**UNIVERSIDADE CATÓLICA PORTUGUESA**

# Privatisation and Commercialisation of Outer Space

To what extent do the Outer Space Treaty and the Moon Agreement allow the exploitation of outer space resources?

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To my wonderful parents, my biggest supporters.

I love you to the Moon and back.

## Abstract

The continuous increase in the emergence of new private plans to exploit and commercialise outer space has highlighted the limitations of the current legal framework and its inability to adapt to the new realities in outer space.

This dissertation aims to provide an introduction to international space law and study the extent to which the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, commonly known as the Outer Space Treaty, and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, commonly known as the Moon Agreement, are legal instruments capable of addressing the contextual changes that have taken place in the outer space industry.

In Chapter One, we will contextualise and introduce international space law, and explain how the roles of private actors have evolved since the beginning of the Space Age.

Chapter Two will analyse the limitations of the Outer Space Treaty and the Moon Agreement on the commercialisation of space resources.

Finally, in Chapter Three, we will discuss the American proposal for a new legal instrument that approaches the exploitation and exploration of outer space resources: The Artemis Accords.

*Keywords*: International Space Law, Outer Space Treaty, Moon Agreement, Space Resources Exploitation, Privatization of Space Resources

## Resumo

O aumento contínuo no surgimento de novos planos privados para explorar e comercializar o espaço sideral destacou as limitações do quadro jurídico atual, bem como a sua incapacidade de se adaptar às novas realidades no espaço exterior. Esta dissertação tem como objetivo fornecer uma introdução ao direito internacional do espaço e estudar em que medida o Tratado sobre Princípios Reguladores das Atividades dos Estados na Exploração e Utilização do Espaço Exterior, incluindo a Lua e outros Corpos Celeste, comumente conhecido como Tratado do Espaço Exterior, e o Acordo que regula as atividades dos Estados na Lua e em outros Corpos Celestes, comumente conhecido como o Tratado da Lua, são instrumentos legais capazes de lidar com as mudanças contextuais que ocorreram na indústria espacial.

No Capítulo um, forneceremos uma contextualização e uma introdução ao direito internacional do espaço, e explicaremos a evolução dos papéis dos atores privados desde o início da Era Espacial.

No Capítulo dois, analisaremos as limitações do Tratado do Espaço Exterior e do Acordo da Lua sobre a comercialização de recursos espaciais.

Finalmente, no capítulo três, exploraremos a proposta americana para um novo instrumento jurídico: Os Acordos Artemis.



*Palavras-chave*: Direito Internacional do Espaço, Tratado do Espaço Exterior, Acordo da Lua, Exploração de Recursos Espaciais, Privatização de Recursos Espaciais

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## Introduction

Government initiatives have previously been the sole source of space exploration and exploitation. Despite this, the space industry has significantly transitioned towards privatisation and commercialisation with the increasing involvement of private entities. There has been a lot of concern over this phenomenon since the current legal framework for outer space activities is primarily designed to regulate government activities.

The Outer Space Treaty[1] referred to herein as the OST, and the Moon Agreement, referred to herein as the MA, two of the most prominent international agreements governing space activities, were adopted when private entities were not considered significant actors in the space industry. Due to this, it is questionable whether they can address the challenges that arise from the privatisation and commercialisation of outer space.

In the first chapter, we aim to introduce international space law, provide historical context, and understand the sources of international law and the evolution of the role of private actors in the space industry.

The second chapter examines the extent to which the OST and the MA allow for the exploitation of outer space resources by private entities and the limitations of the current legal framework.

In chapter three, the dissertation will discuss the American proposal for a new legal regime, the Artemis Accords.

[1]"Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies." Opened for signature January 27, 1967, UNGA resolution 2222 (XXI), accessed October 15, 2022, https://www.unoosa.org/pdf/gares/ARES_21_2222E.pdf.

## Chapter One

## Historical Evolution and Use of Outer Space

Humans have always looked at the stars to find their place in the universe. Our ancestors used them to navigate across oceans and measure time, and today we depend on them for our daily activities. Advances in technology have allowed us to explore and exploit outer space in ways our ancestors could never have dreamed of. The Cold War played a significant role in the development of space technologies as the competition for hegemony between the United States of America (USA) and the Union of Soviet Socialist Republics (USSR) reached the stars.[2] The space race culminated in a significant development of technology and innovation, effectively paving the way for future explorations.

The Soviet launch of Sputnik-1 in 1957 showcased the growing need for a normative foundation of space activities and the emphasis on international cooperation for the peaceful uses of outer space.[3] The launch of the first artificial satellite urged international space law discussions. By 1958, the United Nations (UN) had put in place the Committee on the Peaceful Uses of Outer Space (COPUOS) via Resolution 1348 (XIII)[4], tasked with studying and recommending solutions to problems arising from the exploration and use of outer space for peaceful purposes from the scientific, technical, and legal perspectives. COPUOS has 100 members as of May 2023,[5] and two subsidiary organs: the Legal Subcommittee and the Scientific and Technical Subcommittee.[6] COPUOS contributed to creating the five main international space law treaties[7], which we will further discuss in the next section.

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[2]Tronchetti, *Fundamentals of Space Law and Policy*, 65.
[3]Tronchetti, *Fundamentals of Space Law and Policy*, 65.
[4]Resolution 1348 (XIII), UN General Assembly, Question of the Peaceful Use of Outer Space, December 13, 1958, accessed October 15, 2022, from https://www.unoosa.org/oosa/oosadoc/data/resolutions/1958/general_assembly_13th_session/res_1348_xiii.html.
[5]"COPUOS Membership Evolution," Committee on the Peaceful Uses of Outer Space: Membership Evolution, accessed March 28, 2023, https://www.unoosa.org/oosa/en/ourwork/copuos/members/evolution.html.
[6]Von der Dunk, "International Space Law as a Branch of Public International Law," 37.
[7]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, the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space of 1968, the Liability

Since the beginning of the Space Era, the utilisation of outer space for our benefit has skyrocketed. From weather forecasts to GPS navigation to TV, telecommunications and banking transactions, outer space has become crucial in our daily activities.

The space industry is metamorphosing into commercial space activities comprising public and private actors. What was once monopolised by states has become a multistakeholder. Private entities are playing an increasing role in space utilisation and exploration. The entrants have gained a presence in the industry, reaching 12 000 companies in the space sector by 2021, as opposed to 140 governmental organisations[8], and by 2030 the private sector will represent 35% to 40% of global space activities.[9]

The goal of space exploration has shifted from the Cold War ideology of hegemony to an economic purpose[10], with the new actors aiming for profits and new technologies. What was once a search for supremacy and scientific discovery has become a search for new markets and profits.

A new distribution of roles between public and private actors has emerged as the private sector can launch and operate space objects.[11] At the beginning of the Space Age, states were the only participants as they were the only ones capable of bearing the costs of research and development projects and launching space objects. In contrast, now, the state no longer instigates projects but acts as an investor to private actors.[12] As a result, international space law came to be primarily 'state-centric'[13].

The existing international legal framework faces many uncertainties and legal questions. Times have changed since the writing of the treaties, and the drafters could not have envisaged that the space sector would become a 250 to 350 billion US dollar

Convention of 1972, the Convention on Registration of Objects Launched into Outer Space of 1975 and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies of 1979.
[8]SpaceTech Analytics, "SpaceTech Industry Year Overview," 10.
[9]Bruno Reynaud de Sousa and Christos Ch. Kypraios, "O Papel Da Empresa No Espaço Exterior: Questões Jurídicas Relativas à Exploração Mineira de Asteroides," in *Las Empresas Transnacionales En El Derecho Internacional Contemporáneo: Derechos Humanos y Objetivos de Desarrollo Sostenible* (Valencia: Tirant lo Blanch, 2020), 151–69.
[10]Degrange, "Nouveaux acteurs, nouvelle gouvernance : faire du droit spatial à l'ère du New Space," 155–56.
[11]Degrange, 162.
[12]Degrange, Nouveaux acteurs, nouvelle gouvernance.
[13]Kumar, Subramanian, and Raju, "Viewpoint Research 'Envoys of Mankind' in the Era of Commercial Human Spaceflight."

market[14] made up of states and private entities. This leads to whether the current legal framework established by states via treaties and UN resolutions can be applied to the new actors and uses of space. First, we will analyse the sources of International Space Law.

## Sources of International Space Law

The advancement of technology has been significant and fast-paced, and space law must keep up. The engines that drive the creation of space law are science and technological progress.[15] Tronchetti adds three more elements that move space law forward. Besides the technical and scientific developments that broaden the uses of space technologies, he adds the growing number of space-capable nations and the privatisation of space activities and commercial utilisation.[16] Therefore, as outer space is increasingly explored and exploited, space law must continue growing and evolving.

Adapting to the new challenges of the Space Age required a new branch of international law. Mandl discussed it in a study as early as 1932, where he predicted that air law would not be able to address the new challenges of launching rockets to space, and thus a new branch of international law was needed.[17]

Manuel Catarino defines international space law as a branch of public international law regulating space activities in and for space. It includes all process stages, from manufacturing, operating, launching and returning space objects and all effective control activity over them[18].[19]

Tronchetti and Steer positions space law within public international law.[20] We believe that this is no longer the case. As private entities enter the market, state actors are not the only ones engaging in the space market. We maintain that private international law also plays a role in international space law. This will become more evident with the

[14]Zheleznyakov and Korablev, "Private Astronautics and Its Role in Space Exploration."
[15]Paula Veiga, "Direito do espaço extra-atmosférico: notas sobre uma nova área do direito" (Coimbra, Universidade de Coimbra, 2004): 407.
[16]Tronchetti, *Fundamentals of Space Law and Policy*, 19.
[17]Mandl, ""Das Weltraum-Recht," 4–5.
[18]Translated by us.
[19]Catarino, "Breve Introdução ao Direito Terrestre do Espaço Exterior," 448.
[20]Tronchetti, *Fundamentals of Space Law and Policy*, 3; Steer, "Sources and Law-Making Processes Relating to Space Activities," 3.

growing pace of space privatisation. Ján Klučka points out that applications of private international law in the field of international space law can include determining the appropriate court to settle litigations of a launching contract or employment contracts for manned commercial flights.[21] Von der Dunk explains that since the state is internationally responsible and liable for the endeavours of its governmental or non-governmental entities, as per articles VI[22] and VII[23] of the OST, national laws are put in place to govern and monitor space activities within the state, thus creating "something akin to private international law".[24] Peter Jankowitsch argues that the issues arising from the privatisation of space, such as property rights and the liability of non-governmental entities, call for a regulatory framework and that new space regimes like UNIDROIT Space Assets Protocol and the Permanent Court of Arbitration Rules on Outer Space Disputes have already introduced some aspects of private international law, albeit to a limited extent.[25]

The five main space treaties[26] are:

- the OST;
- the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space[27];

[21]Klučka, "The Role of Private International Law in the Regulation of Outer Space," 920.
[22]Article VI of the OST provides that: "States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the Moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization".
[23]Article VII of the OST provides that: "Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air or in outer space, including the Moon and other celestial bodies".
[24]von der Dunk, "Space Tourism, Private Spaceflight and the Law."
[25]Jankowitsch, "The Background and History of Space Law," 26.
[26]We will focus our attention on the OST and the MA as they are the most relevant for the theme of this dissertation.
[27] "Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space," opened for signature April 22, 1968, adopted by UNGA resolution 2345 (XXII), accessed October 15, 2022, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introrescueagreement.html.

