



# The Guide to Aviation and Space Disputes

**Navigating the Legal Cosmos of Space  
Disputes: Sources of Space Law and  
Core Principles**

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Few industries are more suited to international arbitration than aviation and space. And yet, for different reasons, neither used it frequently. Until recently. Now things are changing, there's need for a guide to how arbitration will interface with those disputes. The GAR Guide to Aviation and Space Disputes is that 'book'. Crammed with important background, especially about the industries and how they think and work, it will help the citizens from these different worlds work together productively. A vital resource for practitioner and client alike.

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**Generated: June 8, 2024**

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# Navigating the Legal Cosmos of Space Disputes: Sources of Space Law and Core Principles

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Bird & Bird

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### *Non est ad astra mollis e terris via.*

This ancient Latin adage is a reminder that there is no effortless path from Earth to the cosmos. Yet, in our current era, the celestial sphere has never been more accessible to human exploration, such that the sky is no longer the limit, not even space. This unprecedented accessibility, while a testament to our technological prowess, raises crucial questions. Who will govern our activities beyond Earth's boundaries? How will we navigate the inevitable legal disputes that will arise in this new frontier? Will it resemble the Wild West or will there be rules framing what would otherwise be a space jungle? The answers to these questions lie in the emerging and complex realm of space law.

The value of the space economy is significantly increasing, valued at US\$469 billion in 2021, marking a 9 per cent increase from 2020<sup>[2]</sup> and the highest recorded growth since 2014.<sup>[3]</sup> According to Morgan Stanley, the space economy will reach US\$1 trillion in 2040. Most of the value is generated by enhancing activities on Earth, but with future functions that will occur entirely in orbit, such as in-orbit servicing, this value will increase significantly.

In parallel, the costs for heavy launches in low-Earth have fallen from US\$65,000 per kilogram to US\$1,500 per kilogram (in 2021) – a decrease of more than 95 per cent.<sup>[4]</sup> The size and weight of satellites have fallen significantly in recent years because of various advances, primarily driven by private companies, such as the use of lighter solar panels and more efficient batteries. Large government satellites, some of which cost upwards of US\$1 billion and tend to be deployed in orbits far from Earth, are now outnumbered by smaller commercial satellites in low Earth orbit, often deployed in constellations, that can cost US\$100,000 or less.<sup>[5]</sup>

With this unprecedented increase in space activity, it is a more pressing issue to govern this new frontier as well as keep up with its constant evolution. This chapter explores the intricate realm of space law, with the aim of providing a broad understanding of the foundational elements of space law. It starts with an overview of the legal framework of space activities followed by a presentation of the main stakeholders of the space industry and finally it sheds some light on the challenges faced by the modern space sector in the context of the new space race.

## **NAVIGATING THE CELESTIAL LEGAL LANDSCAPE: AN OVERVIEW OF SPACE LAW**

Space law is a legal domain that emerged during the space race of the 1960s and 1970s, within the context of the Cold War between the two superpowers, the United States and the Soviet Union. The competition in space exploration and the potential conflicts associated with this new frontier prompted states to legislate on these novel activities. The launch of the first satellite – the Soviet satellite Sputnik – sparked a great deal of speculation. Concerns about its capability to carry a nuclear payload was one aspect that compelled states to regulate space activities. Consequently, the signing and ratification of space treaties facilitated the regulation and oversight of space activities for peaceful purposes.

Following the drafting of these foundational treaties, numerous legal texts were enacted to regulate space law. It is therefore relevant to give an overview of existing legal texts governing space activities. Furthermore, the evolution of this legal form has led to the emergence of significant space principles that are worth highlighting (see below).

## **OVERVIEW OF EXISTING LEGAL TEXTS OVERSEEING SPACE ACTIVITIES**

The legal architecture governing space activity is composed of three primary and interrelated types of legal instruments that, together, create a robust legal framework that navigates the complex terrain of space law.

United Nations treaties lay down binding provisions for states on the conduct of activities in outer space and regulate the operations of private entities engaged in space activities.

Supplementing these more traditional and rigid texts are guidelines and soft law principles. These form the bedrock of normative standards that guide responsible behaviour and exploration in space.

The final component of this legal triad represents an emergent trend: the increasing predilection of states to shape space activities through national or domestic regulations. This response is directly proportional to the burgeoning involvement of private entities in the space industry.

## **BINDING TREATIES**

There are five United Nations treaties that provide principles and rules for states in conducting activities in outer space and make provisions for how states regulate non-government entities (i.e., private operators) carrying out space activities:

### **OUTER SPACE TREATY**

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 1967 (Outer Space Treaty)-<sup>[6]</sup> serves as the cornerstone of space law, embodying the principles that are crucial for maintaining outer space as a place for peaceful exploration. Its emphasis on the peaceful use of outer space lays the foundation for international cooperation in scientific research, satellite deployment and other space-related activities. By prohibiting the use of weapons of mass destruction in space, the Outer Space Treaty aims to prevent the militarisation of space and foster an environment in which nations collaborate rather than compete.

The principle of non-appropriation is hence pivotal, asserting that outer space, including celestial bodies such as the Moon, is the common heritage of all nations. This provision prevents any single state from claiming sovereignty over any part of outer space, fostering a sense of shared responsibility for the preservation and sustainable use of space resources.

### **RESCUE AGREEMENT**

The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space of 1968 (the Rescue Agreement)<sup>[7]</sup> addresses the humanitarian aspects of space exploration by outlining the obligation to assist astronauts in distress. This commitment to the safety of astronauts also reflects the recognition that space missions, with their inherent risks, require a collective international effort to ensure the well-being and survival of astronauts. The Agreement establishes procedures for the prompt return of astronauts and space objects, stressing the global responsibility to provide assistance in the spirit of cooperation.

By incorporating provisions for the rescue and return of astronauts, the Rescue Agreement reinforces the ethical dimension of space activities and underscores the importance of international solidarity in the face of unforeseen challenges or emergencies in outer space. It is a solid ethical counter-balance to the recent trends driven by exclusively commercial considerations.

