orbits useless. Collision Risks: Operational satellites can be seriously damaged or destroyed by high-velocity debris, even tiny paint chips, which would interfere with vital services like GPS, communication, weather forecasting, and climate monitoring.

The space industry prefers to think of itself as a key participant in the fight against climate change. On the surface, this impression is valid. Satellite communications will enable a more effective use of the earth's resources, while space science and exploration have promoted a greater understanding of our globe[24].

[24] Rajeev Suri “What's the environmental impact of space debris and how can we solve it?” https://www.weforum.org/stories/2022/07/environmental-impact-space-debris-how-to-solve-it/

However, the space industry is far from being the pure guardian that it says it is. An unparalleled investment frenzy is engulfing the business. We are collectively launching an increasing number of things into space each year, and at the current rate of growth, we run the risk of diminishing space's value for next generations.

The current rate of expansion is unsustainable. Of the approximately 11,000 satellites launched in the last 60 years, 7,000 are still in orbit. However, as private firms like Elon Musk's Starlink and Amazon join China and other nation governments in constructing mega-constellations in Low Earth Orbit (LEO), that figure may rise to hundreds of thousands by the end of this decade.

Tens of thousands of satellites will be part of some of these new constellations. With an anticipated lifespan of five to ten years, each will produce enormous amounts of space debris that will clog their own orbit and put anybody travelling through it at risk.

Such space debris poses numerous environmental risks, such as light pollution that could impede future scientific advancements. Satellite re-entrances from the mega-constellations, which may release dangerous amounts of alumina into the upper atmosphere, are equally concerning. The environment would be negatively impacted by the ensuing solar radiation. If one nation or business takes over a certain orbit, the proposed mega-constellations may also stifle innovation and competition[25].

On the other hand, intelligent utilization of space can improve life on Earth. By improving flight patterns, satellites are lowering emissions in the aviation sector and assisting container ships in increasing productivity and profitability. In other areas, space technology enables farmers to increase yields, feed the world's expanding population more responsibly, and help us quantify global carbon emissions more precisely. To link approximately three billion individuals who have not yet used the internet, satellites will be crucial. Without satellite communications, entire industries—from retail to mining—could not function.

However, the regulations governing this asset are no longer appropriate. The current regulatory framework is ineffective because it depends on actors' willingness to play fairly and lacks significant sanctions to discourage rule violations. I can't even begin to count how many

[25] Ibid

times I've heard space regulation referred to as a "wild west" since taking over as CEO of Inmarsat last year. The moniker is appropriate[26].

With the introduction of low-Earth orbit (LEO) satellites, many of the advantages of space-based communications are now achievable with low-risk geostationary satellite constellations in high orbit. However, the number of LEO mega-constellations currently under development raises concerns about scale, sustainability, and safety.

The nations with the biggest space footprints must unite at the international level to establish some fundamental guidelines, including capping the number of satellites in a particular orbital shell. The United Kingdom, Europe, the United States, Japan, Brazil, Australia, and other like-minded nations would initially be part of the coalition of the willing Inmarsat has suggested.

The ITU, the United Nations body for information and communications, should be tasked with addressing space sustainability challenges at the global level, which is the most important for a long-term sustainable solution. Although the ITU is not flawless, it has demonstrated its value in guaranteeing the fair and sensible use of spectrum.

International Cooperation: Role of the UN and Emerging Agreements

International space law is developed by the Committee on the Peaceful Uses of Outer Space. Five international treaties and five sets of guidelines for space-related activities have been reached by the Committee.

The non-appropriation of space by any one nation, arms control, freedom of exploration, liability for damage caused by space objects, safety and rescue of spacecraft and astronauts, prevention of harmful interference with space activities and the environment, notification and registration of space activities, scientific research and the exploitation of natural resources in space, and dispute resolution are just a few of the topics covered by these five treaties.

Every treaty emphasises the idea that space, space-related activities, and any potential advantages should be used to improve the welfare of all nations and humanity, with a focus on

[26] id

fostering international cooperation.

The following agreements are frequently referred to as the "five United Nations treaties on outer space"[27]:

The Outer Space Treaty, 1967: The Outer Space Treaty, 1967 is the cornerstone of international space law, forbids the deployment of weapons of mass destruction in space, restricts the use of celestial bodies to peaceful purposes, and requires unrestricted space exploration for the benefit of all nations. In addition to prohibiting national sovereignty claims over space or celestial bodies, the 17-article treaty holds countries accountable for harm caused by their space objects. All the main spacefaring nations are among the 115 nations that have ratified the pact as of March 2024.