- the Convention on International Liability for Damage Caused by Space Objects, from now on referred to as the Liability Convention[28];
- the Convention on Registration of Objects Launched into Outer Space;[29]
- the Moon Agreement[30].

Declarations are another important element of the *corpus iuris spatialis*:

1. The Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space[31] served as the basis for the Outer Space Treaty.
2. Principles Governing the Use by States of Earth Artificial Satellites for International Television Broadcasting[32] aimed to promote free flow and mutual exchange of information in a matter compatible with the States' sovereignty.
3. Principles Relating to Remote Sensing on Earth from Outer Space[33], which acts as a guideline for States capturing and analysing Earth data from space.

[28]"Convention on International Liability for Damage Caused by Space Objects," opened for signature March 29, 1972, adopted by UNGA resolution 2777 (XXVI), accessed October 15, 2022, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html.
[29] "Convention on Registration of Objects Launched into Outer Space," opened for signature January 14, 1975, adopted by UNGA resolution 3235 (XXIX), accessed October 15, 2022, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introregistration-convention.html.
[30] "Agreement Governing the Activities of States on the Moon and Other Celestial Bodies," opened for signature December 18, 1979, adopted by UNGA resolution 34/68, accessed October 15, 2022, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/moon-agreement.html.
[31]"The Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space," December 13, 1963, adopted by UNGA resolution 1962 (XVIII), accessed October 15, 2022, https://www.unoosa.org/oosa/en/ourwork/spacelaw/principles/legal-principles.html; The resolution stipulated that exploration and use of outer space were to be conducted "for the benefit and in the interest of all mankind", equally and according to international law. It stressed that outer space was not subject to national appropriation. It established the international responsibility and liability of states for actions executed by government or non-governmental bodies and the jurisdiction of space objects registered. under the state's name.
[32]"Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting," December 10, 1982, adopted by UNGA resolution 37/92, accessed October 15, 2022, https://digitallibrary.un.org/record/41084.
[33] "Principles Relating to Remote Sensing of the Earth from Outer Space," December 3, 1986, adopted by UNGA 41/65, accessed October 15, 2022, https://www.unoosa.org/oosa/en/ourwork/spacelaw/principles/remote-sensing-principles.html.

4. Principles Relevant to the Use of Nuclear Power Sources in Outer Space[34] that safeguards the safe use of nuclear power sources in outer space.
5. Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries[35], which aims at encouraging international cooperation and the share of benefits of space exploration.

Guidelines are also an important component of soft law within Space Law. As humans look to the future of space exploration, space activities are growing in importance. In addition, the continuous increase of space-capable nations, addressing the issue of space sustainability becomes crucial. More recently, in 2018, COPUOS adopted the Guidelines for The Long-Term Sustainability of Outer Space Activities[36].

As per Article VI of the OST, States are internationally responsible for the activities of governmental and non-governmental bodies. Their role is to monitor and approve space activities via national law to guarantee accordance with international space law. for promoting the principles of space law. As the number of space-capable states increases and the interest in commercialising space rises, countries are implementing domestic regulations, acts and decrees regarding Space. Most notably, the Commercial Space Launch Competitiveness Act of 2015[37], followed by Luxembourg's Law on The Exploration And Use of Space Resources.[38] In recent years Portugal has begun its journey

[34]"Principles Relevant to the Use of Nuclear Power Sources in Outer Space," December 14, 1992, adopted by UNGA resolution 47/68, accessed October 15, 2022, https://www.unoosa.org/oosa/en/ourwork/spacelaw/principles/nps-principles.html.
[35]"Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries," December 13, 1996, adopted by UNGA resolution 51/122, accessed October 15, 2022, https://www.unoosa.org/oosa/oosadoc/data/resolutions/1996/general_assembly_51st_session/ares51122.html.
[36]"Guidelines For The Long-Term Sustainability of Outer Space Activities," June 27, 2018, Committee on the Peaceful Uses of Outer Space, A/AC.105/2018/CRP.20, accessed October 15, 2022, https://www.unoosa.org/res/oosadoc/data/documents/2018/aac_1052018crp/aac_1052018crp_20_0_html/AC105_2018_CRP20E.pdf.
[37] USA, Commercial Space Launch Act, Congress, 98-575, October 30, 1984, section 4) 11, accessed February 28, 2023, https://www.govinfo.gov/content/pkg/STATUTE-98/pdf/STATUTE-98-Pg3055.pdf.
[38]Luxembourg, Chambre des députés, Loi du 20 Juillet 2017 sur l'exploration et l'utilisation des ressources de l'espace, 7093, https://legilux.public.lu/eli/etat/leg/loi/2017/07/20/a674/jo.

in space, first by implementing the 2018 Portugal's Space Strategy[39] followed by its national[40] and regional[41]space acts.[42]

Considered to be the magna carta of Space Law[43], based on UN resolutions 1348[44], resolution 1962 (XVIII)[45] and resolution 1721(XVI)[46], the OST counts with 113 states parties[47] as of May 2023.

The OST lays down the following fundamental principles:

- Exploration and use of outer space shall be executed for the "(...)benefit and in the interests of all countries (...)" regardless of their economic or scientific development level; (Article I§I)[48]
- Characterization of the Moon and other celestial bodies as the "(...) province of all mankind (...)" (Article I §II)[49]
- States have the freedom to explore and utilize outer space without any discrimination; (Article I §III)[50]

[39]Portugal, Resolution of the Council of Ministers, n.º 30/2018, March 12, 2018, https://dre.pt/dre/detalhe/resolucao-conselho-ministros/30-2018-114848692.
[40]Portugal, Council of Ministers, Decree-Law, n.º 16/2019, January 22, 2019, accessed February 5, 2023, https://dre.pt/dre/detalhe/decreto-lei/16-2019-118275382.
[41]Portugal, Regional Legislative Decree n.º 9/2019/A, May 9, 2019, accessed February 5, 2023, https://dre.pt/dre/detalhe/decreto-legislativo-regional/9-2019-122253268.
[42]List of all countries with national space laws available at: https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/index.html.
[43]Lyall and Larsen, Space Law, 49.
[44]Resolution 1348 (XIII), UNGA, 1958.
[45]Resolution 1962 (XVIII), UNGA, 1963.
[46]Resolution 1721 (XVI), UNGA, 1961, acessed December 15, 2022, https://www.unoosa.org/pdf/gares/ARES_16_1721E.pdf. This resolution emphasised that outer space should be explored and used to benefit all states regardless of their economic development. It further acknowledged that outer space exploration and use should be free for all states, in accordance with international law, in particular, the UN Charter and that outer space was not to be subject to national appropriation.
[47]"UNODA Treaties," accessed April 10, 2023, https://treaties.unoda.org/t/moon.
[48]Article I § I of the OST provides that: "The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind".
[49]Article I § II of the OST provides that: "Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies".
[50]Article I § III of the OST provides that: "There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation".

- states must follow the principle of non-appropriation laid out in Article II in which "national appropriation by claim of sovereignty, by means of use or occupation, or by any other means (...)" is forbidden; (Article II)[51]
- Activities in outer space shall be carried out "in accordance with international law and the Charter of the United Nations (...)"; (Article III)[52]
- States hold international responsibility for the undertakings of its national activities in outer space by governmental or non-governmental entities; (Article VI)[53]
- States that "launch or procure the launching of an object into outer space (...)", or from "whose territory or facility an object is launched (...)" are internationally liable for them; (Article VII)[54]
- States have jurisdiction and control over space objects and its respective personnel registered under their name; (Art VIII)[55]

[51]Article II of the OST provides 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".

[52]Article III of the OST provides that: "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 co-operation and understanding".

[53]Article VI of the OST provides that: "States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization".

[54]Article VII of the OST provides that: "Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air or in outer space, including the moon and other celestial bodies".

[55]Article VIII of the OST provides that:" A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party, which shall, upon request, furnish identifying data prior to their return".

The Moon Agreement was adopted by the UNGA in 1979 and counts with 18 State Parties as of May 2023.[56] Despite its lack of widespread acceptance, the Treaty outlines several key provisions regarding Moon exploration and use, including:

- Accordance with international law: Exploration and usage of the moon must adhere to international law, specifically the United Nations Charter and the Principles of International Law concerning Friendly Relations and Co-operation Among States; (Article II)[57]
- Peaceful Uses: State Parties commit to utilising the Moon for peaceful purposes; (Article III§I)[58]
- Ownership and Use: The MA characterises the Moon and its resources as the Common Heritage of Mankind (CHM). Hence, no country has the right to claim ownership of the Moon or any part of it and any form of national appropriation is prohibited; (Article XI§1[59] and XI§II[60])
- Freedom of Exploration: Every country can explore the Moon and other celestial bodies regardless of economic and scientific levels; (Article IV§I)[61]
- Environmental Protection: The Moon Agreement highlights the importance of safeguarding both the Moon's environment and Earth's biosphere from any negative impacts that may arise from Moon activities. It urges countries to carry

[56] "UNODA Treaties."
[57]Article II of the MA provides that: "All activities on the moon, including its exploration and use, shall be carried out in accordance with international law, in particular the Charter of the United Nations, and taking into account the Declaration on Principles of International Law concerning Friendly Relations and Co-operation Among States in accordance with the Charter of the United Nations, adopted by the General Assembly on 24 October 1970, in the interests of maintaining international peace and security and promoting international co-operation and mutual understanding, and with due regard to the corresponding interests of all other States Parties".
[58]Article III§I of the MA provides that: "The moon shall be used by all States Parties exclusively for peaceful purposes".
[59]Article XI§I of the MA provides that: "The moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement and in particular in paragraph 5 or this article".
[60]Article XI§II of the MA provides that:" The moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means".
[61]Article IV§I of the MA provides that: "The exploration and use of the moon shall be the province of all mankind and shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development. Due regard shall be paid to the interests of present and future generations as well as to the need to promote higher standards of living and conditions of economic and social progress and development in accordance with the Charter of the United Nations".

out assessments of the environmental impact and implement measures to prevent any disturbance to the natural lunar characteristics; (Article VII§I)[62]

