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International Space Law
International Law Principles governing the exploitation of outer space resources: assessing a provisional legal framework for allowed activities

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INTRODUCTION

International law is not spatially restricted. It governs and it is applicable to international relations and human activities wherever they may occur, including in outer space.[1] Consequently, since the beginning of the space age, States have decided to adopt specific international rules governing inter-state relations in outer space. This set of coherent and integrated rules is now comprised within international space law, a specialized field of general international law. More specifically, with the adoption in 1967 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* (hereinafter the Outer Space Treaty), the most important international space legal instrument, States agreed to recognize outer space, including the Moon and other celestial bodies, as a *res communis omnium:* an international area that is not subject to sovereign or "national appropriation" but open for free exploration and use by all States.[2] Articles I and II respectively provides for the principle of free use of outer space and the prohibition of any form of national appropriation, where the latter aim has been secured with the so-called "non-appropriation" principle. Therefore, at the time of the conclusion of the 1967 Treaty, the risks associated with the extension of national sovereignty to the space territories or the exploitation of its resources were limited to some extent.[3]

However, it is worth noticing that the international space rules were negotiated and adopted during the Cold War era, when a limited number of countries already had space faring capabilities.[4] Furthermore, at that time the

[1] Crawford J., *Brownlie's Principles of Public International Law*, (Oxford University Press 8th Edition), (2012), (page 347).
[2] Tronchetti F., 'The non-appropriation principle under attack: using Article II of the Outer Space Treaty in its defence', in: 33 *Annals of Air and Space Law* (2008), (page 1).
[3] Dupuy P. and Vinuales J. E., *International Environmental Law*, (Cambridge University Press 2th Edition), (2018), (page 96).
[4] Freeland S., 'Fly Me to the Moon: How Will International Law Cope with Commercial Space Tourism', in: 11 *Melbourn Journal of International Law* 90 (2010), (page 95).

drafters could not foresee every issue related to the future use of outer space.[5] For these reasons, the practical purpose of limiting and regulating access to space resources cannot be considered a result that has been successfully achieved by the international legal instrument. The Treaty, in fact, has not taken into account the future technological and scientific development that will allow States to more easily use outer space. Technology has advanced fast since 1967, to the point that recently the idea of exploiting asteroids or celestial bodies can no longer be considered unreachable, but rather a reality.[6] At the same time, the possibilities for businesses to be able to realize and implement different and ambitious economic ventures in space have been greatly extended. As a result, new entities that want to conduct space exploitation, especially private ones, have proliferated in recent years. But if, on the one hand, the 1967 Treaty prevented States from claiming sovereignty over outer space, on the other hand, it did not specifically address the issue concerning the exploitation of its extraterritorial resources.[7]

As a consequence, in the absence of a rule explicitly or implicitly prohibiting the appropriation and the consequent exploitation of space resources, States have nowadays questioned the scope and the content of the 1967 Treaty's non-appropriation principle. In particular, the United States of America and Luxemburg firmly argue that exploitation of extraterritorial resources is now permitted in space because Article II of the Outer Space Treaty does not forbid them and businesses from owning what can be extracted from asteroids and celestial bodies.[8] Furthermore, as technologically advanced activities have recently developed in space, these States have also decided to adopt specific national laws. Indeed, these national legislations have as their primary objective the promotion of the commercial uses of outer space to ultimately support the new

[5] Wrench J. G., 'Non-Appropriation, No Problem: The Outer Space Treaty Is Ready for Asteroid Mining', in: 51 *Case Western Reserve Journal of International Law* 437 (2019), (page 438).
[6] Ibid.
[7] Bilder R. B., 'A Legal Regime for the Mining of Helium-3 on the Moon: U.S. Policy Options', in: 33 *Fordham International Law Journal* 243 (2010), (page 247).
[8] Wrench, *supra* footnote 5, page 439 to 444.

national economic industries.[9] However, since the sole purpose of these laws is to foster the exploitation in space, it is inevitable that a particular interpretation of the articles incorporated in the Outer Space Treaty is proposed by them. On the contrary, a correct interpretation, the one derived from the text of the Treaty and the subsequent practice of States, is the only one that allows to determine precisely whether these exploitation activities are lawful and how they can also be carried out. And in any case, indeed, all the activities which will in the future operate the exploitation in space must inevitably take into consideration Articles I and II as specifically provided for in the 1967 Treaty.

However, *lacunae* in the legal instrument, which are properly highlighted by these national laws, prevent from concluding with a straightforward answer regarding the legality of space exploitation. Precisely, it is not clear whether Article I of the Outer Space Treaty, in granting free access to outer space to all States, allows for the exploitation of its resources, and whether the prohibition of any appropriation established in the following Article II extends to its resources. These are questions that deserve a detailed and comprehensive answers if we consider that these domestic laws can be capable of interpreting the founding principles, such as Articles I and II, upon which the nowadays international space law was built upon.[10] These questions also include different and even more complex interrogatives, where however these two international principles can provide guidance to the answers. More generally, the following issue arises: in the absence of univocal international space rules, how should the operations of exploitation be conducted? In order to satisfactorily regulate the new phenomenon of exploitation it is indispensable to investigate the correct meaning and understanding of Articles I and II of the 1967 Treaty. In fact, only these two rules indicate what is currently permitted under international law in order to assess if and which operations can pursue the exploitation legitimately. Furthermore, it is equally imperative to take into account the question concerning the preservation of outer space. In particular, what legal rules can be applied to protect its

[9] Tronchetti, *supra* footnote 2.
[10] Ibid, page 1 to 3 and 9.

environment? Are States and these commercial entities forced to comply with the international principles and rules that safeguard the environmental balance of outer space? Thus, and according to what has been established so far, this thesis has the aim of addressing the following research questions:

> *"Do Articles I and II of the Outer Space Treaty allow for the appropriation and consequent exploitation of outer space resources? Furthermore, which principles of international environmental law can regulate the exploitation activities?"*

Regarding the structure of the thesis, and since the research question is complex, the first Chapter aims to introduce the reader to the different types of activities that have the purpose of exploiting the resources of outer space. A distinction will be drawn between entities whose sole purpose is to carry out this activity, and those that are instead driven by more comprehensive plans for the attainment of objectives that are not merely economic. This distinction is of particular importance to show why States have questioned the scope and content of the non-appropriation principle, deciding to support certain exploitation operations. Also in this first Chapter, based on this distinction between the plans and operations that the economic operators wish to pursue, their legal conflicts and relations with Articles I and II of the Outer Space Treaty will be indicated. Finally, the national laws aimed at supporting the private entities will be analyzed. Later, in the second Chapter, I will continue the analysis and I will answer the first research question: the joint interpretation of Articles I and II will serve to conclude by affirming the legitimacy of the activities that envisage the exploitation of the resources extracted only. On the other hand, it is not permitted under international space law to appropriate space resources that have not yet been removed from celestial bodies. Indeed, the international legal basis that allows the first and only lawful activity is the term "use" of Article I of the Outer Space Treaty, which will therefore be the focus of an extensive investigation. Finally, a particular attempt to reflect extensively on the practical implications of specific exploitation activities will be taken into consideration. In fact, in this

second part of this second Chapter, and always based on a joint interpretation of Articles I and II of the 1967 Treaty, I will try to indicate how an exploitation plan should be conducted. Furthermore, in the third section of the thesis I will instead search for the principles of international environmental law applicable to the permitted activities in the absence of a clear and dedicated environmental space discipline. Therefore, I will answer the second research question finding the terrestrial principles that can be used to regulate the environmental aspects of the new space phenomenon. After conducting an analysis of each international environmental principle, I will proceed with their transposition and extension into space: this operation will be carried out in order to highlight their possibile legal effects on exploitation and to assess whether they can contribute to protect the environment of outer space.

Methodology

More precisely, as regards the methodology that will be used in the thesis, national legislations have a primary role. Analyzing the national laws that want to regulate the new activity of exploitation, in fact, serve to adequately identify the gaps within the international framework and, therefore, to better frame the interpretation that Articles I and II accordingly requires and which will be conducted in the second Chapter. However, it must be specified that this thesis does not aim to verify the mere legitimacy of these national legislations with international law. The national Acts rather perform the aim of underlining two issues involved, which I consider important for the future development and supremacy of international law, and which I will therefore consider in the following two Chapters.

The first is that these national laws are evidence of the fact that we are witnessing an evident shift in [the] space law-making: the national approach is prevailing over the international one by providing an interpretation of the latter's

provisions.[11] Specifically, States want to foster their own economic needs and interests but without seeking the acceptance of the international community.[12] Thus, the second Chapter has the aim of investigating on the accurate interpretation of Articles I and II of the Outer Space Treaty in order to ensure that the exploitation will be in accordance with international law in a way that other States' rights are respected and preserved. It follows that, after identifying the correct understanding of the rules established by international law, it will be possible to clarify how exploitation can be legitimately pursued, using the real activities as parameters. The final objective is to ultimately avoid the prevalence of the national dimension over the international one.

Furthermore, the second legal issue involved will be dealt with in Chapter 3. It concerns finding the international environmental law principles applicable to the exploitation of extraterritorial resources in the absence of a clear and dedicated legal discipline of this activity. Since space mining is about to become increasingly feasible, it is not only necessary to address the relevant legal issues and interpretative problems at stake in advance, but also to proactively establish a provisional international legal framework for when it will be operational. This second objective of the thesis would prevent the international approach from being superseded by the national one by introducing pertinent and suitable international principles applicable to exploitation in space.

In this perspective, regarding the third Chapter, a particular and further methodology will be applied. It concerns a general classification of the international environmental norms: indeed, three categories can be identified (concepts, principles and rules) and they are used to make distinctions among them.[13] According to this classification, a "concept", such as declaring outer space as an area beyond any national jurisdiction, is an abstract norm which requires clearer and more binding rules to be realized. Indeed, "concepts" are guiding rules

[11] De Man P., 'State practice, domestic legislation and the interpretation of fundamental principles of international space law', in: *Elsevier Space Policy* 42 (2017), (page 92).
[12] Tronchetti F., 'The Space Resource Exploration and Utilization Act: A move forward or a step back?', in: *Elsevier Space Policy* 34 (2015), (page 8).
[13] Dupuy and Vinuales, *supra* footnote 3, page 59.

which are then implemented by "principles", which, however, in turn need to be specified by more detailed environmental norms.[14] For instance, a "principle", like the duty to prevent an environmental damage, is more precise than a "concept"; but further "rules", which are those included in the third category, are in turn necessary to realise the "principles".[15] It follows that if we want to obtain a satisfactory environmental protection with regard to outer space, both the "principles" and the "rules" should be taken into consideration: they are suitable to specify and clearly explain to States how to protect a common and international area as outer space. Establishing that outer space is a an area beyond national jurisdiction, indeed, is a simple concept and as such is not capable of performing this function and achieve its purposes in an isolated manner. Therefore, in my analysis regarding the "principles" of international environmental law that can regulate exploitation, particular attention will be paid to the "rules" through which these "principles" can be fulfilled. Only the "rules" are in fact the environmental norms that prescribe specific conduct to States and are able to impose environmental parameters and standards on them. In conclusion, for the purpose of achieving environmental protection in outer space, both the "principles" and the "rules" will be taken into account to analyze how they can find application when space exploitation will be conducted, the latter are only a manifestation and an expression of the former to which the third section of the thesis is dedicated.

[14] Ibid.
[15] Ibid.

CHAPTER 1

THE ADEQUACY OF THE CURRENT REGULATORY FRAMEWORK IS CHALLENGED BY THE RISE OF TECHNOLOGICAL DEVELOPMENT IN SPACE

Introduction

Before starting the analysis concerning the legitimacy of the exploitation of extraterritorial resources, it is necessary to familiarize the reader with the activities that have been developed in outer space in recent years. In this introductory Chapter, the main space private economic entities will be introduced in order to explain how the recent technological progress, which could not have been foreseen and regulated when the 1967 Outer Space Treaty was concluded, has occurred allowing them to pursue specific and different exploitation plans.

However, a particular attention will be paid to the real space mining phenomenon. Space mining entities, in fact, are those space private economic entities which have the sole purpose of commercially benefit from the extraterritorial resources. Although in fact there are some characteristics that all these economic entities have in common, namely the desire to pursue exploitation because the revenues that can derive from it are incredibly rewarding, only for the latter evident problems with international legal rules prevent them from operating in the legal certainty. For this reason space mining entities urged States to adopt national laws that apparently provide them with the necessary and sufficient discipline to carry out space exploitation, but which nevertheless firmly establish that respect for and compliance with international law is guaranteed. To conclude, therefore, a survey on the international regulatory framework that directly or indirectly concerns the extraction of space resources will be fundamental in order to analyze how it was received and interpreted by these national laws.

1.1 A new type of space approach

Lowering the financial and technical barriers to enter outer space and enhancing the possibilities to have access to its potential uses, including its commercial applications, have contributed to the evolution of the "new space" industries.[16] The term "new space" refers to the recent phenomenon of commercialisation of the space sector where innovative and economically competitive space ideas and plans are pursued by new and ambitious private entities. Consequently, more and more non-governmental agencies have been engaged in the space field with new and futuristic space plans. However, in recent years, new activities in outer space have prompted discussions on the increasing technological development as well as on the rise of non-traditional actors in the space field that require to be regulated.[17]

The "new space" phenomenon comprises different ventures which pursue *sui generis* or distinctive objectives. For instance, SpaceX is planning to land its first astronauts on Mars in a decade to put in place the first mining activity and eventually establish a permanent human base on the red planet.[18] Recently, the uses of satellites have grown considerably.[19] In addition to telecommunications satellites, the increasingly advanced but almost technologically feasible satellites for defence and security purposes may be soon in operation.[20] Satellites servicing missions have been explored: the development of robotic technology will allow the use of satellites for different functions, including to perform repairs in space.[21] Blue Origin, a rocket company, aims to create a world in which millions of people will be living and working in space and envisions that tapping extraterritorial

[16] Jakhu R. S., Pelton J. N. and Nyampong Y. O.M., *Space Mining and its Regulation* (Springer International Publishing and Praxis Publishing, 1st Edition), (2017), (page 1 and 2).
[17] Breccia P., 'Article III of Outer Space Treaty and its relevance in the international space legal framework', in: *67th International Astronautical Congress (IAC)* (2016), (page 1).
[18] Pershing A. D., 'Interpreting the Outer Space Treaty's Non-Appropriation Principle: Customary International Law from 1967 to Today', in: 44 *Yale Journal of International Law* 149 (2019), (page 149). And see at the SpaceX Website: https://www.spacex.com/mars (last visited 26 May 2019).
[19] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 1.
[20] Ibid.
[21] See at European Space Agency Website http://blogs.esa.int/cleanspace/2018/06/01/esa-opens-the-renegade-activity-for-ssv/ (last visited 5 May 2019).

resources will be required for preserving the Earth and the needs of future generations.[22] Moon Express, the first company to receive U.S government approval to send a robotic spacecraft to the Moon, has ambitious and competitive plans to appropriate precious lunar resources to guarantee Earth's progress for the benefit of humanity.[23] Of worth noticing is its third and larger space aim: collect Moon samples and then return them back to Earth for commercial purposesthe first lunar rocks and dust since the Soviet Union (robotically) brought them back to Earth more than 40 years ago.[24]

These are some examples of the non-traditional space activities conducted by new private economic entities that have been proliferating in the last two decades, namely activities that are not intended to perform traditional space functions.[25] They are accordingly defined as those activities that provide a non-traditional application of outer space, a term usually applied to anything other than the already established sector of communication and Earth observation from space.[26] Notably, non-traditional space activities lack clear international rules that govern them as they are space economic activities whose regulation could not be foreseen in the past. As a result, in the absence of a legal framework at the international level, these private economic entities are forced to operate in the legal uncertainty. However, the most important feature of non-traditional space functions is that, despite a lack of discipline at the international level that has raised concerns about the practical application of their plans,[27] considerable technological and scientific progress has always accompanied the growth and development of these operations.

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[22] See at Blue Origin Website https://www.blueorigin.com/ (last visited 5 May 2019).
[23] See at Moon Express Website http://www.moonexpress.com/ (last visited 5 May 2019).
[24] Ibid., see also Chang K., (2017, November 26), 'If no one owns the Moon, can anyone make money up there?', *The New York Times.*
[25] Hao L. and Tronchetti F., 'The American Space Commerce Free Enterprise Act of 2017: the latest step in regulating the space resources utilization industry or something more?', in: *Elsevier Space Policy* 47 (2019), (page 1 and 2).
[26] Foust J., (2017, December 4), 'Seeking regulatory certainty for new space applications', *The Space Review.*
[27] Siraj A., (2017, September 28), 'Why the Congress Must Act Quickly to Reform U.S Space Law', *Harvard Political Review.*

It follows that, these "new space" entities mentioned above carry out non-traditional economic activities in space. However, they do not have the sole objective of using outer space including its resources in order to pursue exploitation. For instance, SpaceX and Blue Origin also operate in the space tourism sector, where commercial revenues derive from human spaceflights and travel beyond the Earth's orbit for recreational purposes, thus encompassing space exploration plans. Their operations require the use of such advanced technology that the regulation of their activities could not have been included when the international space legal rules were negotiated and adopted. However, the activities, while operating in the absence of an international legal framework, prevent doubts and legitimate questions about their legality from arising spontaneously. Indeed, they are not openly in conflict with some legal rules expressly included in the 1967 Outer Space Treaty.

The same cannot be said about the decision of many "new space" private entities to invest in the exploitation of the resources of outer space only, the most debated space initiative. The future possibility of appropriation and consequent exploitation of extraterritorial resources have given rise to a new type of space industry, namely space mining.

1.2 The advent of space mining ventures

Space mining has the aim of mining celestial bodies and asteroids to obtain natural resources for making profit out of them.[28] It constitutes the next major commercial use of outer space. For instance, according to the European Commission, asteroid mining is one of the "100 Radical Innovation Breakthroughs for the future".[29] Accordingly, States and non-governmental entities have recently expressed the desire to gain profit from the exploitation of natural resources found in space.[30] Mining in outer space, indeed, can be highly economically rewarding: celestial bodies including the Moon and Mars have

[28] Jakhu, Pelton and Nyampong, *supra* footnote 16.
[29] European Commission, '100 Radical Innovation Breakthroughs for the future', (2019), page 6.
[30] Tronchetti, *supra* footnote 12, page 6.

resources that are scarce on Earth and which have an huge value.[31] It should be borne in mind that a single asteroid can contain one billions tons of iron, two hundred million tons of nickel, ten million tons of cobalt, and twenty thousand tons of platinum that have a total net market value of about one trillion U.S. dollars.[32] Regarding its long-term perspectives and according to Goldman Sachs, an American multinational investment bank, asteroid mining could reach the trillion-dollar business.[33]

For these reasons that this business opportunity beyond our planet has witnessed an important technological and financial progress over the last 15 years.[34] This progress is due to a greater extent to U.S private entities, which have always distinguished themselves by their risk-taking approach: they independently planned the mining projects, found and invested financial flows and designed and developed the necessary technology.[35] Bold entrepreneurs have accepted the new challenges posed by the "new space" industries and they, also stimulated by the XPrize competition, have created new business models which involve a highly sophisticated space technology, giving rise to differentiated and even more modern approaches to space.[36] Their unconventional perspectives and the fact that the proposed outcome, if it would turn out successful, will be close to the extraordinary has made it the most publicized type of space ventures.[37]

Particularly two non-governmental entities, Planetary Resources and Deep Space Industries, have ambitious goals regarding outer space.[38] Planetary Resources' plans include mining the near-Earth asteroids in order to establish the

[31] Coffey S., 'Establishing a Legal Framework for Property Rights to Natural Resources in Outer Space', in: 41 *Case Western Reserve Journal of International Law* 119 (2009), (page 120).
[32] Ibid, page 121.
[33] European Commission, *supra* footnote 29, page 220.
[34] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 3.
[35] Ibid.
[36] Ibid. For instance, Xprize Competition created 'The Google Lunar XPRIZE' that has the aim of stimulating bold space entrepreneurs in developing long-term business models for lunar transportation. See at XPRIZE Website https://lunar.xprize.org/prizes/google-lunar (last visited 20 May 2019).
[37] Cookson C., (2017, October 19), 'Space mining takes giant leap from sci-fi to reality', *Financial Times.*
[38] Tronchetti, *supra* footnote 12, page 6.

first permanent commercial mine in space.[39] To achieve this outcome, a specific program has been designed to identify and extract water from selected asteroids, the vital support for the installation of a commercial mine on them. In addition to water, precious materials found in asteroids are the targets of the exploitation: these include platinum, cobalt, nickel and iron.[40] Deep Space Industries has similar purposes: after identifying asteroids with high concentration of natural resources, including water, it will harvest them.[41] The program has ambitious and aspirational goals: according to the company, the space mining activity will bring positive effects for humankind by strengthening its wealth and in achieving what they consider the biggest transformation in human history.[42] This final purpose could become comprehensible if the activity's commercial revenues are taken into consideration. In fact, Deep Space Industries published a report indicating that the value of a small, but pure platinum asteroid, is around $195 billion.[43]

These activities that resemble those portrayed in science fiction movies are not far from being able to be accomplished.[44] "Before it was something really, really hypothetical", said Fabio Tronchetti, Co-Director of the Institute of Space Law and Strategy and a law professor at the University of Mississippi, "but now there are groups that are really serious. It changes everything."[45] However, this seriousness and the high risks undertaken by the non-governmental entities to render the space mining activities operational has not been paid back by the lack of certain and clear rules.[46] A stable legal framework, indeed, in which space mining entities' rights are spelled out is required. In fact, States and private economic entities are unwilling to fund expensive and risky mining operations

[39] See at Planetary Resources Website https://www.planetaryresources.com/ (last visited 5 May 2019).
[40] Vyas K., (2019, January 02), 'Mining in Space: What It Means for the Economy?', *Interesting Engineering*.
[41] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 66.
[42] Ibid.
[43] Spector D., (2013, February 13), 'Deep Space Industry Asteroid Mining Plan', *Business Insider*.
[44] Raclin G. C., 'From Ice to Ether: The Adoption of a Regime to Govern Resource Exploitation in Outer Space', in: 7 *Northwestern Journal of International Law and Business* 727 (1986), (page 729).
[45] The New York Times Editorial Staff, *Space Entrepreneurship: Facing the Next Frontier* (The New York Times Educational Publishing Books 1st Edition), (page 50).
[46] Tronchetti, *supra* footnote 12, page 7.

until they are assured that the appropriation and exploitation of space resources is legal under international space law.[47] This was confirmed by Goldman Sachs which issued a report two years ago confirming that space mining's financial and technological barriers are lower than in the past, but the psychological impediment linked to the lack of detailed rules is highly present in the private space investment sector.[48] Therefore, in the space mining sector the risks already taken by entrepreneurs are extremely high and, consequently, they require a prompt and effective response from the respective governments to ensure that their investments will be protected.[49] In addition, these space mining entities are more than impatient to get involved in the new revenue prospects and, as a result, potential applicable international legal rules and restrictive regulations are perceived as a constraint.[50] Indeed, the eagerness to go ahead quickly has always been a distinct character of the space mining industry.[51]

From a strict legal point of view, this is the difference between the space mining companies and those operating in the other fields comprised within the "new space" phenomenon. The former took considerable risks exposing themselves and their business operations to high chances of failure until the legal framework is defined with certainty. The latter only operate in the legal uncertainty where the adoption of legal rules would be desirable for improving the regulation of their non-traditional activities.

1.3 The relevance of international space law

The distincion stated above concerning the private economic operators is mainly dictated by the fact that there are some *lacunae* in the current international legal framework regarding outer space and its commercial uses but, however,

[47] Coffey, *supra* footnote 31.
[48] Edwards J., (2017, April 6), 'Goldman Sachs: space-mining for platinum is 'more realistic than perceived', *Business Insider.*
[49] Blount P. J., 'Renovating Space: The Future of International Space Law', in: 40 *Denver Journal of International Law and Policy* 525 (2011), (page 522).
[50] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 3.
[51] Ibid.

these effects and consequences on the non-traditional space activities are different. Even if all these new non-governmental economic entities act within an incomplete regulatory framework, the lack of a legal context might interfere with the successful outcome of the other "new space" initiatives, but they are not openly in conflict with the international treaty provisions as space mining plans are. Furthermore, as explained above, the "new space" entities have also the objective of carrying out other non-traditional economic activities in space, unlike the space mining companies whose sole purpose is to conduct exploitation. It follows that, if the space mining private operators were not able to pursue this activity they would fail completely. On the contrary, the other "new space" entities could continue to carry out the other and different operations, not being the exploitation of extraterritorial resources the only commercial activity that they want to achieve. For this precise reason, some States have decided to adopt national laws to guarantee the economic success of space mining ventures, although the effects of these national legislations could have a positive impact on the other "new space" entities.

In this third paragraph of the first Chapter, therefore, it is necessary to briefly but concisely analyze the main applicable international space law rules, in order to correctly underline the main gaps present within the international legal framework that pose problems for the future development of space mining activities. Subsequently, it will be possible to explain how States intervened to support space mining entities. Indeed, these national Acts provide to fill these international regulatory gaps.

1.3.1 The Outer Space Treaty

Concerning the international law governing outer space, there are a number of international treaties, conventions,[52] regulations and "soft law" instruments,

[52] International space law is constituted by five main treaties and conventions, which are in a temporal order the followings: *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies* (1967); the *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects*

including General Assembly Declarations,[53] that have been adopted. However, there are few rules incorporated among them that directly concern and can regulate the exploitation activity. These relevant space provisions will be dealt in this and in the following Chapter 2. These provisions will indeed provide the legal framework in which space exploitation must operate and comply with.

The main and most important international space law treaty is the Outer Space Treaty which was adopted in 1967. During its negotiation and adoption the extraordinary space industries could not have been envisioned due to the lack of technological development. Consequently, all the "new space" activities that have as their purpose the promotion of the commercial uses of outer space are to a small extent regulated by the Outer Space Treaty.[54] Space mining is not an exception, instead it perfectly shows the shortcomings of the international legal regime. Moreover, as previously pointed out in the introduction, legitimate questions about the legality of space mining activities arise, those questions are related to the conformity with the Outer Space Treaty's core provisions. In particular, the provision that is considered violated is codified in one of the most important and significant Articles of the instrument: Article II. According to Article II of the Outer Space Treaty, no State or private entity has the right to claim sovereignty over outer space, celestial bodies including the Moon, or over any parts of them.[55] This provision is known as the "non-appropriation principle" and it was introduced to prohibit the acquisition of territories in space and consequently achieve the ultimate regulatory goal: ensuring the international peace and security in space.[56] Thus, outer space must be free from entitlement claims over it and over its constituting elements. However, space mining

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Launched into Outer Space (1968); the *Convention on International Liability for Damage Caused by Space Objects* (1972); the *Convention on Registration of Objects Launched into Outer Space* (1975); the *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies* (1979).