## LIABILITY CONVENTION

Complementing the Outer Space Treaty, the Convention on International Liability for Damage Caused by Space Objects of 1972 (the Liability Convention)<sup>[8]</sup> plays a crucial role in defining the responsibilities of states for damage caused by their space objects. It establishes a legal framework that ensures accountability in the event of collisions or other incidents involving space assets. By clarifying liability and compensation mechanisms, this Convention encourages states to conduct space activities with due regard for the safety of other astronauts and their assets.

The Liability Convention promotes responsible behaviour in space operations, mitigating the risks associated with the growing number of satellites and space debris in orbit. It encourages states to adopt measures to prevent accidents and provides a legal basis for addressing the consequences when incidents occur.

## REGISTRATION CONVENTION

The Convention on Registration of Objects Launched into Outer Space of 1976 (the Registration Convention)<sup>[9]</sup> contributes to the transparency and safety of space activities by requiring states to register their space objects. This process involves providing detailed information about the characteristics and orbital parameters of launched objects. By maintaining a comprehensive registry of space objects, the international community can track their trajectories, reducing the risk of collisions and enhancing overall space traffic management.

The Convention's emphasis on transparency fosters confidence among states and promotes responsible conduct in space. It enables timely communication and coordination among nations, contributing to the prevention of misunderstandings and conflicts arising from the use of outer space.

## MOON AGREEMENT

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies,<sup>[10]</sup> commonly known as the Moon Agreement, was adopted by the General Assembly in 1979 by Resolution 34/68 and entered into force in July 1984. It represents a significant step forward in the evolution of space law, particularly about the legal status of celestial bodies. It reaffirms many of the fundamental principles of the Outer Space Treaty applicable to the Moon and other celestial bodies. This Treaty adopts similar language to that of the 1967 Outer Space Treaty, for example regarding the use of the Moon and other celestial bodies (including orbits or trajectories around the Moon) exclusively for peaceful purposes, the principle of non-appropriation and that the exploration and use of the Moon will be the 'province of all mankind'.<sup>[11]</sup> The controversies concerning property rights based on Article II of the Outer Space Treaty also apply to the provisions on the exploitation of the resources of the Moon Agreement.

## CONCLUSION ON TREATIES

These binding treaties collectively form a comprehensive legal framework that addresses not only the technical and operational aspects of space activities but also the ethical and humanitarian considerations inherent in exploring and using outer space. Together, they promote a vision of outer space as a shared resource, governed by principles that prioritise peace and cooperation, and the well-being of all those involved in space exploration.

## SOFT LAW IN SPACE GOVERNANCE

In addition to the international space treaties that generally contain binding legal obligations on their state parties, there are several other international legal instruments that do not contain such binding obligations. These non-legally binding instruments are commonly referred to as soft law instruments (as opposed to legally binding treaties, which are hard law).

## ROLE OF SOFT LAW IN GUIDING RESPONSIBLE BEHAVIOUR IN SPACE ACTIVITIES

Soft law principles are integral in guiding behaviour, notably in space activities. They often carry more weight than legal obligations because of political commitments. Two significant examples are the Space Debris Mitigation Guidelines<sup>[12]</sup> and the Outer Space Transparency and Confidence-Building Measures.<sup>[13]</sup> The former offer non-binding recommendations to satellite operators, encouraging responsible space activities and minimisation of space debris. The latter initiative encourages cooperation among states through sharing information about their space activities, including space debris mitigation measures. Both acknowledge the global, interconnected nature of space activities, offering flexibility and facilitating international cooperation by establishing common guidelines.

## UNITED NATIONS GENERAL ASSEMBLY RESOLUTIONS

The United Nations General Assembly (UNGA) resolutions are key soft law elements in the space sector. Resolution 59/115, Application of the concept of the 'launching state', is significant as it adopted the interpretation of the launching state following the conclusions of a United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) legal subcommittee working group. The resolution encourages states to adopt national laws for the supervision of outer space activities of non-government entities. It represents a trend to use soft law instruments to develop new space laws and interpret key concepts.

Resolution 62/101, Recommendations on enhancing the practice of states and international intergovernmental organisations in registering space objects,<sup>[14]</sup> encourages states to comply with their international legal obligation to register space objects. It provides clarity on issues associated with the registration of space objects in joint launches and recommends harmonising the practice in connection with the registration of space objects in orbit. These resolutions, while non-binding, enhance the implementation of conventions and promote cooperation among states.

## NATIONAL SPACE LAW AND REGULATIONS

Space laws are composed through a combination of national legislation, inter-national treaties and regulations set by space agencies. Nations often enact laws to regulate the activities of their own entities in space, whereas international treaties, such as the Outer Space Treaty, provide a framework for cooperation and preventing the militarisation of space. Additionally, regulatory bodies within each country's space agency may establish specific rules and guidelines for space-related activities. The goal is to ensure responsible and peaceful use of outer space.

The composition of national space laws varies by country, but they generally cover issues such as the licensing, liability and regulation of space activities.

The licensing matter determines the authorisation regime for space activities that states grant to private actors. This regime complies with the stipulations of Article VI of the Outer

Space Treaty, which requires states to authorise and control their nationals and the private entities they authorise.

Other regulatory issues are more specific. French space law,<sup>[15]</sup> for example, requires private operators to have insurance to cover their space activities.

The aim of this requirement is to ensure that private entities are solvent in the event of liability being incurred; for example, in the event of an accident during a space operation conducted by a private entity that the state has authorised, the state will have to engage its international liability towards the other state concerned that has suffered damage as a result of the accident. Subsequently, French law specifies that the French state may pursue a claim against the private entity that caused the accident to obtain compensation for the costs that the state had to incur to compensate the other state. Consequently, in the absence of insurance, the private entity may not be sufficiently solvent to reimburse the injured state, hence the need for the private entity to have insurance.