- Resource Exploitation: proposes the creation of a global system to oversee the extraction of lunar resources, which includes measures to distribute the benefits of these activities equitably; (Article XI§V[63] and XI§VII d)[64])
- International Cooperation: the agreement emphasises the importance of sharing scientific data and information and assisting developing countries in their lunar exploration and research endeavours; (Article IV§II[65])
- Liability: Those involved in exploring the Moon are internationally responsible for any harm caused by their space operations, whether governmental or non-governmental bodies execute them. (Article XIV§I)[66]

Privatisation of outer space

At the beginning of the Space Age, the private sector played a minimal role in the space industry as a downstream customer or by supplying subsidiary services to the public agencies involved in space activities.[67] No longer in the space race and with the end of the Cold War, the National Aeronautics and Space Administration (NASA)'s budget

[62]Article VII§I of the MA provides that:" In exploring and using the moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extraenvironmental matter or otherwise. States Parties shall also take measures to avoid harmfully affecting the environment of the earth through the introduction of extraterrestrial matter or otherwise".
[63]Article XI§V of the MA provides that:" States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible. This provision shall be implemented in accordance with article 18 of this Agreement".
[64]Article XI§VII d) provides that: "The main purposes of the international regime to be established shall include: (...) (d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon, shall be given special consideration".
[65]Article IV§II provides that: "States Parties shall be guided by the principle of co-operation and mutual assistance in all their activities concerning the exploration and use of the moon. International co-operation in pursuance of this Agreement should be as wide as possible and may take place on a multilateral basis, on a bilateral basis or through international intergovernmental organizations".
[66]Article XIV§I provides that: "States Parties to this Agreement shall bear international responsibility for national activities on the moon, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in this Agreement. States Parties shall ensure that non-governmental entities under their jurisdiction shall engage in activities on the moon only under the authority and continuing supervision of the appropriate State Party".
[67]Ram S. Jakhu and Joseph N. Pelton, eds., *Global Space Governance: An International Study*, Space and Society (Cham: Springer International Publishing, 2017), https://doi.org/10.1007/978-3-319-54364-2, 114.

decreased significantly. Private companies that had assisted NASA faced a considerable drop in revenue. As a result, these companies that had the know-how in the space industry decided to pursue their own space endeavours by selling satellites to telecommunication operators.[68]

During the 1980's technological advances allowed for more launching capacity, satellites became bigger and better, and production costs decreased, resulting in the commercialisation of space. As a result, there has been a rise in both privately owned and publicly operated satellite service providers. Europe introduced the commercialisation of space with the creation of Arianespace in 1980, the first private launch service operator[69].

Nowadays, privatisation of space has reached all-time levels with the appearance of new applications of space such as private human spaceflight, satellite refuelling and retrofit, private space habitats, satellite constellations, Moon navigation systems, remote sensing and space resource utilisation such as space mineral water and mining and space-based solar power. Some key players exploring these possibilities are Space X, Blue Origin and Virgin Galactic.

New approaches have enabled companies to reach space at a lower cost in recent years, contributing to expanding space commercialisation. These include low-cost satellites, cheap launching via hosted payloads, and piggyback rides for CubeSats[70].[71] Most notably, Space X has been able to reduce the cost of launch significantly by developing Falcon 9, a partially reusable launch vehicle.[72] This is incentivising investments in the space sector. By 2022 the global space economy was a $469 billion market, with the commercial sector growing 6.4% in revenue.[73]

The biggest obstacle private firms face is the law. The legal uncertainties resulting from the current legal framework hinder economic activities' development in outer space,

[68]Peeters, "Evolution of the Space Economy," 207–8.
[69]Ram S. Jakhu and Joseph N. Pelton, eds., *Global Space Governance: An International Study*, Space and Society (Cham: Springer International Publishing, 2017), https://doi.org/10.1007/978-3-319-54364-2, 114.
[70]CubeSats are defined as:" A miniaturised space satellite made from multiples of cubic units 10×10×10 cm in size, with a mass of no more than 1.33 kg per unit."Allaby, "CubeSat."
[71]Walter Peeters, "Evolution of the Space Economy: Government Space to Commercial Space and New Space," *Astropolitics* 19, no. 3 (September 2, 2021): 213, https://doi.org/10.1080/14777622.2021.1984001.
[72]Lyall and Larsen, Space Law, 780.
[73]"Space Foundation Releases The Space Report 2022 Q2 Showing Growth of Global Space Economy."

as firms risk losing their investments. The uncertainties of space law and the increasing pace of privatisation and commercialisation of space raise the question of whether the current legal framework is compatible with the new context of space activities.

# Chapter Two

## Authorization of commercial activities

The OST authorizes private initiatives in space through Article VI:

> *States Parties to the Treaty shall bear international responsibility for national activities[74] in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities[75], and for assuring that national activities are carried out in conformity with the provisions outlined in the present Treaty. The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorisation and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the Moon and other celestial bodies, by an international organisation, responsibility for compliance with this Treaty shall be borne both by the international organisation and by the States Parties to the Treaty participating in such organization.*

The article does not exclude private activities in space but places international responsibility on States and calls for the state's monitoring and approval of private activities in space.

The expression "the activities of non-governmental entities in outer space" should be interpreted to include commercial space activities by non-governmental entities and private firms if such activities are authorised by and under continuing monitorisation.

One major flaw of Article VI of the OST is the lack of a clear definition of "national activities", particularly those carried out by non-governmental organisations. Thus, the

[74]Emphasized by us.
[75]Emphasized by us.

scope of the article remains unclear.[76] Consequently, states are free to choose the best interpretation. Amongst the literature, there are three schools of thought:

1. The first school of thought defines national activities as activities carried out by the state and its nationals, that is, that holds the state's nationality.[77] Von der Dunk calls our attention to Article IX[78] of the OST, in which states must take international consultations before conducting any space activity if they indicate that it could be detrimental to space. Von der Dunk argues that Article IX favours this school of thought as it denominates these activities as "any activity or experiment planned by it or its nationals[79] in outer space".[80] United Kingdom (UK)'s Outer Space Act 1986 follows this interpretation as it only applies to British nationals.[81] Bin argues that this approach is too constraining as it precludes undertakings carried out by foreigners within their jurisdiction.[82] In addition, nationals can already find themselves under the jurisdiction of another state, as

[76]It is important to note that the drafters of the OST did not intend to govern space activities. The treaty was drafted as a foundation of principles of space law that later on would be complemented with more detailed regulations.
[77]Wassenbergh, Principles of Outer Space Law in Hindsight, 23–25.
[78]Article IX of the OST provides that:" In the exploration and use of outer space, including the Moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of cooperation and mutual assistance and shall conduct all their activities in outer space, including the Moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the Moon and other".
[79]Empahsized by us.
[80]von der Dunk, "National Space Legislation in Europe," 12.
[81]United Kingdom, House of Commons, Outer Space Act 1986, chapter 38, https://www.legislation.gov.uk/ukpga/1986/38/pdfs/ukpga_19860038_en.pdf. Article 2 of United Kingdom's Outer Space Act 1986 provides that: "1) This Act applies to United Kingdom nationals, Scottish firms, and bodies incorporated under the law of any part of the United Kingdom".
[82]Cheng, "International Responsibility and Liability of States for National Activities in Outer Space, Especially by Non-Governmental Entities," 12.

per Article VIII[83] of the OST.[84] Under this school of thought, a national of State A will have personal jurisdiction[85]. However, if that national is on a spacecraft registered by State B, that State will hold quasi-territorial jurisdiction[86]. Here we face a conflict of jurisdiction between the personal jurisdiction of the national and the quasi-territorial jurisdiction of the state. According to the hierarchy of jurisfaction[8788], jurisaction[89] would belong to State B, which has quasi-territorial jurisdiction, and not State A, which has national jurisfaction. As outer space continues to be commercialised and privatised, these situations in which people from different nationalities will find themselves under the quasi-territorial jurisprudence of another State will tend to rise in numbers. Therefore, it is important to find a definition of national activities that include those of foreign nationals in another State's territorial or quasi-territorial jurisprudence.

2. The second school of thought looks for answers in Article VII of the OST, in which the launching state is internationally liable for damages. They argue that

[83]Article VIII of the OST provides that: "A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party, which shall, upon request, furnish identifying data prior to their return".

[84]Cheng, "International Responsibility and Liability of States for National Activities in Outer Space, Especially by Non-Governmental Entities," 12–13.

[85]Cheng defines personal jurisdiction as: "(...) the sum total of the powers of a State in respect of individuals or corporate bodies or business enterprises having its nationality or otherwise enjoying its protection or owing it allegiance, wherever they may be." Cheng, "The Extraterrestrial Application of International Law," 2.

[86]Cheng defines quasi-territorial jurisdiction as:" the sum total of the powers of a State in respect of ships, aircraft and spacecraft (to the extent to which they are also granted legal personality) having its nationality or registration (...) Quasi-territorial jurisdiction differs from personal jurisdiction in that it extends not only to the craft in question but also to all persons and things on board, including the activities of such persons, whether on board the craft or elsewhere". Cheng, 2.

[87]Bin Cheng defines jurisfaction as:" (...) normative element of jurisdiction and represents the power of a State to adopt valid and binding legal norms or decisions and to apply or concretise them with binding effect through its appropriate organs, whether judicial or otherwise"; Cheng, 2.

[88]At the top of the hierarchy is territorial jurisaction, who will prevail over quasi-territorial and personal jurisaction, quasi-teritorial juriaction overrides personal jurisaction. See further S.S. Lotus (Fr. v. Turk.).