[53] General Assembly Declarations are: *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space* (1962); *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* (1996).

[54] Blount, s*upra* footnote 49, page 518.

[55] Article II of the *Outer Space Treaty* (1967).

[56] Blount, *supra* footnote 49.

programs aim to first collect data and test material samples, and then profit from them by selling the precious resources or using them for other commercial purposes.[57] All these operations involve the extraction of the material, an appropriation of the natural resources extracted and the subsequent acquisition of entitlements over it, which therefore would be contrary to the Outer Space Treaty.

Despite the recognition that celestial bodies and parts of them cannot be appropriated, Article II does not explicitly refer to space resources. In fact, if on the one hand, the Treaty provided that outer space, the celestial bodies and the Moon are free from any claims of sovereignty, it did not equally foresee that these rules apply to their natural resources. Furthermore, the Treaty contains no other rule regarding the exploitation activities or concerning the use and appropriation of the resources extracted.[58] The Outer Space Treaty is referred to as the "constitution for space"[59] and the fact that neither this treaty, nor other international treaty, regulate the commercial exploitation of space resources has therefore allowed some States to enact national legislations. It follows that, in other words, the adoption of these national laws was possible because a clear reference to the prohibition of appropriation to space resources is lacking.

However, there is another controversial Article that is used by these States to support the space mining industry: Article I of the 1967 Treaty.[60] Article I is used by some States and space mining advocates to indicate the legitimacy of extraterritorial exploitation. Indeed, Article I of the Outer Space Treaty serves to complete the interpretation of Article II. Its term "use", which was intentionally drafted quite broadly, is mobilized for proving that economic activities are encompassed and, consequently, mining extraterritorial resources is one of the lawful operations included.[61] In conclusion, this is the interpretative

[57] Particularly the missions of Planetary Resources aim to gather data and samples even before starting the mining activity. These preparatory missions will be carried out in order to determine the best position for deploying the first mine in space.
[58] Coffey, *supra* footnote 31, page 126.
[59] Blount, *supra* footnote 49, page 517.
[60] Article I of the *Outer Space Treaty* (1967).
[61] Hobe S., 'Adequacy of the Current Legal and Regulatory Framework Relating to the Extraction and Appropriation of Natural Resources', in: 32 *Annals of Air and Space Law* 115 (2007), (page

reconstruction that serves to support the goal of certain States to protect the investment of space mining entrepreneurs in order to promote the economically profitable industry. However, as regards the exercise of the national legislative power, which constitutes the instrument through which it is intended to achieve the regulation of non-traditional space activities, there is a limitation constraining it and originating from the 1967 Outer Space Treaty. Indeed, another rule of international space law deserves to be taken into consideration: Article VI of the Outer Space Treaty, which states 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".*[62]

Under this Article, the activities conducted in space by non-governmental bodies, as well as by governmental agencies, will be attributed to the State, which will therefore bears the international responsibility for their plans.[63] As a result, this rule plays a fundamental role: States that want to support any private activity

129); Gennady D. M., 'Outer Space and the Multilateral Treaty-Making Process', in: *Berkeley Technology Law Journal* 217 (1989).

[62] Article VI of the *Outer Space Treaty* (1967).

[63] For the activities conducted by non-governmental entities Article VI of the Outer Space Treaty also requires State's authorization and continuing supervision of their activities.

that takes place in space, cannot escape the application of international rules. In other words, Article VI ensures that national law cannot be used as a tool to circumvent international responsibility: even if the activities will be performed by other individuals, it is the State that will ultimately be responsible for them. Furthermore, activities that the international rules prohibit to States are likewise not permitted to their private economic entities. More specifically, as required by Article VI, States have the duty to authorize first, and then carry out continuous supervision over the conduct of non-governmental entities. Since the space mining companies and the other "new space" entities are private economic operators and therefore are not classified as governmental entities, States would repeatedly violate the aforementioned space provision if they allowed, authorized and eventually supervised an unlawful activity with the ancillary result that this activity is not even permitted to the private economic operators under international law. This is confirmed by many international space law authors, including Fabio Tronchetti who stated that:

> *"Private entities are allowed to carry out space activities but, according to Article VI of the Outer Space Treaty, they must be authorized to conduct such activities by the appropriate State of nationality. But if the State is prohibited from engaging in certain conduct, then it lacks the authority to license its nationals or other entities subject to its jurisdiction."*[64]

As a result, States cannot allow and regulate a space operation or plan that they do not have the right to perform personally, otherwise they would be responsible internationally. However, in the case of non-governmental entities, a further finding concerning the authorization and supervision that the competent State would have decided to complete should be emphasized: these additional state actions would lead first to invalidate the authorization already granted, and to conclude that the State has further violated Article VI. In conclusion, the enactment of national laws performs the function of carefully indicating, defining,

[64] Pershing, *supra* footnote 18, page 170.

or limiting, in accordance with international law, how non-State entities are required to conduct their allowed operations in space on behalf of the competent State. Therefore, States must be particularly cautious in defining what their operators can or cannot do if it does not want to be held internationally responsible.

It ultimately follows that only if the joint interpretation of Articles I and II of the Outer Space Treaty allows exploitation of estraterritorial resources, this commercial activity can be regulated by States through national laws and, in addition, can be subsequently carried out by other types of private individuals, including by space mining companies and by other "new space" entities. Similiarly, since all the entities that want to exploit extraterritorial resources are non-governmental entities, States must also be careful to authorize and supervise their activities if they do not want to violate this international space rule again.

1.3.2 The Moon Agreement

The 1979 *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies* (hereinafter the Moon Agreement) also deserves attention. In the last decades, States, governmental agencies[65] and non-governmental entities[66] have expressed interest in exploiting its natural resources.[67] Indeed, beyond the common resources that generally concern any celestial body in space, the Moon hosts one of enormous value, for economic and non economic reasons: the helium-3. Helium-3 is a resource that is excessively scarce on Earth, but incredibly present on the Moon and that has the amounts required for its commercial uses as it is found in quantities of about twenty-five parts per billion

[65] See at the European Space Agency Website https://www.esa.int/Our_Activities/Preparing_for_the_Future/Space_for_Earth/Energy/Helium-3_mining_on_the_lunar_surface (last visited 5 May 2019).
[66] Blue Origin and Moon Express Websites, *supra* footnote 22 and 23.
[67] Tronchetti F., 'The commercial exploitation of natural resources of the Moon and other celestial bodies: what role for the Moon Agreement?', in *Proceedings of the International Institute of Space Law* (Vienna, 2010), (page 614).

on the lunar surface.[68] Furthermore, helium-3 in the fusion reaction can create a new, clean and efficient source of energy.[69] Since the supply of fossil fuels is limited as well as harmful for the environment, and since it is now more and more demanding to adapt to the negative impact of climate change and complete the transition from "brown" towards a "green" economy, mining this particular substance is becoming a promising source of energy among States and non-governmental entities. For instance, NASA published a document entitled "NASA's Lunar Exploration Objectives" in which the extraction of helium-3 from the Moon is described as precious and valuable resource, as it is part of one of the aims of NASA's missions on the planet.[70] In this document, NASA enumerated the positive consequences that this resource would produce for the Earth and humankind, stating that:

> *"Utilizing energy produced on the moon can reduce Earth's reliance on fossil fuels (including petroleum, coal, and natural gas) and the associated emission of greenhouse gasses and other pollutants on Earth. This can improve productivity (value per unit cost) associated with activities on the lunar surface; improve the economic sustainability of lunar activities, support permanent human presence and settlement on the moon, and reduce the cost of lunar activities. This activity may encourage investment in space infrastructures by private institutions and others to generate wealth on Earth and on the Moon."*[71]

Similarly, in January 2006, Russia announced that mining the isotope helium-3 constitutes one of the main objectives of the future Russian space exploration program.[72] The prospect of being able to use a resource considered

[68] Coffey, *supra* footnote 31, page 121 and 122.
[69] Ibid.
[70] Ibid, page 123.
[71] NASA, Lunar Exploration Objectives, page 38. Available at: https://www.nasa.gov/pdf/163560main_LunarExplorationObjectives.pdf (last visited 20 July 2019).
[72] Bilder, *supra* footnote 7, page 245.

highly sustainable and which can positively contribute to the development of all humanity has been evaluated fundamental by China: Luan Enjie, director of the Chinese National Aerospace Administration, admitted that the use of the helium-3 would be "the most important driving force to return to the moon".[73] Among non-governmental entities, the European Space Agency (ESA) affirmed its intention to mine helium-3 from the lunar surface in order to support other missions in the Solar System and produce a energy source that is not radioactive and wold not damage the environment.[74]

Since the Treaty comprehensively regulates the Moon, it would seem obvious to assume that it should deal with the regulation of the exploitation that will concern this celestial body, but it is very unlikely to happen. Indeed, the Moon Agreement has been ratified only by 17 States and none of spacefaring States is among those: in the absence of ratification of the 1979 Agreement by the States that have satisfactory technological and scientific means to exploit its resources, its practical effect is very limited.[75] For this reason, many scholars agree on the Treaty's inability to provide a management framework for the orderly administration of Moon's resources.[76] In fact, its provisions are not widely supported, instead they lack of States' general acceptance.[77]

Nevertheless, the Moon Agreement contains interesting and relevant elements that deserve attention and following analysis here. In particular because the international legal concept of "common heritage of mankind" is introduced in this international space treaty.[78] According to this concept, national appropriation and consequent exploitation of its resources are prohibited, but on the contrary is possible to economically benefit from these resources if a management system is

[73] Coffey, *supra* footnote 31, page 123 and Daid L., (2018, August 23), 'China's Bold Moon Sample-Return Mission Will Target a Young Volcanic Plain', *Space.com.*
[74] European Space Agency Website, *supra* footnote 21.
[75] Dupuy and Vinuales, *supra* footnote 3, page 96.
[76] Ibid and Tronchetti, *supra* footnote 67, page 614.
[77] Specifically Article 11 of the Moon Agreement which recognizes that the Moon and its resources are *common heritage of mankind* and how to implement it.
[78] Article 11 of the *Moon Agreement* (1979).

created.[79] This managements system must be established in order to protect the rights and interests of the less developed States as the appropriation and the use of the resources are intended for the benefit of all States and stakeholders.[80] It follows that if this particular regime were implemented it would be legally possible to carry out exploitation activities on the Moon. But, this is not practical possible as the Moon Agreement has not been universally accepted, as stated above, and because this joint management system has never been created. However, the inclusion of a concept as the "common heritage of mankind" concerning the management of resources of the Moon which are located outside state control can be useful as it clearly refers to and allows for an economic exploitation of extraterritorial resources. In particular, for instance, as evidence of the subsequent practice of States, as will be accordingly analyzed in the second and following Chapter.

Following from the above, the 1967 Outer Space Treaty is the only generally accepted and binding international space treaty that contain rules which directly or indirectly concern exploitation of space resources, including the rare helium-3. As a result, it will also apply to lunar mining activities for most States, except for those who have ratified the 1979 Moon Agreement. The most important consequence regarding the different international acceptance of the two space treaties is that provisions of customary international law can be found only in the latter instrument. Thus, States are bound by the Outer Space Treaty's rules which already have the status of international custom even if they have not ratified the international instrument. However, at the moment this difference between the nature and origin of the sources of international law does not have relevant effects; States that have taken steps to adopt national laws on space mining are in any case party to the 1967 Outer Space Treaty and, consequently, the binding treaty nature of its articles binds them. Nonetheless, the customary nature of the Outer Space Treaty's core provisions will be taken into consideration in the second Chapter: if those States that adopted national legislations decide to

[79] Dupuy and Vinuales, *supra* footnote 3, page 96.
[80] Ibid.

terminate the Outer Space Treaty, it would be necessary to verify whether its rules concerning exploitation are part of customary international law and therefore eventually binding on them. An operation that cannot equally concern the 1979 Moon Agreement. As shown above, this international space treaty cannot contain any provision that have cristallyzed in customary international law due to the lack of universal acceptance regarding the whole legal instrument.[81] Failure to accept an international treaty, indeed, totally precludes the general and widespread acceptance of its rules, which, in turn, can never attain the status of international custom.

1.3.3 COPUOS's work and agenda regarding exploitation

International space law, as a distinct field of international law, has its own independent bodies and technical committees that have specific tasks and roles regarding space and space activities. Indeed, they play a fundamental function: that of cooperating and coordinating efforts between States and of providing a framework for the negotiation of international treaties.[82] Their activities and works deserve to be noted here, as they could serve as agreed *fora* in the future for the adoption of shared and agreed international rules relating to the exploitation of space resources. In addition, they have been involved in the adoption of legal documents, which although not binding, provide information about the complexity of the exploitation issue and constitutes evidence of the opinion of the States.

Among the independent space bodies, there is the The Committee on the Peaceful Uses of Outer Space (hereinafter COPUOS) that was established by the UN General Assembly in 1959. The Committee has two subsidiary bodies: the

[81] The two elements that constitute international custom are: (1) practice which must be general, widespread and consistent and (2) the *opinion iuris* that makes the States feel this practice accepted as law. Since the 1979 Treaty itself has not received the necessary ratifications to consolidate a given practice, the subjective element of the *opinion iuris* cannot be verified.

[82] The international space bodies have been instrumental for the creation and adoption of the five international space treaties tha adopted so far.

Scientific and Technical Subcommittee, and the Legal Subcommittee.[83] The COPUOS performs significant functions, including: governing the use and exploration of outer space for the benefit of all humanity, studying, preparing and prompting discussions on space-related activities that can be undertaken by the United Nations or that can create legal problems with the use and the exploration of outer space.[84] Therefore, it is not surprising that the Committee in the last few years has been interested and has been involved in the regulation of exploitation and appropriation of resources in space. Indeed, the activity is space-related activity that poses legal and interpretative problems with regard to the use of outer space and also, even if only partially, it can contribute to benefit all mankind, mainly for development reasons.

The first time exploitation appears on the COPUOS agenda was in 2017, more precisely it was included in an indicative schedule of work on January 27, 2017.[85] In this document the Committee planned to start discussions on the potential legal framework applicable to exploitation and utilization of space resources in the form of general exchange of views.[86] Subsequently, this unique agenda item entitled "General exchange of views on potential legal models for activities in exploration, exploitation and utilization of space resources" was accordingly received and accepted by the Legal Subcommittee which started the discussion on March 30, 2017. The result led to the adoption of the first important legal draft by the Committee in which various relevant points were raised: indeed, COPUOS provided a significant platform at the global level by having initiated general discourses on how to monitor the economic, social and legal effects related to exploitation as a new commercial activity in space. Also, many delegations shared this opinion and expressed the view that adopting a broad

[83] See at United Nations Office for Outer Space Affairs Website: http://www.unoosa.org/oosa/en/ourwork/copuos/index.html (last visited 24 July 2019).
[84] Ibid.
[85] COPUOS, Annoted provisional agenda (including indicative schedule of work), A/AC. 105/C.2/L.2.99 of 2017, Available at: http://www.unoosa.org/res/oosadoc/data/documents/2017/aac_105c_2l/aac_105c_2l_299_0_html/AC105_C+2_L299E.pdf (last visited 24 July 2019).
[86] Ibid, page 4.

multilateral approach to space resources within COPUOS constitutes the only way to ensure that all States, including the less developed, were taking into consideration and were involved in the discussions,[87] thus underlining its delicate role in coordinating the efforts of all States. As a result, as COPUOS had the role of stimulating an appropriate forum to start dialogues on exploitation, several views have been exposed. However, in this thesis only those that are related to what has been said so far in this first introductory Chapter will be reported.

First of all, delegations have repeatedly expressed the need to shed light on the content and the accurate interpretation of the core principles of the 1967 Outer Space Treaty in order to understand whether exploitation in space is lawful, in order to guarantee the respect of all the rights of other States and in order to correctly guide the participation of the private sector in space.[88] Furthermore, with regard to this last point, a view similar to the one introduced in the previous paragraph has been advanced, thus confirming the limits within which private entities are required to operate. In fact, States agreed that private economic companies can, if properly authorized and supervised by the competent State, carry out economic activities but as long as they are "exercised in accordance with the existing legal framework and relevant principles governing outer space activities."[89] Consequently, the functions performed by Article VI of the Outer Space Treaty are confirmed by the inclusive and broad discussions undertaken by States: authorization and subsequent supervision are mandatory conditions to be fulfilled if they want to operate exploitation, but nonetheless international law must be fully respected by all the international subjects involved, including the competent State and non-governmental entities. This means that it is even more necessary to clarify the contents of Articles I and II of the 1967 Treaty and to

[87] COPUOS, Draft Report: Addendum *IV. Status and application of the five United Nations treaties on outer space & XIII. General exchange of views on potential legal models for activities in exploration, exploitation and utilization of space resource*, A/AC.105/C.2/L.301/Add.1 of 2017, page 3, paragraph 19. Available at: http://www.unoosa.org/res/oosadoc/data/documents/2017/aac_105c_2l/aac_105c_2l_301add_1_0_html/AC105_C2_L301Add01E.pdf (last visited 24 July 2019).
[88] Ibid, page 4 and 5, paragraph 22, 23 and 25 and 31.
[89] Ibid, page 4, paragraph 26.

establish their accurate understanding, otherwise this operation of ensuring compliance with international law is at risk. This, in turn, leads to the third point which was expressed within COPUOS and that is worth emphasizing here: the consistency and coherence of international space law. States have expressed the opinion that the adoption of national laws with the purpose of regulating exploitation could have negative impact on outer space and on its legal regime, more precisely the following view was affirmed:

> *"Some delegations expressed the view that unilateral domestic initiatives aimed at regulating commercial activities in outer space could lead to the development of multiple incompatible national frameworks, which would pose a risk of conflicts among States and potentially impact the sustainability of outer space."*[90]

It follows that, not only the issue of national laws can prevent private economic entities from operating in compliance with international law in the event that the content of such national instruments is not in conformity with the Outer Space Treaty, but may also lead to conflicts between States. Risks of disagreements would depend, indeed, on the fact that these domestic legislations are not uniform with one another, but rather conflicting. As a consequence, it is necessary to clarify precisely what international space law can allow States to do, otherwise each of them may prescribe conduct that are not permitted or may recognize rights that cannot be guaranteed with the further danger of fragmenting international space law.

Ultimately, in this legal document the delegations highlighted for the first time the need to adequately address the issue of the benefits deriving from exploitation of space resources so that they can be equally enjoyed by all States and people.[91] However, this important and delicate discussion was only taken up again at a later date. Already in a subsequent document adopted within COPUOS on April 6, 2017, the issue was duly emphasized and the delegations shared the

[90] Ibid, page 4, paragraph 27.
[91] Ibid, page 5, paragraph 32.

idea that a potential legal framework concerning exploitation had to take into account two points: "that all States are able to benefit from the exploitation of space resources and that exploitation should not be reserved for a monopoly".[92] Therefore, there is an intrinsic link between, on the one hand, how States and their private entities can carry out exploitation, if it is possible under international law, and, on the other hand, how to ensure that their conduct is in accordance with the rights and interests that other States have on outer space. In other words, if international space law allows the appropriation of extraterritorial resources, exploitation cannot be boundless but must guarantee that all States are involved. These critical issues were noted in the COPUOS agenda but they were discussed later. Indeed, the Legal Subcommittee considered the agenda item4, entitled "Information on the activities of international intergovernmental and non-governmental organizations relating to space law" which led to the adoption of a new legal document only on April 9, 2019.[93] This soft law instrument contains several questions that States have expressed, namely: how to ensure that exploitation is carried out for the benefit of all the States, how to ensure that outer space and celestial bodies remained free for use and exploration by all States without discrimination of any kind and how to ensure that there is no form of national appropriation in space.[94] The delicate balance that must be achieved between, on the one hand, the use of outer space and its resources and, on the other hand, guaranteeing respect for the rights of other States by preventing the use from becoming appropriation of territories in space, will be extensively examined in the second Chapter. Here it is important to report all the details of the

[92] COPUOS, Draft Report: Addendum *Proposals to the Committee to the Peaceful Uses of Outer Space for new items to be considered by the Legal Subcommittee at its fifty-sixth session*, A/AC.105/C.2/L.301/Add.5 of 2017, page 2, paragraph 6. Available at: http://www.unoosa.org/res/oosadoc/data/documents/2017/aac_105c_2l/aac_105c_2l_301add_5_0_html/AC105_C2_L301Add05E.pdf (last visited 24 July 2019).

[93] COPUOS, Draft Report: Addendum *(III. Information on the activities of international intergovernmental and non-governmental organizations relating to space law; & XIII. General exchange of views on potential legal models for activities in the exploration, exploitation and utilization of space resources),* A/AC.105/C.2/L.309/Add.3 of 2019, page 1, paragraph 1. Available at: http://www.unoosa.org/res/oosadoc/data/documents/2019/aac_105c_2l/aac_105c_2l_309add_3_0_html/AC105_C2_L.309Add03E.pdf (last visited 24 July 2019).

[94] Ibid, page 5, paragraph 27.

discourse around Articles I and II of the Outer Space Treaty and to emphasize that a definitive result or clear answers to these complex questions have not been achieved by States within COPUOS. In the light of the above, in my opinion, the intense debate that took place within the committee has further clarified the need to adopt a comprehensive international legal framework regarding the exploitation of extraterritorial resources in which all these views and opinions of all States can find expression.

In this perspective, it is worth noting that Belgium and Greece submitted a working paper for the creation of an *ad hoc* Working Group for the development of an international regime for the exploitation of space resources.[95] Indeed, this Working Group was established and on April 8, 2019, COPUOS released a document defining its future agenda until 2022.[96] Its purpose is first and foremost to assess the current regulatory framework and to indicate in advance potential applicable international principles, before reaching the complete creation of a legal regime.[97] Accordingly, this document allows to grasp two important elements: the first is that there are existing international law principles applicable to this new activity, secondly, that the adoption of a multilateral treaty could take years and, consequently, since space mining is becoming increasingly feasible, until then it is necessary to have a temporary but effective international legal framework. Indeed, this thesis reflects these two points: it aims to evaluate whether exploitation of space resources is lawful and how it should be conducted by identifying the applicable rules, to then indicate which principles of international environmental law can be used to preserve the environment of outer space. In conclusion, the prerogative, which was shared by the delegations within

[95] COPUOS, *Proposal for the establishment of a working group for the development of an international regime for the utilization and exploitation of space resources*, A/AC.105/C.2/L.311 of 2019. Available at: https://undocs.org/A/AC.105/C.2/L.311 (last visited 24 July 2019).
[96] COPUOS, *Addendum on the Working Methods and Work Plan of the Working Group proposed under document*, A/AC.105/C.2/L.311 entitled "Proposal for the establishment of a working group for the development of an international regime for the utilization and exploitation of space resources", A/AC.105/C.2/2019/CRP.22 of 2019. Available at: http://www.unoosa.org/res/oosadoc/data/documents/2019/aac_105c_22019crp/aac_105c_22019crp_22_0_html/AC105_C2_2019_CRP22E.pdf (last visited 24 July 2019).
[97] Ibid, page 1.

COPUOS, is to research on the current space legal obligations in force that, even in the absence of a detailed and comprehensive legal framework, would be fully applicable to this commercial activity nowadays.

1.4 National Space Laws concerning exploitation of resources

Following from the above, in the absence of a clear and dedicated international legal framework that regulates the exploitation of resources found in space, and considering the lack of the international space treaties and instruments in addressing whether it is possible to appropriate them, some States have decided to enact national space laws.[98] However, these national legislations regulate the conduct of their private space entities and non-governmental agencies for the purpose of accomplishing their own economic objectives. As a result, these laws, in protecting the risky ventures, have interpreted the provisions of the Outer Space Treaty to serve national interests.

On May 21, 2015, the U.S House of Representatives adopted the *"U.S. Commercial Space Launch Competitiveness Act"*.[99] The Act performs an instrumental function towards achieving the primary objective of supporting the new U.S space mining companies. The purpose of the Act is, indeed, to "facilitate the commercial exploration and utilization of space resources to meet national need".[100] However, its compliance with international law is concerned. Particularly with the above-mentioned Article II of the Outer Space Treaty, which has made celestial bodies and any parts of them not susceptible of appropriation. In fact, the most debatable elements of the national legislation arise with regard to the recognition of property rights over the natural resources: the acquisition of property rights would amount to either a claim of sovereignty or a national appropriation, which would also prevent the use of such resources from other

[98] Tronchetti, *supra* footnote 12, page 7.
[99] U.S. Commercial Space Launch Competitiveness Act of 2015, Available at: https://www.congress.gov/bill/114th-congress/house-bill/2262/text/enr (last visited 5 May 2019).
[100] Ibid.,''§ 51302. Commercialization of space resource exploration and utilization, Letter A, paragraph 1.