The Rescue Agreement, 1968: The Outer Space Treaty's Articles 5 and 8 are expanded upon in the Rescue Agreement. It requires nations to do all within their power to save and aid astronauts in need and bring them back to the nation whence they were launched. Additionally, it states that nations must help retrieve and return space objects that land outside the territory of the launching nation upon request.

The Liability Convention, 1972: The Liability Convention, 1972 builds Articles 7 of the Outer Space Treaty by imposing absolute accountability on launching states for harming their space objects to aircraft or the Earth's surface.

The Registration Convention, 1976: The Registration Convention, 1976 mandates that nations register their spacecraft in orbit with the UN. This registry is kept up to date by the UN Secretary-General, who guarantees access to the data supplied by nations and other intergovernmental organizations.

The Moon Agreement, 1984: The Moon Agreement forbids disturbing the environment and mandates that the Moon and other celestial bodies be used only for peaceful reasons. It declares the Moon and its natural resources to be the shared legacy of all people and mandates that nations notify the UN of the location and function of any stations built on these bodies.

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[27] https://www.un.org/en/peace-and-security

National Space Laws: Balancing Domestic Interests with Global Norms

By combining a state's commercial and national security objectives with international standards of sustainable development, peaceful use, and state responsibility, national space laws help to operationalize international space accords domestically.

National Laws' Function: Balancing Domestic Interests[28]

International treaties are not self-executing; to implement these principles, individual countries must pass domestic legislation. National space laws are crucial for:

Legal Certainty and Predictability: They give government and private actors a stable and transparent regulatory environment, which is essential for drawing investment and encouraging innovation in the expanding commercial space industry.

Putting International Duties into Practice: In order to ensure that the state fulfils its international obligations under the OST, domestic laws set up the procedures for approving and monitoring national space operations.

Determining Insurance and Liability Frameworks: National laws can require third-party insurance for private firms, controlling risk and defining liability for potential losses, even though the state is ultimately liable globally.

Protecting National Interests: Through legislation, nations can define intellectual property rights, control dual-use technology, protect their national security interests, and set guidelines for the use of space resources in accordance with national goals.

Simplifying Regulation: As demonstrated in nations like India that are still constructing their frameworks, a comprehensive national statute can avoid regulatory obstacles and delays brought on by the need for clearances from several ministries[29].

Principal Difficulties in Balancing

The main difficulty is balancing national laws that give property rights to businesses

[28]https://www.google.com/search?q=National+Space+Laws%3A+Balancing+Domestic+Interests+with+Global+Norms&sca_esv

[29] ibid

that mine space resources, like the U.S. Commercial Space Launch Competitiveness Act of 2015, with the OST's non-appropriation principle.

Why Does India Need a National Space Law:

Operationalize International Commitments: India has ratified the 1967 Outer Space Treaty and other relevant UN accords. Principles such as liability for damages, state accountability for domestic operations, and peaceful use of space are established by these treaties. Treaties from the United Nations Office for Outer Space Affairs (UNOOSA) are not self-executing; nations must pass their own space legislation. Laws pertaining to commercial use, liability, and licensing exist in the US, Japan, and Luxembourg. India runs the danger of non-compliance and slipping behind the rest of the world without one.

Balance Domestic Gaps with Geopolitical Realities: Although the Outer Space Treaty has been upheld internationally, growing hostilities between the US, China, and other space superpowers pose a threat to space administration. Even with ongoing international uncertainty, India needs to fortify its internal legal system to protect its business interests.

Give Industry Legal Certainty: Although they lack statutory authority, policies such as the Indian Space Policy 2023 and the IN-SPACe Guidelines 2024 demonstrate intent. In addition to streamlining licensing, cutting down on delays, and boosting investor confidence in India's space industry, a national space law would grant the Indian National Space Promotion and Authorization Centre (IN-SPACe) legal authority as the central regulator[30].

Encourage Innovation and Startups: Despite the substantial risks associated with satellites and launch vehicles, startups do not have access to reasonably priced insurance.

To promote R&D and stop brain drain, legislation can require third-party liability coverage, create transparent procedures for claims and accident investigations, offer startups reasonably priced insurance, and enforce robust intellectual property rights.

India Space Policy, 2023[31]

- **Objective:** Augment space capabilities, encourage private sector participation, drive

[30] ibid
[31] id

technology development, and strengthen international cooperation.