[89]Bin Cheng defines jurisaciton as:"(...)the physical or concrete element of State jurisdiction and denotes the power of a State, at any given time or place, physically to perform any governmental function, be it the act of actually making, applying, implementing or enforcing laws, such as holding a legislative assembly, conducting an administrative inquiry, setting up a tribunal, or arresting a wanted person".Cheng, "The Extraterrestrial Application of International Law," 2.

national activities are to be decoded as the launching state's activities.[90] We believe that this approach is no longer adequate. We adhere to Von der Dunk's claims that articles VI and VII address different types of activities. The concept of responsibility as per Article VI of the OST relies on the states' international responsibility for activities, whereas the concept of Article VII of the OST addresses the state's international liability for launching activities only.[91] As per Article I of the Liability Convention, a launching state is a state that "launches or procures the launching of a space object (...)" and " from whose territory or facility a space object is launched".[92] In the early days of the Space Age, the launching state and the state who owned, operated, and controlled the object were almost always the same, so identifying the liable state was not a problem. It has become more difficult to identify the liable state due to the commercialisation of space that has brought new players to the market and interconnected them, resulting in a magnitude of players. This issue has presented us with several legal questions. When State A produces a satellite, State B buys it, and State C launches it, who is responsible, and who is liable for this space object? Are State A and B procuring the launch?[93] What about in the instances where States buy space objects that are already in orbit and therefore have no implication in their launch? Even though there has been a transfer of ownership and the original state no longer has control and jurisdiction of the space object, the launching state remains internationally liable. The new owner is only internationally responsible under Article VI of the OST as it would run the satellite's activities. Therefore, it is important to note that the concept of responsibility and liability address different and separate types of activities[94], and even though they often overlapped at the beginning of the Space

[90]Traa-Engelman, Commercial Utilization of Outer Space, 61, 281–82.
[91]F.G. von der Dunk, "The Origins of Authorisation: Article VI of the Outer Space Treaty and International Space Law," in *National Space Legislation in Europe Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation*, vol. 6, Studies of Space Law (Leiden: Martinus Nijhoff Publishers, 2011), 13.
[92]Article I c) of the Liability Convention provides that: "The term "launching State" means:(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(...)"
[93]Qizhi, "Certain Legal Aspects of Commercialization of Space Activities Space Law," 337.
[94]Bin Cheng describes responsibility as: "(...)judged by legal norms, one is considered to be the author of a given act or omission, and to be the cause of all what, in law, are regarded as the consequences of that act or omission. One is consequently answerable for such action or omission being in conformity with the law, and also answerable for its consequences." and liability as: "(...) a legal obligation incumbent on the author

Age, this is no longer the case. Transfers of ownership between launching and non-launching states have already occurred: a Swedish company bought satellite BSB-LA, launched in the USA and procured by the UK. In this case, the launching states were the USA and the UK. Whereas the USA and the UK bore international liability, Sweden bore international responsibility for the satellite's activities. Other examples include the Dutch company New Sky Satellites' acquisition of INTELSAT satellites. The Netherlands was not implicated in the launch as France and the USA launched the satellites for INTELSAT. We adhere to Dasgupta's view that the fact that a company that no longer controls the space object remains liable after the transfer, impedes the commercialisation of space objects.[95] This issue could be tackled by an agreement between the new and the former owners containing a clause allowing for the transfer of the liability burden to the new owner or a clause establishing each party's liability obligations[96]. Belgium's new space law[97] tackles this issue through a transfer of registration via an agreement between the entities. Whenever a transfer of activity in orbit happens, the registration of such object is also transferred.

3. The third and final school of thought seeks an answer within Article VI. They argue that national activities are those in which the state has the power to control them, thus those activities that fall under the state's jurisdiction.[98] Von der Dunk identifies three other elements of international law that verify this school of thought. Principle 8 of UN GA Resolution 37/92[99] on satellite direct television

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of the breach to make integral reparation to the victim for the damage so caused in order to restore the position to what it probably would have been had the breach not taken place"; Cheng, "International Responsibility and Liability of States for National Activities in Outer Space, Especially by Non-Governmental Entities," 5.

[95]Dasgupta, "On-Orbit Transfer of Satellites between States: Legal Issues-with Special Emphasis on Liability and Registration," 6.

[96]Qizhi, "Certain Legal Aspects of Commercialization of Space Activities Space Law," 337.https://heinonline.org/HOL/P?h=hein.crasl/nairspl0015&i=350Qizhi, 337; de O. Bittencourt Neto, "Regulatory Options for Dealing with the Transfer of Ownership."

[97]Kingdom of Belgium, Royal Decree implementing certain provisions of the Law of 17 September 2005 on the activities of launching, flight operations and guidance of space objects, Article III, accessed February 15, 2023, https://www.belspo.be/belspo/space/doc/beLaw/AR20220315_en.pdf.

[98]I Marboe and F Hafner, "Brief Overview Over National Authorization Mechanisms In Implementation Of The UN International Space Treaties," in *National Space Legislation in Europe Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation*, vol. 6 (Leiden: Martinus Nijhoff, 2011), 58. Lee, *Law and Regulation of Commercial Mining of Minerals in Outer Space*, 131.

[99]Principle 8 of the UN GA Resolution 37/92 provides that: "States should bear international responsibility for activities in the field of international direct television broadcasting by satellite carried out by them or

broadcasting affords international responsibility to activities of states in which they are conducted or that fall under their jurisdiction. Principle XIV of the UN GA Resolution 41/65[100], recalls article VI of the OST and asserts the State's international responsibility for "their activities", either governmental or non-governmental.[101] Article XIV, paragraph I of the Moon Agreement holds states internationally responsible for undertakings "under their jurisdiction".[102] The legal tools mentioned above demonstrate a link between the state's responsibility and its jurisdiction. Bin Cheng goes even further than jurisdiction by asserting that to be effective, the state should be held responsible when it has effective jurisaction.[103] Several domestic laws follow the approach of jurisdiction, in addition to the nationality criteria: Belgian[104], French[105] and Portuguese[106] Space Law follow these criteria for their national activities. The United States Commercial Space Launch Act also follows this approach as it includes the space activities of any foreigners done in American territory.[107] We maintain that this approach is the most rational and fair for States as they would be held accountable for the activities they have authority over, thus the activities in which they have territorial or quasi-territorial jurisaction. Article VIII of the OST follows this logic

under their jurisdiction and for the conformity of any such activities with the principles set forth in this document". Resolution 37/92, UNGA, 1982.

[100]Principle XIV of resolution 41/65 provides that: "In compliance with article VI of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, States operating remote sensing satellites shall bear international responsibility for their activities and assure that such activities are conducted in accordance with these principles and the norms of international law, irrespective of whether such activities are carried out by governmental or non-governmental entities or through international organizations to which such States are parties. This principle is without prejudice to the applicability of the norms of international law on State responsibility for remote sensing activities". Resolution 41/65, UNGA, 1986.

[101]See further Gorove, *Developments in Space Law*.

[102]Von der Dunk, "National Space Legislation in Europe," 10–11.

[103]Bin Cheng defines jurisaction as: "(...) concrete element of State jurisdiction which enables a State physically to carry out the functions of a State by setting up machinery to make laws and to take decisions, or by actually taking steps to implement and to enforce its laws and decisions". Cheng, "International Responsibility and Liability of States for National Activities in Outer Space, Especially by Non-Governmental Entities," 3.

[104]Kingdom of Belgium, Law of 17 September 2005 on the Activities of Launching, Flight Operation or Guidance of Space Objects, accessed February 15, 2023, https://www.belspo.be/belspo/space/doc/beLaw/Loi_en.pdf, Art. II § 1.

[105]France, Loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales, accessed February 10, 2023, https://www.legifrance.gouv.fr/loda/id/JORFTEXT000018931380 Article II§1

[106]Portugal, Decreto-Lei n.º 16/2019, Presidência Do Conselho De Ministros, accessed February 5, 2023, https://ptspace.pt/wp-content/uploads/2020/05/lei-do-espaco.pdf, Article I §a).

[107]USA, Commercial Space Launch Act, Congress, 98-575, October 30, 1984, section 4) 11, accessed February 28, 2023, https://www.govinfo.gov/content/pkg/STATUTE-98/pdf/STATUTE-98-Pg3055.pdf.

as it issues jurisdiction of the space object and its personnel to the State that registered it.

The interpretation of "national activities" as per Article VI is significant because it will influence domestic law. States' domestic regulations will differ depending on their view of what constitutes "national activities", potentially resulting in flags of convenience[108]. Suppose a private firm perceives that the licensing regime of another state is more favourable and that the scope of that state's regime could include them. In that case, they will be more likely to undertake their activities in a more favourable state.

## The Exploitation of Natural Resources

The Moon and celestial bodies hold valuable resources that can be extracted and used in space or brought back to Earth. Asteroids hold valuable resources, namely water and minerals. For instance, Asteroid 16 Psyche contains enough gold to give each person on Earth US$93 billion.[109] The Moon is rich in Helium-3, an isotope with few supplies on Earth that can generate nuclear power without toxic waste, potentially replacing fossil fuels on Earth and becoming our main energy source.[110] In addition, the Moon counts with large amounts of iron, titanium, hydrogen and oxygen that could be used for *in situ resource utilisation.*[111] Furthermore, lunar minerals could also be utilised to harvest solar energy and send it to Earth via microwave beams.[112]

There is a clear demand for new energy sources, which the Moon provides. Private companies are enticed by Moon mining because there is demand for new energy sources and because it is an extremely valuable good, estimated to be worth around $5 billion a tonne[113]. The European Space Agency has partnered with ArianeGroup to pursue lunar mining[114], India Space Research Organization has scheduled for July 2023 the

[108]See further von der Dunk, "Towards 'Flags of Convenience' in Space?"
[109]Smith, "Giant Asteroid Has Gold Worth $700 Quintillion. But It Won't Make Us Richer."
[110]Tronchetti, *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies*, 6.
[111]Definition of *in-situ*: "Generation of consumables for autonomous or human activities from raw materials found in situ on the Moon or other planetary bodies." Crawford, Joy, and Anand, "Chapter 25 - Lunar Exploration."
[112]Tronchetti, The Exploitation of Natural Resources of the Moon and Other Celestial Bodies, 5.
[113]"The Quest to Find a Trillion-Dollar Nuclear Fuel on the Moon."
[114]Kent, "The European Space Agency Plans to Start Mining for Natural Resources on the Moon."

Chandrayaan-3 mission that will study the mineral composition of the lunar surface[115], Luxembourg has partnered with NASA in a mission to gather lunar soil[116] and has passed a law that allows the ownership of space resources[117], the USA has also adopted the Commercial Space Launch Competitiveness Act, which permits the possession, ownership, transportation, use and selling of space resources with a disclaimer that the Act does not claim "sovereignty, jurisdiction, ownership or exclusive rights" over celestial bodies.[118] The United Arab Emirates adopted a law on the Regulation of the Space Sector, including provisions dealing with the extraction, exploitation and utilisation of space resources[119]. Most recently, the Japanese Diet enacted the Act for Promotion of Business Activities Regarding Exploration and Exploitation of Space Resources[120].

NASA is studying lunar mining as part of the Artemis programme, and China and Russia are also working towards lunar mining.[121] Private companies are also investing in lunar mining. Recently, the Japanese company iSpace failed to land a rover on the Moon to study the possibilities of mining equipment transportation and rocket fuel production[122]. The non-profit SpaceIL of Israel also failed to send a Moon lander that would study the Moon's geology.[123] Other companies developing technology for mining on the Moon and other celestial bodies include ConsenSys Space, Deep Space Industries and Moon Express.