States. Also, the Act confirms that the private entities acquire property rights over asteroid resources, establishing that:

> *"Any asteroid resources obtained in outer space are the property of the entity that obtained such resources, which shall be entitled to all property rights thereto, consistent with applicable provisions of Federal law and existing international obligations".*[101]

Subsequently, on July 20, 2017, Luxemburg adopted the *"Luxembourg Space Resource Act"*.[102] This Act also includes troublesome aspects, particularly in granting private entities the right to extract natural resources, which in turn are considered susceptible of appropriation.[103] The Luxemburg Act should not be underestimated: it is the first national law enacted in Europe and it could soon produce more significant and widespread effects. Especially because Russia has shown interest in the space mining industry and wants to follow the Luxembourg initiative. Indeed, Russia has proposed to the former an agreement on cooperation in the use of outer space, which includes mining its resources.[104]

In addition to the national laws already adopted, which are therefore in force and produce their legal effects, attention must be paid to the future State initiatives regarding compliance with the 1967 Outer Space Treaty. On June 6, 2017, the "*American Space Commerce Free Enterprise Act",* an American draft bill, was presented to the US House of Representatives which approved the text on April 25, 2018.[105] Even if by the time of this writing the bill has not been adopted yet,[106] its content allows to better grasp the problems raised by national interpretations of the international legal framework, when the latter do not always include clear

[101] Ibid., § 51303. Legal framework, Paragraph A.
[102] Luxembourg Space Resource Act of 2017, Available at: http://luxembourg.public.lu/fr/actualites/2016/11/11-space-resources/projet-de-loi-espace.pdf (last visited 5 May 2019).
[103] Ibid., Article 1.
[104] Soldatkin V., (2019, March 06), 'Russia wants to join Luxembourg in space mining', *Reuters.*
[105] Bill, American Space Commerce Free Enterprise Act of 2017, Available at: https://www.congress.gov/bill/115th-congress/house-bill/2809/text#toc-H5B2BDFF09DD74242854135474F390FBA (last visited 5 May 2019).
[106] According to the American legislature procedure, the bill must still be approved by the U.S Senate before it reaches the President of the United States for his/her signature.

rules regulating any space issue involved. First of all, the bill is not intended to regulate only the space mining activity, but rather addresses non-traditional space ventures planned by non-governmental entities.[107] In fact, the purpose of the bill is precisely to regulate the authorization procedures and the supervision mechanisms of non-traditional space activities to limit the legal uncertainty in which they operate.[108] As far as space mining is concerned, three provisions of the bill are significantly controversial. Firstly, the United States recognizes that its citizens and entities are free to *use* space resources *without condition and limitation*,[109] thus precluding that outer space and celestial bodies can be explored and used by other States and in the same way. In addition, the obligations under the Outer Space Treaty shall be interpreted "in a manner that minimizes regulations and limitations on the freedom of United States non-governmental entities to explore and use space",[110] creating clear and evident legal collisions with Article VI of the 1967 Treaty which requires continuous and rigorous authorization and supervision on them by the competent State, which, in turn, will be held internationally responsible for such negligent conduct. To conclude, property rights on space resources are not only recognized, but the bill states that the President of the United States must also protect them.[111] According to the drafters, the procedures contained in the bill performs the function of securing compliance with the Outer Space Treaty.[112] However, the bill is the result of an arbitrary and new interpretation of the international space treaty advanced by the United States, with

[107] The bill does not spell out all the activities covered by its rules and regulations. As long as non-traditional space activities are concerned, the bill applies. However, the text certainly includes the commercialisation of remote sensing satellite. See also article by Foust J., (2017, June 8), 'House bill seeks to streamline oversight of commercial space activities', *SpaceNews* and see also BHO Legal Website https://www.bho-legal.com/en/american-space-commerce-free-enterprise-act-of-2017/. (last visited 5 May 2019).

[108] As previously stated, non-traditional space activities, like space mining, could not have foreseen and regulated when the Outer Space Treaty was adopted, therefore they operate in legal uncertainty. However, unlike space mining, they are not in open conflict with international law.

[109] Bill, American Space Commerce Free Enterprise Act of 2017, *supra* footnote 105, Finding; Policy; Purposes, (b) Policy (1).

[110] Ibid.,"§ 80103. Certification application and requirements, (c) compliance with the Outer Space Treaty, (2) limitations for determinations (A).

[111] Ibid.,"§ 80111. Protecting the interests of United States entity space objects (2).

[112] Sanford T., (2018, April 25), 'CSF Applauds House Passage of the American Space Commerce Free Enterprise Act', *Commercial Spaceflight Federation*.

the aim of circumscribing, if not eliminating, its core rules and founding principles. Indeed, beyond a clear conflict with Articles I, II and VI of the 1967 Treaty, another founding rule of international space law is challenged by the United States: the rule that denies the nature of *global commons* to outer space. Denying the intrinsic nature of global commons could have devastating effects, including: restricting other States' access to celestial bodies and limiting their rights to use outer space and its resources.[113] As a consequence, the ultimate aims of ensuring that States use outer space on the basis of equality, for the benefit and interests of all mankind and in accordance with the equivalent right to access it, which have also been recently discussed within COPUOS, would be totally prevented.[114]

These international and global goals are likely to be even more at risk if we consider that the national regulation of space exploitation will be further enhanced in the near future. Indeed, there is already a next country that is prepared to adopt a national legislation that resembles the U.S bill: the United Arab Emirates (UAE).[115] According to Mohammed Al Ahbabi, the UAE Space Agency director general, the United Arab Emirates is currently drafting a comprehensive law that will deal with space mining.[116] Also, in order to achieve the goal of appropriating extraterritorial resources, the UAE has established a "Space Agency Working Group on Space Policy and Law": the body has the tasks of firstly assessing the existence of an appropriate legal framework and, subsequently, to adopt specific procedures, mechanisms and legal rules regarding the space sector.[117] Furthermore, other spacefaring States that can count on a developed and technologically advanced space power, including Japan, China and Australia, are considering to adopt similiars laws in the future.[118] Thus, the integrity of international space law has never been so threatened.

[113] Bill, American Space Commerce Free Enterprise Act of 2017, s*upra* footnote 105, "§ 80308. Global commons.
[114] Article I of the *Outer Space Treaty* (1967).
[115] Pershing, *supra* footnote 18, page 160.
[116] Ibid.
[117] Ibid.
[118] Ibid.

Conclusion

It follows that, after having introduced the reader into the realm of exploitation in space, after the international regulatory gaps have been succinctly explained and it has been clarified how they have been filled by national legislation, it is necessary to proceed towards a more substantial analysis. Throughout the first Chapter many questions have accordingly arisen: can States recognize and protect property rights on space resources? Can space mining companies and "new space" entities extract these resources from celestial bodies? How to ensure that claims of sovereignty or national appropriation by these States are equally excluded?

Complex and probably unambiguous questions. Therefore, attempts to capture and frame them in the legal context require deep and substantial analyses. On the one hand, the substantial analysis will take into account the comprehensive and accurate interpretations of Articles I and II of the Outer Space Treaty; on the other hand, a more precise investigation concerning the different operations, plans and activities of the new private economic operators will be extensively considered in order to fully answer to the aforementioned questions. These substantial investigations are intended to shed light on compliance of these domestic legislations with international space law. Furthermore, and more precisely, the international legal framework currently in force for the appropriation and the consequent exploitation of space resources will emerge. It is now therefore necessary to go into such substantive analyses.

CHAPTER 2

CONSTRUCTING THE INTERPRETATION OF ARTICLES I AND II OF THE OUTER SPACE TREATY

Introduction

As was stated in the previous Chapter, Article I of the Outer Space Treaty is invoked by the spacefaring States for demonstrating that space mining is a lawful activity. Specifically, in these States' view, all commercial activities are included within the right to *use* outer space. Following from the above, the "use" of outer space encompasses activities that are not expressly mentioned in the 1967 Treaty and States rely on this term for affirming the legality of their space mining Acts and mining plans. However, according to this reading, the legality of exploitation stems from an international space treaty and, consequently, States are forced to acknowledge the applicability of international space law as a set of coherent rules. For instance, the Grand Duchy of Luxembourg recognized that the collection, extraction and appropriation of the resources will be in accordance with international law because its provisions remain untested on those who owns rights over the natural resources of space.[119] In a similar fashion, the United States confirmed that no provision in the 2015 Act violates its obligations under international law and recognized the applicability of international rules when it comes to asteroid mining.[120]

For this reason an accurate interpretation of the main provisions of this international law treaty must be conducted. The 1967 Treaty, as recognized by the United States, will regulate and govern the exploitation of space resources.

[119] See at The Government of the Grand Duchy of Luxembourg Website, Luxembourg's framework, What are the legal issues? Available at: https://spaceresources.public.lu/en/faq.html (last visited 5 May 2019).

[120] U.S. Commercial Space Launch Competitiveness Act of 2015, s*upra* footnote 99, ''§51302. Commercial exploration and commercial recovery, (a) In general (2) and (3).

However, it is not as it has been affirmed by the State of Luxembourg, that international law cannot be applied since there has not yet been any practice or conduct of States on exploitation. On the contrary, the international treaty is clear about what actions are allowed or prohibited, in particular when it comes to the appropriation of the resources and the prohibition of national appropriation. Therefore, this Chapter aims to investigate on the correct meaning of both Articles I and II of the Outer Space Treaty, whose correct understanding will also indicate which operations and plans can be considered in compliance with these two rules.

2.1 Article II of the Outer Space Treaty

The analysis concerning Article II of the Outer Space Treaty is certainly not simple and requires attention, particularly the adjective "national" which accompanies the term appropriation. Indeed, numerous elements and fundamental issues and questions surround the full understanding of the international space rule today. For this reason, this paragraph of the second Chapter has two aims: the first is to provide both an introduction and an explanation regarding the original meaning of the non-appropriation principle, the second is to indicate the shifts of customary international law that have concerned this principle in order to frame its current meaning nowadays.

I will support the theory that the provision was originally designed and interpreted quite broadly by States and international subjects to encompass any form of appropriation that occurred in space, including national appropriation.[121] Subsequently, however, the conduct and general practice of States have contributed to slightly change the content of Article II of the 1967 Treaty. There has indeed been a shift in customary international law which reinterpreted the non-appropriation principle more narrowly in scope.[122] According to these shifts, nowadays States and their private economic operators, albeit with some limitations, are allowed to appropriate and exploit extracted natural resources

[121] Pershing, *supra* footnote 18, page 151.
[122] Ibid, page 157.

from the Moon and other celestial bodies. However, the appropriation of natural resources *in situ* remains completely prohibited under Article II of the Outer Space Treaty as it is to be considered a national appropriation, that despite the customary changes related to the non-appropriation principle, it is still considered strictly forbidden.

2.1.1 Subject matter of Article II of the Outer Space Treaty

First of all, it is useful to define what the scope of this provision is before examining the original meaning of the non-appropriation principle and which States behaviors and activities are covered by this rule. Thus, it is here necessary to quote the article in its entirety. Article II of the Outer Space Treaty states 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"*[123]

Therefore, the prohibition of national appropriation would incontrovertibly extend to outer space and its celestial bodies, including the Moon.[124] As far as the Moon and outer space as a whole are concerned, no particular interpretive problem arises. In addition, the Moon is currently considered a potential destination to be exploited only by intergovernmental organizations[125] and by some non-traditional "new space" entities.[126] Furthermore, there is no doubt about its identification and the fact that it is included under Article II regulation, as it is clearly mentioned within the text of the provision. However, from a legal point of view, it may be necessary to clarify what constitutes a "celestial body". Indeed, the national laws discussed in the previous Chapter, particularly the *"U.S.*

[123] Article II of the *Outer Space Treaty* (1967).
[124] Gorove S., 'Interpreting Article II of the Outer Space Treaty', in: 37 *Fordham Law Review* 349 (1969), page 349 and 350.
[125] The Government of the Grand Duchy of Luxembourg Website, *supra* footnote 119.
[126] As explained in the previous Chapter, under the first paragraph, Blue Origin and Moon Express are planning to appropriate Moon's natural resources, to bring them back to Earth and to finally use them for economic purposes.

Commercial Space Launch Competitiveness Act" of 2015, refer mainly to asteroids. Furthermore, asteroids are the primary target of true space mining entities, in particular of Planetary Resources. Consequently, it is first necessary to verify whether the non-appropriation principle includes and regulates them so that these non-governmental and governmental entities do not attempt to evade or circumvent the application of Article II of the Outer Space Treaty.

Even if there is no agreed international definition of what a celestial body is, it is widely supported by international space law scholars that it comprises asteroids, regardless of whether they are known or not, their size, position in outer space and other specific physical features.[127] Universe Today, a non-commercial space and astronomy website, provided a definition of celestial bodies: "a celestial body is any natural body outside of the Earth's atmosphere", thus unquestionably and undoubtedly confirming asteroid's nature of celestial bodies.[128] Furthermore, Manfred Lachs, an authoritative expert of international space law who was also the chairman of the United Nations COPUOS for the negotiation of the Outer Space Treaty,[129] stated that when the term "celestial bodies" is used in an international space law instrument, all areas present in outer space are encompassed.[130] More precisely he affirmed that: "celestial bodies" as employed in the relevant instruments should therefore be viewed as the largest common denominator of all "land areas in outer space".[131] In conclusion, all the planets, including Mars where SpaceX is planning to land its astronauts and humans in a decade,[132] the Moon where many States and private enitities are considering to extract the rare and precious helium-3, the stars and all asteroids are governed specifically by Article II of the Outer Space Treaty and, more in general, by international space law.

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[127] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 117.
[128] Ibid and Coffey J., (2009, December 27) 'Celestial Body', *Universe Today.*
[129] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 117.
[130] Ibid.
[131] Lachs M., *The Law of Outer Space: An Experience in Contemporary Law-Making*, (1972), (page 46).
[132] Pershing, *supra* footnote 18.

2.1.2 Article II of the Outer Space Treaty under customary international law

Moving on to the content of Article II, it is demanding and necessary to consider its evolution under international law and, precisely, under customary international law. According to Article 38 of the Statute of the International Court of Justice (hereinafter the ICJ), international custom is a source of international law. It is defined as "the evidence of a general practice accepted as law" and therefore two elements contributes to its formation: state practice and *opinio iuris sive necessitatis.*[133] The following analysis will take into account both these two components of international custom to demonstrate that there have been variations under customary international law which concerned Article II of the Outer Space Treaty. Indeed, there is a new interpretation according to which the non-appropriation principle allows the extraction of the resources of outer space. This construction is now accepted as binding under customary international law, despite the fact that Article II was originally drafted broadly, prohibiting any form of national appropriation.

A. Original interpretation of the non-appropriation principle under customary international law

The non-appropriation principle was originally constructed broadly for the purpose of preventing any form of national appropriation in space.[134] Any claims by States and by private individuals regarding any area of outer space and of celestial bodies, irrespective of the means of establishment of titles, were strictly prohibited under Article II of the Outer Space Treaty.[135] Therefore, the well-recognized customary international law methods which allow subjects of international law, including individuals, to obtain sovereignty over unknown lands by means of occupation or effective possession are forbidden under international

[133] Dixon M., *International Law*, (Oxford University Press 7th Edition),(2013), (page 32-37).
[134] Pershing, *supra* footnote 18, page 154 and 155.
[135] Hobe, *supra* footnote 61, page 121.

space law.[136] In this perspective, as far as space mining is concerned, the words "by other means" or "by means of use" had a fundamental importance:[137] all claims by States and private entities would have been considered unlawful, including claims that could have been based on a mere utilization of an asteroid or another celestial body for the purpose of exploring or exploiting the resources. It follows that when a new advanced technology had been used by space mining companies (by other means), or the simple total exploitation of a small asteroid had been implemented (by means of use), it would have been in violation of Article II of the Outer Space Treaty.

This reconstruction of the non-appropriation principle is confirmed by the *Travaux Préparatoires* of the Outer Space Treaty. States'reactions to the inclusion of the international principle in the legal instrument are evidence of a widespread and general acceptance regarding its original meaning: the international community at that time agreed that any form of appropriation in space would be contrary to the non-appropriation principle. For instance, the Belgian delegation stated that it "had taken note of the interpretation of the term 'non-appropriation' advanced by several delegations -apparently without contradiction- as covering both the establishment of sovereignty and the creation of titles to property",[138] an opinion shared by the French delegation.[139] Furthermore, both the United States and the Soviet Union agreed to include in the text of the 1967 Treaty an article that prohibits any national appropriation.[140] The British representative also made a proposal to introduce an anti-sovereignty principle within the text of Article II of the Treaty.[141]

The is also some evidence that the broad exclusion encompassing any national appropriation with regard to areas of outer space had already attained the status of customary international law before the adoption of the 1967 Treaty. Two

[136] Tronchetti, *supra* footnote 2, page 2.
[137] Article II of the *Outer Space Treaty* (1967).
[138] UN Doc. A/ AC.105/C.2/SR 71 (4 August 1966).
[139] UN Doc. A/C.1/PV.1492 (16 December 1966).
[140] Hobe, *supra* footnote 61, page 122.
[141] Ibid.

General Assembly Resolutions, which prepared the final text of the Outer Space Treaty, mentioned the extensive non-appropriative nature of outer space.[142] Therefore, States and the international community were already in support of the existence of a principle that strongly prohibited any national appropriation.[143] This is also demonstrated by a statement of the Canadian Delegate who affirmed that:

> *"the legal principles contained in the draft resolution…reflected international law as it was currently accepted by Member States".*[144] *Also, the two Resolutions were unanimously adopted, thus showing States' widespread acceptance regarding the non-appropriability of outer space and of its resources.*[145]

Furthermore, the unanimity reached for the soft law instruments and States' uniform interpretation concerning Article II are evidence of the *opinio iuris* among States that outer space must be free from any appropriation claims.[146] As a result, the *opinio iuris*, the subjective element of international custom, can be inferred from the general practice of States before, during and after the adoption of the 1967 Outer Space Treaty. However, its existence before the inclusion of the non-appropriation principle in the Treaty has a fundamental importance because it shows that States already felt the rule as binding and for this precise reason they decided to carefully draft Article II as a provision that rejects any national appropriation. The final purpose of this widely supported solution was to avoid repeating in space all the historical events that have marked our human evolution, including: wars between States for sovereignty over lands, colonization, and more specifically for the purpose of this thesis, the degradation of the unique space environment, exploitation and depletion of natural resources.[147] In conclusion, under international customary law, States and private individuals had the duty to

[142] International Cooperation in the Peaceful Uses of Outer Space, G.A. Res. 1721, U.N. Doc. A/4987, (December 20, 1961) and Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, G.A. Res. 1962, (December 13, 1963).
[143] Tronchetti, *supra* footnote 2, page 5.
[144] Ibid
[145] Ibid.
[146] Pershing, *supra* footnote 18, page 156.
[147] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 121.

refrain from appropriating outer space and its constituting elements, which in turn include resources, by any possible means. Among the potential means to be used are those that could not be foreseen when the 1967 Treaty was adopted as the advanced technological development that private individuals currently intend to employ in order to exploit space resources.

B. New interpretation of the non-appropriation principle under customary international law

After the adoption of the Outer Space Treaty, the general practice of States has begun to move slightly in a different direction from that previously traced by the broad prohibitive rule included in the international treaty. States' acceptance of Article II, in particular of spacefaring States, has started to mutate as soon as the first technology allowed human beings to enter outer space and reach celestial bodies. More precisely, a new interpretation of the non-appropriation principle started to emerge in 1969.[148] Indeed, an extensive practice of two of the most important States parties to the Outer Space Treaty, indicates how the international community has initiated to carved out an exception to Article II, allowing the appropriation of the resources that have been extracted from celestial bodies.[149]

The beginning of this change started when both the United States and the Soviet Union collected samples of Moon's rocks and other materials and brought them back to Earth. Following this operation, NASA recognized the acquisition of U.S property rights over its lunar resources, stating that the "[l]unar material retrieved from the Moon during the Apollo Program is U.S. government property".[150] Later, the Soviet Union claimed similar property rights over its lunar samples that robotically returned back to the earth surface.[151] In addition, some of

[148] Pershing, *supra* footnote 18, page 158.
[149] Ibid, page 159.
[150] NASA Office of INSPECTOR GEN., IG-12-007, NASA's MANAGEMENT OF MOON ROCKS AND OTHER ASTROMATERIALS LOANED FOR RESEARCH, EDUCATION, AND PUBLIC DISPLAY (2011).
[151] Pershing, *supra* footnote 18, page 158.

the samples were eventually sold to private individuals by the Soviet Union,[152] which therefore engaged itself in an economic activity involving resources extracted from space. This new practice shows that States have begun to believe and consider legally possible, in accordance with the Outer Space Treaty, that the extraction and appropriation of space resources is allowed despite the part of the rule which prohibits any form of national appropriation has continued to be respected. In fact, despite the inclusion of an extensive codified provision that rejects any appropriation, the general and consistent practice of States has started a shift towards the recognition of property rights over resources extracted from the Moon, one of the celestial bodies closest to our planet. The acts of gathering lunar materials have not even encountered and met any objection from other States, which have therefore implicitly accepted this new practice.

However, this practice is limited and is in itself insufficient to form a new norm of customary international law.[153] Particularly, the second psychological component of custom, the *opinio iuris*, had not yet occurred, but these actions of accumulation of extraterritorial resources after they have been removed indicate the new belief of what can be accepted by States as law. This practice has indeed been reiterated and currently the United States owns more than 381 kg of lunar resources, without the other States having considered this appropriation as in violation of Article II of the Outer Space Treaty.[154]

Furthermore, domestic legislation of the United States and of other countries can provide further evidence of this shift concerning the non-appropriation principle under customary international law.[155] In fact, these national laws and the subsequent practice of the governmental and non-governmental agencies are likely to become the new interpretation of Article II of the Outer Space Treaty.[156] According to Article 31(3)(b) of the *Vienna Convention on the Law of Treaties*

[152] Ibid.
[153] Tennen L. I., 'Towards a New Regime for Exploitation of Outer Space Mineral Resources', in: 88 *Nebraska Law Review* 794 (2010), (page 811).
[154] Pershing, *supra* footnote 18, page 158.
[155] Ibid, page 159.
[156] De Man, *supra* footnote 11, page 93.

(hereinafter the VCLT), for the purpose of clarying the meaning of a international provision, national legislations shall be taken into consideration as "any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation". Since, as was widely explained in the previous Chapter, there are provisions in these domestic laws that recognize and protect property rights over the resources that have been appropriated, it must be concluded that these Acts are expression and evidence of this already complete shift under customary international law. Indeed, the subsequent practice was already aimed at allowing the appropriation and recognition of ownership rights over the extracted resources. The national laws only performs the function of confirming and codifying this subsequent practice in a legal text, thus clarifing the new meaning and understanding of the non-appropriation principle. Accordingly, Article II now allows the appropriation, recognizes property rights and, therefore, does not prohibit any use or exploitation involving space resources, even if only of those extracted. In addition, this interpretation and construction of the non-appropriation principle has recently been confirmed by the whole international community: within COPUOS the following view was expressed:

> *"The view was expressed that the principle of non-appropriation found in the Outer Space Treaty applied to the natural resources of the Moon and other celestial bodies only when such resources were "in place", and that once such resources were removed from their "place", the prohibition on national appropriation no longer applied, and that ownership rights over those extracted natural resources could thereafter be exercised by States or private entities".*[157]

This statement above was discussed and drafted by the majority of the delegations in March 2017, when the national law of the United States had already been adopted and that of Luxembourg was preparing to be published. Thus, the other States agreed with the interpretation of the non-appropriation principle

[157] COPUOS, Draft Report, *supra* footnote 87, page 6, paragraph 42.

proposed by these two spacefaring States, demonstrating that their national Acts constitute a subsequent practice that specifies the meaning of a provision contained in an international treaty, Article II of the Outer Space Treaty, pursuant to Article 31(3)(b) of VCLT.

However, those scholars who do not want to consider these national acts as an interpretative aid of the 1967 Treaty refer to another Article of the VCLT, Article 27, which establishes that: "A party may not invoke the provision of its internal law as a justification for its failure to perform a treaty."[158] The relation between the two rules of the international instrument therefore deserves to be analyzed in order to demonstrate that domestic Acts contribute to forming the subsequent practice. As clarified by the International Law Commission, despite the importance of Article 27 of the VCLT, the provision does not prevent national laws from being used as an interpretative means in the form of subsequent practice in the implementation of an international treaty.[159] However, it remains to be seen whether and to what extent this subsequent practice is shared by the entire international community.[160] In particular because Article 31(3)(b) requires that this subsequent practice is performed in a way that it establishes the agreement of the parties. However, it is not necessary that the subsequent practice is universally accepted by all States, but rather, as stated by Gardiner:

> *"[i]t does not […] necessarily mean that there has been abundant practice by all parties to the treaty. It is sufficient if there is practice of one or more parties and good evidence that the other parties have endorsed the practice".*[161]

In conclusion, in my opinion, the subsequent practice of allowing the extraction and appropriation of space resources has already been endorsed by the international community, especially considering that the US and Luxembourg

[158] Article 27 of the V*ienna Convention on the Law of Treaties* (1969).
[159] ILC, First report on subsequent agreements and subsequent practice in relation to treaty interpretation, UN Doc. A/CN.4/660 of 19 March 2013, paragraph 113.
[160] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 125.
[161] Gardiner R., *Treaty interpretation*, (Oxford Oxford University Press 2nd Edition), (2008), (page 239).

initiatives will soon be followed by many States, including United Arab Emirates (UAE), Japan, China and Australia.[162] Indeed, the primary aim of these domestic legislations is to use outer space and to take advantage of its resources, as senior officials within China's space program have clearly stated.[163] Similiarly, and following from the above, the new interpretation of the non-appropriation principles, as clarified by this subsequent practice, has already attained the status of international custom. Indeed, in order to develop a rule of international customary law, the generality of the practice is required,[164] not complete consistency.[165] In my opinion, the subsequent new practice is already general, uniform and widespread: on the one hand, there are many States that are interested in extracting resources, on the other, the international community has not opposed to the practice, but rather it has shared the new interpretation of Article II within COPUOS. Thus, the extraction and appropriation of space resources, with the ancillary recognition of property rights on them, now appear to be generally accepted and binding under customary international law.

2.1.3 The prohibition of national appropriation or in situ appropriation

However, the recognition of the subsequent practice as binding only concerns the space resources that have been removed and extracted from celestial bodies. In fact, despite the conduct of some States, which are those that have adopted the controversial national laws introduced in the previous Chapter, is pushing to introduce a new practice that allows the appropriation of resources *in situ*, this is not yet legally possible under Article II of the Outer Space Treaty.

There are exactly two cases that provide us with further clues as to what is permitted today according to the non-appropriation principle. The first occurred in 1976 when eight countries (namely, Brazil, Colombia, Congo, Ecuador, Indonesia, Kenya, Uganda, and Zaire) made several attempts to appropriate parts

[162] Pershing, *supra* footnote 18, page 160.
[163] Ibid, page 161.
[164] *Anglo-Norwegian Fisheries (Uk v Norway)*, Judgment, ICJ Reports 1951, paragraph 116.
[165] Crawford, *supra* footnote 1, page 25

of outer space and celestial bodies.[166] However, the international community as a whole rejected these claims as being contrary to Article II of the Outer Space Treaty.[167] The second challenge to the non-appropriation principle was submitted by a citizen of the United States, Gregory Nemitz, who asserted the ownership and *in situ* property rights over Eros, a twenty-one-mile long asteroid from the sun's orbit.[168] He also tried to accuse NASA for having used the asteroid in the past, therefore claiming exclusionary rights over it.[169] The case was settled before a U.S court, which relied on a reasoning that is well aligned with the original meaning ascribed to the non-appropriation principle. The court, indeed, denied that the private individual has property rights over the celestial body because otherwise it would be in violation of Article II of the Treaty, which in turn rejects any national appropriation.[170] What distinguishes these two significant cases from the subsequent customary practice that allows the extraction of resources, is that the former are aimed at claiming sovereignty over all or part of a specific celestial body. This, in turn, would amount to a national appropriation which is strictly prohibited under Article II of the Outer Space Treaty.