Furthermore, French space law was reformed through the French military programming law for 2024–2030 (No. 2023-703) of 1 August 2023.<sup>[16]</sup> Notable modifications include the adaptation of the law to the activities of the New Space era, particularly concerning reusable launches and mega-constellations.<sup>[17]</sup>

Other laws and regulations have specific features that add to the complexity of space law. The space laws of the United Arab Emirates<sup>[18]</sup> and Luxembourg<sup>[19]</sup> establish authorisation mechanisms for the exploitation of space resources. Moreover, the simple fact of allowing private players to exploit space resources for commercial reasons is already an original feature of space law. Not all national space laws contain this type of mechanism.

Finally, some regulations are even more specific. Space agencies sometimes have their own regulations that determine certain financial aspects or the procedures for awarding public contracts; for example, the European Space Agency (ESA) has an intergovernmental convention<sup>[20]</sup> as its founding text (as it is a transnational space agency).<sup>[21]</sup> This text establishes the principle of ‘fair geographical return’. It means that the ESA invests in national companies in proportion to the participation of a state party to the organisation’s budget (excluding operating costs).<sup>[22]</sup> This expression of ‘fair return’ means that the states parties expect to receive contracts for their national industries for an amount corresponding approximately to their contributions.

In conclusion, national space laws and soft regulations complement inter-national space law. The purpose of national law is to define the national framework for space activities and to ensure that their activities comply with international law. In addition, national law makes it possible to specify certain national aspects, such as the rules for awarding public contracts.

## CORE PRINCIPLES OF SPACE LAW

The field of space law is governed by several key principles, which are prominently outlined in international treaties that serve as the foundational framework for space law. It is pertinent to examine these key principles alongside an analysis of the foundational principles of space law, such as freedom of exploration and peaceful use of space. Additionally, particular attention is given to the study of the principle of responsibility, as this is commonly relevant in arbitration proceedings.

## EXPLORATION OF FOUNDATIONAL PRINCIPLES



The first principle, the peaceful use of outer space, is a cornerstone of space law, enshrined in the 1967 Outer Space Treaty. This principle underscores the global commitment to conducting space activities in a manner that benefits all nations and eschews conflict. It is a testament to the international community's determination to prevent the militarisation of space. As humanity advances into the cosmos, it is paramount that we continue to uphold this principle, ensuring that our exploration and exploitation of space do not become a new theatre for terrestrial disputes and power struggles.

The second principle, the non-appropriation of celestial bodies, is a safeguard against the monopolisation of space by a select few. The Outer Space Treaty prohibits any state from claiming sovereignty over celestial bodies. By establishing these bodies as the province of all mankind, space law encourages the use of space resources for the collective benefit of humanity. It is a principle that discourages a space race based on territorial acquisition, fostering instead a cooperative approach to space exploration and the use of resources.

The third principle, freedom of exploration, underlines that outer space is open to all nations, free from discrimination. It promotes international cooperation by allowing any state to conduct space exploration and scientific research. This principle nurtures an environment of mutual respect and collaboration among states, fostering collective efforts that can lead to shared technological advancements and scientific discoveries.

Preventing harmful activities in outer space, the fourth principle, is an essential tenet of space law. Although not explicitly stated in the Outer Space Treaty, it is inferred through several articles. This principle includes measures to mitigate space debris and ensure responsible conduct of space operations to avoid collisions and accidents. Adherence to guidelines and best practices minimises potential harm to space objects and the space environment, promoting sustainable and responsible use of space.

The fifth principle, the maintenance of international peace and security, is a reflection of the overarching aim of space law. The Outer Space Treaty prohibits states from placing nuclear weapons or other weapons of mass destruction in orbit or on celestial bodies. This provision helps to maintain the stability and security of space activities, ensuring that space remains a realm of peace rather than a battleground for terrestrial conflicts.

Last, the principle of the common heritage of mankind, primarily associated with the Moon Agreement, posits that resources of the Moon and other celestial bodies should be used for the collective benefit of all nations. Although the Moon Agreement has not been widely adopted, the principle has influenced discussions on the use of space resources. This concept emphasises that space, and its riches, should not be claimed by a select few but should be shared equitably among all nations.

These six principles form the bedrock of space law, guiding humanity's approach to outer space. As we continue to explore and exploit the cosmos, it is essential that we uphold these principles, ensuring that space remains a realm of peace, cooperation and shared prosperity. They serve as a reminder that space is not a new frontier for the powerful to conquer but a shared heritage for all humanity to explore and benefit from.

### **PRINCIPLE OF LIABILITY IN SPACE LAW**

The liability principle in space law, established by the 1967 Outer Space Treaty's Articles VI and VII, has been refined through the 1972 Liability Convention. This section examines the

practical framework for resolving disputes from space activities, focusing on the sources of liability in space law as well as the liability regime applicable to activities in space.

### **SOURCES OF LIABILITY IN SPACE LAW**

The 1967 Outer Space Treaty, a cornerstone of space law, introduced the principle of liability via its practical approach, ensuring the continuing relevance of this legal structure. Article VI establishes the 'responsibility' principle, stipulating that states supervise their own space operations, as well as those of their nationals or authorised entities.

The Article implies states' obligations to regulate not only their own space endeavours but also those carried out by non-government entities, particularly private firms under their jurisdiction. National laws meticulously outline the authorisation process for private entities' space activities. This responsibility framework extends to liability for potential damage, embodying the liability principle.

Article VII further contributes to this topic by asserting that states are internationally liable for damage caused by their space activities to another state or its nationals. This Article differentiates liability from the responsibility principle in Article VI.

Whereas responsibility entails a structured framework for space activities, including granting authorisation and maintaining oversight, liability assigns accountability for damage resulting from these activities. The Outer Space Treaty thus inaugurates a comprehensive liability regime for both private and public activities in outer space; however, the Liability Convention further expands on this liability framework within space law.

### **LIABILITY REGIME IN SPACE LAW**

The Liability Convention significantly enhances the liability framework introduced by the Outer Space Treaty's Article VII. This Convention meticulously refines the international liability regime for space activities by addressing the ambiguities and gaps of its predecessor.