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[115]"Chandrayaan-3 Mission: ISRO Getting Ready for Chandrayaan-3 Mission in July Second Week: Senior Official."
[116]Clive Cookson, "Luxembourg Space Programme to Work with Nasa on Moon Mining," *Financial Times*, February 16, 2021, sec. Space industry, accessed April 30, 2023, https://www.ft.com/content/3ced3460-abf2-4048-bce4-66f01e16ade4.
[117]"Luxembourg_-_20221216_WG_SR_LU_Contribution.Pdf," accessed March 2, 2023, https://www.unoosa.org/documents/pdf/copuos/lsc/space-resources/LSC2023/StatesResponses/Luxembourg_-_20221216_WG_SR_LU_Contribution.pdf.
[118]Section 4 § 51303 of the Commercial Space Launch Competitiveness Act provides that: ''A United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States''.
[119]Melissa Maday, "UAE Space Law Details Announced To Facilitate Space Sector Development," SpaceWatch.Global, February 25, 2020, accessed April 30, 2023, https://spacewatch.global/2020/02/uae-space-law-details-announced-to-facilitate-space-sector-development/.
[120]Taijiro Suzuki, "Japan: Legal Issues in Space Business in Japan - Volume 2," Baker Mckenzie, July 9, 2021, accessed April 30, 2023, https://insightplus.bakermckenzie.com/bm/real-estate_1/japan-legal-issues-in-space-business-in-japan-volume-2.
[121]Steer, "The Artemis 1 Mission Marks the Start of a New Space Race to Mine the Moon."
[122]"ISpace: Japanese Moon Lander Likely to Have Crashed," *BBC News*, April 25, 2023, sec. Asia, accessed April 30, 2023, https://www.bbc.com/news/world-asia-65389730.
[123] "First Privately Funded Moon Lander Crash-Lands."

Technological advances will allow for cost reductions and inherent risks of space activities[124]. Thus, the law is the main limitation of commercial exploitation of natural space resources. It has become urgent to establish a legal regime to regulate it.

The MA was the first instrument of international law to address the utilisation of space resources.[125] The OST addresses the uses and exploitation of outer space, the Moon and other celestial bodies, while the MA dives into utilising its resources. Under the MA, private exploitation of natural resources is theoretically achievable.

## The Moon Agreement's Limitations to Private Commercialisation

The MA aimed to put in place a legal framework for the exploitation of the Moon and celestial body resources.[126] It was considered unsuccessful because few states adhered to it, and none of the space-faring nations have ratified it, with only 18 State Parties as of May 2023.[127] Tronchetti argues that this is due to Article XI §I[128], §V [129] and §VII[130], which establishes the Moon as and its natural resources as CHM and appeals for a regulatory system for the exploitation of lunar resources.[131] The CHM principle is a highly controversial element of space law. Even though the MA does not define this term, paragraph I tells us that one can find it in the agreement's provisions, most notably in paragraph V, which calls for the exploitation of the Moon's natural resources to be managed by an international regime.

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[124] Lee, *Law and Regulation of Commercial Mining of Minerals in Outer Space*, 92.
[125]Svec, "Outer Space, an Area Recognised as Res Communis Omnium," 1.
[126]Jakhu and Pelton, *Global Space Governance*, 29.
[127] "UNODA Treaties."
[128]Article XI §I of the Moon Agreement provides: "The moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement and in particular in paragraph 5 or this article".
[129]Article XI §V provides that: "States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible. This provision shall be implemented in accordance with article 18 of this Agreement".
[130]Article XI §VII provides that: "The main purposes of the international regime to be established shall include: (a) The orderly and safe development of the natural resources of the moon; (b) The rational management of those resources; (c) The expansion of opportunities in the use of those resources; (d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon, shall be given special consideration".
[131]Tronchetti, The Exploitation of Natural Resources of the Moon and Other Celestial Bodies, 41.

The CHM principle has its roots in the concept of *res communis*. However, these two concepts are not to be confused with one another. Whereas *res communis* refers to the idea that since some areas represent a common interest for humanity, states cannot appropriate it.[132] The CHM principle sits on the premise that outer space is so valuable that it should be owned by everybody. Thus, managing its natural resources should be entrusted to an international regime representing humanity. The goal of the international framework would be to guarantee the proper governance of space exploitation and the share of benefits in an equitable manner.[133]

This provision fails to answer the question of how the equitable sharing of benefits shall be settled and, more importantly, what form it will take. Would they be obliged to share their profits from space exploitation with the developing states?

There are two opposing views regarding the interpretation of the CHM principle.

The position of developing countries is that the CHM areas are owned by humanity. Thus, the benefits resulting from such regions should also belong to all of us. On the other hand, developed nations argue that the "equitable share of benefits" relates to resource access rather than monetary and technological benefits. Following this logic, the countries capable of exploiting outer space that invested their resources in those projects would be entitled to decide how the interest of the developing countries would be considered.[134] In addition, developed countries argue they are under no obligation to share the benefits because the MA does not put in place a system to govern that[135].

The MA is detrimental to the development of commercial space activities, most notably space mining, because:

1. the potential obligation of profit share irrespective of the level of investment under the Common Heritage principle of article XI§I.
2. the establishment of an international organisation to regulate exploitation could prove to be bureaucratic and burdensome.

[132]Tronchetti, "Legal Aspects of Space Resource Utilization," 783.
[133]Tronchetti, "The Moon Agreement in the 21st Century," 504.
[134]Buxton, "Property in Outer Space," 693.
[135]Von der Dunk, "Back in Business? The Moon Agreement, Private Actors and Possible Commercial Exploitation of the Moon and Its Natural Resources," 255.

3. Developing states will be tempted to let the developed nations pursue their projects and receive the resulting benefits.[136]

Despite its benevolent and egalitarian nature of providing developing countries with the know-how and profits of space exploration, it entails the hindrance of commercial initiatives and scientific and technological development from developed and developing nations because the profits from their investments would be shared amongst all states, even those that did not contribute to the project. Nonetheless, developing countries would gain know-how, technological advances and profits, thus, they too could contribute to the advancement of science and technology.

The next question is the scope of action of the non-appropriation principle in Article XI§II. Does the non-appropriation principle forbid the ownership, not of the area designated as *res communis omnium*[137], but instead of its resources? Considering that the treaty does not permit claims of the sovereignty of the Moon and celestial bodies, the question to be made is whether the resources of the Moon and other celestial bodies are part of this restriction.

We begin our analysis by first establishing that the MA encompasses private entities. Article XIV, that holds states internationally responsible for activities of governmental or non-governmental bodies, includes private entities in the scope of the treaty in the same way that Article VI does for the OST. The next question to be asked is how private entities can use the Moon.

Article VI§II[138] consents to the right to harvest and extract minerals and other samples and use them for their space activities. However, this does not constitute

[136]Buxton, "Property in Outer Space," 692.
[137]Fellmeth and Horwitz define *res communis omnium* as: "The common heritage of all human-kind, not subject to the appropriation by or sovereignty of any state or group of states, such as the high seas, Antarctica, or celestial bodies".Fellmeth and Horwitz, "Rescommunis(Omnium)."
[138]Article VI§II provides that: "In carrying out scientific investigations and in furtherance of the provisions of this Agreement, the States Parties shall have the right to collect on and remove from the moon samples of its mineral and other substances. Such samples shall remain at the disposal of those States Parties which caused them to be collected and may be used by them for scientific purposes. States Parties shall have regard to the desirability of making a portion of such samples available to other interested States Parties and the international scientific community for scientific investigation. States Parties may in the course of scientific investigations also use mineral and other substances of the moon in quantities appropriate for the support of their missions".

authorisation for lunar mining because the article clearly states that the extraction would be for scientific purposes.

Article XI §III of the MA prohibits the property of the surface, subsurface and natural resources (in the surface or subsurface) by "states, intergovernmental or non-governmental organisations, domestic governmental or non-governmental organisations and natural persons", nor can the "placement of personnel, vehicles, equipment, facilities, stations and installations on the surface or subsurface of a celestial body" result in its ownership.

We believe that this does not explicitly prohibit Moon mining, but it does limit it to a regime in which they would not have any property rights of the territory. Thus, their investments would be vulnerable as they would not have the legal grounds to prevent others from mining in that place. Yet, this does not mean that the ownership of the resources extracted from the territory cannot be the object of ownership.

It is worth noting that the choice of words "resources in place" in Article XI§III alludes to an indirect authorisation of the exploitation of lunar resources as it excludes resources that are not "in place" from the ban on ownership rights. After extracting the minerals or substances, no legal prohibition dismisses their right of ownership as long as its execution follows international space law. The treaty's goal, regulating the exploitation of lunar resources, further emphasises this[139]. As a result, Freeland and Jakhu assert that Article XI does not inhibit the commercialisation and privatisation of space resources as long as this would be subject to the management of an international regime mentioned in paragraph V.[140]

However, some consider that Article XI§III lays out a moratorium on the commercialisation of space resources until the establishment of the international regime that would govern such activities.

Nonetheless, Tronchetti claims that the term "natural resources in place" excludes the post-extraction of natural resources from the supposed moratorium. He further

[139]Tronchetti, *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies*, 219.
[140]Jakhu, Pelton, and Nyampong, Space Mining and Its Regulation, 127–28.

develops that, as per the view of the USA during the drafting of the agreement, a moratorium would prove detrimental to motivating firms to create new technologies and their respective experiments.[141]

As per Article XI§V, states must try and reach a consensus for establishing the international regime. The parties will engage in honest negotiations to establish a regime, but they are not obligated to come to an understanding at any expense.[142]

We maintain that the treaty's text does not explicitly express a moratorium in Article XI§V. The article is unclear, and the reference to creating an international regime in Article XVIII merely instructs for establishing a conference to review the agreement and any technological advances. If the moratorium proved to exist, the treaty would become ineffective because developing and developed states would not be willing to reach a compromise during the negotiations for an international system regarding the question of CHM.

While technically the MA allows for privatisation and commercialisation of Moon resources, its provisions allow room for multiple interpretations and do not provide a clear, cohesive understanding of the treaty.

## OST limitations to private commercialisation

Outer space is characterised as *res communis omnium*[143], as it is an area of common interest, free for exploration to all states without discrimination, under Article I while at the same time not subject to national appropriation, as per Article II.

The characterisation of space as *res communis omnium* impacts the authorisation of outer space for commercial purposes. A clear example is property rights for mining on the Moon. Due to the legal status of the Moon, outer space and celestial bodies as *res communis omnium*, private firms can not own the land where they mine minerals. On the

[141]Tronchetti, *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies*, 51.
[142]Impallomeni, *Spazio Cosmico e Corpi Celesti Nell'ordinamento Internazionale / Elisabeth Back Impallomeni*, 70.
[143]Sachdeva, "Select Tenets of Space Law as Jus Cogen," 18; Tronchetti, The Exploitation of Natural Resources of the Moon and Other Celestial Bodies, 11–14.

one hand, they can conduct space activities under government approval and monitorisation per Article VI.

On the other hand, as per Articles I and II, they cannot own the land or prevent other entities from enjoying their freedom of access, use and exploration. Thus, even though they are allowed to carry out activities in outer space, there is no financial motivation since they do not have the right to prohibit other's from carrying out activities in the same area.