In conclusion, in my opinion, there has been a shift in customary international law which concerned the non-appropriation principle. The rule remains unchanged when it is challenged by actions or operations which have the aim of establishing a real national appropriation over celestial bodies, but the extraction of natural resources from outer space is now considered permissible. The extraction of natural resources, in turn, allows States to use them in order to carry out exploitation, which, as a consequence, would be now in accordance with international space law. There is a further element that demonstrates that there has been this shift under customary international law: Article I of the Outer Space Treaty.

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[166] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 122.
[167] Ibid.
[168] Pershing, *supra* footnote 18, page 163.
[169] Ibid, page 162.
[170] Ibid. and Emitz v. United States, No. CV-N030599-HDM (RAM), 2004 WL 3167042 at 1 and 2.

2.2 The term "use" of Article I of the Outer Space Treaty

Likewise, Articles I of the 1967 Treaty must be analyzed. The second paragraph of Article I is known as the "freedom principle" and purports the encouragement of freedom of exploration and use of outer space. It is also broadly drafted as to include and, consequently, regulate all the activities that may occur in outer space, those known and those unknown at the time of its conclusion.[171] Furthermore, the Outer Space Treaty has been negotiated and concluded so that it contains few prohibitions, including the exclusion of the national appropriation of outer space and celestial bodies, but many freedoms of action for States.[172] Therefore, there is no reason to believe that the term "use" employed by the provision and the freedom to use outer space do not allow exploitation of extracted resources.[173] This interpretation of the "freedom principle" within the text of Article I of the Outer Space Treaty was also recently endorsed by the international community within COPUOS:

> *"The removal of resources from the Moon or a celestial body was a use within the meaning of and permitted by article I of the Outer Space Treaty, which provides that "outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States. "*[174]

It follows that all "new space" operations and space mining plans, which are activities that could not be foreseen when the 1967 Treaty was negotiated, are implicitly included within the text of the international space rule and, ultimately, lawful provided that they exploit resources that have been removed. This interpretation is also confirmed by the adoption of a subsequent international space treaty: the Moon Agreement. Indeed, when the Moon Agreement was negotiated in 1979, an important article, Article 11, was proposed, considered,

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[171] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 118
[172] Ibid.
[173] Pershing, *supra* footnote 18, page 157-162; Hobe, *supra* footnote 61, page 129; Gorove, *supra* footnote 124, page 350.
[174] COPUOS, Draft Report, *supra* footnote 87, page 6, paragraph 40.

debated and finally adopted. On the one hand, Article 11 paragraph 2 resembles Article II the Outer Space Treaty by prohibiting national appropriation of the Moon by any claim of sovereignty, by means of use or occupation, or by any other means. However, on the other hand, paragraph 3 of the same Article also establishes that:

> *"Neither the surface nor the subsurface of the Moon, nor any part thereof or natural resources in place, shall become the property of any States or intergovernmental or non-governmental organization or natural person".*[175]

From the wording it is apparent that a distinction between natural resources in place and space resources that have been extracted is clearly envisaged by Article 11 of the Moon Agreement. As a result, while the appropriation of in place or *in situ* resources is strictly prohibited, Article 11 paragraph 3 suggests that once the resources have been removed from the Moon's surface it is legally permitted to appropriate them.[176] This interpretative reconstruction is also confirmed by the 1979 international space treaty when it clearly establishes that the resources extracted are subject to a dedicated regime, which is described under paragraph 7 of the same Article 11. In this perspective, during the negotiation of the Moon Agreement, the U.S delegation clarifies that in its view the wording "in place" allows for the appropriation and the acquisition of property rights over the extracted resources since a clear distinction between *in situ* and removed resources is implied by the provision.[177] This statement went completely unchallenged by the other States, thus confirming that the established practice of appropriation of lunar samples has been accompanied by a new States' belief, the *opinio iuris*, that the removal and collection of extracted resources has replaced the general and broad prohibition of appropriation.

[175] Article 11(3) of the *Moon Agreement* (1979).
[176] Hobe, *supra* footnote 61, page 124.
[177] Gangale T. and Dudley-Flores M., 'To Build Bifrost: Developing Space Property Rights and Infrastructure', in: *American Institute of Aeronautics and Astronautics*, (2015), (page 5).

In conclusion and following from the above, already in 1979, long before the States adopted the national laws, the principle of non-appropriation has changed its content under customary international law. The analysis regarding Article 11 of the Moon Agreement confirms that the changes that occurred after the adoption of the Outer Space Treaty had already been crystallized: Article I allowed States to derive the new meaning of the non-appropriation principle under Article II, namely the distinction between resources that have not been extracted and those that have been removed for economic purposes. Nowadays, States and private economic entities under their authorization and supervision can extract resources from celestial bodies and acquire rights over them, provided that no claim of sovereignty or national appropriation is established. Also, this was recently endorsed by the majority of delegations within COPUOS, on March 30, 2017:

> *"The view was expressed that national legislation regarding the extraction and utilization of space resources by a private entity was in conformity with that State's international obligations under the United Nations treaties on outer space when such legislation included provisions that demonstrated the absence of a will or intention by the State to claim sovereignty over all or part of any celestial body, provided that the activities of the private entity were carried out under an authorization and a supervision regime of that State and that authorized use of the space resources would be purely for peaceful purposes."*[178]

In a broad multilateral forum such as COPUOS, in which States have been engaged in discussions to reach an agreement on the adoption of common rules governing exploitation, a view that perfectly mirrors and synthesizes the joint interpretation of Articles I and II so far conducted in this thesis was expressed.

[178] COPUOS, Draft Report, *supra* footnote 87, page 5, paragraph 33.

This allows to conclude that the exploitation of extracted resources is now permitted under international space law.

Conclusion

The joint interpretation of both Articles I and II of the Outer Space Treaty has clarified the international regulatory framework concerning exploitation in space. Therefore, it is now possible to partially answer the first research question: "Do Articles I and II of the Outer Space Treaty allow for the appropriation and consequent exploitation of outer space resources?". The answer is that currently, after the subsequent practice of States, it is possible to establish that Article II distinguishes between *in situ* appropriation and appropriation of extracted resources and that, secondly, Article I confirms this distinction by completing the previous construction. Indeed, it is possible to affirm with certainty that States wanted to create a special exception to Article II where now the appropriation of the extracted resources is no longer understood as a national appropriation, thus allowing their exploitation. Article I of the Outer Space Treaty, on the other hand, provides for the economic removal of the resources from space, thus confirming that their commercial use after they have been removed would not amount to national appropriation. Intention to appropriate resources when they have not yet been extracted (in place or *in situ*) is it equivalent to national appropriation, which is firmly and clearly prohibited under Article II of the Outer Space Treaty.

The analysis carried out so far allows to answer numerous questions that have arisen throughout the first Chapter. However, the investigation conducted is not able to respond exhaustively to the range of issues that exist in connection with this new activity: namely, how to guarantee that the rights and interests of other States are equally respected? And similarly, how to ensure that these States, when they remove these resources from space, do not establish a national appropriation or a claim of sovereignty over the celestial bodies? Therefore, the analysis and joint interpretation of Articles I and II of the Outer Space Treaty require further attention.

2.3 Further interpretative attention concerning the joint analysis of Articles I and II

Since the adoption of the Outer Space Treaty, all the debates on the legality of the appropriation of the space resources that could be extracted by States and their private entities have always concerned Article II. For the same reason, in the preceding paragraphs of this thesis the reader has been given a conspicuous introduction to the applicable international and national regulatory regime which has focused mainly on this provision, to provide a better understanding on how discussions concerning exploitation of space resources are currently framed.

However, the interpretative attention on Article II has produced two misleading results: the first is to believe that it is only this international provision, and not the delicate balance achieved by the non-appropriation principle in conjunction with Article I of the Outer Space Treaty, to indicate whether the exploitation of the extracted resources is legal under international space law.[179] With the ancillary result that, a legal analysis concerning Article I does not seem equally necessary to assess whether, when and how the commercial use of extraterritorial resources is allowed. The second deceptive result of focusing only on the non-appropriation principle is that it has also produced a distorted interpretative construction. Indeed, a faithful interpretative analysis on the exploitation of the resources that are planned to be removed from celestial bodies must necessarily start from Article I of the Outer Space Treaty and then be integrated by the subsequent Article II, and not vice versa. Article I performs a fundamental function: it provides that the exploitation of the extracted resources could be equally unlawful under certain circumstances: when, for instance, a State or a private entity establishes national appropriation by means of use or occupation or by any other means prohibiting others States to explore and to use the celestial body. At first sight, and in accordance to the analysis that has been done so far, the appropriation is not national and therefore lawful as long as a claim on *in situ* resources is not advanced; however, alleged legal appropriation of

[179] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 116 to 123.

extracted resources can, and is very likely, transform into a national appropriation pursuant to Article I, preventing the "use" of resources to other States. It is, ultimately, the international space provision that ensures that the interests and rights of other States are respected, thus being able to complete the partial joint interpretation so far conducted.

In the following paragraphs and subparagraphs these problems will be further analyzed so that the correct and complete interpretative construction of these two Articles of the 1967 Treaty emerges. Consequently, the accurate understanding of the international legal rules will be used to inquiry whether, on a case-by-case basis, the operations planned by the space mining companies and the activities arrenged by the other "new space" entities are lawful, or not, according to international space law.

2.3.1 Problems and legal consequences connected with the previous interpretation

As explained in the previous Chapter, all the programs of the space mining companies and certain aims of the other "new space" entities have as their objective the appropriation and the consequent economic commercialisation of the natural resources of outer space. In this perspective, the legal examination on the legitimacy of these activities has always paid particular attention to Article II of the Outer Space Treaty. It could not be otherwise. In fact, how to legitimately allow for the appropriation, collection and consequential economic application of the extraterritorial resources if there is an international principle that prohibits the appropriation of celestial bodies?[180] The response of space mining advocates, including the majority of space law scholars,[181] and of the States[182] that have adopted the aforementioned national laws, is equally simple. If on the one hand,

[180] This interpretation is supported by Fabio Tronchetti, see for instance Tronchetti F., 'Private property rights on asteroid resources: Assessing the legality of the ASTEROIDS Act', in: *Elsevier Space Policy* 4 (2014) and Tronchetti, *supra* footnote 2.
[181] Gorove, *supra* footnote 124, page 350 and Jakhu, Pelton and Nyampong, *supra* footnote 16, page 123-127.
[182] The Government of the Grand Duchy of Luxembourg Website, *supra* footnote 119.

the 1967 Treaty provided that outer space, the celestial bodies including the Moon, are free from any claims of sovereignty, it did not equally foresee that these rules apply to their natural resources. Indeed, this has been shown to be a correct interpretation even if with certain and precise limits as only the appropriation of the extracted resources is allowed under international space law. However, according to this interpretative reconstruction of the non-appropriation principle, Article I of the Outer Space Treaty serves only to complete the interpretation of Article II. Its term "use", which was intentionally drafted to comprise other and future activities, is mobilized to demonstrate that economic activities are encompassed and therefore the exploitation of resources is one of the legitimate operations included.[183] More specifically, as has been indicated before, the real legal conflict seems to concern only Article II with two distinct and opposite interpretative results: allowed appropriation of extracted resources and unlawful appropriation of *in situ* or in place resurces. Article I, on the other hand, concludes only a reading of the non-appropriation principle: namely, that which establishes that the exploitation of the resources that have been removed is legally permitted because the principle is applicable only to the outer space as a whole or to entire areas of celestial bodies, including the Moon.

The interpretative analysis that focused on Article II, and which also constructed Article I as a purely instrumental in relation to the first, has practical reasons. Until a few years ago, the debate could only be a purely doctrinal and theoretical debate and States and private entities were only interested in engaging in discussions with space law scholars in order to assess whether there were certain possibilities to profit from these new activities. It was not yet possible to imagine how their plans would be carried out and it was thought that these mining operations were not yet technologically feasible, thus postponing a real and technical debate on their compliance with international space law. It follows that the analysis relating to these two Articles could in the past support the prevalence of simple interpretations such as that which in any case concludes that the non-

[183] Hobe, supra footnote 61, page 129; Gennady, *supra* footnote 61.

appropriation principle is not applicable to extracted resources, thus allowing their exploitation. By way of explanation, there were insufficient elements and information on the individual exploitation activity to fully address the legal issues that may arise and are connected with a complete interpretation of the two Articles of the Outer Space Treaty. As a result, it was similarly not even necessary to enter into detailed interpretative investigations and verify if what had been established by Article I, besides the term "use", would have been respected in the event that an activity involving the extraction of space resources had been carried out. In particular, this turned out to be a mistake: it is Article I of the Outer Space Treaty which indicates when and how exploitation of extracted resources is allowed as it aims to ensure that the rights of other States are taken into account. Therefore, in my opinion, two elements must be amply underlined before completing the analysis of the two international space rules: the need to distinguish between the activities and operations that will be conducted and the prelevane of the most fundamental Article of the whole 1967 Outer Space Treaty: Article I.

I. The assessment on the legality of the exploitation activity must be conducted on a case-by-case basis and according to both Articles I and II

However, issues related to the legality of space mining and how private companies are prone to make profit from their space ventures, require more complex legal analysis and answers accordingly. Indeed, the simple interpretation reached by the analysis of the single Article II based on its customary evolution is *de facto* illusory. On the contrary, specific inquiries and complex and fundamental questions surruond the initiatives of space mining companies and any single mining conduct could require accurate and distinct legal assessments. Now that the specific plans and programs of the private entities have become clearer and more detailed and more information has been made available, a precise and complete investigation regarding their legality can and must be conducted on the basis of both Articles I and II of the Outer Space Treaty. The accurate

construction of the two Articles, in turn, should be applied to each specific and individual characteristic of the individual exploitation plan. Indeed, the final objective is to verify their legitimacy under international space law and, ultimately, to avoid that univocal and general answers can equally concern all the conduct of all the space stakeholders willing to exploit the resources.

Therefore, to achieve these goals, the starting point is the examination of Articles I and II of the Outer Space Treaty in their entirety; in particular Article I, which in the previous analysis had not been fully taken into consideration. Both the international principles, in fact, are the result of long, balanced and difficult negotiations between States and for this reason they deserve equal attention when a new activity that is entering the market, such as the exploitation of extracted space resources, require a precise legal analysis. More specifically, both Articles were included in the international legal instrument to also perform the function of ensuring respect for all the rights and interests of other States, which is, indeed, a decisive element in the individual assessment on the legality of each activity of exploitation. Their delicate role is confirmed by the draft history of the 1967 Outer Space Treaty, as reiterated also by a statement by the United States, which established that:

> *"[The] spirit of compromise shown by the space Powers and the other Powers had produced a treaty which established a fair balance between the interests and obligations of all concerned, including the countries which had as yet undertaken no space activities ... [Article I para 1] like the provision prohibiting national appropriation by claim of sovereignty, was a strong safeguard for those States which at present had no space programme of their own."*[184]

In conclusion, both Articles, and not only the non-appropriation principle, were inserted into the 1967 Treaty to preserve the rights and interests of all

[184] *Official Records of the General Assembly, Twenty-First Session, First Committee,* Summary Records of Meetings, 1492nd Meeting, 17 December 1966, UN Doc. A/C.1/ SR. 1492, pp. 427-428.

concerned and involved States. Indeed, from the existence of the strict prohibition of national appropriation or *in situ* appropriation it would seem that only Article II is concerned with the preservation of the nature of *res communis omnium* of outer space, an international area that does not belong to any State and that cannot be appropriated; but this is particularly inaccurate and depends on the wrong interpretative construction that has always been proposed by some space law scholars and which places the non-appropriation principle at the center of the analysis. As a result, Article I must be analyzed in its entirety because its constituting elements have introduced numerous limitations on the conduct of States and other international subjects, including, as a consequence, on exploitation. Accordingly, the provision strongly influences the results of the case-by-case assessment on the legality of the exploitation plans. Also, it equally follows that the term “use” it is not the only relevant aspect of the whole international provision. In conclusion, the interpretation that considers an integrated reading of the two Articles is the only accurate analysis that is able to satisfactorily tackle the complex questions and issues posed by the new space activity of exploitation. The ultimate aim is to avoid the prevalence of one Article over the other, but instead to use them jointly to assess which exploitation plan, program or individual conduct is allowed under international space law.

II. The supremacy of Article I over Article II of the Outer Space Treaty

Furthermore, a focus on the mere investigation of the non-appropriation principle of the 1967 Outer Space Treaty, and the subsequent utilization of a single term of the previous Article I (the term "use") as a means of interpretation of the former, does not only lead to impaired and erroneous results but would also imply a defective and flawed legal analysis. While it is strictly required to analyze the non-appropriation principle, as well as its interpretative evolution, to assess whether the appropriation of its natural resources is now considered allowed, on the other hand, Article I deserves special attention. Its role is more important than what a simple term may suggest and therefore it cannot be bound to become a

simple instrument for completing the interpretation of Article II. On the contrary, and more precisely, the correct interpretation should necessarily start from Article I of the Outer Space Treaty. The non-appropriation principle is, indeed, only one of the two limits set by the previous Article I when it specifically requires that under no circumstances can the "use" of outer space amount to a national appropriation. In order to shed light on this connection between the two international rules, I quote a view that has been widely supported by States within COPUOS:

> *"The view was expressed that article I of the Outer Space Treaty not only prohibited appropriation of the Moon or a celestial body by a claim of sovereignty, which would necessarily require the intention to do so, but it also prohibited national appropriation by means of use or occupation or any other means."*[185]

It logically follows that, first, it is necessary to examine Article I of the Outer Space Treaty in order to establish when the "use", even on the resources that have been extracted, can be considered disproportionate and accordingly become a national appropriation, which is prohibited. Similarly, Article I requires to be analyzed first to evaluate which are these two limits dictated by the international provision so that the legal framework of what is considered permitted (from the term "use") is outlined. Among these limitations, the non-appropriation principle is included, which is therefore one of the two restrictions set by the previous Article. As a result, the non-appropriation principle in establishing what is certainly encompassed by the rule and, consequently, prohibited under Article II, in turn, states what is unlawful under Article I of the Outer Space Treaty. Following from the above, Article II performs a more limited and circumscribed function than the one normally attached to it by space law scholars and by the States that adopted national legislations regulating non-traditional space activities. It only participates in the definition of what is legal

[185] COPUOS, Draft Report, *supra* footnote 87, page 5, paragraph 34.

permissible under international space law in conjunction with Article I, even if it is subordinated to the previous space provision. Consequently, it cannot comprehensively regulate activities such as the exploitation of the resources extracted from space on its own, as it depends partially on Article I. Therefore, it is now necessary to examine this rule more closely, as also its impact on the individual assessments of the activities that pursue the exploitation in space.

2.4 Article I of the Outer Space Treaty

Accordingly, the non-appropriation principle is only one of the limitations stemming from Article I of the Outer Space Treaty. Therefore, it is not sufficient to analyze the shifts under customary international law that concern Article II to assess which exploitation operations are nowadays allowed. But it provided a partial legal framework on how the exploitation activity must be implemented: the appropriation of the extracted resources is possible, but as long as the activity does not change into a national appropriation of the celestial body. Consequently, Article I is the provision that requires an accurate analysis to complete the biased legal picture provided by the non-appropriation principle. Article I of the Outer Space Treaty states 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.*
> *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.*
> *There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall*

facilitate and encourage international cooperation in such investigation".[186]

The Article is equally complex as the non-appropriation principle, however its analysis can be simpler if one considers that the provision can be divided in two significant parts. The first is composed by the first paragraph and is known as the "common interest principle", which is certainly the most important element, often forgotten or simply ignored by many space law scholars and spacefaring States. The "common interest principle" was proposed by Brazil and other developing countries with the aim of protecting their future rights and interests in outer space.[187] Particularly, it must be seen as a provision that guarantees their future use of outer space and celestial bodies for when they become technologically and scientifically capable of doing so.[188] Therefore, the Article is intended to invalidate any conduct or action by developed States that could have the effect of compromising the future use of outer space by developed countries. Furthermore, the inclusion of the "common interest principle" within the text of the international space treaty, and not in the aspirational preamble, gives it a binding legal value that, in my opinion, should be highly taken into consideration and applicable when any State carries out any activity in space. And it may be noted that at the time the international treaty was adopted the developing States did not have the technological and financial capacities necessary even to enter outer space and carry out a scientific exploration. For this precise reason they carefully negotiated the inclusion of the "common interest principle" into the 1967 Treaty, so that their interests would have been preserved if those States that already had that technological and financial means had decided to be already involved in the use of space and engaged in exploration activities. Thus, the first paragraph of Article I was at the beginning connected and performed this function in relation to other type of space activities, namely others than exploitation. It naturally follows that if we consider that the costs associated with the

[186] Article I of the *Outer Space Treaty* (1969).
[187] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 117.
[188] Ibid.

development of the technology required for pursuing exploitation activities are considerably higher than those that in the past were associated with other operations, Article I, paragraph 1, assumes greater importance nowadays. It should therefore guide any plan that involves the extraction and the use of space resources in order to protect the position of States that cannot yet carry out this new activity. Furthermore, the extraction of the natural resources, which according to Article II is permitted today, and the subsequent exploitation can at least modify the nature of outer space or its composition, if not even damage it and create a significant environmental harm. In this perspective, the "common interest principle" should be re-evaluated in the light of these technological changes and its possible, or more likely, consequences so that future rights of developing countries can be even more preserved and equality between all States can be maintained. In particular, because Article I, paragraph 1, establishes the "common nature" of outer space; indeed, not only does the article require outer space to be open for exploration and use of all States for the benefit and interest of all the countries, but it also states that it shall be the "province of all mankind".[189] Thus, the international provision is implicitly restricting the discretion of developed States in implementing any space activity as even future rights of future generations are included under Article I and must therefore be equally guaranteed.

On the other hand, the second paragraph of Article I of the Outer Space Treaty is known as the "freedom principle" and, as explained before, its term "use" allows for the exploitation of extracted resources. However, there are two elements that deserve to be observed and analyzed here. Firstly, this principle is not boundless or unlimited, rather it must be read together with the first paragraph cited above. In this regard, within COPUOS, the delegations have raised concerns about the failure to respect the "common interest principle" and the fact that States, with their actions, can jeopardize the achievement of the goals of the 1967 Treaty: indeed, with their national legislations, they are merely relying on the

[189] Ibid, page 4.

"freedom principle", totally disregarding the principle of the first paragraph of Article I of the Outer Space Treaty. More precisely, they expressed the following view:

> *"Some delegations expressed the view that the principle of freedom of exploration, use and exploitation was not absolute, but rather was limited by the principles of non-discrimination, equality among States and observance of international law established under the Outer Space Treaty. The delegations expressing that view also expressed the view that any national legislation should be based on the guiding principle that the use and exploration of space is to be carried out in a sustainable manner and exclusively for the benefit of all countries, regardless of their level of economic and scientific development."*[190]

To act or to carry out an activity partially respecting the provision means that this rule is not respected in its entirety; thus, compromising compliance with international law if exploitation is conducted without taking into account the rights and interests of all States and their technological and developmental means. Similarly, it is equally wrong to interpret Article I by taking only this single word "use" to support the legality of the exploitation. Indeed, the same term "use" appears in the first paragraph of Article I of the Outer Space Treaty. Thus, if it is correct to conclude that, and I support this interpretation, space mining and other activities are encompassed under the second paragraph, they are consequently also comprised by the "common interest principle" where the same terminology, "use", is adopted. In other words, if States wanted to take a single terminology into great consideration, "use", or a single paragraph, the "freedom principle", they could not escape the application of the first paragraph, the "common interest principle", where the same term is applied and which therefore would demand an equal legal respect and compliance. In conclusion, on the one hand, the term "use" permits the exploitation activity. On the other hand, the same terminology rejects that the use of outer space, which therefore includes the extraction of resources

[190] COPUOS, Draft Report: Addendum, *supra* footnote 93, page 4, paragraph 23.

from space, is performed by only certain States, mainly because outer space and celestial bodies are there for the common utilization by all States and for all mankind.[191] From this analysis become clearer why I have argued that the non-appropriation principle is merely a norm that depends on Article I of the Outer Space Treaty. Indeed, outer space and natural resources simply cannot be used freely by, and for the benefit of, all countries if some technologically advanced States can exploit, without any limitations, this common area of humankind.[192] Therefore, the non-appropriation principle has the role of ensuring that outer space can equally belong to any State by prohibiting that areas of celestial bodies or *in situ* resources can be appropriated. However, it is equally true that for the attainment of this goal certain precise and detailed obligations regarding the performance of the exploitation activity are derived from Article I, paragraph 1. Indeed, this is the second limitation deriving from Article I of the Outer Space Treaty and which inclusion is necessary in order to protect the "province of all mankind" nature of outer space. Therefore, in conclusion, the two limits to the conduct of States stem both from the "common interest principle" and from Article II of the Outer Space Treaty. The analysis on the legality of the individual space mining activity or plan, or on another operation that involves the extraction of the resources of outer space, must be carried out taking into consideration the complex connections that arise between these two Articles.

2.5 The individual assessments on the exploitation plans

Following from the above, I have argued that the gap of a clear and meaningful interpretation concerning the two Articles has always been lacking because considerable problems have always surrounded space mining, in particular the legal ambiguity of the Outer Space Treaty and the lack of knowledge about private exploitation programs. Coherent and precise answers could easily be ignored because there were no consistent rules and since

[191] Hobe, *supra* footnote 61, page 123.
[192] Crawford, s*upra* footnote 1, page 120.

completely different resource extraction plans were recently released over time with the ancillary claim of their compliance with international law, creating confusion over legal certainty. This was also recently stated by Henry Hertzfeld, a space policy and international affairs professor at the George Washington University: "The law on this is not settled and not clear, there are a lots of opinions on the status here, and nobody is necessarily right because it is complicated".[193]

As regards this legal uncertainty within the Outer Space Treaty, although other interpretations have been put forward, I have fully supported the reading of both Articles advanced by the same space law scholars who certainty consider this new activity as lawful and, therefore, permissible. Indeed, I have argued that Article II now allows the appropriation and the extraction of the resources, and that the term "use" of Article I, second paragraph, contemplates and covers the economic activity in itself. However, I have also stressed that this cannot be a complete interpretation and on this basis I indicated Article I, paragraph 1, as the primary legal parameter for understanding the legitimacy of the actions pursued by the States and their own economic operators. Moreover, if the term "use" of Article I, second paragraph, must be taken into account as it legitimizes the activity and is also encompassed by the same term in the first paragraph (the "common interest principle"), similarly these two terms "use" encompass Article II of the Outer Space Treaty where I support that the appropriation of natural resources is permitted, but the "appropriation by use" is prohibited.[194] And this is the reason that has also lead me to conclude that the non-appropriation principle is a limitation set by the previous Article I: appropriation is intrinsically linked to "use" and is therefore allowed to the extent that it is permitted by the joint reading of the two paragraphs of Article I. Indeed, even if the extraction of the resources is lawful under customary international law, this appropriation must always prevent a national sovereignty from being exercised in outer space to ensure the equality of States and ultimately protect the "province of all mankind" nature of space.