The Convention delineates state responsibilities for damage caused by their space objects, shedding light on liability and compensation mechanisms. It facilitates a safety-conscious environment for space activities, promoting responsible behaviour in space exploration.

The Convention also encourages proactive measures to prevent accidents while providing a legal basis for handling the aftermath of unforeseen incidents. It introduced the concept of dual liability (i.e., strict liability for accidents on Earth and in airspace (Article II) and fault-based liability for outer space accidents (Article III)), coupled with a system of joint and several liability (Article V).

Article I of the Convention defines essential terms.<sup>[23]</sup> Consequently, it serves as a crucial tool in managing space exploration repercussions, emphasising the importance of liability in space law.

### **NO-FAULT LIABILITY FROM EARTH TO SPACE**

Article II of the Liability Convention sets forth a no-fault liability principle, stipulating that a launching state is absolutely liable for damage caused by its space object on Earth's surface or to aircraft in flight. This implies that liability applies regardless of fault during a launch sequence.

This principle affirms that launching states must ensure successful launches, considering their predictability at this stage. Despite inherent risks in space activities, launch operators

can predict the launch window and prevent collisions with aircraft or unauthorised airspace intrusion.

Failure to meet these standards makes the launching state liable for any resultant damage, emphasising the necessity for caution during launch processes and thorough assessments for launch authorisations granted to private operators.

A case in point is the 1978 Kosmos 954 incident.<sup>[24]</sup> The satellite, launched by the Soviet Union, malfunctioned and scattered radioactive debris over northern Canada upon re-entry. The Canadian government, invoking the Outer Space Treaty, claimed more than C\$6 million from the USSR for the clean-up operation, dubbed Operation Morning Light. Eventually, the USSR compensated Canada with C\$3 million, exemplifying the Treaty's role in managing the repercussions of space-related incidents.

### **FAULT-BASED LIABILITY IN SPACE**

Article III of the Liability Convention enshrines a fault-based liability principle. It establishes that in outer space, the launching state is liable only if the damage caused to another state's space object is due to its fault or the fault of the persons under its responsibility.

This principle implies that, if a state suffers damage in space, it must prove the fault of the other state to obtain compensation; however, proving fault can be challenging, particularly with issues such as space debris where the ownership is often ambiguous.

An illustrative example is the 2009 collision between the operational Iridium 33 satellite and the decommissioned Russian military Kosmos 2251 satellite.<sup>[25]</sup> This incident shows the difficulties in proving wrongdoing; it remains unclear whether one of the satellites was at fault and whether fault could be proven conclusively.

The complexities of attributing fault and liability are exacerbated by the prevalence of space debris. These fragments, often not traceable or attributable, pose a significant risk to operational space objects. Despite these challenges, Article III remains a pragmatic mechanism. A no-fault liability principle could lead to a significant increase in litigation owing to the frequency of space debris-related incidents, as indicated by frequent reports from the International Space Station. Thus, Article III strikes a balance in space law, fostering responsible conduct while providing a recourse for addressing damage.

### **OTHER LIABILITY MECHANISMS PROVIDED BY THE CONVENTION**

The Convention<sup>[26]</sup> introduces auxiliary mechanisms to fortify the liability regime. Article V institutes a joint and several liability system for states launching a space object jointly. Articles VIII to XI establish a system for compensation claims through diplomatic channels within one year. Additionally, a claims commission is set up to handle disputes (Article XIV et seq.).

The Convention's liability regime for space activities is pragmatic, offering a robust framework for potential disputes arising from space-related damage. The primary challenge, however, lies in the technical means of self-protection and determining liability in outer space, as the growing incidents involving space debris exemplify. These mechanisms, despite their challenges, reinforce the Convention's commitment to responsible and accountable space activities.

### **KEY ACTORS IN THE SPACE INDUSTRY**

The space sector would not have legal domains without space activities and associated actors. Historically, public entities were the driving forces behind the space sector during the Cold War era, at a time when the world was less liberalised. In recent decades, however, numerous private actors have emerged, revolutionising the space sector.

### **PUBLIC AND INSTITUTIONAL ACTORS**

Space exploration, although a platform for superpower rivalry, has also advanced for the benefit of humanity's benefit. Notable missions, such as the 1970s Voyager 1 and 2 probes and the James Webb Space Telescope,<sup>[27]</sup> were spearheaded by public entities.

They have retained a crucial role in the space sector, leading space research, developing space law, advancing space technologies and implementing space programmes. It is important to distinguish between international institutional actors such as the United Nations and national public entities in space activities.

### **UNITED NATIONS ORGANISATION FOR THE SPACE SECTOR**

The United Nations primarily handles space affairs through COPUOS and its secretariat, the United Nations Office for Outer Space Affairs (UNOOSA).

Established in 1958,<sup>[28]</sup> COPUOS promotes international cooperation in the peaceful use of outer space and offers recommendations on space exploration and utilisation issues. From 18 members at inception,<sup>[29]</sup> it had grown to 92 members as of 2019, making it one of the UNGA's largest committees.<sup>[30]</sup> COPUOS has two subsidiary bodies that were established in 1961:<sup>[31]</sup> the Scientific and Technical Subcommittee and the Legal Subcommittee, which annually formulate an internationally accepted framework to support outer space activities.

UNOOSA, established in 1958, serves as COPUOS's secretariat. Initially, a small expert unit within the UN Secretariat, UNOOSA underwent several structural changes and relocated to Vienna, Austria, in 1993. UNOOSA facilitates the implementation of COPUOS decisions, aids in applying major international treaties, legal principles and UNGA resolutions forming space law, and advises governments and non-government organisations on space law. It also maintains a space object registry, convenes space-related discussions, and sponsors programmes providing access to space technology.

### **MAJOR SPACE AGENCIES**

Historically, significant space agencies, such as the National Aeronautics and Space Administration (NASA), Roscosmos State Corporation for Space Activities in Russia, ESA, the French National Centre for Space Studies (CNES) and the Japan Aerospace Exploration Agency (JAXA), have been instrumental in pioneering space exploration.