The scope of Article II concerning non-appropriation divides the scholarship. We will first approach whether Article II encompasses states and non-governmental entities.

The article fails to mention non-governmental entities. Hence, many scholars are of the view that it does not apply to private entities, arguing that the applicability falls only on the states.[144] In addition to the lack of mention, it is important to note that during the treaty's drafting, the expression "or by any other means" was included to bring under the scope of the treaty private endeavours.[145]

Wrench argues that allowing private enterprises to transgress their state's obligations under the treaty would be "paradoxical", exemplifying this idea with the international liability obligation under Article VII of the OST and the Liability Convention, in which nations are internationally responsible for damages induced by space objects under their jurisdiction, thus including space object firm's within their jurisdiction.[146]Because private firms' space objects are under the state's jurisdiction. If the private firm's actions are under the state's umbrella for international responsibility and international liability, it would only be logical that the state's obligations extend to private firms.

In addition, Article II aimed to prevent conflicts in outer space, namely between the USA and the former USSR. Allowing private firms to appropriate areas in outer space

[144]White, Jr., "Real Property Rights in Outer Space," 2.
[145]Lee, "Commentary Paper on the Discussion Paper Titled The Acceptability of the Moon Agreement and the Road Ahead by Dr. Frans von Der Dunk In," 9.
[146]Wrench, "Non-Appropriation, No Problem," 445.

would also result in conflict and could potentially negatively affect peace in outer space.[147]

Even though Article II does not explicitly mention private entities, we maintain that they fall under the scope of the non-appropriation principle. We find the foundation of our argument by analysing the rest of the treaty, most notably in Article VI. Private enterprises act under the umbrella of states, and it is the state's role to enforce the right application of the treaty within them. If a private firm unlawfully appropriates an area of the Moon, the state would bear the international responsibility for this action. In an international sphere, the state would be held accountable. Hence the transgression would be considered a national appropriation.

The next logical question is whether Art II of the OST encompasses the utilisation of space resources.

We maintain that Article II allows for the utilisation of space resources. The legal status of outer space as *res communis omnium* resulting from Article II[148] forbids the appropriation of space. Still, it establishes it as an area of free access where private and public actors can utilise it. If private entities extract space resources, they could legally own them, but not the territory from which they were extracted[149].

In sum, we conclude that:

1. private actors fall under the scope of Article II of non-appropriation.
2. Article II allows for the utilisation of space and its resources as long as they are not appropriated.

Article I of the OST is an object of controversy.

> *The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of*

[147]Sprankling, The International Law of Property, 180.
[148]Sachdeva, "Select Tenets of Space Law as Jus Cogen," 18; Tronchetti, The Exploitation of Natural Resources of the Moon and Other Celestial Bodies, 11–14.
[149]Wrench, "Non-Appropriation, No Problem," 452.

*all countries*[150]*, irrespective of their degree of economic or scientific development, and shall be the province of all mankind*[151].

The term "province of all mankind" is a forerunner concept to the CHM principle. Despite being similar, these two terms are not to be confused. Diederiks-Verschoor and Kopal argue that the concept of the "province of mankind" represents a broad political concept regarding global collaboration in the exploration and use of outer space, considering the interest of other states. In contrast, the CHM principle relates to the exploitation of the Moon's natural resources.[152]

Regarding the expression "the benefit and in the interests of all countries", two opposing views are to be considered.

While developing countries argue that this provision is binding, developed countries assert that the wording of the article is vague and unclear as to the scope of interest and whether it refers to a monetary or moral interest. In addition, the provision places no indications or obligations as to how this ought to be done. Therefore, it should be interpreted as a guiding moral principle as opposed to a binding provision.[153]

Cheng contends that the purpose of State Parties was not to issue a right or an obligation, depending on the perspective, but rather to establish a moral principle.[154]

However, this argument is contended by the fact that during preparatory works, this expression was placed in the treaty's preamble, and it was only after Brazil's proposal that it was placed within the body of the treaty. This demonstrates the developing country's intention to place a binding character on this term.[155]

In sum, the OST allows the use of the Moon for profit-oriented purposes as long as they do not possess property rights over the Moon and do not imbibe others' right of free access, use and exploration. Consequently, firms must find a way to privatise and

[150]Emphasized by us.
[151]Emphasized by us.
[152]Diederiks-Verschoor, Kopal, and Diederiks-Verschoor, *An Introduction to Space Law*, 50.
[153]Maiorsky, "A Few Reflections on the Meaning and the Interrelation of 'Province of All Mankind' and 'Common Heritage of Mankind' Notions."
[154]Cheng, "The United Nations and the Development of International Law Relating to Outer Space," 38–39.
[155]Jakhu, "Legal Issues Relating to the Global Public Interest in Outer Space," 9.

commercialise lunar resources while respecting these principles. The next chapter will discuss the American proposal to do this.

## Chapter Three

## The Artemis Accords

The Artemis Accords, signed in October 2020, aim to put in place principles and guidelines for the governance of civil exploration and the use of outer space.[156]

The accord is significantly based on the provisions of the OST but presents us with a new concept in its section 11: Safety zones.[157] The Accords define these areas in Section XI§VII as an "area in which nominal operations of a relevant activity or an anomalous event could reasonably cause harmful interference". Thus, states carrying out activities in outer space create safety zones to prevent harmful interferences with other's activities, resulting in a temporary exclusion area.

The Safety Zones are presented as a way to protect and preserve the heritage of the Moon. Paragraphs I[158] and III[159] of Section 11 of the Artemis Accords refer to Article IX of the OST[160] concerning due regard and harmful interference. The Artemis Accords

[156]Laura Movilla, "¿Hacia un cambio de paradigma en el derecho del espacio ultraterrestre?: los Acuerdos Artemisa," 1.
[157]McKeown, Dempster, and Saydam, "Artemis Accords," 4.
[158]Section XI§I of the Artemis Accords provide that:" The Signatories acknowledge and reaffirm their commitment to the Outer Space Treaty, including those provisions relating to due regard and harmful interference".
[159]Section XI§III of the Artemis Accords provides that: "Consistent with Article IX of the Outer Space Treaty, a Signatory authorizing an activity under these Accords commits to respect the principle of due regard. A Signatory to these Accords with reason to believe that it may suffer, or has suffered, harmful interference, may request consultations with a Signatory or any other Party to the Outer Space Treaty authorizing the activity".
[160]Article IX of the OST provides that:" In the exploration and use of outer space, including the moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the moon and other celestial bodies, would cause potentially harmful interference

rely on Article IX to support the establishment of safety zones. Establishing a Safety Zone by claiming that it would harmfully interfere with their activities can be envisaged within the OST and the Artemis Accords. Accordingly, the Artemis Accords enable the establishment of safety zones in consideration of Article IX.

Many authors are concerned about the Artemis Accords' legality, particularly their detrimental effects on the non-appropriation and free access principles. Even though State Parties agree to follow the OST provisions in paragraph I, safety zones have raised doubts that they could become zones of exclusion and be detrimental to the free access principle, non-appropriation principle[161] and provide the states within the zone with the rights of sovereignty claims without its obligations.[162]

Jack Nelson points out that while the OST gives states the right of free access, use and exploration enshrined in Article I of the OST, it is also true that the treaty provides us with a system of lunar facilities visits through Article XII[163]of the OST based on mutual reciprocity. It follows that due to the condition of reciprocity and the fact that visits are subject to "reasonable advance notice", means that there is a limitation to the right of free access.[164]

Even though one could argue that a prolonged installation on the Moon could be considered as appropriation, the Artemis Accords do not envision this possibility. As per Section XI§VII c), Safety Zones shall be temporary, "(...) Safety zones will ultimately be temporary, ending when the relevant operation ceases;" In addition, analysing the rest of the OST, Article XII envisions this by using terms that imply long duration stays such as "station" and "installation".[165]

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with activities in the peaceful exploration and use of outer space, including the moon and other celestial bodies, may request consultation concerning the activity or experiment".

[161]McKeown, Dempster, and Saydam, "Artemis Accords," 4.

[162]Laura Movilla, "¿Hacia un cambio de paradigma en el derecho del espacio ultraterrestre?: los Acuerdos Artemisa," 291.

[163]Article XII of the OST provides that: "All stations, installations, equipment and space vehicles on the moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity".

[164]Nelson, "Safety Zones," 606–7.

[165]Nelson, 608.

It is of interest to note that section X§II clarifies the American position concerning their interpretation of Article II of the OST[166]:

> *The Signatories emphasize that the extraction and utilization of space resources, including any recovery from the surface or subsurface of the Moon, Mars, comets, or asteroids, should be executed in a manner that complies with the Outer Space Treaty and in support of safe and sustainable space activities. The Signatories affirm that the extraction of space resources does not inherently constitute national appropriation under Article II of the Outer Space Treaty, and that contracts and other legal instruments relating to space resources should be consistent with that Treaty*

As per Mosteshar, they follow the opinion that extraction and utilisation of space resources does not represent appropriation and is compliant with the non-appropriation principle. Hence, the Artemis Accords are an international regime that promote the exploitation and utilisation of space resources.

The Artemis Accords count 24 Sigantoires[167] as of May 2023, however many space-faring nations have not adhered to it, mainly China, India and Russia. What steps would be taken if there was a dispute between countries that have signed the Accords and those that have not? We share Din's view that a multiplicity of legal instruments governing outer space activities will undermine the very aim of international law. Thus, the best approach would be a multilateral agreement under the COPUOS.[168]

## Conclusion

Space law faces numerous legal implications due to the establishment of private space enterprises in the space market. The OST and the MA allow for private commercial uses of outer space and the utilisation of space resources for profit-oriented purposes. However, they should be a starting point and should be further developed. They constitute vague, uncertain and outdated elements of space law. Thus, they do not provide enough

[166]Mosteshar, "Artemis," 596.
[167]Australia, Bahrain, Brazil, Canada, Colombia, Czech Republic, France, Israel, Italy, Japan, Luxembourg, Mexico, New Zealand, Nigeria, Poland, South Kora, Romania, Rwanda, Singapore, Saudi Arabia, Ukraine, United Arab Emirates, UK, and USA. "NASA."
[168]Din, "The Artemis Accords," 148.

certainty to private enterprises. They were written in times in which the commercialisation of space was but a dream, and therefore they are general enough to allow space commercialisation. The OST was conceived to be a guide of principles at the beginning of the Space Age that was meant to be followed by more precise and focused-oriented legal instruments. The MA attempted this, but the controversial provisions, most notably the CHM principle, resulted in poor adhesion to the treaty. The international community should discuss the best course of action in light of these concerns, as doubt and uncertainty will only hinder economic and technological advances.

The Artemis Accords establish themselves as an international framework that promotes exploiting and utilising space resources. However, powerful space-faring nations like China, India, and Russia have not joined the Accords. Hence, they do not represent a harmonised and cohesive solution.