[193] Wolchover N., (2012, April 23), 'Does asteroid mining violate space law?', *Live Science.*
[194] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 125.

It logically follows that, the answers regarding the legitimacy of the exploitation activity under international space law will vary according to different parameters at stake. In particular, the differentiation between the aims and goals pursued by these companies will have an impact on the way in which space mining activities will be carried out and accomplished, thus influencing the final assessment on the legality of the activity. Furthermore, since space mining concerns activities and operations that require high technological progress and an advanced scientific development, which for the moment only a few States are able to afford, it is legally mandatory to verify if the interests and rights of all the other States in outer space are equally respected in accordance to the "common interest principle". Indeed, only commercial activities that guarantee the protection of the rights of other States can be considered lawful activities according to international space law. These reflections were widely shared by the delegations within COPUOS:

> *"The view was expressed that, as long as activities were undertaken in an orderly manner, avoiding abuse, recklessness or risk-taking, and undertaken with the purpose of exploration of space, such activities should be considered for the benefit and in the general interest of all countries because of the technological progress and scientific advancements flowing from such activities."*[195]

I proposed throughout this second Chapter a precise, coherent and clear interpretation of the two international provisions of the Outer Space Treaty where their facets and numerous connections have been equally analyzed, thus eliminating the legal uncertainty. However, as the key elements that must be taken into account in this interpretation have been underlined and the extraction space plans are now better known, a brief analysis will be provided on the legal points that could emerge between them and this proposed legal framework if such plans or operations were conducted today.

[195] COPUOS, Draft Report, *supra* footnote 87, page 5, paragraph 36.

2.5.1 The legality of "new space" activities

The introduction in the first paragraph of the first Chapter concerning the non-traditional space activities pursued by "new space" entities makes it clear that their final objectives are very different from those of space mining companies. There are indeed three major elements that differentiate these operations from the plans of the others: the activities are usually planned and programmed in such a way as not to produce any permanent change in the space environment. In addition the operations have a purely scientific purpose or at least the economic use of the natural resources is part of a research framework to promote the progress of humanity or to help the needs of future generations. Finally, the activity or operations almost never claim to be able to exercise an exclusive use on the single celestial body. For instance, Blue Origin has the aspiring aim of preserving the environment and the ecosystem of the Earth and for this precise reason it has decided to engage in space exploration and exploitation programs. According to this private entity, outer space is an instrument that humanity should use for the benefit of the Earth and its population and, as a consequence, appropriating and utilizing extraterritorial resources could help the whole humankind.[196] Similarly, Moon Express has an analogous plan: the appropriation of the resources of the Moon is subordinated to the ambitious aim of guaranteeing the development of the youngest generations and of humanity as a whole.[197]

The main features of these goals influence other relevant aspects considered in the legal assessment. For instance, I regard decisive the fact that the exploitation of the natural resources is put in place in the name of scientific research and exploration, and not only to achieve the mere economic and profit aim, which is instead pursued by those private individuals who invested in space mining. Since the 1967 Treaty repeatedly emphasizes the importance of promoting scientific research, including in the second and third paragraphs of Article I, this prevents *prima facie* from concluding that their exploitation

[196] Blue Origin Website, *supra* footnote 22.
[197] Moon Express Website, *supra* footnote 23.

activities and programs are not permitted under international space law. Moving to a more careful investigation, it seems that, even if the ways of collecting these resources are not precisely known, the methods that will be used for the extraction should not allow these private entities to appropriate areas of the Moon or of asteroids in a way that their future uses by other States could be prevented. It follows that, in my opinion, Article I, paragraph I, of the Outer Space Treaty would be respected since the celestial bodies could be freely utilized by other States and no local or in place appropriation would be carried out by the individual private entities. This assumption is even strengthen if it is considered that no particularly significant change would be made to outer space and its environment. Therefore, the lack of a permanent transformation regarding celestial bodies could contribute to respect outer space's nature of "province of all mankind" and the "common interest principle": outer space would remain intact, without transformations and ready for a similar future use by all States.

A more complex analysis could instead be required for the plans programmed on Mars by SpaceX. As stated by Elon Musk, lead designer and entrepreneur of the private company, starting from 2022 it will be possible to initiate mining activities on the red planet, while in 2024 a permanent base will be created on the celestial body.[198] Since for a permanent base to be established it is necessary to use the natural resources that are in place, an investigation concerning both these activities are required. The establishment of a permanent human base on Mars creates two problems that the other two previous activities planned by Blue Origin and Moon Express did not pose. The first is that the operation could irreversibly prevent other States from having access to the surface where the future colonizers will settle. It would therefore be an activity that could be characterized as an exclusive appropriation of the areas of the celestial body, contrary to what was asserted under Article II of the Outer Space Treaty which currently rejects any *in situ* appropriation. The breach of the non-appropriation principle, as a limitation arising from the "common interest principle", would in

[198] SpaceX Website, *supra* footnote 18.

turn lead to the violation of Article I, paragraph 1 of the Outer Space Treaty: indeed, the operation would be considered as an exclusive use or appropriation by use that is not permitted. Similarly, the "province of all mankind" nature of outer space would be compromised as other States would not be able to fully use celestial body as we know it.

However, on the other hand, SpaceX's plans are composed of a series of operations that have the purpose of promoting the development of scientific research. Therefore, as for the other "new space" operations those who will benefit from the space mining activity will be the entire world population. Furthermore, no distinction based on the nationality seems to appear in the colonization program, so the possibility that different private individuals from different developing countries could equally use and exploit outer space may almost replace the apparent breach of the "common interest principle" and non-appropriation principle. It is in this case to be verified, also on the basis of the reactions of other States and of the international community regarding the acceptance of SpaceX activities. In particular if the objective of carrying out scientific research would prevail over an appopriation by use that is such as to violate both Articles I and II of the Outer Space Treaty.

I personally believe that a favorable and permissive interpretation should be prevalent, allowing SpaceX to exploit the resources and use them to build a permanent structure on the red planet. However, when the plans to be implemented become clearer and more details are provided on how the exploitation activity will be conducted, it will be possible to complete a more precise and decisive legal assessment.

2.5.2 The legality of space mining activities

After conducting this previous investigation, it seems easier to proceed with the interpretations and the analysis concerning the operations of the pure space mining entities. Not surprisingly, for reasons that can already be easily understood from the previous paragraph, there are serious problems in concluding that

exploitation activities of these other entities respect and are in compliance with international space law, and more precisely with Article I and II of the Outer Space Treaty. Both Planetary Resources and Deep Space Industries, which are the most prominent examples of private entities that are part of this new space mining industry, have the sole purpose of achieving an economic objective. Indeed, they plan to extract natural resources that will not be used for the purposes of science and scientific research, nor will they contribute to improve the lives of people on Earth or at least allow them to have a better life on the terrestrial planet or on space. Therefore, that "use", as envisaged by Article I of the 1967 Treaty, is purely an exclusive use because what is programmed to be exploited will not be invested in something that involves or can benefit all humanity, thus the "common interest principle" could be considered totally violated.

Furthermore, two elements that characterize the space mining entities are significant as they prevent from asserting that their activities are legal. The first concerns the way in which the operations will be carried out and the exclusive methods of appropriation of the resources while and after they have been extracted. Especially with regard to the utilization of the celestial bodies, there are no differences with respect to what was previously stated regarding the plans of SpaceX. Indeed, Planetary Resource similarly aims to put in place a permanent commercial mine on asteroids, thus breaching Article II of the Outer Space Treaty which currently prohibits any establishment of national appropriation or an appropriation by use, constructed as a limitation arising from the term "use" of Article I. The establishment of a mine, which has the sole aim of fostering the activity without benefiting humankind, would monopolize the territory and would indeed be equal to an appropriation *in situ* that is prohibited. Furthermore, this method would prevent all States, future generations and all humanity from using and accessing celestial bodies, so the "common interest principle" would be violated for the second time. The second characteristic of the operations of space mining entities concerns their potential harmful effects: instead of prompting positive improvements regarding the use of outer space, they would affect and

permanently and irreversibly damage the celestial bodies and their unique environment. Indeed, mining asteroids would lead to their destruction and disappearance, thus preventing humanity and other States, especially those that do not yet have the advanced technology that allows them to enter space today, to likewise use the resources in the future. The permanent harm produced to a "province of all mankind" and the inevitable transformation brought by a limited number of individuals to outer space ultimately defeat and nullify the core objectives of the Outer Space Treaty: the protection of the space environment and the maintenance of international peace and security.[199] In particular, the latter aim of the 1967 Treaty can be jeopardized by the continuous emergence of tensions among States due to the control exercised by a few private individuals in outer space.[200]

Conclusion

The erroneous interpretation that allows only one reading of the two Articles to prevail would create confusion with the legal assessments relating to the individual activities conducted by other non-traditional space entities. Indeed, the classic interpretation of Articles I and II, which was extensively carried out in the first part of this Chapter, would not take into account important variations that should be foreseen. Division must be made between the exploitation operations that will be pursued by true and pure space mining companies and those planned by the private entities described in the first paragraph of the previous Chapter, namely those that fall within the comprehensive term "new space". In fact, even the latter sometimes envisages and expects natural resources to be used for economic purposes. However, the exploitation is programmed to be implemented differently by these non-governmental entities. In addition, their ultimate objectives are wider in scope and the utilization of natural resources should be

[199] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 121 and Blount, *supra* footnote 49, page 516-518.
[200] Tronchetti, *supra* footnote 2, page 8.

considered and evaluated in light of their own characteristic and unique operations. It follows that all aspects and distinctions of each operation and plan must be considered in a case-by-case analysis in order to find the best and most accurate interpretation of the aforementioned Articles. If, on the contrary, the usual interpretation of Articles I and II of the Outer Space Treaty prevails, all the activities involving the extraction and exploitation of the resources of outer space would be either legal or unlawful without allowing for any distinction between them. Instead, these distinctions do exist and influence the final legal assessment regarding compliance with international law. In particular because it is inherent in Articles I and II of the Outer Space Treaty a legal protection that concerns the interests of other States.

Indeed, a more in-depth reading and interpretation have shown how the international principles prevent an appropriation by use, an appropriation which is not carried out in a sustainable way and an appropriation that does not recognize access and use for all. As a result, it is imperative to consider these further connections between the two international space provisions in order to be able to correctly answer the research question and grasp and solve the issues that arose throughout the first Chapter. Including how to ensure that the allowed extraction of resources from space does not turn into a national appropriation and how to guarantee the protection of the rights and interests of all States. The analysis and the legal assessments that I proposed and applied brought out important elements. Among these: if the extraction of resources is carried out in order to promote the improvement of scientific research or the development of humankind the rights of other States can be considered respected because in this way everyone would "use" outer space and as such the activity is lawful within the meaning of Article I. Furthermore, the way in which the activity will be conducted is fundamental: it could violate Article I of the Outer Space Treaty because it does not allow the access of that celestial body to other States, or because it amounts to a national appropriation by use, or because the techniques and methods that will be used to extract the resources from the celestial bodies are not adequate, thus putting at risk

the protection of their environment and their future use. To conclude, in my opinion, Articles I and II of the Outer Space Treaty are rules that prevent an exclusive and national appropriation from occurring: this is not only the territorial one in which an international subject or a private entity appropriates an area of the celestial body or *in situ* resources, but also includes the one that foresees that the extraction of the resources from space must not be monopolized by a limited number of economic operators or States. Indeed, if we look more closely at the results of the analyses conducted previously it is clear that technological development must be used by States with diligence and attention so as to enable the international community to benefit from their achievements globally and in a sustainable manner. These views and ancillary issues were expressed by the majority of the delegations within COPUOS, thus ultimately demonstrating how these "uses" are considered the expression of monopolistic situations which are strongly denied in space. Indeed, these practices should be configurable as a national appropriation within the meaning of Article II of the Outer Space Treaty and therefore should be forbidden. States accordingly agreed that the "use", since it can now only be conducted by a few subjects, must not turn into situations of supremacy as they are in violation of the principles of the 1967 international treaty:

> *"The view was expressed that, at present, space resources were accessible only to a very limited number of States and to a few private sector actors within those States and that it was therefore relevant to assess the impact on the world economy of applying a doctrine of "first come, first served", as it would create a de facto monopoly and would thus be in absolute contradiction with the letter and spirit of the Outer Space Treaty."*[201]

Following from the above, to accurately answer the research question and fully understand whether the extraction and exploitation of space resources is allowed it is necessary to consider from time to time numerous elements of the

[201] COPUOS, Draft Report, *supra* footnote 93, page 6, paragraph 34.

single activity. The legal assessments I have proposed above constitute only an attempt to highlight the fundamental interpretative points and elements that are likely to emerge and which I believe should be taken into consideration and discussed by the international community when the mining activity in space will be feasible. But from the analysis it is evident that a hypothetical exploitation conduct will have to primarily and necessarily take into account the limits that flow from Article I to Space Outer Space Treaty: finding political balance and preventing abuses against developing States from occurring. This certainly excludes operations that establish a national appropriation, which degrade the environment and prevent an equitable use of space and its resources.

CHAPTER 3

PROTECTING THE UNIQUE OUTER SPACE ENVIRONMENT: THE APPLICATION OF INTERNATIONAL ENVIRONMENTAL LAW PRINCIPLES

Introduction

Two of the three guiding principles set by the 1967 Outer Space Treaty have been analyzed so far: that outer space must be free for exploration and use by all States and that no national appropriation or sovereign claims can be established on it. However, it is indeed possible to find out a third constituting element within the legal framework governing outer space: the applicability of international law principles.[202] According to Article III of the Outer Space Treaty, the activities carried out by States in the "use" of outer space are required to be conducted in accordance with general international law.[203] More generally, international space law is a specialized field of public international law and, in not being a "self-contained" regime, it should not be considered in isolation.[204] It follows that general international law principles and rules can be used to fill the existing *lacunae* found in the Outer Space Treaty.

Among the most important gaps in the legal instrument, a lack of a regime devoted to the environmental protection of outer space is present.[205] However, nowadays all the new space ventures and the exploitation activity can threaten and endanger the unique outer space environment. [206] Thus, in my opinion, protecting

[202] Raclin, *supra* footnote 44, page 732.
[203] Article III of the *Outer Space Treaty* (1967).
[204] Breccia, *supra* footnote 17, page 4.
[205] Bhat B. S., 'Application of Environmental Law Principles for the Protection of the Outer Space Environment: A Feasibility Study', in: 39 *Annals Air & Space Law* 323 (2014), (page 331-338).
[206] Sample I., (2019, May 12), 'Protect solar system from mining 'gold rush', say scientists'**,** *The Guardian.*

this environment from the new operations that technology allows and will allow to be implemented in the future is obligatory and inevitable. Therefore, in the search for the principles of international law applicable to outer space and its celestial bodies, those of environmental law must have priority. This is an assumption of mine, but which is nevertheless confirmed by the Outer Space Treaty itself. Because despite the lack of rules regulating the preservation of its environment, the 1967 Treaty prefigures and anticipates the application of future earthy principles of international environmental law. Indeed, in having declared outer space "province of all mankind", a legal regime which considers the rights and the interests of all States and of future generations is implied. It follows that, determining the proper and necessary environmental protection of outer space and celestial bodies becomes imperative.[207]

Furthermore, the principles of international environmental law could be the sole international principles capable of effectively regulating the exploitation of resources that have been extracted from outer space. Indeed, some environmental principles have already attained the status of customary international law and therefore are binding for all the international subjects, regardless of where the conduct takes place. However, not all of them should be applied indiscriminately to the international space activity of exploitation: in fact, the principles of international environmental law were originally evolved in order to tackle transboundary or even global terrestrial problems.[208] Therefore, their application in space is not automatic. But instead, an analysis regarding their practical feasibility, both legal and technical, is necessary for the purpose of mobilizing them correctly in order to complete the legal framework that can currently regulate the removal and exploitation of space resources.

[207] Harminderpal S. R.,'The Common Heritage of Mankind &(and) the Final Frontier: A Revaluation of Values Constituting the International Legal Regime for Outer Space Activities', in: 26 *Rutgers Law Journals* 225 (1994) and this was subsequently confirmed by the Moon Agreement under Article 4, first paragraph, which expressly provides that "due regard shall be paid to the interests of present and future generations".

[208] Jakhu, Pelton and Nyampong, *supra* footnote 16, page 116.

This last Chapter aims to develop a provisional and accurate, albeit incomplete, legal framework for safeguarding outer space and celestial bodies from the exploitation that will soon concerns it. Bearing in mind that space mining is an unpredictable activity and its impact on the environment is still unknown, my primary interest is to verify whether the principles of international environmental law relevant to the notion of environmental prevention are applicable to outer space. Indeed, is possible to make a distinction between those environmental law principles that have as their purpose the avoidance of environmental damage (principles linked to the idea of prevention), and those that are introduced in a particular legal framework in order to take into account the differentiations between States and accordingly provide for a distribution of different obligations and efforts among them (principles relating to the idea of balance).[209] Only the former principles linked to the notion of prevention are applicable to all States, without allowing any distinction among them. Their sole purpose is, indeed, to prevent an environmental damage that would be difficult to repair because it is often simply irremediable or irreversible.[210] For their particular purpose it follows that, in my opinion, these are the principles of international environmental law that are best suited to regulate the exploitation of the resources extracted from outer space. At the moment the most important aim is to prevent environmental space damage from occurring in any case, and to find beneficial rules that have the purpose of preserving outer space and its unique environment. The principles of international environmental law relating to the idea of prevention are both substantive, such as the principle of prevention and the precautionary principle, as well as procedural, such as the duty to cooperate (through notification and consultation) or the duty to conduct an environmental impact assessment.[211]

However, the other principles of international environmental law that are linked to the idea of balance, as opposed to the idea of prevention, can also be

[209] Dupuy and Vinuales, *supra* footnote 3, page 61.
[210] Ibid.
[211] Ibid.

useful and valuable and, consequently, should be equally identified and analyzed. As a general matter, this second category of principles aims to distribute the efforts and burdens related to the protection of the environment among the different States and stakeholders, including private economic entities. Their ultimate purpose is to strike a balance between environmental protection *per se* and other considerations.[212] Indeed, these principles are not unique as those associated with the idea of prevention, which are applicable to all States in much the same way but, instead, they intend to introduce differentiations among States.[213] Therefore, degree of financial, technical and technological development or progress of each State is taken into account and is channeled through different environmental principles such as the polluter-pays principle, the principle of common but differentiated responsibilities and the principle of inter-generational equity.[214] These principles have a fundamental importance if we consider that at the moment, since the technological and scientific development required to carry out exploitation in space is extremely high, the extraction of outer space resources can be conducted only by few States. Thence, according to the principles of international environmental law relating to the idea of balance, only these developed States would be responsible for the economic consequences and would pay the cost of addressing the environmental problems. On the other hand, the interests and rights of developing States would eventually be strengthened.

Furthermore, a distinctive and funding concept, the concept of sustainable development, can be found within this category. It has not the function of operating as a primary norm but, instead, of guiding the formulation of such norms.[215] Particularly, its purpose is to integrate the demands of growth and development (both economic and social) with the protection of the environment.[216] It follows that, it is not able to provide further information and useful elements concerning the environmental regulation of exploitation, but

[212] Dupuy and Vinuales, *supra* footnote 3, page 81.
[213] Ibid, page 61.
[214] Ibid.
[215] Ibid, page 90.
[216] Ibid.

rather to play a fundamental role in guiding the use of the principles of international environmental law in space, both of those relating to idea of prevention and both of those connected with the idea of balance. Indeed, exploitation of the extracted resources of outer space is a manifestation of this economic and social development and, consequently, the concept of sustainable development can contribute to counterbalance this growth with the required environmental protection.

Later, and precisely because it has this particular function of guiding concept, a final analysis about the application of sustainable development to the general phenomenon of pollution in outer space, to which exploitation will also contribute in the future, will ultimately be conducted in this third Chapter. Indeed, sustainability is the key to comprehensively protect the space environment from all the commercial activities and circumstances which pollute outer space, including from those that are contributing to an another widespread phenomenon: the space debris. In conclusion, sustainable development is a concept of international environmental law that expresses the idea of balance, but which is nevertheless able to provide interpretative clues and elements regarding the utilization of environmental principles for the preservation of outer space from exploitation and space debris.

In what follows, my analysis will take into account the two main ideas underlying international environmental law, namely the idea of preventing environmental damage and pollution while finding a satisfactorily balance between States.[217] The analysis of these environmental principles will serve to extend their application to outer space and, in particular, to the exploitation and, finally, to the phenomenon of space debris.

3.1 The prevention principle

Starting from the analysis of the first substantive principle, I personally consider the principle of prevention one of the international rules that can be more

[217] Ibid, page 62.

appropriately applied to the environmental protection of outer space. At the heart of the principle of prevention lies the duty to preserve the environment and minimize negative or adverse impacts and damage to it, especially when an exploitation activity is planned to be carried out. Moreover, its recent evolution under customary international law allows to easily framing it in the outer space context, thus simplifying its transposition into the exploitation regime.

Tracing back its development, the first case that mentioned the principle of prevention, which is also one of the most important cases of general international law, is the *Corfu Channel* case of 1949. The ICJ stated: "The Court points out that the principle of prevention, as a customary rule, has its origin in the due diligence required of a State in its territory."[218] Thus, in order not to cause harm to the environment, planned activities or operations within the territory of a State must be carried out in accordance with the required degree of due diligence. However, at its origins, the duty to prevent a significant environmental damage was still considered to be closely connected to a well-defined and precise territorial context: the transboundary one. Indeed, the principle initially required States not to create an environmental damage only to the territory of another State.[219] This limited conception of the prevention principle, which originates from the no-harm principle, remained in force until the 1970s.[220] Probably for this reason also that the original principle of prevention was not included and codified in the 1967 Outer Space Treaty. Outer space is, in fact, free from all state sovereignty and does not belong to any State.[221] Furthermore, there are no territorially defined boundaries and, consequently, it has not been possible to adopt for outer space a principle that relied on and regulated cross-border relations between States.

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[218] *Corfù Channel (United Kingdom v. Albania)*, Judgment, ICJ Reports 1949, paragraph 22.

[219] As expressly emphasized by the ICJ in the well-known passage from the *Corfù Channel* case when it noted the existence of: "Well-recognised principles, namely every State's obligation not to allow knowingly its territory to be used for acts contrary to the rights of other States", ultimately stressing both the transboundary element and the obligation to not create damage to another State.

[220] The no-harm principle is the oldest international environmental principle and was for the first time used by an arbitral tribunal in 1965 in the *Trail Smelter Arbitration* case between the United States and Canada.

[221] Article I of the *Outer Space Treaty* (1967).

However, this rule has subsequently experienced a considerable expansion in scope.[222] The current formulation of the principle of prevention was for the first time introduced in 1972 by the *Stockholm Declaration on the Human Environment* (Principle 21), which established that any environmental damage must be prevented. More specifically, it stated that every State has the right to exploit its own resources but, in doing so, it has the duty and the correlative responsibility of not causing damage to the environment.[223] Therefore, the Stockholm Declaration intrinsically linked the duty to protect the environment with the activity of exploitation.[224] Then, this construction of the principle of prevention was subsequently confirmed in 1992 by the *Rio Declaration on Environment and Development* (Principle 2), which provided that:

> *"States have…the sovereign right to exploit their own resources…and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."*[225]

What is extremely relevant is that both the rules established that any environmental damage must be avoided, even the harm that can be produced to "areas beyond the limits of national jurisdiction". Also, the *United Nations Convention on The Law of the Sea* (hereinafter the UNCLOS)[226] for the activities in the "Area" and the *Convention on Biological Diversity* (hereinafter the CBD)[227] contained a similar provision, as evidence of the general acceptance among States that exploitation must be carried out in accordance with high environmental standards, including in areas beyond the national jurisdiction of States. This new revolutionary formulation could therefore have a productive and beneficial relevance for the protection of the unique environment of outer space: it could equally apply to outer space as a whole, an area that is not subject to any national

[222] Dupuy and Vinuales, *supra* footnote 3, page 66.
[223] Principle 21 of the *Stockholm Declaration on the Human Environment* (1972).
[224] Dupuy and Vinuales, *supra* footnote 3, page 64.
[225] Principle 2 of the *Rio Declaration on Environment and Development* (1992).
[226] Article 145(a) of the *United Nations Convention on the Law of the Sea* (1982).
[227] Article 3 of the *Convention on Biological Diversity* (1992).

jurisdiction. Indeed, it can be seen that there has been a shift that concerned the object of the legal protection: first it was the territory of the other State that had to be protected; now it is the environment *per se*, irrespective of the spatial dimension and independently of any territorial limitation.[228] However, even if authoritative, both the international Declarations are soft law instruments, preventing a compulsory *prima facie* extension of the principle of prevention to outer space. The broad conception of the environmental law principle has had to wait until the 1990s to become fully binding on States. In its *Advisory Opinion on the Legality of Nuclear Weapons* of 1996 the ICJ established that:

> *"The existence of the general obligation of States to ensure that activities within their jurisdiction and control respect the environment of other States or of areas beyond national control is now part of the corpus of international law relating to the environment."*[229]

This judgment opened the door to a new, but more comprehensive notion of the principle of prevention.[230] On the one hand, having formally acknowledged that the principle is now part of positive international law, the applicability of the obligation to prevent environmental damage in any area outside national jurisdiction, including outer space, becomes mandatory. More specifically, the principle has become binding under customary international law and this specific legal status allows the international custom, the flexible source of international law, to be easily applicable and extended to the field of international space law. On the other hand, the advisory opinion contains a landmark statement: the Court has also firmly established that the protection and conservation of the environment has become required by law and is no longer considered a simple moral guide. Indeed, it recognized in the same passage from the judgment that: "the environment is not an abstraction but represents the living space, the quality

[228] Dupuy and Vinuales, *supra* footnote 3, page 66 and 67.
[229] *Advisory Opinion on the Legality of Nuclear Weapons*, Advisory Opinion, ICJ Reports 1996, paragraph 29.
[230] Dupuy and Vinuales, *supra* footnote 3, page 65.

of life and the very health of human beings, including generations unborn".[231] It follows that, the content of the legal protection, the protection of the environment *per se*, has now become universal and, consequently, it does not change according to the different fields of application allowing the extension of the duty to protect the environment as such to all other areas of international law, including to international space law. This assumption has recently been confirmed by the Arbitral Tribunal constituted under Annex VII of UNCLOS in the *South China Sea Arbitration* case. The tribunal emphasized that the duty to protect and preserve the marine environment, stemming from Article 192 of UNCLOS, applies to all the maritime areas, both inside the jurisdiction of the States and in those areas that are beyond it.[232] This decision relied on the fact that the marine environment exists regardless of any question of sovereignty,[233] and independently from any effective jurisdiction exercised over it.[234] Therefore, under international law of the sea, States are required to prevent any environmental damage, wherever it may occur, making the protection of the environment as an indipendent value one essential element of the entire discipline.[235] Furthermore, it is worth noticing that the judgment of the arbitral tribunal, and more specifically Article 192 of UNCLOS, flows spontaneously and it directly concerns Article 193 of the same legal instrument, which recognizes the sovereign right of each State to exploit its own natural resources.[236] Thus, the intrinsic link and connection that exists between exploitation and protection of the environment *per se*, after having been previously established both by the Stockholm Declaration and Rio Declaration, is reaffirmed in binding terms by the law of the sea tribunal. In addition, the *South China Sea Arbitration* case

[231] *Legality of Nuclear Weapons*, *supra* footnote 229, paragraph 29.
[232] *In the matter of the South China Sea Arbitration before an Arbitral Tribunal constituted under Annex VII of the United Nations Convention on the Law of the Sea (Republic of the Philippines v. People's Republic of China),* PCA Case No. 2013-19, Award (12 July 2016), paragraph 940.
[233] Ibid.
[234] For instance, there are othere maritime areas regulated by international law of the sea: the territorial sea or the Exclusive Economic Zone (EEZ). In the Exclusive Economic Zone States have the duty to protect the environment with reference to the control that they exercise over the areas.
[235] Part XII of the *United Nations Convention on the Law of the Sea* (1982).
[236] Article 193 of the *United Nations Convention on the Law of the Sea* (1982).

confirmed that the binding obligation to prevent any environmental damage applies to all areas beyond national jurisdiction, ultimately proving that it does not matter under which branch of international law such areas is regulated. In conclusion, since the legal interest protected by the law is the same, the environment *per se*, the customary international principle of prevention can be used to ensure that the same level of environmental preservation is always provided, including in outer space.