NASA, established in 1958, is renowned for iconic space missions such as the Apollo programme, which led to the first manned lunar landing. Roscosmos, the successor to the Soviet space agency, has its roots in significant milestones such as launching Sputnik, the first artificial satellite, and sending Yuri Gagarin, the first human in space.

The ESA, created in 1975, is an intergovernmental organisation that includes several European countries. It has been involved in numerous space missions, including Earth observation satellites and planetary exploration missions. France's CNES has been a major space player since its establishment in 1961, launching its first satellite, Astérix, in 1965, and significantly contributing to the ESA.

JAXA, despite its relatively recent establishment in 2003, has accomplished notable missions such as Hayabusa, which returned asteroid samples to Earth.

Emerging space agencies are increasingly marking their presence in space exploration, contributing to advancements in technology, research and inter-national cooperation.

The China National Space Administration (CNSA) has rapidly risen to prominence with several significant achievements. Established in 1993, it has launched numerous successful missions, including the Chang'e lunar exploration programme, which aims to explore the Moon's South Pole. The Tianwen-1 Mars rover, launched in July 2020, represents another milestone, marking China's first independent Mars mission. The CNSA also launched the Tiangong space station, highlighting China's growing capabilities in manned space missions.

The Indian Space Research Organisation (ISRO), founded in 1969, has made remarkable strides in space technology. Though ISRO is not a new agency, its recent achievements place it among the emerging space powers. The Chandrayaan-1 mission in 2008 marked a milestone by discovering water molecules on the Moon. Following this, the Mars Orbiter Mission in 2013 made India the first Asian country to achieve Martian orbit and the fourth space agency globally to reach Mars.

The United Arab Emirates (UAE) Space Agency, established in 2014, has demonstrated the UAE's ambitious vision for space exploration. The Mars Hope mission, launched in July 2020, made UAE the fifth country to reach Mars. The probe will study Mars' atmosphere, and is the first such mission from an Arab nation.

Other emerging space agencies, such as the recently established Saudi Arabian Space Commission,<sup>[32]</sup> the Australian Space Agency and the New Zealand Space Agency, are also making strides in space technology and exploration. These agencies are focusing on areas such as satellite technology, space law and policy, and inter-national space partnerships, contributing to the global space sector's growth and diversity.

Also notable is the expenditure by world governments on space programmes (taking 2022 as an example),<sup>[33]</sup> although these budgets may not necessarily reflect the respective space agencies' operational capabilities.

#### GOVERNMENT EXPENDITURE IN 2022

Country/Region	Government expenditure on space programmes (US\$ millions)	National space agency
United States	National Aeronautics and Space Administration	
China	China National Space Administration	
Europe	European Space Agency	
Japan	Japan Aerospace Exploration Agency	
France	National Centre for Space Studies	
Russia		

	Roscosmos State Corporation for Space Activities	
European Union <sup>[[34]]</sup>	European Union Agency for the Space Programme	
Germany	German Aerospace Centre	
India	Indian Space Research Organisation	
Italy	Italian Space Agency	
United Kingdom	UK Space Agency	
South Korea	Korea Aerospace Research Institute	

### SPACE AGENCY ACTIVITIES

Space agencies are crucial entities driving the advancement of space exploration, scientific research, technology development and international cooperation. They orchestrate both manned and unmanned space missions, with the former involving astronauts for research or exploration purposes, and the latter deploying robotic spacecraft for a range of purposes from planetary exploration to satellite deployment and operation of space telescopes.

In the realm of scientific research, space agencies use satellites and space telescopes to observe and collect data about Earth<sup>[35]</sup> and the wider universe. They also conduct experiments in a variety of scientific fields, such as astrophysics, astronomy, planetary science and astrobiology.

Technology development is another critical role of space agencies, embracing the design, development and launching of spacecraft and launch vehicles. They also contribute to the innovation of cutting-edge technologies suitable for space environments, including propulsion systems and communication technologies.

Also significant are the contributions of space agencies to the formulation of national and international space policies and their engagement in collaborative efforts with other countries and space agencies to promote shared goals and avoid conflicts.

In the context of national security, some space agencies develop and manage satellite systems for communication, surveillance and reconnaissance. They also monitor space objects to ensure the safety of space activities and prevent collisions in orbit.

Space agencies also develop and fund programmes of national interest, designed to ensure the sovereign strategic independence of states. These projects can range from developing a space launch vehicle to setting up a constellation of geonavigation satellites or Earth observation systems.

Finally, education and outreach form an important part of the work of space agencies. They engage with the public through educational programmes, public talks and media outreach, and they support educational initiatives to encourage students to pursue careers in the space sector.

In summary, space agencies are multifaceted organisations with diverse teams of scientists, engineers, technicians and administrators working collaboratively to achieve their objectives. The roles and competences of different agencies may vary but all contribute significantly to space exploration and technology development.

### **PRIVATE ACTORS**

The rise of private actors in the space sector has been a recent trend. Technological advances in manufacturing propulsion and launch have made it much easier and less expensive to venture into space and conduct missions.

The European Space Policy Institute (ESPI) has reported that private actors are playing a more prominent part in the space sector.<sup>[36]</sup> The ESPI report highlights the viewpoint of some observers on the traditional space sector: 'Old Space . . . is slow, bureaucratic, government-directed, and completely top-down. . . . New Space is the opposite of all that. It's wild. It's commercial, bootstrapping, imaginative, right up to the point of being delusional.'<sup>[37]</sup>

Public space agencies have traditionally been the main investors in space but with the combination of lower costs and sophisticated technology, the sector is attracting more investments from the private sector. For instance, in 2021, the private sector funding in space-related companies topped US\$10 billion – an all-time high and roughly a tenfold increase over the past decade. The percentage of global space funding on research and development by the US government decreased from about 70 per cent to about 50 per cent over the same period.<sup>[38]</sup> Meanwhile, the number of space-related start-ups funded annually increased more than twofold from 2010 to 2018.<sup>[39]</sup> It estimated that commercial funding could surpass government funding within 20 years, a trend that governments are largely embracing and that could lead to mutually beneficial public–private partnerships.