Nevertheless, we must ensure the sustainable utilisation of space. Space exploration is at its dawn, and we already face an environmental problem in space that the privatisation and commercialisation of space could worsen. There are over 23,000 pieces of fragments of space debris that are sufficiently big to be monitored. These pieces travel at such high speeds that they could damage space objects.[169] It is of utmost importance that moving forward, space law considers sustainability. We have reached a pivotal moment in space evolution, and it is our responsibility to establish a system that will safeguard the safety and sustainability of outer space for future generations.

## Bibliography

"Agreement Governing the Activities of States on the Moon and Other Celestial Bodies." Opened for signature on December 18, 1979. UNGA resolution 34/68. Accessed October 15, 2022. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/moon-agreement.html.

[169]Wei-Haas, "Space Junk Is a Huge Problem—and It's Only Getting Bigger."

"Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space." Opened for signature on April 22, 1968. UNGA resolution 2345 (XXII). Accessed October 15, 2022. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introrescueagreement.html.

Allaby, Michael. "CubeSat." In *A Dictionary of Geology and Earth Sciences*. Oxford University Press, 2020. https://www.oxfordreference.com/display/10.1093/acref/9780198839033.001.0001/acref-9780198839033-e-10171.

*BBC News*. "ISpace: Japanese Moon Lander Likely to Have Crashed." April 25, 2023, sec. Asia. https://www.bbc.com/news/world-asia-65389730.

Buxton, Carol. "Property in Outer Space: The Common Heritage of Mankind Principle vs. the First in Time, First in Right, Rule of Property." *Journal of Air Law and Commerce* 69, no. 4 (January 1, 2004): 689–707. https://scholar.smu.edu/jalc/vol69/iss4/3.

Catarino, Manuel. "Breve Introdução ao Direito Terrestre do Espaço Exterior." *JURISMAT*, no. 13 (2021): 447–60. https://revistas.ulusofona.pt/index.php/jurismat/article/view/8216.

Cheng, Bin. "International Responsibility and Liability of States for National Activities in Outer Space, Especially by Non-Governmental Entities." In *Studies of International Space Law*, 8. Oxford University Press, 1997. https://doi.org/10.1093/acprof:oso/9780198257301.001.0001.

———. "The Extraterrestrial Application of International Law." In *Studies in International Space Law*, 11. Oxford University Press, 1997. https://doi.org/10.1093/acprof:oso/9780198257301.001.0001.

———. "The United Nations and the Development of International Law Relating to Outer Space." In *Studies in International Space Law*, 1–63. Oxford Scholarship Online, 2012.

Committee on the Peaceful Uses of Outer Space: Membership Evolution. "COPUOS Membership Evolution." Accessed April 28, 2023. https://www.unoosa.org/oosa/en/ourwork/copuos/members/evolution.html.

"Convention on International Liability for Damage Caused by Space Objects." Opened for signature on March 29, 1972. UNGA resolution 2777 (XXVI). Accessed October 15, 2022. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html.

"Convention on Registration of Objects Launched into Outer Space." Opened for signature on January 14, 1975. UNGA resolution 3235 (XXIX). Accessed October 15, 2022. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introregistration-convention.html.

Cookson, Clive. "Luxembourg Space Programme to Work with Nasa on Moon Mining." *Financial Times*, February 16, 2021, sec. Space industry. https://www.ft.com/content/3ced3460-abf2-4048-bce4-66f01e16ade4.

Crawford, Ian A., Katherine H. Joy, and Mahesh Anand. "Chapter 25 - Lunar Exploration." In *Encyclopedia of the Solar System (Third Edition)*, edited by Tilman Spohn, Doris Breuer, and Torrence V. Johnson, 555–79. Boston: Elsevier, 2014. https://doi.org/10.1016/B978-0-12-415845-0.00025-6.

Dasgupta, Upasana. "On-Orbit Transfer of Satellites between States: Legal Issues-with Special Emphasis on Liability and Registration." *International Institute of Space Law Proceedings 2016*, 2016, 641–66. https://www.elevenjournals.com/tijdschrift/iisl/2016/7%20Interactive%20Presentations/IISL_2016_059_007_001.pdf.

"Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries." December 13, 1996. UNGA resolution 51/122. Accessed October 15, 2022.

https://www.unoosa.org/oosa/oosadoc/data/resolutions/1996/general_assembly_51st_session/ares51122.html.

Degrange, Valentin. “Nouveaux acteurs, nouvelle gouvernance : faire du droit spatial à l’ère du New Space.” *Stratégique* 126–127, no. 2–3 (2021): 153–72. https://doi.org/10.3917/strat.126.0153.

Diederiks-Verschoor, I. H. Philepina, Vladimír Kopal, and I. H. Philepina Diederiks-Verschoor. *An Introduction to Space Law*. 3rd rev. ed. Alphen aan den Rijn, The Netherlands: Kluwer Law International, 2008.

Din, Athar ud. “The Artemis Accords: The End of Multilateralism in the Management of Outer Space?” *Astropolitics* 20, no. 2–3 (September 2, 2022): 135–50. https://doi.org/10.1080/14777622.2022.2144241.

Dunk, F.G. von der. “The Origins of Authorisation: Article VI of the Outer Space Treaty and International Space Law.” In *National Space Legislation in Europe Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation*, 6:12. Studies of Space Law. Leidem: Martinus Nijhoff Publishers, 2011.

Dunk, Frans G. von der. *National Space Legislation in Europe: Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation*. Vol. 6. Studies of Space Law. Leiden: Martinus Nijhoff Publishers, 2011.

Dunk, Frans G. von der. “Space Tourism, Private Spaceflight and the Law: Key Aspects.” *Space Policy* 27, no. 3 (August 1, 2011): 147. https://doi.org/10.1016/j.spacepol.2011.04.015.

Dunk, Frans von der. “Towards ‘Flags of Convenience’ in Space?” *Space, Cyber, and Telecommunications Law Program Faculty Publications*, March 1, 2012. https://digitalcommons.unl.edu/spacelaw/76.

Fellmeth, Aaron X., and Maurice Horwitz. “Rescommunis(Omnium).” In *Guide to Latin in International Law*. Oxford University Press, 2022.

https://www.oxfordreference.com/display/10.1093/acref/9780197583104.001.0001/acref-9780197583104-e-1867.

France. Loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales. Accessed February 10, 2023. https://www.legifrance.gouv.fr/loda/id/JORFTEXT000018931380. Article II§I.

Gorove, Stephen. *Developments in Space Law: Issues and Policies*. Utrecht Studies in Air and Space Law, v. 10. Dordrecht ; Boston : Norwell, MA, U.S.A: M. Nijhoff ; Sold and distributed in the U.S.A. and Canada by Kluwer Academic Publishers, 1991.

"Guidelines For The Long-Term Sustainability of Outer Space Activities." June 27, 2018. Committee on the Peaceful Uses of Outer Space. A/AC.105/2018/CRP.20. Accessed October 15, 2022. https://www.unoosa.org/res/oosadoc/data/documents/2018/aac_1052018crp/aac_1052018crp_20_0_html/AC105_2018_CRP20E.pdf.

Impallomeni, Elisabeth Back. *Spazio Cosmico e Corpi Celesti Nell'ordinamento Internazionale / Elisabeth Back Impallomeni*. Pubblicazioni Della Facoltà Di Scienze Politiche Dell'Università Di Padova ; 6. Padova: CEDAM, 1983.

Jakhu, Ram s. "Legal Issues Relating to the Global Public Interest in Outer Space." *Journal of Space Law* 32 (2006): 31–110. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2801681.

Jakhu, Ram S., and Joseph N. Pelton, eds. *Global Space Governance: An International Study*. Space and Society. Cham: Springer International Publishing, 2017. https://doi.org/10.1007/978-3-319-54364-2.

Jakhu, Ram S., Joseph N. Pelton, and Yaw Otu Mankata Nyampong. *Space Mining and Its Regulation*. New Space Ventures. Cham: Springer International Publishing, 2017. https://doi.org/10.1007/978-3-319-39246-2.

Jankowitsch, Peter. "The Background and History of Space Law." In *Handbook of Space Law*, 1–28. Cheltenham: Edward Elgar, 2015.

Kent, Lauren. “The European Space Agency Plans to Start Mining for Natural Resources on the Moon.” CNN, January 22, 2019. https://www.cnn.com/2019/01/22/europe/mining-on-moon-trnd/index.html.

Kingdom of Belgium. Law of 17 September 2005 on the Activities of Launching, Flight Operation or Guidance of Space Objects. Accessed February 15, 2023. https://www.belspo.on be/belspo/space/doc/beLaw/Loi_en.pdf. Article II§ I.

Kingdom of Belgium. Royal Decree implementing certain provisions of the Law of 17 September 2005 on the activities of launching, flight operations and guidance of space objects. Article III. Accessed February 15, 2023. https://www.belspo.be/belspo/space/doc/beLaw/AR20220315_en.pdf.

Klučka, Ján. “The Role of Private International Law in the Regulation of Outer Space.” *The International and Comparative Law Quarterly* 39, no. 4 (1990): 918–22. https://www.jstor.org/stable/760396.

Kumar, Vijay, S. R. Subramanian, and K. D. Raju. “Viewpoint Research ‘Envoys of Mankind’ in the Era of Commercial Human Spaceflight.” *Astropolitics* 18, no. 2 (May 3, 2020): 144–57. https://doi.org/10.1080/14777622.2020.1787015.

Laura Movilla, Pateiro. “¿Hacia un cambio de paradigma en el derecho del espacio ultraterrestre?: los Acuerdos Artemisa.” *Revista Española de Derecho Internacional* 73/2 (June 9, 2021): 285–310. http://www.revista-redi.es/es/articulos/miscelanea-hacia-un-cambio-de-paradigma-en-el-derecho-del-espacio-ultraterrestre-los-acuerdos-artemisa/.

Lee, Ricky. “Commentary Paper on the Discussion Paper Titled The Acceptability of the Moon Agreement and the Road Ahead by Dr. Frans von Der Dunk In.” In *Workshop on Policy and Law Relating to Outer Space*. McGill University Institute of Air and Space Law International and Interdisciplinary, 2006.

Lee, Ricky J. *Law and Regulation of Commercial Mining of Minerals in Outer Space*. Space Regulations Library, v. 7. Dordrecht, The Netherlands ; New York: Springer, 2012.

"Luxembourg_-_20221216_WG_SR_LU_Contribution.Pdf." Accessed May 2, 2023. https://www.unoosa.org/documents/pdf/copuos/lsc/space-resources/LSC2023/StatesResponses/Luxembourg_-_20221216_WG_SR_LU_Contribution.pdf.

Lyall, Francis, and Paul B. Larsen. *Space Law: A Treatise*. 2nd edition. London New York: Routledge, 2018.