Furthermore, the practical results of utilizing this principle to regulate space exploitation have significant and substantial consequences and States would not be completely free to conduct their mining programs and operations. In fact, according to the environmental principle, in exercising their right to use outer space, States would be required to proactively take the necessary measures to prevent any environmental damage.[237] In addition, failure to effectively implement the measures adopted at national level would equally breach the duty.[238] Furthermore, as stated by the ICJ, the principle of prevention is an obligation of due diligence or, in other words, an obligation of conduct.[239] This means that a required due diligence must be established in accordance with certain and specific standards, including the type of activity that is planned to be carried out and the environmental risks associated with such activity. Also, these parameters are objective and are not limited to any branch of international law.[240] Consequently, in being space mining a highly harmful activity, which can also create irreversible effects on the environment of outer space, this due diligence must be agreed at a very high level. Following from the above, the intervention of the prevention principle would force States to legally desist from conducting exploitation if the necessary and high due diligence has not been put into practice. Or where, for instance, it is very likely that the activity itself negatively affects the

[237] Dupuy and Vinuales, *supra* footnote 3, page 69.
[238] *South China Sea Arbitration*, *supra* footnote 232, paragraph 964.
[239] Dupuy and Vinuales, *supra* footnote 3, page 64 and *Corfu Channel*, *supra* footnote 218.
[240] Berkes A., 'The standard of "Due Diligence" as a result of interchange between the Law of Armed Conflict and General International Law', in: *Journal of Conflict and Security Law*, Volume 23 (2018), (page 433).

environment. As a general matter, the principle would prohibit the implementation of any *a priori* plan, requiring instead States to take into consideration the intrinsic value of the environment of outer space before carrying out and completing their exploitation programs.

In conclusion, the environmental principle of prevention, in being a rule forming part of the *corpus* of customary international law and therefore binding,[241] and being constantly applied to areas beyond any national jurisdiction, can fill those *lacunae* present in the 1967 Outer Space Treaty. Furthermore, the protection of the environment *per se* has become an underlying duty whose respect is constantly required in other fields of international law, as in the international law of the sea context, thus making its application to outer space not only legally feasible but also compulsory.[242] States are therefore forced to comply with the obligations set forth above in order to preserve the environment of outer space as such.

3.2 The duty to cooperate

Implementing the duty to prevent an environmental damage, as previously shown by the analysis concerning its extension to space exploitation, is complicated. Therefore, the prevention principle requires that certain procedural obligations are fulfilled and completed by States to ultimately ensure that the harm to the environment does not occur and to guarantee compliance with the substantive environmental principle. Among these procedural obligations there is also the duty to cooperate, which always involves a duty of notification and consultation,[243] which I am now going to analyze in the context of the environmental protection of outer space from exploitation.

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[241] Its legal status of custom has been subsequently confirmed and applied by the ICJ in the *Gabcikovo-Nagymaros Project* case (1997) and in the *Pulp Mills* case (2010).

[242] Another field of international law that has incorporated the duty to protect the environment and the duty to prevent an environmental damage is international water law. See Articles 7, 20, 21 and 23 of the *United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses* (1997).

[243] *South China Sea Arbitration, supra* footnote 232, paragraph 946, 984-985.

The importance of the environmental obligation lies in the key role that the duty has always had in history of international law. In fact, considering the duty to cooperate one of the most principal rules of general international law, whose main purpose is to resolve potential conflicts between States, it follows that it must also be applied in the context of international space law, particularly that now new activities, including exploitation, are becoming practicable. Indeed, as pointed out in the first Chapter, new technology, scientific progress and space technological development now allows space actors to pursue futuristic and ambitious exploitation plans and therefore considerate tensions may arise. These tensions may also increase and may become difficult to resolve if one considers that an official and clear interpretation of the international space rules concerning exploitation are lacking. It follows that an obligation of cooperation must be constantly applied by States if they intend to carry out this new commercial activity in space. In this perspective cooperation must have the objective of protecting the environment as it could be at risk. In this way, the obligation of cooperation would play the role of environmental procedural obligation of the substantive principle of prevention, thus securing the objective of environmental protection and that of avoiding any environmental damage. Given the importance that this international rule has, the 1967 Outer Space Treaty contains a provision concerning the duty of cooperation, Article IX, which 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… 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."[244]

However, the provision is formulated in general terms and it lacks binding force that calls into question its effectiveness and the possibility of guaranteeing adequate environmental protection.[245] This is evidently true for the part of the norm which does not provide for any specific and stringent consultation obligation in the event that any planned activity may create environmental damage. It is not clear, indeed, according to which parameters a planned operation could "cause potentially harmful interference", or whether such activity is suspended until an agreement between the States involved is found, precluding until then its implementation. These and other interpretation problems can be solved if we consider how the duty of cooperation was consequently made explicit under international environmental law. It is surprising, in this sense, to realize that there has been such progress with regard to this procedural environmental principle that Article IX could be defined as extremely clear if one applied to space what was legally defined on earth.

For this reason I believe that the duty of cooperation as developed under international environmental law should be used as a means of integration for the completion of this defective space norm. Indeed, in the context of international environmental law there have been developments that have led to the creation of more precise rules that are able to clarify the content of the more general obligation of international cooperation. The numerous cases that have environmental components, and on which decisions have been rendered on them by the international courts in recent years, have strengthened the binding nature of the international environmental principle. This, in turn, allows to specify the content of the duty to cooperate of Article IX of the Outer Space Treaty and to

[244] Article IX of the *Outer Space Treaty* (1967).
[245] Zhukova E. G., 'Environmental Protection of Outer Space: The Principle of International Cooperation', in: *IISL proceedings of the 33rd Colloquium on the Law of Outer Space* (1990), (page 188).

facilitate the process of its mobilization and use in order to ensure satisfactory environmental protection when an exploitation activity is carried out in space. For instance, the ICJ stated that the duty to cooperate always implies the duty to negotiate in good faith among States.[246] In the same judgment, on the *Pulp Mills* case, the Court also established what is required by customary international law to a State acting in good faith. Firstly, before starting an activity which is likely to have negative effects on the environment of other States, the State that wants to pursue the activity has the duty to notify the latter.[247] This notification must also include elements that allow the assessment of the potential environmental impacts of the planned activity in order to put into practice and stimulate an effective cooperation mechanism between States. Therefore, prior notification always requires the exchange of data and information and the sharing of the results of the environmental impact assessment already conducted and concluded, which will be analyzed in the next paragraph.[248] As regards the following phases of the activity, in the event that after receiving this information a disagreement occurred, customary international law imposes on States the duty to consult.[249] Furthermore, until a consensus was reached between them, the Court clarified that the State that planned the activity is not entitled to start or even continue it, thus strengthening the goal of achieving environmental protection.[250] Indeed, the relevant passage from the *Pulp Mills* case in which consultation is designed as a necessary precondition for the continuance of a planned activity could have a fundamental and beneficial result for the environmental protection of outer space as it would automatically make exploitation actors dependent on cooperation with the international community. In this perspective, the ICJ stated that:

> *"As long as the procedural mechanism for co-operation between the parties to prevent significant damage to one of them is taking its*

[246] *Pulp Mills on the River Uruguay (Argentina v. Uruguay),* Judgment, ICJ Reports 2010, paragraph 145.
[247] Ibid., paragraph 120.
[248] *MOX Plant Case (Ireland v. United Kingdom),* ITLOS Case No. 10, Order (3 December 2001), paragraph 89(a).
[249] *Lake Lanoux Arbitration (Spain v. France),* Award of 16 November 1957, paragraph 22.
[250] *Pulp Mills, supra* footnote 246, paragraph 144.

course, the State initiating the planned activity is obliged not to authorize such work and, a fortiori, not to carry it out."[251]

This passage, like the others mentioned, contains significant elements for the regulation of exploitation in space. If the necessary clarifications of international courts and tribunals were used and applied, Article IX of the Outer Space Treaty would become clear and the legal consequences deriving from the obligation of cooperation would be certain and coherent. For instance, if we suppose that a "new space" entity has the aim of undertaking a planned activity that can territorially monopolize an asteroid or a celestial body for the purpose of exploiting them (therefore an invasive and potentially detrimental activity), the other States would thus be capable of activating a comprehensive cooperation mechanism. This comprehensive mechanism would have the effect of allowing these other States to request objective information, to independently evaluate them, to be able to start consultations if they consider that there is a high risk that the environment may be damaged and eventually suspend the activity if the consultation has not been successful. In sum, if we allow the use of these international rules, a considerable environmental protection of outer space would be achieved.

Furthermore, this analysis carried out above with its environmental specifications regarding the obligation to cooperate are an accurate reflection of the nature and content of the duty as specifically envisaged under international space law. Therefore, they would not be translated into the space realm without any legal reasoning. In fact, for instance, even international space law provides for mutual cooperation as a necessary preliminary condition for being allowed to complete the commercial activity if it is considered harmful by other States; even if it is not explicitly stated in the Outer Space Treaty and with identical terms to those used in the international environmental law regime. Indeed, a final aspect of the international cooperation rule in space deserves to be analyzed. Through a more careful reading of the aforementioned Article IX of the 1967 Treaty, it is

[251] Ibid.

clear how the provision requires States to take appropriate cooperation measures only when a planned activity can produce "harmful interference with the activities of other States in the peaceful exploration and use of outer space". Therefore according to Article IX of the Outer Space Treaty, the effects of exploitation could be considered negative or harmful, and consequently ask for cooperation, if they prevent other States from performing other activities in the use of outer space and of its celestial bodies. Instead, according to this construction, the provision does not specifically refer to an adverse environmental impact, although it can be implicitly inferred from the overall reading of Article IX that it is included and cooperation for the preservation of the environment equally comprised.[252] For this reason, Article IX of the Outer Space Treaty confirms, in my opinion, the interpretation of Article I, paragraph 1 (the "common interest principle") which declares that the use of outer space and celestial bodies, including exploitation, must be conducted in accordance with the concurrent or even future use by other States. Otherwise there would have been no provision that, in regulating cooperation in space, would have been primarily interested in addressing a peaceful and concomitant use of outer space by States. Paradoxically, Article IX is less aimed at protecting the environment of outer space, preferring rather to preserve the interests and rights of other States and space actors. This inclination towards the recognition of equal rights in the use of outer space would indeed be necessary to achieve one of the main objectives of the entire 1967 Treaty: the protection of the nature of "province of all mankind" of outer space,[253] an open area of international law that does not belong to any State. Therefore, the duty to cooperate under international space law would take a particular form and connotation: a form that is aimed at guaranteeing the preservation of outer space as a common area which is there for the exploration and use by all States.

[252] Particularly, the part of the provision that provides that: "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"

[253] Article I of the *Outer Space Treaty* (1967).

However, the characteristic of outer space as a "province of all mankind", which recognizes the equal rights of each State over it, cannot be without legal effects, particularly when it comes to its environmental protection. How, in fact, to ensure its concomitant and future use to everyone, without distinction, if States in using outer space do not pay attention to its environment? If the environment of a celestial body or asteroid is, for instance, irrevocably damaged by an exploitation plan so as to prevent its future use, would it not be in violation of Article I, paragraph 1 of the Treaty? And consequently, should the planned activity have required cooperation between States pursuant to Article IX in order to prevent the occurrence of harmful effects? The answers to these questions cannot be unambiguous and will depend to a greater extent on the concrete case, but nevertheless Article IX is clear in stating that cooperation must exist as long as harmful activities in space are planned. If activities are considered harmful even for reasons other than purely environmental, it is not excluded that the component of environmental preservation is not included: indeed, it is one of the elements that contributes to forming outer space as a "province of all mankind".

It follows that outer space is an area that, although it does not belong to any State, requires that all States manage it correctly, also in order to ensure its environmental protection. And environmental protection would therefore take on an interesting connotation in space: States would be called upon to cooperate together and constantly in order to achieve a goal that transcends simple friendly relations among them and which encompasses the environment. This assumption may also be confirmed by a recent analysis concerning the duty to cooperate. Indeed, following an authoritative distinction or categorization of the Group of Experts of the United Nations Commission on Sustainable Development (CSD), there are different forms that characterize the duty to cooperate.[254] With respect to the "global commons", such as outer space, the obligation to cooperate would take place and should be implemented "in spirit of global partnership".[255] This would

[254] Dupuy and Vinuales, *supra* footnote 3, page 74.

[255] Ibid. This would be also confirmed by the *Rio Declaration* (Principle 7), which states that: "States shall co-operate in a spirit of global partnership to conserve, protect and restore the health

confirm the above analysis: outer space and celestial bodies require an orderly and comprehensive management system in order to preserve its nature that otherwise would not be respected if the decisions were not taken together and in a spirit of global partnership by States. In conclusion, cooperation to obtain environmental protection in space is aimed at ensuring the conservation of the common area in order to be equally enjoyed by all States.

The previous examination concerning cooperation in space has therefore identified three salient elements: the first is that Article IX of the 1967 Treaty is not able to be generally effective in ensuring cooperation between States. Secondly, the provision does not include any specific obligation regarding environmental cooperation, thus making it even more doubtful to believe that a potentially positive result for the preservation of the environment of outer space can be guaranteed. These two first conclusions led me to conclude that it would be necessary to use the developments that occurred under the aegis of international environmental law to fill the gaps present in Article IX of the Outer Space Treaty. The third finding, however, allows to extend and to apply these legal specifications relating to the duty of cooperation. In my opinion, they prove to be possible and even perfectly adapted to the space discipline. Indeed, Article IX of the Outer Space Treaty is subordinated to the implementation of the guiding principles present in the Treaty, in particular the "common interest principle" which makes the duty to cooperate as an instrument available to States to preserve as it is space and to obtain the protection of outer space and celestial bodies. Therefore, not unlike the *Pulp Mills* case, the international courts would proceed to affirm that if the States are cooperating to verify if there are harmful effects that can result from an activity, the planned exploitation is suspended. Following from the above, I personally believe that, since there is an international space law provision that provides for cooperation between States, these well-established international environmental rules, which have the legal value of international custom, can easily be applied to outer space in order to achieve the prevention of

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and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities."

an environmental damage. Article IX of the Outer Space Treaty is not very precise in defining the legal contours of the duty; therefore these judgments allow specifying the content of the obligation in the international space context and consequently helping States to cooperate effectively when disagreements arise. The duty to cooperate under international environmental law, which is the correct instrument through which adequate environmental protection can be achieved,[256] can therefore guide all the international subjects when they carry out a space mining activity. In fact, only with specific and binding provisions the complex aim of preventing environmental damage can be reached. In conclusion, in the absence of clear and detailed space rules that allow States to be able to obtain the prevention of environmental adverse impact in space, recent developments in the field of international environmental law should be used as procedural extensions of the same substantive duty: protecting the environment *per se*, as well as on earth so in space.

3.3 The duty to conduct an environmental impact assessment

The obligation to conduct an environmental impact assessment (hereinafter the EIA) is the second procedural extension of the substantive principle of prevention. Therefore, like the obligation of cooperation which comprises the ancillary duty to notify and consult, it contributes to avoid the risk that an environmental damage will occur.[257] According to the Rio Declaration on Environment and Development, when proposed activities are likely to have a negative impact on the environment, States have the obligation to put in place a system that aims to prevent and to monitor these harmful effects.[258] More precisely, the environmental impacts of the planned activity must be assessed and

[256] *Gabcikovo-Nagymaros Project (Hungary v. Slovakia)*, Judgment, ICJ Reports 1997, paragraph 17.
[257] Dupuy and Vinuales, *supra* footnote 3, page 69.
[258] Principle 17 of the *Rio Declaration on Environment and Development* (1992) defined the EIA as a national instrument, thus requiring States to have national procedures in place capable of implementing the international obligation, particularly the creation of a competent national authority for verifying the whole procedure.

monitored at the early stage.[259] Thus, its role, which consists in obtaining environmental protection, allows to mobilize the principle in space to eliminate or minimize the risks associated with the damage that the exploitation can produce on the environment of celestial bodies.

The importance of the procedural principle is evidenced by the fact that it is included in many international treaties. [260] Also, many of them aim to achieve global environmental protection,[261] demonstrating its effectiveness and therefore its indispensability in protecting the environment of vast areas such as outer space. Furthermore, like the environmental principles previously discussed, the duty to conduct an EIA derives from customary international law. The ICJ recognized in the *Pulp Mills* case that the obligation was so constantly applied by States and included in treaties that, consequently, the formal source of international law from which it now derives is also the custom:

> *"…which in recent years has gained so much acceptance among States that it may now be considered a requirement under general international law to undertake an environmental impact assessment where there is a risk that the proposed industrial activity may have a significant adverse impact in a transboundary context, in particular, on a shared resource."*[262]

It is also interesting to note that in this passage the Court considered it even more imperative, precisely as a requirement under general international law, to undertake the EIA when the activities can have a negative impact on shared resources. This aspect is very relevant as regards the extension of the environmental principle to the regulation of exploitation of space resources. It can

[259] See at the United Nations Economic Commission for Europe (UNECE) Website: https://www.unece.org/env/eia/eia.html (last visited 15 July 2019).
[260] For instance, in the *Convention on Environmental Impact Assessment in a Transboundary Context* (1991) or in Article 11 of the *Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution* (1978).
[261] For instance, it is included in Article 206 of the *United Nations Convention on the Law of the Sea*(1982) regarding the protection and the preservation of the marine environment or in the *Protocol on Environmental Protection to the Antarctic Treaty* (1991) regarding the Antarctica, an other common area as outer space regulated under international law.
[262] *Pulp Mills, supra* footnote 246, paragraph 204.

also be stated that with regard to this activity in space, numerous, if not all, elements that require States to conduct an EIA are met and completely satisfied. Indeed, mining activities are planned activities that can produce permanent effects on outer space and on its celestial bodies,[263] therefore they would at least require a previous environmental assessment. They are also capable of creating serious environmental damage to the other *in situ* resources after some of them have been extracted and appropriated, thus irremediably changing the surrounding environment. Furthermore, all space resources are resources that are common to all States; indeed, to be even more precise, they are not just common resources but rather belong to the whole mankind as being an integral part of an area that has been established as "province of all mankind" under international law.[264] It follows that the duty to conduct an EIA can constitute an appropriate tool through which States can be aware in advance of the potential environmental damage that could result from their exploitation activities. In addition, through the EIA procedure, they would know how they can monitor these risks and act accordingly to prevent an environmental adverse impact in space in order to be able to respect the rights of other States since the resources covered by these planned activities are shared.

Furthermore, the procedural principle can easily be applied to outer space. In fact, regarding where the duty to carry out an EIA exists, it should be noted that it has developed so extensively that the spatial scope of the requirement has also been modified accordingly.[265] As pointed out by the ICJ in the above passage from the *Pulp Mills* case, the obligation was previously conceived as confined to the transboundary context, which could have prevented its application to outer space, an area beyond any national jurisdiction. However, two decisions have contributed to make the principle operational and binding beyond the

[263] Sample, *supra* footnote 206.
[264] Article I of the *Outer Space Treaty* (1967) and Dupuy and Vinuales, *supra* footnote 3, page 95.
[265] Dupuy and Vinuales, *supra* footnote 3, page 79.

transboundary context.[266] In its *Advisory Opinion on the Responsibilities in the Area*, ITLOS Seabed Chamber stressed that:

> *"[t]he [ICJ]'s reasoning in a transboundary context may also apply to activities with an impact on the environment in an area beyond the limits of national jurisdiction; and the Court's references to 'shared resources' may also apply to resources that are the common heritage of mankind."*[267]

This statement has a great relevance and significant legal consequences: not only it does start the process of transposition of the environmental principle in areas of international law that lie outside any national jurisdiction and control but, in expressly recalling the historical passage of the judgment of the *Pulp Mills* case, it also recognizes that resources that likewise do not belong to any State are considered shared resources. This establishes that the space resources are similarly included in the subject of the EIA requirement and therefore States have the duty to conduct an EIA before proceeding to exploit these resources. Subsequently, the content of the judgment has been confirmed by the Arbitral Tribunal in the *South China Sea Arbitration* case.[268] In this case the tribunal stated that the duty to prevent pollution or other significant or harmful changes to the marine environment[269] is always linked to the obligation to complete an EIA under customary international law.[270] In conclusion, these two decisions make it possible to establish that the customary obligation also applies to areas beyond national jurisdiction, thus encompassing outer space and its resources.

Not only does general and environmental international law allow to reach the conclusion that there is a duty to conduct an EIA in space, but likewise customary international law clarifies the content of the obligation. Following the

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[266] Ibid.
[267] *Responsibilities and Obligations of States sponsoring Persons and Entities with respect to Activities in the Area*, ITLOS (Seabed Dispute Chamber) Case No 17, Advisory Opinion (1 February 2011), paragraph 148.
[268] *South China Sea Arbtration, supra* footnote 232, paragraph 947, 948.
[269] Article 206 of the *United Nations Convention on the Law of the Sea* (1982).
[270] *South China Sea Arbtration, supra* footnote 232, paragraph 940 and Dupuy and Vinuales, *supra* footnote 3, page 79.

same methodology used for the duty to cooperate, some decisions of courts in the field of international environmental law can specify what States must do before performing an exploitation activity or plan in space. According to the ICJ and under customary international law, States have the duty to conclude the assessment before the planned activity is allowed to start in order to verify if any environmental damage can occur.[271] Furthermore, they have also the obligation to monitor the subsequent effects of the already initiated activity.[272] This would optimize the possibility that outer space and resources are preserved and their environment respected. In fact, States would not only have the duty to conduct an EIA in the case of exploitation, whose application of the obligation is not discussed as it is part of the *corpus* of customary international law, but would also be constrained in the way in which the EIA must be completed. Therefore, these more stringent rules can again contribute to achieving the environmental protection of outer space. Indeed, the duty to conduct an EIA, like the duty to cooperate, becomes more specific and its legal content more detailed, thus making the obligation to prevent an environmental damage more effective and binding on States. For this reason, in my opinion, the minimal requirements relating to the obligation to conduct an EIA established by customary international law should regulate space exploitation. Cases and decisions of international courts and tribunals must be used and followed by States even in the context of international space law when a mining activity is planned. In fact, the duty to prevent environmental damage is not properly performed without reference to other specific duties of a procedural nature, including the duty to cooperate or to conduct an EIA.[273]

[271] *Construction of a road in Costa Rica along the river San Juan (Nicaragua v. Costa Rica),* Judgment, ICJ Reports 2015, paragraph 163.
[272] Ibid, and *Pulp Mills*, *supra* footnote 246, paragraph 205.
[273] Dupuy and Vinuales, *supra* footnote 3, page 62.

3.4 The precautionary principle

The other substantive principle of international environmental law that can be applied to outer space is the precautionary principle. The rule, contrary to the duty to prevent, to cooperate and to conduct an EIA in order to avoid environmental degradation is not yet part of the *corpus* of customary international law.[274] However, from 1990 onwards it was included in numerous international treaties, such as the UNFCC (Article 3.3) and the CBD (preamble, alongside the principle of prevention).[275] Later it was also incorporated in the more complex multilateral environmental agreements (MEAs),[276] such as the *Agreement on Straddling Fish Stocks* of 1995 and the *Stockholm Convention on Persistent Organic Pollutants* of 2001. Therefore, it is of great interest to note that the application of the precautionary principle in international treaties has recently taken place constantly and has become binding on States. Furthermore, it is worth noticing that the whole conservation and management system created by the agreement that implements the provisions of UNCLOS for fish stocks is entirely built on this international environmental principle, the only one that proves to be capable of correctly administering these common resources.[277] The universal acceptance of the environmental principle, as demonstrated by its consolidated treaty law based, as well as its indispensability in protecting resources that are difficult to preserve, such as the straddling or high migratory stocks, indicate that it is possible, to extend the application of the precautionary approach to space. Indeed, it would contribute, in conjunction with the other principles, to the environmental management of space resources during their exploitation in order to likewise promote their conservation.

Following from the above and based on these historical and legal developments, ITLOS Seabed Chamber has recently stated that the legal value of

[274] Ibid, page 70.
[275] Ibid, page 71.
[276] Ibid.
[277] See at Division for Ocean Affairs and The Law of the Sea Website: https://www.un.org/depts/los/convention_agreements/convention_overview_fish_stocks.htm

the substantive principle of international environmental law is witnessing an important progress, which may soon lead to its customary recognition:

> *[T]he Chamber observes that the precautionary approach has been incorporated into a growing number of international treaties and other international instruments…In the view of the Chamber, this has initiated a trend towards making this approach part of customary international law".*[278]

The explicit recognition of the legal nature of custom by the international law of the sea court does not make the normative basis of the precautionary principle definitive or clear. However, to logically complete what has been analyzed above regarding the evolution that the precautionary approach has had so far, it would be natural to determine that now, after that States have further complied with the rule, the principle has completely reached the level of custom, which would require them to apply it also to exploitation in space. Waiting for a formal acknowledgment regarding its general nature of international custom, which could occur if a commercial activity would be conducted in space without taking into account the principle, its transfer into the legal framework regulating the commercial activity of space resources is made possible by further elements.