- **Delineation of Roles:** The policy delineates the roles and responsibilities of Indian Space Research Organisation (ISRO), space sector PSU NewSpace India Limited (NSIL), IN-SPACe, and and the Department of Space.
    - **ISRO:** Focus on research, innovation, and advanced space technologies.
    - **IN-SPACe:** Serve as a single-window agency for authorising space activities by government and private entities, ensuring safety, national security, and compliance with international obligations.
    - **NSIL:** Commercialize publicly funded space technologies and provide space-based services to government and private entities.
    - **Department of Space:** Implements policy, ensures safe and sustainable operations, coordinates international cooperation, and resolves disputes.
    - **Applicability:** This policy covers all space activities in Indian territory and its exclusive economic zone, with the Government reserving the right to grant case-by-case exemptions.

What Challenges Does India's Space Industry Face Without a National Space Law

Regulatory Obstacles: Approvals are handled by several ministries (Defence, Telecom, Commerce, Department of Space), which results in redundancy and delays. For instance, activities are hampered by the need for simultaneous clearance from DoT, DoS, and Defence for satellite communication projects.

IN-SPACe does not have official legislative authority: Instead, it functions through presidential orders. Due to the possibility of legal challenges to regulatory decisions, this lowers investor trust.

Liability Issues: India is internationally responsible for all space operations, including private launches, under the terms of the Outer Space Treaty.

Due to expensive liability insurance requirements, startups face significant barriers to entry.

Foreign Direct Investment (FDI) Concerns: Foreign investors are discouraged by unclear automated clearance processes and the restricted amount of FDI permitted in satellite manufacturing.

To draw in investment, India's space sector aims for 100% automatic FDI in satellite components. With more lenient investment regulations, rival countries like Luxembourg and the United Arab Emirates draw space startups.

Cybersecurity Risks: GPS spoofing, hacking, and space-based espionage can all affect satellites. There are national security risks because India does not have an autonomous ISRO cybersecurity branch or an independent Space Cybersecurity Command.

Infrastructure Risks and Climate Change: Thumba and Sriharikota, two coastal launch locations, are vulnerable to climate change. Infrastructure is susceptible to extreme weather since there is no legislative mandate for climate adaption measures.

Strategic Military Gaps: The absence of legislative support makes it more difficult to form integrated commands and space-based defence assets.

What Measures are needed to enhance India's Space Industry

Give Legal Support: Pass a comprehensive space law that establishes liability standards, defines the duties of public and private players, and is in line with OST.

Increase Startup and Private Sector Involvement: Enable commercial development of deep-space technology, satellites, and launch vehicles by fully implementing New Space Policy 2023. To expedite approvals and cut down on bureaucratic delays, strengthen IN-SPACE.

Boost Debris Mitigation and Space Traffic Management: Create a separate Space Traffic Management (STM) system to monitor and reduce debris. Use robotic arms and laser ablation to deploy active debris removal satellites. Boost global collaboration for sustainable space activities through UNOOSA and the Inter-Agency Space Debris Coordination Committee (IADC).

Improve Space Asset Protection and Cybersecurity: Establish a Space Cybersecurity Command under ISRO and DRDO.

Ethical and Human Rights Issues in Space Exploration

Ethical and human rights challenges in space exploration include assuring astronaut well-being, addressing the possibility for space militarisation, controlling resource exploitation and property rights, and conserving the space environment. Long-duration missions raise worries about astronaut mental and physical health, while the idea of long-term colonies needs a framework for human rights and governance beyond Earth. There are also problems concerning the right to claim celestial bodies and the ethical consequences of modifying extra-terrestrial settings.

Psychological well-being: For astronauts on extended missions, isolation, confinement, and distance from Earth present serious psychological issues that need for strong mental health support.

Physical health: Astronauts encounter threats like radiation, which is difficult to guard against, and the effects of microgravity, which can lead to health difficulties. Human modification: The potential for genetic alteration to protect astronauts from space radiation raises bioethical considerations regarding human augmentation and the prospect of modifying the human species.

Outer space as a site of ambition for human activity is rising, as are the linkages between space technology and questions of human rights and ethics.

The Ethics and Human Rights project group seeks to identify and present space-related procedures pertinent to the UN's larger human rights agenda, in accordance with SGAC's support for the UN Programme on Space Applications (UNPSA) and the UN's Human Rights Office of the High Commissioner (OHCHR). These processes include:

"Give equal consideration to the realization of social, political, economic, cultural, and civil rights, including the right to development[32]."

[32] https://spacegeneration.org/projects/ehr

"Measure the impact of its (space applications) work by looking at the significant benefits it provides to people worldwide."