Maday, Melissa. "UAE Space Law Details Announced To Facilitate Space Sector Development." SpaceWatch.Global, February 25, 2020. https://spacewatch.global/2020/02/uae-space-law-details-announced-to-facilitate-space-sector-development/.

Maiorsky, B. "A Few Reflections on the Meaning and the Interrelation of 'Province of All Mankind' and ' Common Heritage of Mankind' Notions." In *Proceedings of the Twenty-Ninth Colloquium on the Law of Outer*, 59. Innsbruck: American Institute. of Aeronautics and Astronautics, 1987.

Mandl, Vladimir. "Das Weltraum-Recht. Ein Problem der Raumfahrt." *J. Bensheimer Verlag*, 1932, 1–48. https://ntrs.nasa.gov/api/citations/19850008388/downloads/19850008388.pdf.

Marboe, I, and F Hafner. "Brief Overview Over National Authorization Mechanisms In Implementation Of The UN International Space Treaties." In *National Space Legislation in Europe Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation*, 6:20–71. Leiden: Martinus Nijhoff, 2011. https://brill.com/edcollbook/title/20120?contents=editorial-content.

McKeown, Ben, Andrew G. Dempster, and Serkan Saydam. "Artemis Accords: Are Safety Zones Practical for Long Term Commercial Lunar Resource Utilisation?" *Space Policy* 62 (November 1, 2022): 101504. https://doi.org/10.1016/j.spacepol.2022.101504.

MINING.COM. “The Quest to Find a Trillion-Dollar Nuclear Fuel on the Moon,” June 27, 2018. https://www.mining.com/web/quest-find-trillion-dollar-nuclear-fuel-moon/.

Mosteshar, Sa’id. “Artemis: The Discordant Accords Commentary.” *Journal of Space Law* 44, no. 2 (2020): 591–603. https://heinonline.org/HOL/P?h=hein.journals/jrlsl44&i=612.

NASA. “NASA: Artemis Accords.” Accessed May 8, 2023. https://www.nasa.gov/specials/artemis-accords/index.html.

Nelson, Jack Wright. “Safety Zones: A near-Term Legal Issue on the Moon Select Scholar.” *Journal of Space Law* 44, no. 2 (2020): 604–24. https://heinonline.org/HOL/P?h=hein.journals/jrlsl44&i=620.

O. Bittencourt Neto, Olavo de. “Regulatory Options for Dealing with the Transfer of Ownership.” Presented at the IISL/ECSL symposium “Transfer of ownership of space objects: Issues of responsibility, liability and registration,” UNCOPUOS LSC, March 19, 2012. https://www.unoosa.org/pdf/pres/lsc2012/symp-06E.pdf.

Peeters, Walter. “Evolution of the Space Economy: Government Space to Commercial Space and New Space.” *Astropolitics* 19, no. 3 (September 2, 2021): 206–22. https://doi.org/10.1080/14777622.2021.1984001.

“Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting.” December 10, 1982. UNGA resolution 37/92. Accessed October 15, 2022. https://digitallibrary.un.org/record/41084.

“Principles Relating to Remote Sensing of the Earth from Outer Space.” December 3, 1986. UNGA 41/65. Accessed October 15, 2022. https://www.unoosa.org/oosa/en/ourwork/spacelaw/principles/remote-sensing-principles.htm.

“Principles Relevant to the Use of Nuclear Power Sources in Outer Space.” December 14, 1992. UNGA resolution 47/68. Accessed October 15, 2022. https://www.unoosa.org/oosa/en/ourwork/spacelaw/principles/nps-

principles.html.

Portugal. Decreto-Lei n.º 16/2019. Presidência Do Conselho De Ministros. Accessed February 5, 2023. https://ptspace.pt/wp-content/uploads/2020/05/lei-do-espaco.pdf. Article I §a).

Qizhi, He. "Certain Legal Aspects of Commercialization of Space Activities Space Law." *Annals of Air and Space Law* 15 (1990): 333–42. https://heinonline.org/HOL/P?h=hein.crasl/nairspl0015&i=350.

Resolution 1348 (XIII). UN General Assembly. Question of the Peaceful Use of Outer Space. December 13, 1958. Accessed October 15, 2022 from https://www.unoosa.org/oosa/oosadoc/data/resolutions/1958/general_assembly_13th_session/res_1348_xiii.html.

Resolution 1721 (XVI). UNGA. 1961. Accessed December 15, 2022. https://www.unoosa.org/pdf/gares/ARES_16_1721E.pdf.

Reynaud de Sousa, Bruno, and Christos Ch. Kypraios. "O Papel Da Empresa No Espaço Exterior: Questões Jurídicas Relativas à Exploração Mineira de Asteroides." In *Las Empresas Transnacionales En El Derecho Internacional Contemporáneo: Derechos Humanos y Objetivos de Desarrollo Sostenible*, 151–69. Valencia: Tirant lo Blanch, 2020.

Sachdeva, G. S. "Select Tenets of Space Law as Jus Cogen." In *Recent Developments in Space Law*, edited by R. Venkata Rao, V. Gopalakrishnan, and Kumar Abhijeet, 7–26. Singapore: Springer Singapore, 2017. https://doi.org/10.1007/978-981-10-4926-2_2.

Science. "First Privately Funded Moon Lander Crash-Lands," April 12, 2019. https://www.nationalgeographic.com/science/article/spaceil-beresheet-first-privately-funded-israeli-spacecraft-crash-lands-on-moon.

Smith, Noah. "Giant Asteroid Has Gold Worth $700 Quintillion. But It Won't Make Us

Richer." *ThePrint* (blog), July 9, 2019. https://theprint.in/opinion/giant-asteroid-has-gold-worth-700-quintillion-but-it-wont-make-us-richer/260482/.

Space Foundation Editorial. "Space Foundation Releases The Space Report 2022 Q2 Showing Growth of Global Space Economy." *Space Foundation* (blog), July 27, 2022. https://www.spacefoundation.org/2022/07/27/the-space-report-2022-q2/.

SpaceTech Analytics. "SpaceTech Industry Year Overview." SpaceTech Analytics, January 2022. https://analytics.dkv.global/spacetech/s%D1%80%D0%B0%D1%81%D0%B5tech_industry_year_2021_overview.pdf.

Sprankling, John G. *The International Law of Property*. First Edition. Oxford, United Kingdom ; New York, NY: Oxford University Press, 2014.

S.S. Lotus(Fr. v. Turk.), No. 10 (Permanent Court of International Justice September 7, 1927).

Steer, Cassandra. "Sources and Law-Making Processes Relating to Space Activities." In *Routledge Handbook of Space Law*, 3–24. New York: Routledge, 2017.

———. "The Artemis 1 Mission Marks the Start of a New Space Race to Mine the Moon." Space.com, September 3, 2022. https://www.space.com/artemis-1-moon-mission-mine-resources.

Suzuki, Taijiro. "Japan: Legal Issues in Space Business in Japan - Volume 2." Baker Mckenzie, July 9, 2021. https://insightplus.bakermckenzie.com/bm/real-estate_1/japan-legal-issues-in-space-business-in-japan-volume-2.

Svec, Martin. "Outer Space, an Area Recognised as Res Communis Omnium: Limits of National Space Mining Law." *Space Policy* 60 (May 1, 2022): 101473. https://doi.org/10.1016/j.spacepol.2021.101473.

*The Economic Times*. "Chandrayaan-3 Mission: ISRO Getting Ready for Chandrayaan-

3 Mission in July Second Week: Senior Official." May 18, 2023. https://economictimes.indiatimes.com/news/science/isro-getting-ready-for-chandrayaan-3-mission-in-july-second-week-senior-official/articleshow/100333170.cms?from=mdr.

Traa-Engelman, Hanneke Louise Van. *Commercial Utilization of Outer Space: Law and Practice*. Martinus Nijhoff Publishers, 1993.

Tronchetti, Fabio. *Fundamentals of Space Law and Policy*. SpringerBriefs in Space Development. New York, NY: Springer, 2013. https://doi.org/10.1007/978-1-4614-7870-6.

———. "Legal Aspects of Space Resource Utilization." In *Handbook of Space Law*, 1100. Cheltenham, Northampton: Edward Elgar Publishing, 2015.

———. *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies: A Proposal for a Legal Regime*. Studies in Space Law, v. 4. Leiden ; Boston: Martinus Nijhoff Publishers, 2009.

———. "The Moon Agreement in the 21st Century: Addressing Its Potential Role in the Era of Commercial Exploitation of the Natural Resources of the Moon and Other Celestial Bodies." *Journal of Space Law* 36 (2010): 489. https://heinonline.org/HOL/Page?handle=hein.journals/jrlsl36&id=505&div=&collection=.

"UNODA Treaties." Accessed May 2, 2023. https://treaties.unoda.org/t/moon.

USA. Commercial Space Launch Act. Congress. 98-575. October 30, 1984. Section 4) 11. Accessed February 28, 2023. https://www.govinfo.gov/content/pkg/STATUTE-98/pdf/STATUTE-98-Pg3055.pdf.

Veiga, Paula. "Direito do espaço extra-atmosférico: notas sobre uma nova área do direito." Universidade de Coimbra, 2004.

Von der Dunk, Frans. "Back in Business? The Moon Agreement, Private Actors and

Possible Commercial Exploitation of the Moon and Its Natural Resources." In *The Acceptability of the Moon Agreement and Road Ahead?*, 244–69. McGill University Institute of Air and Space Law International and Interdisciplinary Workshop on Policy and Law Relating to Outer Space, 2006.

———. "International Space Law as a Branch of Public International Law." In *Handbook of Space Law*, 1100. Cheltenham, Northampton: Edward Elgar Publishing, 2015.

Wassenbergh, H. A. *Principles of Outer Space Law in Hindsight*. Dordrecht ; Boston: M. Nijhoff Publishers, 1991.

Wei-Haas, Maya. "Space Junk Is a Huge Problem—and It's Only Getting Bigger." *National Geographic*, April 25, 2019, sec. Science. https://www.nationalgeographic.com/science/article/space-junk.

White, Jr., Wayne N. "Real Property Rights in Outer Space." In *International Institute of Space Law's 40th Colloquium on the Law of Outer Space,* 1998.

Wrench, John. "Non-Appropriation, No Problem: The Outer Space Treaty Is Ready for Asteroid Mining." *Case Western Reserve Journal of International Law* 51, no. 1 (January 1, 2019): 437–62. https://scholarlycommons.law.case.edu/jil/vol51/iss1/11.

Zheleznyakov, Alexander B., and Vadim V. Korablev. "Private Astronautics and Its Role in Space Exploration." In *Industry 4.0: Entrepreneurship and Structural Change in the New Digital Landscape*, 231–42. Heidelberg: Springer, 2017.

Zhukov, G. P., and IUriĭ Mikhaĭlovich Kolosov. *International Space Law*. New York: Praeger, 1984.