Under international law, the precautionary principle binds States to take all appropriate measures to prevent environmental damage when actual or potential effects of their activities or operations on the environment are unknown or imprecise.[279] Therefore, scientific uncertainty cannot be used as a reason for postponing the adoption of adequate measures to minimize or avoid harmful effects.[280] However, outer space has a fragile environment which does not permit any mistakes to be made.[281] Also, there is total scientific uncertainty about the

[278] *Adisory Opinion on Responsibilities of the Area*, *supra* footnote 267, paragraph 135.
[279] Dupuy and Vinuales, *supra* footnote 3, page 70.
[280] As stated, for instance, in the *United Nations Framework Convention on Climate Change* (Article 3.3) or in the *Rio Declaration on Environment and Development* (Principle 15).
[281] Larsen P. B., 'Application of the Precautionary Principle to the Moon', in: 71 *Journal of Air Law & Commerce* 295 (2006), (page 298).

effects that any activity can have on outer space and celestial bodies.[282] For this reason, although the environmental principle was not incorporated into the 1967 Treaty, many of its articles suggest or oblige States to act with a high degree of caution when operating in outer space, being already aware that irremediable changes in space are easy to be achieved and that it is often not possible to identify the effects in advance.[283] It follows that, the precautionary principle, which developed after the adoption of the Outer Space Treaty, can be inferred from the content of the legal instrument and from the physical and technical characteristics of outer space. It should therefore apply to outer space in order to ensure that States and space actors are always in compliance with international space law since many of its rules intrinsically and implicitly require the precautionary principle to be respected, particularly when mining activities are performed. The use of the principle would also have positive results as regards the protection of outer space. In mining the Moon and other celestial bodies, States should pay particular attention to the potential adverse impact that could occur. In addition, if States wanted to undertake an exploitation operation, they would have the duty to monitor any phase of mining operations, taking into account the scientific uncertainty in any decision-making.[284]

Furthermore, another legal basis for the transposition of the principle within the realm of space exploitation is constituted by the analogy between outer space and Antarctica. A group of scholars has recently proposed the application of the precautionary principle to the activities carried out in Antarctica.[285] The reasons behind this proposal are the fragility of its environment and the high scientific uncertainty regarding the impact of these activities on its environment. Based on the fact that the Antarctic Treaty served as a model to the 1967 Outer Space Treaty, that both areas do not belong to any State, and that outer space, including

[282] Ibid.
[283] Ibid, page 299 and 300. And these Articles include Article V, VI an IX of *the Outer Space Treaty* (1967).
[284] Ibid, page 303.
[285] Bastmeijer K. & Roura R., 'Regulating Antarctic Tourism and the Precautionary Principle', in: 98 *American Journal of International Law* 763 (2004).

the Moon, is fragile as Antarctica, the precautionary principle should also apply to the exploitation activities in space.[286]

Lastly, a rule that provides for equality between all States in the use of outer space is present within the Outer Space Treaty: precisely in Article 1, paragraph 1 (the "common interest principle"). This rule requires States to have due regard to the interests of all the other States and therefore a duty to pay particular attention to the impact of their activities on the environment exists accordingly, flowing from the first.[287] Thus, in my opinion, the precautionary principle, and more generally the principles of international environmental law previously discussed, should find their application to outer space automatically only for the presence of the "common interest principle". Outer space belongs to all States and exploitation has the limitation of having to consider all the rights and interests of all mankind.

It follows that States and their private economic entities that want to carry out exploitation must be particularly careful in preserving outer space and celestial bodies. The purpose of this precaution is to ensure that outer space can be used by other States in the same way in the future. The precautionary principle would serve to achieve this goal as it forces States to take action despite the lack of scientific certainty about the negative impact that a space mining activity poses to the environment and to consequently adopt necessary measures.

3.5 The polluter-pays principle

The polluter-pays principle is one of the most well-established norms of international environmental law,[288] and its customary international value is confirmed through other environmental norms, namely no-harm and prevention principles.[289] However, this principle that expresses the idea of balance does have

[286] Larsen, *supra* footnote 281, page 295.
[287] Ibid, page 302 and 303.
[288] Bhat, *supra* footnote 205, page 342.
[289] Dupuy and Vinuales, *supra* footnote 3, page 81.

its distinct dimension and content,[290] as demonstrated by its inclusion in certain international treaties,[291] conventions on civil liability,[292] and soft-law instruments.[293]

In order to grasp its legal contours the theory of "externalities" should be introduced. According to this theory, the negative externalities produced by an economic activity will be "internalised".[294] This means that the polluter(s) are the sole responsible for the negative effects and for the environmental damage that can occur from the activity and, consequently, must bear the costs of the pollution.[295] This payment of compensation is required in order to ensure that the financial burden is borne by those individuals or enterprises who caused the environmental harm.[296] In the absence of this principle, the costs of environmental damage would fall on the consumers (those who receive the benefit from the activity) and on the public or society at large (including members who do not necessarily and individually profit from the economic activity)[297] either in terms of higher taxes to be paid or in terms of having a less satisfactory environment, thus ultimately bearing the costs.[298]

This international environmental principle was initially introduced in an Council Recommendation of the Organization for Economic Cooperation and Development (OECD),[299] and subsequently the Rio Declaration on Environment and Development has strengthened the role of polluter-pays as a guiding norm requiring States to incorporate the principle at domestic level, establishing that:

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[290] Ibid.
[291] The polluter-pays principle has been incorporated in the *Convention on the Protection and Use of Transboundary Watercourses and International Lakes* (Article 2(5)(b)) and in the *Convention for the Protection of the Marine Environment of the North East Atlantic* (Article 2(2)(b)).
[292] For instance in the Protocol amending the *International Convention on Civil Liability for Oil Pollution Damage* (CLC/92).
[293] Paragraph 3.1 *of ILA New Delhi Declaration of Principles of International Law Relating to Sustainable Development*
[294] Dupuy and Vinuales, *supra* footnote 3, page 81.
[295] Bhat, *supra* footnote 205, page 342.
[296] Ibid.
[297] Dupuy and Vinuales, *supra* footnote 3, page 81 and 82.
[298] Bhat, *supra* footnote 205, page 342.
[299] OECD Council Recommendation on Guiding Principles concerning the International Economic Aspects of Environmental Policies, C(72)128 (1972).

"National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment".[300]

Cost "internalisation" has become the established and consolidate rule of the market mechanisms in all environmental policy,[301] thus allowing its application in the space sector where economic activities are carried out by few States, even if environmental damage in space is actually suffered by all mankind. The transposition of the polluter-pays principle to outer space, as the Rio Declaration requires States to do because it has declared necessary to incorporate it into national legislations, would establish the sole liability of those that perform exploitation and of those that create an environmental damage for the payment of costs. In conclusion, in using this environmental rule all the damage suffered by all mankind, who did not participate in the activity that caused it, must not be borne by them, but rather by the polluters who pay the costs of their own pollution. Thus, the environmental harm produced by the exploitation activity would not affect developing States and individuals as a society at large, both economically and financially.

Furthermore, the application of the polluter-pays principle in outer space and to economic activities that take place in space is also possible and legally feasible because certain strict conditions required for the use of the international norm are fully respected. Accordingly, "internalisation" of the costs can only apply to externalities under three conditions: namely (i) that the economic activity producing the externality is socially desirable, (ii) that the negative externality is confined within the bounds of what can be considered as a tolerable or repairable damage.[302] Indeed, if the damage was a serious or significant, international law would not allow cost "internalisation", but rather the prevention of environmental

[300] Principle 16 of the *Rio Declaration on Environment and Development* (1992).
[301] Dupuy and Vinuales, *supra* footnote 3, page 82.
[302] Ibid.

damage, making the prevention principle operational and preventing the polluter-pays principle from being applied. The third requirement (iii) concerns the fact that is often particularly difficult to distribute the environmental costs incurred by the international community but generated by States on the States that have produced these costs.[303] On the contrast, a recent promotion of polluter-pays at the level of individuals and enterprises has recently been implemented as it is more appropriate to apply other environmental principles to States, such as the no-harm principle and prevention principle.[304] Applying these criteria to exploitation in space, it is evident that the activity can be regulated by the international principle. Indeed, exploitation is able to produce externalities that can be considered socially desirable: in addition to the mere economic interest that can derive from it, which would benefit entire industries that need to use natural resources, a valuable scientific advantage for all humanity is often present, as has been demonstrated when the assessment on the legality of the individual exploitation activity was previously carried out. Furthermore, using extracted resources to produce cleaner energy to improve the earth's environment would also be particularly beneficial. Regarding the second requirement, in case the damage caused is repairable, the polluter-pays rule can be applied, while when it is irreversible the prevention principle is used. In accordance with the third condition, since exploitation is an activity conducted either by private and governmental enterprises or by individuals rather than by the States, ensuring "internalisation" of the costs on them becomes technically feasible.

Although it has been shown that the polluter-pays principle is a valuable environmental norm that can aptly regulate the negative effects that can occur from the exploitation of extracted resources in space, specific compensation modalities required to be defined.[305] Particularly because the utilization of two widely accepted methods are currently debated: the *ex post facto* compensation

[303] Ibid.
[304] Ibid, page 83.
[305] Ibid.

model and the environmental taxation model.[306] While according to the former the polluters are responsible and accordingly pay for environmental pollution or damage after it has already been occurred, the environmental taxation model requires enterprises and individuals to pay in advance the possible future pollution.[307] Therefore, the main difference is that the first method provides for the payment of compensation for the damage, instead, the environmental taxation model, which is *ex ante*, anticipates the future reinstatement of the environment.[308] Both the modalities of the "internalisation" of the costs have their shortcomings and practical difficulties may arise in the implementation of the two accepted methods.[309] On the one hand, the *ex post* model could create problems in associating the consequences of environmental damage to the individual polluters. Indeed, the establishment of a causal link between an act or omission and its environmental effects has always been an issue that international environmental law has tried to solve,[310] in particular if the environmental damage was caused in a cumulative manner by the conduct of many States and the effects of their actions are felt by many or even by all States.[311] In outer space with multiple and different space actors that want to carry out distinctive exploitation plans pursuing specific objectives, it would be extremely challenging to determine the individual liability of each polluter.[312] On the other hand, the *ex ante* model would create difficulties in establishing in advance the risks that are associated with each space activities in order to foresee the possible environmental damage that must be paid.[313] However, the infancy and the scientific and technological barriers that currently exist and surround space exploitation can provide clues for the creation of a mixed model based on these two universally accepted. Indeed, the environmental taxation model is feasible because, even if the environmental risks connected with

[306] Bhat, *supra* footnote 205, page 342.
[307] Ibid, page 342 and 343.
[308] Ibid.
[309] Ibid.
[310] Dupuy and Vinuales, *supra* footnote 3, page 299.
[311] Ibid, page 315.
[312] Bhat, *supra* footnote 205, page 343.
[313] Ibid.

each space venture is difficult to be predicted, a clear distinction can be made between the activities whose sole purpose is to carry out exploitation and the others. In the first case, a considerable amount of money would be required since the possibility that pollution or environmental damage is produced by them is high, while as regards the space ventures that operate to pursue also other commercial purposes, the compensation to be paid in a hypothetical pool of funds could be reduced in monetary terms. Furthermore, the difficulty presented by the *ex post* model could be overcome if one considers that at the moment there are very few space actors who can technically afford to extract resources from celestial bodies, so the determination of individual liabilities would not require a complex operation.

Failure to incorporate the polluter-pays principle into the international space treaties must not prevent a system that provides for liability for payment of compensation from being introduced to regulate the environmental effects that could derive from exploitation. The polluter-pays principle has in fact developed after the adoption of the Outer Space Treaty;[314] therefore the time for its extension to the space regime becomes imperative for making enterprises and individuals committed to respect outer space as a "province of all mankind".

3.6 The principle of common but differentiated responsibilities

The principle of common but differentiated responsibilities (hereinafter the CBDR) has the aim of distributing the costs and the effort required to protect the environment among different States and according two parameters: (i) their historical responsibilities and (ii) respective capabilities (both financial and technical).[315] The idea underlying the principle is to promote cooperation in a spirit of global partnership.[316] Indeed, the international environmental rule shows that the preservation of the environment has a "common dimension", which is

[314] Ibid.
[315] Dupuy and Vinuales, *supra* footnote 3, page 83.
[316] Ibid, page 84.

highly suitable to regulate problems concerning global commons.[317] Since outer space and celestial bodies are global commons, the idea of introducing a principle such as the CBDR to regulate the exploitation of extraterritorial resources is more than viable. The CBDR principle was incorporated for the first time in a soft law instrument, the Rio Declaration on Environment and Development which establishes that:

> *"States shall co-operate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command."*[318]

In affirming that developed countries recognize their respective responsibilities in achieving sustainable development for the purposes of its attainment under international law, the principle provides for an active and considerable participation of the States that are in effect the largest, if not the only ones, emitters of pollution and producers of environmental degradation. For this reason that the CBDR has been defined as a concept from developing world:[319] it ensures that the States that in their development process have mostly contributed to damage the environment recognize their higher responsibilities, thus bringing developed States closer to those that are not.

However, over time there have been several ways to operationalize the principle of CBDR.[320] In order to understand how this environmental rule can be properly extended to international space law, the different normative contexts in which it was developed deserve to be analyzed here. Prior to its formulation in the

[317] Ibid.
[318] Principle 7 of the *Rio Declaration on Environment and Development* (1992).
[319] Bhat, *supra* footnote 205, page 349.
[320] Dupuy and Vinuales, *supra* footnote 3, page 84.

Rio Declaration, the principle was included in the ozone regime and subsequently reaffirmed in many international treaties regarding climate change. With regard to the ozone layer, the preamble of the *Vienna Convention for the Protection of the Ozone layer* (1985) referred to "the circumstances and particular requirements of developing countries".[321] Furthermore, the CBDR was also spelled out within the text of the Convention, thus making the principle as a real and stringent obligation and not just a mere aspirational rule. States are required to perform their obligations "in accordance with the means at their disposal and their capabilities"[322] and specific modalities are accordingly described to make the CBDR effective among the parties.[323] Subsequently, its 1987 *Montreal Protocol* introduced different obligations for developed and developing countries by imposing quantified but differentiated obligations for both the categories of States.[324] Indeed, the system provided for a certain degree of flexibility and other advantages, such as longer-time-periods, for the developing countries to ensure their implementation of the Convention.[325]

Concerning the climate change regime, the international environmental rule is fleshed out in two ways: on the one hand it was operationalized by the UNFCCC and the *Kyoto Protocol*, to then be extensively amended by the recent *Paris Agreement*. The UNFCCC reproduced the principle in similar terms to those previously provided for by the international instruments analyzed so far:

> *"The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the*

[321] Preamble, paragraph 3 of the *Vienna Convention for the Protection of the Ozone Layer* (1985).
[322] Ibid, Article 2(2).
[323] Ibid, Article 4(2), including technology transfer and forms of cooperation among States.
[324] Article 5 of the *Montreal Protocol on Substances that Deplete the Ozone Layer* (1987).
[325] Dupuy and Vinuales, *supra* footnote 3, page 85.

developed country Parties should take the lead in combating climate change and the adverse effects thereof".[326]

The principle of CBDR is of paramount importance for the whole discipline created by the UNFCCC to combat climate change.[327] The entire architecture of the Convention provides for a distribution of burdens among States for the fight against the global environmental problem, thus making the presence of the international principle fundamental in dealing with the substantive aspects of the international legal instrument. Indeed, the UNFCCC distributed the obligations at different levels, creating two distinctive categories of States: (i) those included in Annex I (developed States or States in transition to market economy)[328] and (ii) those included in Annex II (developing States).[329] Furthermore, this system of differentiation was subsequently enhanced and implemented by the Kyoto Protocol. The Protocol required developed States (those listed under Annex I of the UNFCCC) to meet stringent and quantified obligations,[330] but on the other hand, it did not impose any new obligation on developing States. Indeed, since the adoption of the Berlin Mandate the prevalent idea was to "not introduce any new commitments for Parties not included in Annex I",[331] thus strongly widening the gap between industrialized and non-industrialized countries.[332] The result is that, fifteen years later, the regime introduced has become obsolete. In fact, the States that contributed most to the creation of the problem of climate change (Brazil, China and India) at that time were considered developing countries and are therefore not currently subjected to specific and quantified obligations.[333] It

[326] Article 3(1) of the *United Nations Framework Convention on Climate Change* (1992).
[327] Dupuy and Vinuales, *supra* footnote 3, page 178.
[328] Article 4(2), Article 4(6) and Article 12 of the *United Nations Framework Convention on Climate Change* (1992).
[329] Article 4(3), 4(5) and 12(3) of the *United Nations Framework Convention on Climate Change* (1992) and Dupuy and Vinuales, *supra* footnote 3, page 179.
[330] Article 3(1) of the *Kyoto Protocol to the United Nations Framework Convention on Climate Change* (1997).
[331] Paragraph II.2(b) of *The Berlin Mandate: Review of Paragraphs a) and b) of Paragraph 2 of Article 4 of the Convention to Determine if They ara Adequate, Plans for a Protocol and Follow-up Decisions*, Decision 1/CP.1 (1995).
[332] Dupuy and Vinuales, *supra* footnote 3, page 175.
[333] Ibid, page 181.

follows that the CBDR principle was rendered operational incorrectly, as it did not distribute international responsibilities equally among States.

For this reason, the later Paris Agreement completely changed this approach.[334] Now developed States must grant financial,[335] technological[336] and technical assistance[337] to developing States in exchange of their contribution to meet their international obligations. However, each State is now free to set their own level of ambition in the form of "nationally determined contributions" or NDCs.[338] Thus, the CBDR has taken on a completely different form, leaving the States the power to make decisions concerning their individual responsibilities in coping with the adverse effects of the environmental problem.

Following from the above, it is clear that the CBDR principle should also be adopted in the space exploitation regime. Indeed, it would equally deal with the management of the adverse effects that can derive from the activity among States. In particular, in my opinion, two fundamental aspects included in the previous international treaties and protocols deserve to be maintained. Firstly, the part that constructs the CBDR as a principle that provides for a differentiated regime for developed and developing countries. In this way, the former would be forced to assist the developing States, which, in turn, would also possess the necessary technology and tools to address the environmental problems. Secondly, the idea of maintaining precise and detailed obligations in order to prevent States from freely deciding how to spell out the CBDR, as was instead envisaged by the Paris Agreement, should be preferred. Furthermore, I believe that both the areas of international environmental law in which the principle has developed, the protection of the ozone layer and the climate change regime, provide useful insights to understand how the CBDR should be applied to outer space and how it should be extended to the context of exploitation. On the one hand, it is desirable

[334] Ibid, page 85.
[335] Financial assistance is provided for by Article 9 of the *Paris Agreement* (2015).
[336] Technology transfer mechanisms are envisaged by Article 10 of the *Paris Agreement* (2015).
[337] In the form of capacity-building as described by Article 11 of the *Paris Agreement* (2015).
[338] Article 3 and 4 of the *Paris Agreement* (2015). NDCs are subject to two requirements: its must be updated at least every five years and an obligation of progression in the level of ambition must be observed.

to maintain a precise and clear distinction between the two categories of States: therefore, the adoption of annexes, as introduced for the first time by the UNFCCC, could be used again. However, as regards the content of the differentiation system, it is the regime established by the Montreal Protocol that must be taken into consideration. Indeed, in the history of international environmental law the 1987 Montreal Protocol stands as a success and, as stated by Dupuy and Vinuales, it has much to teach us.[339] In my opinion, the two distinct regimes of obligations with a particular structure for those obligations that developing countries are required to comply with, more flexible deadlines[340] and a system that justifies developing countries' failure to implement the Protocol because the transfer of technology on them by developed States has not occurred appropriately,[341] are all international rules that can influence the content of the CBDR principle to outer space.

Furthermore, it is interesting to note that the profound difficulties of bringing together and finding compromises between industrialized and developing countries are not as meaningful in outer space as they have been in other environmental regimes. Indeed, the CBDR would be called to reconcile few conflicting positions, since at the moment, it is repeated, only a limited number of States can carry out exploitation and, consequently, only the developed States are those who will have the primary responsibility of dealing with environmental degradation. On the contrary, the developing countries, until they have the technological and financial means to extract the resources from celestial bodies, cannot contribute to damage the environment of outer space.

Considering the particular characteristics of outer space and the useful elements that can be borrowed from the other environmental regimes, I provided a personal formulation of the CBDR principle. I therefore hope that in the near future the international environmental rule will be adopted in space in the following or in similar terms. Especially because all States, even the developing

[339] Dupuy and Vinuales, *supra* footnote 3, page 161.
[340] Article 5(1),(3) and (8bis) (a) of *Montreal Protocol on Substances that Deplete the Ozone Layer* (1987).
[341] Ibid, Article 5(5).

ones, would participate in addressing and coping with the damage created to the environment of outer space. And this would allow compliance with Article 1, paragraph 1 of the Outer Space Treaty, which declares outer space as a "province of all mankind", thus creating obligations for all States and without placing strong distinctions when it comes to protect the global commons. However, at first, a collective participation of all States in a spirit of global partnership will only be possible through a succesfull technology transfer by the industrialized countries to those that are not. In this perspective, Article 10 (A) of the Montreal Protocol could serve as a model, as it allows to justify certain deficiencies of developing countries in the implementation of environmental measures because of the absence of assistance from industrialized States.[342] In this way a participation of all the international community would be guaranteed even if developed States would be required to make higher commitments. In fact, although all States must respect their respective and strict obligations to promote sustainable development in space, the primary or exclusive responsibility lies with those who had the scientific and technical means to pollute outer space when the exploitation was carried out. It is therefore particularly desirable to adopt a rule such as Article 10 (A) of the Montreal Protocol to allow all States to combat the negative effects caused by exploitation in space but which nevertheless takes into account a correct and real situation.

In conclusion, I would maintain two differentiated regimes, but with specific and detailed obligations that provide for forms of assistance and which are clearly divided by annexes as envisaged by the UNFCCC. All these elements would increase the overall ability and capacity of all States in managing environmental problems and would affirm the highest contribution and responsibility that developed States have for their creation.

[342] Dupuy and Vinuales, *supra* footnote 3, page 165.

3.7 The principle of inter-generational equity

The principle of inter-generational equity has the aim of distributing the burden of environmental protection between present and future generations.[343] Furthermore, with its development throughout time, this principle of international environmental law has acquired a specific function now that the object of legal protection has shifted. Indeed, it aims to distribute the necessary efforts required for the conservation of the natural resources between present and future generations.[344] Hence, the principle of inter-generational equity recognizes and protects the rights of each individual to have access to all natural resources, including the environment.[345] It follows that, the use of the principle would promote the sustainable use of the resources of outer space in order to protect the future rights of all States and those of future generations. Its application would be more than valuable as it would prevent exploitation from becoming boundless.

There are different traces of its origins and subsequent developments in different international instruments, both old and new.[346] One of the first international instruments that cited the principle of inter-generational equity is the *International Convention for the Regulation of Whaling* of 1946, which referred to the interest of "nations of the world in safeguarding for future generations the great natural resources represented by the whole stocks".[347] It is extremely interesting to note that, although the Convention is one of the oldest environmental conventions, and although it was originally dedicated to regulating only the exploitation of whales as a resource,[348] it had already foreseen that exploitation should be carried out within certain limits. Indeed, economic interests

[343] Ibid, page 81.
[344] Ibid, page 88.
[345] Bhat, *supra* footnote 205, page 345.
[346] Dupuy and Vinuales, *supra* footnote 3, page 88.
[347] Preamble, paragraph 1 of the *International Convention for the Regulation of Whaling with Schedule of Whaling Regulations* (1946).
[348] Dupuy and Vinuales, *supra* footnote 3, page 212.

must be reconciled with considerations of conservation and preservation of species.[349] Similarly, the Stockholm Declaration of 1972 established that:

> *"Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being, and he bears a solemn responsibility to protect and improve the environment for present and future generations".*[350]

The soft-law instrument underlined the strong synergistic link that exist between environmental protection and human rights.[351] And it is by virtue of this link that every man has the corollary duty to preserve and protect the environment in order to prevent future impairment of human rights and, finally, to ensure that every man can equally use the environment and its resources.

Later, when the concept of sustainable development was introduced, the focus of the principle of inter-generational equity shifted on the achievement of the correct balance between the needs of present and future generations. However, sustainable development has a distinct and autonomous dimension and for this reason it will be analyzed in the following paragraph. On the contrary, with regard to the inter-generational equity principle, its new and comprehensive content was carefully drafted by the Rio Declaration of 1992, which stated that: "The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations".[352] Indeed, the Declaration emphasized that the right to development, which includes the right to use and exploit the resources from outer space, is not boundless.[353]

It follows that, the use and application of the principle of inter-generational equity to outer space would ensure and guarantee equal rights to present and future generations.[354] In this perspective, the international principle would guide the performance of exploitation so that the use of resources takes place within

[349] Ibid, page 204.
[350] Principle 1 of the *Stockholm Declaration on the Human Environment* (1972).
[351] Dupuy and Vinuales, *supra* footnote 3, page 358.
[352] Principle 3 of the *Rio Declaration on Environment and Development* (1992).
[353] Dupuy and Vinuales, *supra* footnote 3, page 89.
[354] Bhat, *supra* footnote 205, page 346.

certain boundaries. For instance, according to Bath, rights and needs of all the generations, including future generations, must be taken into account in planning any activity.[355] Therefore, private economic entities and States would be required to carefully plan the extraction of resources so as not to prevent the use of outer space and celestial bodies in the future. In conclusion, exploitation of extraterritorial resources would have the duty of reconciling, on the one hand, the need and rights to use the resources of the present generations, without depriving, on the other hand, the rights of future generations.[356]

Furthermore, in my opinion, the principle of inter-generational equity would contribute to achieving what was firmly crystallized under customary international law and codified in the 1967 Outer Space Treaty under Article 1, paragraph 1. Indeed, the "common interest principle", as explained previously in the second Chapter, stated that outer space must be used by all States.[357] Therefore, numerous limitations on how to conduct activities such as exploitation are implicitly introduced, in order to guarantee its future utilization. For this reason I believe that the inter-generational equity principle would operationalize the "common interest principle": on the basis of this clear distinction between rights of present and future generations, it would impose practical and stringent limits on States, distributing the availability of resources between the present and the future. Thus, the "province of all mankind" nature of outer space would be preserved.