From a space perspective, ethics and human rights concerns also align with the objectives of the 1967 Outer Space Treaty (OST) as Article III states: "States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the Moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding."[33]

This guiding document of the Committee on Peaceful Uses of Outer Space (COPUOS) highlights the relevance of international law and human rights for space activities, including necessary consideration of the UN Charter and relevant international law such as the UN Universal Declaration of Human Rights in all space activities.

Additionally, the United Nation's Sustainable Development Goals (SDGs) overlap considerably with both human rights and ethics issues as well as space technology. This connection makes the SDGs, and their human rights components, a defining challenge of the emerging space generation.

Finally, the objective of the SGAC is to support the UN Programme on Space Applications (PSA) through networking and representation of young professionals in the space sector. While also immersed within the broader UN agenda discussed above, the Programme on Space Applications, PSA too, has ethics and human rights as core driving principles of its mission statement, especially related to the uptake of space technology to progress sustainable economic and social development globally[34].

Space ethics, Astro ethics or Astro bioethics[35] is a discipline of applied ethics that addresses the moral and ethical consequences coming from Astro biological research, space exploration and space flight.[36] It addresses both hypothetical future challenges related to our

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[33] Ibid

[34] Id

[35] Chon-Torres, Octavio A. (2017-04-10). "Astro bioethics". *International Journal of Astrobiology*. **17** (1): 51–56. doi:10.1017/S1473550417000064. hdl:20.500.12724/3641. ISSN 1473-5504. S2CID 232248384.

[36] Milligan, Tony; Johnson-Schwartz, J. S. (2023-06-19), "Space Ethics", *The Routledge Handbook of Social Studies of Outer Space*, London: Routledge, pp. 108–120, doi:10.4324/9781003280507-10, ISBN 978-1-003-28050-7, retrieved 2025-01-04

interactions with extraterrestrial life forms and realistic current issues such as the preservation of the space environment[37].

Specific challenges of space ethics include space debris mitigation, the militarisation of space and the ethics of SETI and METI, but also more theoretical topics like space colonization, terraforming, directed panspermia and space mining. The field also concerns itself with more fundamental moral questions, such as the value of abiotic environments in space, the intrinsic value of extraterrestrial life, and how humans should treat extraterrestrial non-intelligent life (like microbes) and extraterrestrial intelligent life (and whether this distinction should be made in the first place)[38].

Future Horizons: Towards a Comprehensive Global Space Governance

The twenty-first century has experienced an unparalleled acceleration in space operations driven by technological innovation, decreasing launch costs, commercialization, and the arrival of new State and non-State entities. As space moves from an exclusive strategic domain to a crowded and economically vibrant arena, the constraints of the present governance framework—primarily the 1960s–1970s UN space treaties—have become increasingly clear. The Outer Space Treaty 1967[39], Liability Convention 1972[40], Registration Convention 1975[41], and Moon Agreement 1979[42] establish the underlying rules. However, they were designed during the bipolar Cold War era and do not fully address contemporary concerns such as space debris[43], long-term sustainability[44], anti-satellite weapons[45], and dual-use military

[37] Williamson, Mark (2003-02-01). "Space ethics and protection of the space environment". *Space Policy*. **19** (1): 47–52. Bibcode:2003 SpPol..19...47W. doi:10.1016/S0265-9646(02)00064-4. ISSN 0265-9646. Retrieved 2022-03-28.

[38] Dirks, Nicholas (2021-08-06). "The Ethics of Sending Humans to Mars". *Scientific American*. Retrieved 2022-10-15.

[39] 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.

[40] Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187

[41] Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15.

[42] Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15

[43] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 18, 1979, 1363 U.N.T.S. 3.

[44] U.N. Office for Outer Space Affairs (UNOOSA), *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010).

[45] U.N. Office for Outer Space Affairs (UNOOSA), *Guidelines for the Long-term Sustainability of Outer Space Activities* (2019).

technologies. The future of space administration thus necessitates a more holistic, cooperative, and enforced global structure that promotes sustainability and security, equity and morality.

1. **The Current Regime's Limitations:** Despite their normative strength, the foundational accords are insufficient to handle issues like militarization, mega-constellations, and the use of space resources. New frameworks, such as the Artemis Accords, try to close these gaps, but they are still not universal and have no legal weight behind them. Furthermore, the lack of a single worldwide Space Traffic Management (STM) system has increased the likelihood of collisions and interference due to the growth of space players. The distribution of radio frequencies and orbital slots through the ITU system[46] also under strain due to increased demand.