### **TRADITIONAL SPACE SECTOR**

The traditional actors in the space sector primarily consist of both industrial entities and space operators, including satellite operators.

### **INDUSTRIAL ACTORS**

The space industry is a specialised sector dedicated to space-related activities<sup>[40]</sup> and primarily involves the manufacturing of space systems' components, including spacecraft, artificial satellites, launchers and more. This sector distinguishes itself from space commerce, which encompasses a broader range of activities. The space industry's narrow definition includes only hardware providers, mainly associated with launch vehicles and satellites.<sup>[41]</sup> Traditionally, this industry comprises private sector enterprises that fulfil orders for government agencies involved in space programme development.

The space industry is structured around three primary sectors: satellite manufacturing, support ground equipment manufacturing and the launch industry. Satellite manufacturing involves the production of satellites and their subsystems; the ground equipment sector manufactures essential components, including mobile terminals, control stations, very-small-aperture terminals, direct broadcast satellite dishes and other specialist equipment; and the launch sector is responsible for providing launch services, vehicle manufacturing, and subsystem production.<sup>[42]</sup>

Historical industrial actors in the space sector include renowned companies such as Boeing, Lockheed Martin and Northrop Grumman in the United States, and Airbus, ArianeGroup,

Thales, Safran, Avio and OHB in Europe.<sup>[43]</sup> These companies not only manufacture space equipment but also develop space technologies, conduct space missions and provide space services, playing a crucial role in advancing the global space industry.

### **PRIVATE SPACE OPERATORS**

A space operator is an entity or organisation responsible for orchestrating the planning, management and execution of activities relating to space assets operation, such as satellites, spacecraft, space probes and other equipment deployed in outer space. These operators are instrumental in maintaining the functionality and achieving the objectives of space missions.

Space operators can be categorised into space launch operators and satellite operators. Space launch operators, such as SpaceX, Arianespace, United Launch Alliance<sup>[44]</sup> and Rocket Lab, provide the critical service of launching satellites, spacecraft or other payloads into specific orbits or trajectories.<sup>[45]</sup> Their services are fundamental for deploying satellites used for communication, Earth observation, scientific research and national security. These operators cater to various clients, including private companies, government agencies and international organisations, managing the technicalities of launch logistics, mission planning and actual launch operations.

Satellite operators, such as Eutelsat, Intelsat, Telespazio, SES, Iridium and Planet Labs, manage satellites and space infrastructure. Their services range from telecommunications to high-resolution Earth imaging, affecting various industries. Their responsibilities encompass satellite deployment, control, payload operations, data reception and processing, and mission planning. They ensure satellites are launched into designated orbits and remain in their intended orbits, and that their payloads, which could include communication transponders, cameras, sensors, or scientific instruments, function effectively. Additionally, they receive and process data transmitted by satellites and disseminate the information to end-users. Depending on their focus, these operators may provide services globally or cater to specific regions, industries or applications.

### **NEW SPACE SECTOR**

The New Space movement, an industrial and entrepreneurial trend that has arisen during the past decade, brings novel initiatives to the space industry, including space tourism, satellite constellations and space launches. It has been instrumental in driving innovation within the space sector. Notably, SpaceX has pioneered reusable rockets and spacecraft, significantly reducing the cost of space launches. Blue Origin is working on a lunar lander, potentially facilitating a human return to the Moon within the next decade. Furthermore, Virgin Galactic is crafting a spaceplane to enable space tourism.

A comprehensive analysis of the New Space sector is provided in the final section of this chapter; however, it is worth highlighting some prominent companies within the New Space domain:

- SpaceX (Space Exploration Technologies Corporation) – United States (established by Elon Musk): renowned for developing reusable rocket technology and has ambitious space exploration plans.
- Blue Origin – United States (founded by Jeff Bezos): concentrates on creating reusable rocket systems and engages in space tourism ventures.



- Rocket Lab – New Zealand/United States: excels in offering cost-effective launches for small satellites via its Electron launch vehicle.
- OneWeb – international: a subsidiary of the Eutelsat Group since 2022 that aims to establish a global satellite constellation for broadband internet access.
- Virgin Galactic – United States (led by Sir Richard Branson): a trailblazer in commercial space tourism with its suborbital spaceplane, SpaceShipTwo.
- Relativity Space – United States: leverages 3D printing technology to produce rockets, aiming to revolutionise rocket production.
- Planet Labs – United States: specialises in Earth observation, using a large constellation of small satellites to capture high-resolution imagery.
- Clearspace – Switzerland: committed to space debris removal and satellite servicing, addressing the escalating issue of orbital debris.
- UnseenLabs – France: uses small satellites for Earth observation, focusing on maritime surveillance and vessel tracking.

### **SPACE INDUSTRY AND ITS ACTORS, CUSTOMERS AND MARKET SEGMENTS**

The space industry, growing at an annual rate of 6.7 per cent since 2005,<sup>[46]</sup> is a dynamic and lucrative market that is attracting investors owing to its promising prospects. The global revenue of the space sector, which was around US\$240 billion in 2018, is projected to increase tenfold by 2040.<sup>[47]</sup> The reduction in entry costs has opened the sector to new players, including emerging states and private entities such as Amazon's Jeff Bezos and SpaceX's Elon Musk.

Key market segments include telecommunications, Earth observation, space tourism, launch services and satellite services. Companies such as Intelsat and SES provide satellite communications services integral to global networks. Earth observation companies, including Maxar Technologies and Planet Labs, use satellite data for various applications. In the budding space tourism market, companies such as SpaceX, Blue Origin and Virgin Galactic offer unique experiences. Launch services are provided by SpaceX, Rocket Lab and Arianespace, among others, catering to diverse payloads. Radio and television broadcasting and other satellite-based services are offered by companies such as SiriusXM and DirecTV.