Ultimately, the application of the international principle to outer space would be legally feasible since in recent years it has been widely recognized in case-law by courts, in both the international and national context. Regarding the international cases, the ICJ applied the principle of inter-generational equity for assessing the legality of nuclear weapons in its *Advisory Opinion on the Legality of Nuclear Weapons.*[358] In the *Gabcikovo-Nagymaros Project* case, the ICJ

[355] Ibid.
[356] Ibid, page 345.
[357] Article I of the *Outer Space Treaty* (1967).
[358] *Legality of Nuclear Weapons*, *supra* footnote 229, paragraph 36; Dupuy and Vinuales, *supra* footnote 3, page 89.

referred to the need to find a satisfactory balance between the protection of the environment for present and future generations and its uses.[359] However, the most important step was made at the national level, namely by the Supreme Court of the Philippines in the *Minors Oposa* case. A group of Philippine children brought a collective action to stop the destruction and deforestation of a forest in their country but, surprisingly, the plaintiff based their claim on the principle of inter-generational equity.[360] The Supreme Court of Philippine ruled in favor of the children and recognized the right to provide access to natural resources to future generations.[361] It follows that, if States and their private economic entities in exploiting the celestial bodies do not take into consideration the rights of future generations, the international or national courts, in following the previous jurisprudence, can indicate to these space actors the duty to act finding the correct balance between the needs of the present and those of future generations.

3.8 Sustainable development

Sustainable development is one of the most important and prominent rules of international environmental law. Also, no concept comprised within this field of law has been used and applied more than the concept of sustainable development,[362] leading me to reflect on its possible application to outer space and to the exploitation of its resources. Its extension to outer space would also be in line with one of the urgent needs that humankind has had to face recently, as on earth, so in the sky: reconciling economic growth and progress with environmental protection.[363] Indeed, since the adoption of the concept of sustainable development on earth has been fundamental to ensure the protection

[359] *Gabckovo-Nagymaros Project*, *supra* footnote 256, paragraph 140.
[360] *Juan Antonio Oposa and others v. Fulgencio S. Factoran, Jr, and others,* Supreme Court of the Philippines, Decision, (30 June 1993), paragraph 22.
[361] Minors Oposa v. Secretary of the Department of Environmental and Natural Resources, Child Rights International Network, See at Child Rights International Network Website https://archive.crin.org/en/library/legal-database/minors-oposa-v-secretary-department-environmental-and-natural-resources.html (last visited 10 July 2019)
[362] Dupuy and Vinuales, *supra* footnote 3, page 91.
[363] Ibid, page 90.

of the terrestrial environment, so outer space could require the same legal interventions in order to further protect its unique environment and achieve a correct balance between the various and different interests at stake. Furthermore, sustainable development is a mere concept of international environmental law and, consequently, it has also the function of acting as a guide within the general structure of the international environmental regime. Its purpose is to help States and stakeholders to put into effect the substantial and procedural environmental obligations.[364] And as a general matter, all the principles analyzed so far are further specified by the concept of sustainable development, thus guaranteeing that the ultimate goal of environmental protection is certainly strengthened. It follows that, its particular role of concept could be fundamental and very useful to guide States and "new space" entities to implement the rules and principles of international environmental law. Precisely because all my previous investigation have underlined that there is no effective and defined environmental regulation of outer space, and consequently there is only a translation and an extension of the general rules and principles of international environmental law to space, that the space actors would need a concept such as sustainable development to make this environmental protection succesful. It is therefore now necessary to analyze the historical and legal evolution of the concept in order to grasp its content and to finally evaluate its effects after the legal extension to outer space and to the exploitation regime has been completed.

The concept gained momentum with the publication of an influential and authoritative report entitled "Our Common Future" of the so called "Brundtland Commission", a commission established by the UN General Assembly.[365] According to this report, the future of international environmental law will be characterized by the legal necessity to meet "the needs of the present without

[364] Ibid.

[365] Report of the World Commission on Environment and Development, 22 December 1989, UN Doc. A/RES/44/228. However, the concept of sustainable development was for the first time introduced in another report: IUCN, UNEP, WWF, World Conservation Strategy. Living Resource Conservation for Sustainable Development (1980).

compromising the ability of future generations to meet their own needs".[366] From this effective and renowned definition the reference to the principle of inter-generational equity is evident. However, as pointed out in the previous paragraph, the concept of sustainable development has a distinct nature and content. In particular with regard to the regulation, protection and conservation of natural resources, thus demonstrating that its application to the regime of exploitation of space resources could be essential. Nevertheless, this formulation, which denotes its interaction with the principle of inter-generational equity, underlines a definitive and fundamental component and feature of the concept of sustainable development: namely, its connection with the implementation dimension of the international environmental principles. Indeed, sustainable development was primary conceived as a concept that could guide States to implement rules and principles of international environmental law, both those already established and the future ones. In this regard, Dupuy and Vinulas even stated that the concept would give legal expression to the "sustainable dimension of development, above all prevention",[367] later specifying that so constructed, sustainable development means the application of other principles, in particular those that have customary nature and status.[368] It naturally follows that sustainable development, even if it is an autonomous concept, it has also the role of expressing and supporting the cause of other principles and norms of international environmental law.

However, this does not exclude that the two functions of the concept of sustainable development can never coincide or that in the dispute settlement mechanism its double dimension does prevent the courts and tribunals from taking into consideration both simultaneously. For instance, an arbitral tribunal in the *Iron Rhine Arbitration* of 2005 recalled the strong connection between, on the one hand, the autonomous concept of sustainable development and, on the other hand, the prevention principle and more generally all the environmental principles in force between the Parties to the dispute. The arbitral tribunal noted that:

[366] Ibid, paragraph 49.
[367] Dupuy and Vinuales, *supra* footnote 3, page 93.
[368] Ibid. The authors clearly mentioned the principle of prevention, the principle of cooperation and the duty to conduct an environmental impact assessment.

"Where development may cause significant harm to the environment there is a duty to prevent or at least mitigate, such harm. This duty, in the opinion of the Tribunal, has now become a principle of general international law. This principle applies not only in autonomous activities but also in activities undertaken in implementation of specific treaties between the Parties."[369]

From this statement of the tribunal the importance of the two functions performed by the concept of sustainable development is evident. Although independent from the no-harm principle, it is able to clarify the importance of preventing environmental damage by specifying its content. Furthermore, it simply manages to explain to States how the process of technological growth, or development understood in a broad sense, must not negatively affect the environment. Thus it also indicates how to proceed with the implementation of the principles developed by international environmental law, in this particular case the no-harm principle. Therefore, although sustainability has an indistinct nature and content, it cannot be separated from other principles by performing a second function intrinsically connected with them. In conclusion, the judgment from the *Iron Rhine Arbitration* case is able to determine the two roles of sustainable development: that of improving the protection of the environment by showing States how to achieve a correct balance between the different interests involved. However from this passage of the judgment, sustainable development almost seems to be absorbed by the principle of prevention and finally deprived of its own autonomy. The risks that this may happen and that we forget that sustainability exists as such is high. Confusion concerning its lack of independence without realizing that it is not under the rule or control of another international environmental principle depends on the fact that at the heart of sustainable development lies the comprehensive integration between the

[369] *Iron Rhine Arbitration (Ijzeren Rijn) (Belgium/Netherlands),* Award (24 May 2005), RIAA XXVII, paragraph 59.

protection of the environment, economic development and social development.[370] Therefore, sustainable development encompasses all the principles of international law that express at least one of this idea or regulate one of these aspects, making it very difficult in practice to distinguish among the functions performed by all the environmental rules and principles. The ability to explain the two functions fulfilled by sustainable development more clearly and concisely takes place in another international legal instrument: *The New Delhi Declaration on the Principles of International Law Related to Sustainable Development*. The preamble defines sustainable development as:

> *"We may well arrive at describing sustainable development as a comprehensive economic, social and political process, which aims at the sustainable use of natural resources of our planet and the protection of the environment on which nature and human life as well as social and economic development depend and which seeks to realize the right of all human beings to an adequate living standard on the basis of their active, free and meaningful participation in development and in the fair distribution of benefits resulting therefrom, with due regard to the needs and interests of future generations".*[371]

Indeed, on the one hand, this formulation of sustainable development refers to numerous international environmental principles that have been previously discussed and analyzed: namely, the principle of prevention, the no-harm principle and the princinciple of inter-generational equity.[372] As pointed out by Dupuy and Vinuales, these are the main components of sustainable development that are usually attached to the concept by the legal commentators, contributing to

[370] Mey J.H., 'Space Debris Remediation', in: 61 *German Journal of Air and Space Law* 251 (2012), (page 255).
[371] Preamble of *ILA New Delhi Declaration of Principles of International Law Relating to Sustainable Development* (2002).
[372] Dupuy and Vinuales, *supra* footnote 3, page 92.

form its legal content.[373] However, on the other hand, the definition mainly stresses the importance on two separate elements regarding sustainability. These two elements constitute and express the second autonomus function of the environmental concept: the need to adopt an integrated approach to development and environment and the duty that every State has of exploiting the resources but in a sustainable way, thus introducing two different features to the concept.[374] Consequently, this definition allows to specify how sustainable development can be extended to outer space. Accordingly, States have therefore the right to exploit space resources but they must carry out the activity in a sustainable way. For the commercial activity to be conducted in a sustainable manner, States would be thus obliged to integrate environmental considerations into their development policies.[375] States, for instance, can adopt domestic legislations such those discussed in the first Chapter of this thesis but they must necessarily introduce developmental considerations: they could foster the "new space" entities but only in conjuction with environmental elements capable of counterbalancing them.

Following from the above, the cited definitions have clarified the two legal functions of sustainable development and have shown the legal reasons that support its transposition to the space exploitation regime. Regarding its first meaning, since both the substantive and procedural environmental principles are legally appropriate for regulating the commercial activity in space, so should sustainable development be extended to exploitation in order to ensure that the concept equally performs the function of specifying them in outer space. Indeed, it would guide States and the "new space" entities to further respect the environment and achieve environmental protection, guaranteeing that they comply with the specific and binding international principles. As for the second, sustainable development would show States how to adopt measures that take into account both the environmental and the developmental dimension. For instance, if an exploitation activity were carried out or if even more progressive technologies

[373] Ibid.
[374] Ibid.
[375] Ibid.

were created to appropriate and exploit space resources, sustainable development would limit their conduct requiring them to integrate a duty of sustainability. Indeed, States cannot ignore all the elements that are regulated by the concept of sustainable development. On the contrary, they would be forced to constantly consider all the components that are comprised by it. According to the legal instrument adopted at the third major international environmental conference of Johannesburg, *Political Declaration*, those elements are: economic development, social development and environmental protection which are defined as the "interdependent and mutually reinforcing pillars of sustainable development".[376] In conclusion, States would therefore be forced to adopt an integrated approach capable of incorporating these characteristics, constraining them not to disregard the environment. Principle 13 of the Stockholm Declaration on the Human Environment perfectly sums up the above and therefore deserves to be reported here in its entirety as it is capable of demonstrating the indispensability of the concept of sustainable development in space:

> *"In order to achieve a more rational management of resources and thus to improve the environment, States should adopt an integrated and coordinated approach to their development planning so as to ensure that development is compatible with the need to protect and improve environment for the benefit of their population."*[377]

From the 70s on, sustainable development is the environmental rule that provides the best expression of one of the dilemmas of our time: using the resources that international areas allow us to exploit but respecting the profound value of the environment. An increasingly valid concept now that development and progress permit it in an area that was previously totally inaccessible as outer space and celestial bodies.

[376] Report of the World Summit on Sustainable Development, 4 September 2002, A/CONF.199/20, Chapter 1, item 1 Political Declaration, paragraph 5.
[377] Principle 13 of the *Stockholm Declaration on the Human Environment* (1972).

An even more cogent concept since it is characterized by a particularly flexible nature that allows it to be adopted effectively to combat different and new phenomena, including future ones. In fact, whenever there is economic progress or development there is a duty to integrate these aspects with social and environmental ones. Although the exploitation of space resources is the best example of growth that must be balanced, it is not the only activity that has affected outer space. Outer space has always been the subject of numerous interventions by States which, not paying attention and not respecting the surrounding environment, have partially damaged it. Indeed, space stations and human constructions have produced a detrimental result: space debris.[378] Space debris can be defined as: "all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non functional".[379] What characterizes space debris is that they are objects left there in space and therefore are not able to perform any function: they are useless things which restrict the portion of space that can be freely explored by States.[380] Therefore, they also limit the ability of States and international community to "use" space and celestial bodies, violating Article I of the Outer Space Treaty.[381] Furthermore, since they do not serve and do not respond to any "benefit and interests" of any country they have never been removed from the States that created and released the floating objects, thus also breaching Article II of the 1967 Treaty.[382] This phenomenon will increase considering that feasible mining activities will contribute to widen the problem: permanent structures are planned to be built on celestial bodies and numerous space launches and spaceflights will be completed, producing huge masses of debris as before.

Concerns can be, in the absence of clear and global international instruments, defeated using the principles of international environmental law

[378] Brital O. F., 'Space station and space debris', in: 42 *Colloquium on the Law of Outer Space* 71 (1999), (page 71).
[379] Mey, *supra* footnote 370, page 251.
[380] Brital *supra* footnote 378, page 73.
[381] Ibid.
[382] Ibid.

explained so far. Similarly, sustainable development will still be the norm/concept that will guide how to mitigate pollution. Firstly, cooperation as envisaged under Article IX of the Outer Space Treaty and as previously analyzed in its environmental dimensions proves to be an extremely effective norm. In fact, the purpose of cooperation lies in avoiding "harmful interference with the activities of other States in the peaceful exploration and use of outer space". Accordingly, cooperation, technical assistance and information exist in space in order to preserve interests and rights of other States in using outer space and to correctly manage the "province of all mankind" in a spirit of global partnership. States will therefore be subject to the obligation to enter consultations before proceeding with any activity capable of producing space debris if requested by a State that considers itself restricted in its ability to use outer space if debris were created. Implicitly the acting State is thus forced to adopt mitigation measures or remove the subsequent debris released if it does not want to renounce conducting the exploitation activity in its entirety. Cooperation in this form does not require the adoption of a new international treaty nor to amend an existing one.[383] The elements of cooperation as correctly understood by States in the 1967 Outer Space Treaty combined with customary international changes under international environmental law are fully applicable and binding. Therefore, these rules and environmental components will curb the space debris that are likely to derive from the exploitation. Furthermore, space debris damages the unique space environment, so the customary international duty to prevent any environmental damage will also be applied. Preventive measures such as launch licensing must be adopted by States if they do not want to bear international responsibility for not having used the adequate due diligence when performing the exploitation plans.[384] Due diligence will vary depending on the type of exploitation operation but it will necessarily be high. It would require particular attention and precaution to the "new space" entities and space mining companies on how to extract resources in

[383] Lafferranderie G., 'Space Debris', in: 45 *Proceedings on the Law of Outer Space Treaty* 44 (2002), (page 46).
[384] Ibid.

order to prevent the production of space debris. In relation to whether the exercise of due regard to the environment and the adoption of appropriate preventive measures correspond to the same level of contribution of all States, the principle of CBDR could be used.[385] Respective level of development, technology and growth will spell out the differential treatment between States: the developed ones will have the highest and primary responsibility to manage the space debris phenomenon by also providing assistance to undeveloped countries in exchange of their contributions. Particularly, the obligations to remove and to mitigate space debris will vary according to the historic use of outer space, the amount of space debris that has been produced by that State and if it has a necessary technical and financial capabilities to act.[386] However, since every space activity entails legal obligations to guarantee long-term sustainability,[387] space debris can be validly regulated by the concept of sustainable development. States, private entities, governmental bodies, are all under the greatest prohibition of non overusing outer space and of achieving a rational balance between economic growth and the respect for the environment. This would require international community to restore the previous situation by removing space debris created over time. Furthermore, always respecting the mutual interdependent pillars of sustainable development, no furher space debris may be added and States must be committed to obey to this rule.

In conclusion, since sustainable development is a concept that specifies all the other international environmental rules and establishes the reasons States must respect them, all the principles analyzed in this third Chapter of this thesis are applicable to combat new space debris creation and achieve succesfull results. In particular, the primary instruments may be the principle of prevention and cooperation as balanced by the CBDR as reported above. Indeed, the absence of an international framework still forces to fill the regulatory gaps with the customary international norms, among which the pivotal rule is that which

[385] Mey, *supra* footnote 370, page 262.
[386] Ibid, page 263.
[387] Ibid, page 261.

indicates how and why to do it: sustainable development. In the words of Judge Weeramantry, the concept of sustainable development: "reaffirms in the arena of international law that there must be both development and environmental protection, and that neither of these rights can be neglected."[388] In this perspective, economic progress and its developments cannot be ignored, but the environment requires equal respect. This fair balance between the two is achieved by sustainable development.

Conclusion

The above analyses have shown that these environmental norms can be applied to outer space, thus being able to regulate the exploitation. Indeed, it has been demonstrated that some principles and rules have achieved the status of international custom and therefore their extension to outer space is possible and must be observed. Furthermore, a general duty to protect the environment exists under international law and is binding. It follows that all the other general international rules, the specifications regarding the content of international obligations and the legal clarifications of international courts are equally applicable when States and economic entities perform mining operations in space. Indeed, compliance with these norms is instrumental to the achievement of the ultimate aim of environmental protection. Therefore, terrestrial principles of international environmental law prove to be more than adequate to fill the gaps of the 1967 Outer Space Treaty.

[388] *Gabczkovo-Nagyrnaros Project* ICJ. Reports 1997, *Judge Weeramantry's separate opinion* and Ibid.

CONCLUSION

The primary purpose of this research was to analyze the main elements and questions intrinsically linked to one of the many future operations that will be carried out in space in the near future: the exploitation of its resources. Whether it takes the form of pure exploitation or that it falls within broader space operations of "new space" entities that pursue the commercial activity in combination with other different objectives, it made no difference as regards the aim of the thesis. Indeed, the primary aim of this work was to investigate on the alleged lack of an international regulation. Particularly, if the vagueness of existing rules could prevent international space law from regulating the exploitation activity as a whole, as widely affirmed by space law scholars and spacefaring States. For this reason, particular attention has been paid to the national laws adopted or which will be adopted. As shown, they are intended to independently interpret Articles I and II of the Outer Space Treaty, raising potential conflict that may emerge between international and national law. Similarly, I was also interested in verifying whether these national laws were able of nullifying or circumventing the core objectives of the 1967 Treaty. Therefore, and as stated in the introduction, in this thesis the phenomenon of national legislation has been functional and instrumental to the true focus of the research: the adequacy of the international rules and the possibilities of using the current international framework to regulate appropriation and exploitation of space resources.

On the basis of the above, I then elaborated a research question that would have lead me to consider all the activities that want to pursue exploitation and to analyze the correct interpretation of Articles I and II of the Outer Space Treaty. This was necessary to establish whether international rules were effective in regulating exploitation as a general phenomenon. Finally, based on their accurate interpretation, I indicated which operations were actually possible to carry out today. The answers to the first research question raised various and valuable information, some of which are based more generally on the textual data and a literal interpretation of the 1967 Treaty, others on a more practical inquiry relating

to the individual exploitation activities. I accordingly concluded that, firstly: Article II of the Outer Space Treaty originally prohibited any national appropriation of outer space and of celestial bodies, where the term "national" prevented any economic activity on the extratteritorial resources. However, secondly, shifts under customary law have contributed to carve out an exception to the non-appropriation principle as previously conceived by the international community. Indeed, changes in the subsequent practice of States, which began after the Treaty was adopted in 1967, now allow for the appropriation of the resources extracted from celestial bodies. In conclusion, the non-appropriation principle and the entire Article II of the Outer Space Treaty permit to carry out exploitation on the resources that were previously appropriated after they have been extracted. As a result, the difference between, on the one hand, a resource *in situ* or in place and, on the other hand, an extracted extraterritorial resource, is fundamental. The former, which is still located on the celestial body, is considered to be part of it and its appropriation would therefore still be considered as national appropriation. The resource that has been extracted, instead, is a space resource that is no longer part of outer space or of the single celestial body and, consequently, its appropriation is now permitted pursuant to Article II of the Outer Space Treaty. In addition, both Article I of the 1967 Outer Space Treaty and Article 11(3) of the 1979 Moon Agreement allow for the same conclusion to be reached. The previous interpretation is in fact confirmed and supported by the term "use" of Article I of the 1967 Treaty and by the particular management and conservation regime established by Article 11 of the subsequent Moon Agreement. Indeed, this system is designed only for the extracted resources of the Moon and in clearly mentioning the resources in place Article 11 recalls the distinction above, namely the one between *in situ*/place and extracted resources. This particular attention in selecting the words of the 1979 Treaty indicate that the shifts concerning the non-appropriation principle already occurred a few years after its adoption.

Although these interpretative results are important, they are based on completely abstract facts and data. Furthermore, such clear distinctions between resources extracted or in place or between what constitues a "national" or non-national appropriation are not easy to resolve or so clear-cut. As more information on individual and future activities is now available, a more complex investigation was conducted to highlight which interpretative problems can be raised and to identify which specific behaviors are prohibited. I therefore concluded, at the end of Chapter II, with personal and individual assessments concerning the plans and operations that these private entities are planning to implement. My main finding is that particular attention should be paid to Article I of the Outer Space Treaty. It requires that constant respect for the rights and interests that the other States and international community as a whole have over celestial bodies is given. As also underlined within COPUOS, this provision is the true parameter to verify the legitimacy of the single exploitation activity under international space law. Thus, accordingly, space mining entities are often in conflict with this Article because their mere economic purpose prevents them from operating within the legal framework of equality that is established by the 1967 Treaty. Indeed, their operations would lead to a degradation of outer space, violating Article I, paragraph 1 of the international legal instrument. Furthermore, their actions could amount to a territorial monopolization of celestial bodies, thus breaching the non-appropriation principle. The primary reason for justifying this conclusion is that this presence over the celestial body can only be considered as "national" since it prevents other States from using it. All these elements complement each other and make it impossible to conclude that both the “province of all mankind” value of outer space and the “common interest principle” are respected.[389] On the other hand, the other "new space" individuals that do not fall into the category described above can easily conduct their activities relying on the fact that scientific and technological development and progress will be pursued. It is indeed legitimate to want to use outer space for wider and even bold objectives, which can also

[389] Article I of the *Outer Space Treaty* (1967).

potentially involve all States and which could favor and benefit future generations.

Subsequently, based on the fact that most of the time exploitation of space resources can therefore be accepted internationally, my concern and my interest was to assess whether the 1967 Treaty had legal rules that could effectively protect outer space and its environment. The negative answer led me to verify whether the principles of international environmental law could fill the gaps of the Outer Space Treaty and provide satisfactory environmental protection. Particularly because, as stated in the introduction of this thesis, recognizing outer space as an area beyond any national jurisdiction is not sufficient to ensure that this rule and other obligations arising from it are always respected. Indeed, the international norm is only a "concept" which requires that more specific environmetnal rules define it so that it can actually be realized in its entirety. In other words, States would not spontaneously respect this nature of outer space when it would be technically possible to conduct an exploitation activity that is economically profitable. Therefore, it is necessary to look for such other specific rules to prevent this from happening and these more precise rules are the "principles". And as regards the terrestrial principles of international environmental law that can provide outer space protection, my primary finding is that the duty to prevent an environmental damage is the environmental norm that can mainly guarantee the preservation of outer space from exploitation. However, the application of this principle to space, as well as of the others that I analyzed immediately afterwards (for instance, the precautionary principle and the duty to cooperate) may require further analysis. Because even if the "principles" are clearer than the "concepts", they do not ensure that the latters are always respected. As a result, clearer norms of international environmental law have also been analyzed and they are the real "rules" that implement the "principles". Thus, for instance, the principle of acting with the due diligence required to ensure that planned activities do not cause damage to the environment (prevention principle), is complemented by "rules" that require States to conduct an EIA and to notify

other involved stakeholders of this assessment.[390] What makes their use and subsequent extension possible is the fact that these precise rules have been explained by international courts and tribunals. Indeed, courts contributed to specify the content of the principles of international environmental law and have clarified the importance that the implementation of procedural principles play for the purpose of achieving successful results. Furthermore, another finding of mine is that when "principles" and "rules" have attained the status of international custom it is possible to force States to protect the environment. Their application to areas beyond national jurisdiction is clearly established (for instance, prevention principle or precautionary principle) that the regulation of issues and activities that may emerge in outer space according to general international law becomes spontaneous as rules concerning common areas are always similar or identical (for instance, the regime of the Area under international law of the sea). On the contrary, when these environmental norms have not been declared by international courts as derived from customary international law (for instance, the CBDR principle or the principle of inter-generational equity) their extension to outer space is legally and technically possible, as demonstrated by their analysis, but not strictly binding on States and space actors. Nevertheless, there is a duty to protect the environment *per se* which can support new customary international developments concerning the norms that have not attained this status under international law. Or in any case, since States have yet to achieve adequate environmental protection, the analyses conducted in the thesis indicate possible patterns of use of these environmental norms, as has been presented for the CBDR principle or for the polluter-pays principle. It will then be up to States to negotiate specific models to be adopted, but the need to comply with these environmental standards is not discussed. Therefore it would be desirable to draw inspiration from the other treaties and international models already in force. Furthermore, from the concept of sustainable development comes the application of a distinct set of rules, those of an environmental nature, which therefore all have full effect.

[390] *Pulp Mills, supra* footnote 246; *Construction of a road in Costa Rica along the river San Juan, supra* footnote 271.

Set of coherent rules which will also apply to another phenomenon addressed: space debris. Indeed, they are among the harmful effects that will be produced by exploitation and therefore will be subject to the same environmental principles and rules discussed, under the largest extension of sustainable development.

The identification of external but potentially applicable principles and the correct interpretation of the rules already present in the 1967 Treaty (particularly, Articles I and II) have the merit of being able to provide the legal framework applicable today. It is not true, as the United States and Luxembourg argue, that an international regulatory framework is lacking. Rather, the latter can and must be derived from the legal instruments at our disposal. My research aims to establish one of the possible outcomes, which even if incomplete due to the failure to foresee the activities in question when the international space treaties were adopted, has legal value. In conclusion, the identification of the environmental principles and rules that can correctly regulate exploitation of outer space resources, as well as identifying the correct interpretation of the core principles of the 1967 Treaty, constitues a successful result as they are the norms that are now in force. If the international community takes years to negotiate rules and agree on satisfactory environmental standards capable of governing the appropriation and exploitation of space resources, it can be said that there are existing international norms and that they will apply *medio tempore*.

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