2. The Need for a Comprehensive Global Space Governance Model:

a. Sustainability and Safety: Enforceable debris-mitigation regulations are necessary for environmental sustainability in orbit; this topic is covered in detail in academic publications like von der Dunk's examination of international space law. Current standards are soft laws in nature, requiring translation into binding requirements. AI-enabled systems, massive satellite constellations, and in-orbit servicing require future-proof regulatory procedures.

b. Security and Peace: Geopolitical pressures have accelerated military actions in outer space, making future governance contingent on demilitarization standards and confidence-building initiatives. Studies on resource governance and the Moon's legal status, such as Tronchetti's work[47], demonstrate the necessity for explicit restrictions on exploitation. The global expansion of counterparts of capabilities necessitates the inclusion of verification and transparency procedures in governance.

c. Economic Fairness & Shared Benefits: As more private entities enter space, a precise structure for liability, insurance, and benefit-sharing is required. The need for revised models for STM and responsibility distribution is emphasized by legal scholarship.[48] The "benefit of all humankind" principle must be reflected in the equitable regulation of orbits,

[46] Brian Weeden, Anti-Satellite Weapons and the Outer Space Treaty: Seeking Legal Clarity in an Era of Strategic Competition, Secure World Foundation (2020).
[47] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies: A Proposal for a Legal Regime* 1–15 (Brill Nijhoff 2009)
[48] Jessica West, Norms for Responsible Space Behavior, Project Ploughshares Space Security Index 2023.

spectrum, and resource access.

d. Inclusive Multistakeholder Participation: The future of space administration must incorporate academics, private firms, underdeveloped states, and civil society. Blount's research on security governance and Freeland's work on militarization and weaponization demonstrate the necessity of common standards resulting from inclusive discussion rather than just great-power negotiations.

3. Emerging Trends Shaping Future Governance:

a. Commercialization and New Space: Through global internet constellations, lunar expeditions, and reusable launch vehicles, commercial actors are transforming space. Coordinated governance is required due to the absence of consistent regulations on property rights, liability, and resource extraction.

b. Technological Disruption: Soon, rapid launch techniques, automation, and AI-powered satellites will rule. International law must include cybersecurity requirements, algorithmic responsibility, and oversight systems.

c. Multipolar Geopolitics: Fragmentation in space law is developing as geopolitical blocs push competing rules. UN General Assembly efforts like PAROS[49] try to avoid weaponization but lack enforcement.:

4. Towards a Comprehensive Governance Framework: A future-ready global space governance framework should include:

a. An Updated International Treaty: A reformed legal regime must support OST principles while encompassing concerns such as debris mitigation (as advocated by ISO standards[50]), STM, cybersecurity, and resource exploitation.

b. A Global Space Authority: While guaranteeing fair access, an UN-mandated body may control licensing, registration, safety, and debris collection.

[49] U.N. General Assembly, Prevention of an Arms Race in Outer Space (PAROS), G.A. Res. 36/97C, U.N. Doc. A/RES/36/97C (Dec. 9, 1981).

[50] International Organization for Standardization (ISO), Space Systems — Space Debris Mitigation Requirements, ISO 24113 (2019).

c. Space Traffic Management (STM) System: An STM platform incorporating worldwide data-sharing, automatic warnings, and AI-driven congestion management is vital for preventing catastrophic collisions.

Case Reference

Martin Marietta Corp. v. International Telecommunications Satellite Organization (INTELSAT), 763 F. Supp. 1327 (D. Md. 1991)

Commercial satellite activities and liability concerns under space-related contracts were at issue in this U.S. federal district court case. An intergovernmental satellite group called INTELSAT filed a lawsuit against launch contractor Martin Marietta for damages resulting from an unsuccessful satellite launch that rendered the satellite inoperable. Martin Marietta requested that INTELSAT's tort claims be dismissed, claiming that the Commercial Space Launch Act, a U.S. federal legislation controlling commercial space launches, superseded normal tort law by requiring cross-waivers of liability in launch contracts. The court addressed the interaction between contractual responsibility frameworks that apply to satellites and domestic regulatory regimes for commercial space activities, refusing to dismiss some claims.

Why this case is relevant

- It illustrates how domestic law handles responsibility and contractual obligations for commercial satellite activities, which is a crucial aspect of space law governance as private actors increase in number.

- It demonstrates the legal complexity that results from the intersection of international space law concepts and commercial disputes with national legislation (such as launch licensing and liability waivers).