In summary, the space industry's landscape is a dynamic ecosystem of public and private actors collaboratively shaping the future of space exploration and commercial space applications, unlocking the vast potential of outer space.

### **BEYOND EARTH'S GRAVITATIONAL PULL: CONTEMPORARY CHALLENGES TO NEW SPACE RACE**

The past decade has witnessed the emergence of an industrial phenomenon that has revolutionised the space sector: New Space. It is essential to understand that the rise of New Space has been facilitated by the enactment of new legislation and it is important to consider the legal, ethical, and political debates entailed by New Space.

### **HOW SPACE LAW PRINCIPLES ALIGN WITH AND ADAPT TO THE EVOLVING LANDSCAPE OF SPACE ACTIVITIES**

The space sector has undergone significant transformations in the past two decades, particularly within the industrial sector, which has cultivated new activities and economic

strategies. The catalysts behind this evolution are the actors within the New Space movement. Although there is no legally precise definition, several characterising elements define New Space:

Born in the United States at the instigation of NASA as an efficiency initiative, the New Space phenomenon continues to generate interest from the public and governments around the world, offering the promise of a space sector finally accessible to as many people as possible thanks to the magic of a few audacious businessmen.<sup>[48]</sup>

## EVOLUTION OF SPACE ACTIVITIES AND THE ADVENT OF NEW SPACE

The concept of New Space signifies a paradigm shift in the space industry, driven by innovative technologies, entrepreneurial ventures and a departure from traditional government-centric approaches. Originating in the United States, New Space is characterised by a dynamic ecosystem of pioneering companies, visionary entrepreneurs and cutting-edge technologies, all facilitated by a supportive legal framework<sup>[49]</sup> tailored to commercial space activities.<sup>[50]</sup>

The term 'New Space' represents a dynamic evolution from the traditional space industry. In clear contrast to the era of Old Space, characterised by the predominant influence of government agencies and large corporations, New Space signifies a democratisation of the cosmos, allowing a diverse array of actors to actively participate and innovate.

The fundamental distinction between Old Space and New Space lies in their respective roles within the space industry. In the Old Space era, projects revolved around functioning as industrialists dedicated to servicing national space agencies. Essentially, these companies operated as manufacturers, producing space objects exclusively for government agencies, which, in turn, assumed the responsibility of executing their space missions, particularly on the institutional front.

This transformative wave in the space sector has yielded a multitude of technological breakthroughs and has given rise to entirely new business sectors. The key hallmarks of New Space encompass the following:

- *Private entrepreneurship: Private companies, often funded by visionary entrepreneurs and private investors, have an increasingly important role in the development and operation of space activities.*
- *Technological innovation: The New Space is characterised by the adoption of innovative technologies, such as mini-satellites, satellite constellations, reusable launchers, 3D printing and artificial intelligence, which reduce costs and increase efficiency.*
- *Innovative business models: New Space companies are exploring new business models, such as the provision of space services, the sale of satellite data, in-orbit services, space debris mitigation (debris monitoring, cleaning satellites, etc.), space tourism and other non-traditional commercial applications.*
- *Increased accessibility to space: Efforts to reduce costs and make space more accessible are at the heart of the New Space movement. These include the reuse of*

*rocket components, the standardisation of space technologies and other strategies to lower barriers to entry.*

Prominent players in the New Space arena include aforementioned industry leaders alongside a multitude of dynamic start-ups. In the European context, there are also notable start-ups such as Unseen Lab, The Exploration Company, Isar Aerospace, Clearspace, and many more. These companies demonstrate the transformative potential of New Space ventures, driving innovation and pushing the boundaries of space exploration and technology.

It is essential to understand, however, that New Space is an ideological movement, modernising the sector in technological, industrial and economic terms, but its legal aspect has not undergone a similar transformation. The legal framework supporting New Space endeavours largely accommodates private companies, fostering their development through permissive legislation<sup>[51]</sup> and partnerships with public players.<sup>[52]</sup>

The transition from Old Space to New Space marks a significant shift in the space industry, both legally and operationally. Old Space entities primarily acted as contractors for national space agencies, manufacturing space objects while agencies operated their missions. For instance, the aim of the Ariane project was to build a European launcher, leading to the creation of Arianespace in the 1980s, dominating the telecommunications satellite launch sector until SpaceX's arrival in 2009.

New Space, led by SpaceX, operates differently, acting as its own space operator for both institutional and commercial missions. Unlike Old Space, which supplied equipment but did not operate missions, New Space companies directly conduct missions; for example, NASA now subcontracts missions to private companies rather than operating them directly, as seen in resupplying the International Space Station since 2016.

This shift extends to lunar missions, with NASA subcontracting transport missions to private operators, which is indicative of a broader trend. As New Space companies take on more operational roles, the traditional model of space agency-led missions is evolving, signifying a pivotal change in the space sector's approach and paradigm.

## **NATIONAL SPACE REFORMS THAT HAVE ENABLED NEW SPACE DEVELOPMENT**

The emergence of New Space, driven by permissive legislation encouraging entrepreneurial endeavours in the space sector, marks a significant ideological shift. Spearheaded by the United States through the enactment of the US Commercial Space Launch Competitiveness Act (CSLCA) in 2015,<sup>[53]</sup> the aim of this legislative move was to complement existing space laws and stimulate growth in the commercial space industry.

The CSLCA encompasses various aspects of space activities, including launch licensing, use of space resources, extended liability, indemnification, streamlining regulations, space traffic management, interagency coordination, remote sensing regulations and the development of space tourism. By providing a supportive legal framework, the CSLCA facilitates innovation, economic growth and competition in the commercial space sector, notably by promoting the exploration and exploitation of space resources.