- The liability and regulatory difficulties it covers are comparable to the legal issues encountered in space tourism operations, even though they are not directly related to it. This is especially true when private businesses run spaceships and orbiting systems and must manage risk and legal obligation.

Additional Contextual Reference (Non-Judicial but Relevant)

The Convention on International Liability for Damage Caused by Space Objects (the

"Liability Convention") is the main treaty-based legal framework that has been used in claims pertaining to damage by space objects (such as satellite re-entry incidents), even though direct judicial precedents under international space law are uncommon. Following the Soviet satellite Kosmos 954 crash in Canada in 1978, this pact was used in the only acknowledged claims action in which the Soviet Union compensated Canada for harm done on Earth in accordance with the treaty's requirements.

Another case regarding the same is….

CC/Devas (Mauritius) Ltd. v. Antrix Corp. Ltd., 605 U.S. 223 (2025)

The commercial satellite contract dispute between a private telecommunications company (CC/Devas (Mauritius) Ltd. and related entities) and Antrix Corporation Ltd., the commercial arm of India's national space agency, involved the leasing and launch of satellite communication capacity. In this historic ruling, the U.S. Supreme Court addressed jurisdictional and enforcement issues. Antrix terminated the underlying satellite services agreement, which led to international arbitration and awards in Devas' favor. The Supreme Court ruled that, without requiring "minimum contracts" under conventional due process analysis, federal courts have personal jurisdiction over a foreign state (or its instrumentalities) sued under the Foreign Sovereign Immunities Act (FSIA) once an applicable immunity exception (such as the arbitration exception) is met and proper service is made. This case has ramifications for the litigation and enforcement of contractual and liability conflicts involving satellites and commercial space organizations across nations, particularly considering the global proliferation of private players and satellite services.

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Why is it relevant:

- It addresses commercial agreements and enforcement concerns related to satellite activities in global settings.

- As space tourism and satellite services converge in a commercialized space era, it draws attention to jurisdictional issues and legal adjustments that arise when private space-related businesses engage in cross-border disputes.

- The ruling provides guidance for the more comprehensive space law framework required for new ventures like space tourism by demonstrating how domestic courts interpret the execution of international responsibilities related to space infrastructure.

Even though the case primarily involved satellite communication services, the ruling in CC/Devas (Mauritius) Ltd. v. Antrix Corp. Ltd. is extremely pertinent to the developing legal framework governing satellites and space tourism. The case demonstrates the increasing commercialization of space and the growing participation of private organizations in addition to state-owned space agencies. Similar contractual arrangements between private operators and state-affiliated companies are anticipated to emerge since space tourism endeavors significantly rely on satellite infrastructure for communication, navigation, safety monitoring, and space traffic management.

Furthermore, the case highlights the need for updated legal frameworks that explicitly govern private involvement, dispute resolution, and risk allocation in space tourism and highlights the shortcomings of current international space law treaties, which were drafted prior to the development of commercial human spaceflight. As a result, in a time when satellites and space tourism are becoming more intertwined, CC/Devas v. Antrix adds significant jurisprudence to the growing field of space law.

Conclusion:

The governance of space must transcend the constraints of its Cold War-era roots as humankind enters a period characterized by unparalleled scientific capabilities and growing commercial ambition. A legal framework based on sustainability, equity, and shared responsibility is necessary to guarantee that space continues to be a tranquil, accessible, and long-lasting domain. A sustainable space framework must prioritize the long-term health of orbital ecosystems through binding debris-mitigation regulations, responsible satellite deployment practices, and continuing environmental management. At the same time, equity must stand as a basic principle—ensuring that developing states, rising space actors, and private organizations are not marginalized in the competition for access to orbital resources, lunar territory, and the deep-space economy.

Building such a framework demands a multilateral and inclusive strategy that harmonizes the interests of States, commercial industries, scientific communities, and international organizations. Stronger global coordination, transparent data-sharing, and unified space traffic management will be critical to lowering hazards and maintaining the safety of the orbital commons. Similarly, innovation can thrive without weakening the fundamental idea that space is the "province of all humankind" if there are clear rules governing resource extraction, technology transfers, and benefit-sharing. In the end, a fair and sustainable legal framework for space is more than just a legislative requirement; it is a shared moral responsibility to guarantee that future generations inherit a region that is safe for the environment, peaceful, scientifically active, and economically open. Humanity can create a space future that accurately reflects our common goals and obligations through prudent governance, collaborative leadership, and the careful balance of commercial potential with global stewardship.