Additionally, measures such as NASA's long-term commitments, anchor tenancy provisions and the Buy American Act<sup>[54]</sup> further support the development of New Space ventures in the

United States by fostering a favourable business environment and bolstering the domestic institutional market.<sup>[55]</sup>

Following the US lead, other countries such as Luxembourg<sup>[56]</sup> and the United Arab Emirates,<sup>[57]</sup> have adopted similar legislative frameworks to promote New Space within their jurisdictions. For instance, Luxembourg has been proactive in promulgating space legislation, particularly concerning the use of space resources, aiming to attract private investment and stimulate commercial activities.

International agreements such as The Artemis Accords,<sup>[58]</sup> signed by multiple countries, including the United States and Luxembourg, aim to codify principles for space exploration and encourage private investment in the sector. Not all states share this vision, however, as evidenced by rival initiatives such as the International Lunar Research Station programme led by China and Russia.

The legal landscape surrounding New Space activities raises complex questions regarding compliance with international space law. Although national laws provide support for private space ventures, ensuring harmony with international treaties remains a challenge. Issues such as property rights in space, liability for space accidents and space traffic management regulation require careful consideration and international cooperation.

In summary, the rise of New Space signifies a transformative shift in the space industry, fuelled by permissive legislation, entrepreneurial initiatives and international collaboration. Although national laws lay the groundwork for commercial space activities, ensuring adherence to international space law remains crucial for the sustainable development of the New Space sector.

## **SPACE ACTIVITIES ENVISAGED BY NEW SPACE AND RELATED DEBATES**

As New Space is an ideological process seeking to conquer new activities in space, these New Space activities prompt a consideration of their legality under international space law. Whereas some are explicitly permitted or raise ethical and political debates, others spark complex legal discussions, highlighting the need for doctrinal interpretation of international treaties.

### **RELATED ETHICAL AND POLITICAL DEBATES**

The burgeoning New Space sector has sparked discussions surrounding its ethical, political and environmental implications, particularly concerning space tourism and the proliferation of satellites in low orbit, notably mega-constellations for high-speed internet.

One critical aspect of these activities is how they affect the environment, including the increasing number of space launches and their potential effects on the atmosphere. Studies have shown that rocket launches can significantly affect the troposphere and stratosphere, potentially damaging the ozone layer. For instance, frequent launches in the past – particularly following NASA's Space Shuttle launches – have caused holes in the ozone layer above Cape Canaveral, leading to increased ultra-violet radiation exposure and health risks. With the current surge in launch frequency, primarily driven by mega-constellations, concerns about environmental repercussions intensify.<sup>[59]</sup>

Mega-constellations pose multifaceted challenges from environmental, operational, economic and societal perspectives. Their proliferation in low Earth orbit raises concerns about the viability of space operations owing to the potential onset of Kessler Syndrome. This

phenomenon, first hypothesised in 1978 by NASA consultant Donald J Kessler, describes a scenario in which the accumulation of space debris reaches a critical threshold, leading to cascading collisions and rendering space activities unfeasible for generations. This risk has drawn attention from specialists, industry leaders and even heads of administrations in the space sector,<sup>[60]</sup> highlighting the urgency of mitigating space debris and managing orbital congestion.

Although New Space activities offer promising opportunities, careful management is essential to prevent adverse consequences for both the space sector and society at large. Balancing innovation with environmental stewardship, regulatory frameworks must address the sustainability of space operations while fostering technological advancement and economic growth. Collaboration between stakeholders, including governments, private companies and inter-national organisations, is crucial to develop effective strategies for exploring and using space responsibly.

In conclusion, the rise of New Space activities brings significant benefits and challenges, prompting discussions on ethical, political and environmental dimensions. Addressing these concerns requires proactive measures to mitigate environmental effects, to prevent the proliferation of space debris and to ensure sustainable development in the space sector. By fostering collaboration and responsible governance, the potential of New Space can be harnessed while safeguarding the future of space exploration for generations to come.

### **COMPATIBILITY WITH INTERNATIONAL SPACE LAW**

New Space activities bring forth significant legal considerations, particularly regarding the exploitation of space resources and liability issues arising from satellite collisions and space debris clean-up missions.

The exploitation of space resources, enabled by regulations such as the US Commercial Space Launch Competitiveness Act,<sup>[61]</sup> has sparked debates about its legality and adherence to international space treaties. Although the Act grants property rights to US private companies over space resources,<sup>[62]</sup> interpretations of the Outer Space Treaty vary. Some argue that resource exploitation is permissible as long as it serves peaceful purposes and does not involve national appropriation,<sup>[63]</sup> whereas others contend that any such activity infringes on the Treaty's mandate for the common benefit of humanity.<sup>[64], [65]</sup> The aim of The Artemis Accords,<sup>[66]</sup> initiated by the United States, is to facilitate private enterprise in space exploration and resource mining, further complicating the legal landscape.

Satellite collisions and the proliferation of space debris present additional legal challenges. Although past incidents have mostly involved unidentified space debris, the rise of mega-constellations increases the risk of collisions between satellites.<sup>[67]</sup> This underscores the importance of arbitration in resolving liability disputes in the space sector, especially as identifying satellite ownership becomes more feasible.

Furthermore, initiatives to clean up space debris, such as ClearSpace-1,<sup>[68]</sup> face legal complexities. Companies conducting clean-up missions must obtain authorisation from the registering state and the associated space operator; however, complications arise if the debris being cleared has collided with another object, necessitating permission from the controlling state of the third-party debris. This scenario becomes even more intricate when multiple states are involved in the clean-up operation.

Moreover, the feasibility of clean-up missions is constrained by the risk of causing further accidents and incurring liability. If a clean-up mission authorised by a first state results in new accidents that render operational satellites of third states inoperative, the authorising state may be held accountable and required to compensate affected states. This potential financial burden may dissuade states from engaging in or authorising such missions, despite the pressing need for orbital debris mitigation.

Therefore, there is a pressing need for new international legal rules to regulate space clean-up missions and limit liability, potentially through the establishment of an international control committee or arbitration mechanisms. These rules could ensure that clean-up missions are conducted in the interests of all and provide clarity on liability issues. In the interim, arbitration remains crucial for addressing potential future challenges and resolving disputes in the space sector.

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