Current Trends and Challenges in International Space Law

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ABSTRACT:

Space Law is a relatively new field of Public International Law, comprising mainly a combination of customs and treaties, while the general principles of Public International Law transcend it. Space Law expands accordingly with the subject to be regulated and its main task, since its inception has been to ensure free, unimpeded and non-discriminatory access of humankind into space. Though the founding treaties of Space Law define the activities in this area, there are current issues that have arisen and it is a necessity to review whether and how these issues are incorporated in this legal framework. The present article aims to provide a holistic understanding of the current trends and challenges in Space Law with a special focus on issues, such as space tourism, "new space", space debris and climate change. This aim will be achieved through an overview of the founding treaties of Space Law, and the subsequent review of the current issues and the way the existing literature discusses and interprets them. The goal is to both present the emerging issues of Space Law and the existing law, and to provide pragmatic solutions and highlight the prospects for the legislative developments within the realm of Space Law.

Keywords: Outer Space Legal Regime, Privatization and Commercialization of outer space, New Space, Environmental Aspects, Climate Change, Space Debris

I. Introduction

International Space Law (hereinafter: "Space Law") is a part of Public International Law (P.I.L.) and much like other branches of P.I.L., it is a combination of

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customs and treaties[3] that govern relations between members of an increasingly organized international community. In addition, the general principles of Public International Law transcend it, as well. Regarding the secondary sources of law, according to Article 38(1) of the Statute of the International Court of Justice,[4] no international court decision has been rendered generating a new rule of Space Law. There is, however, literature that has elaborated many aspects of the relevant legal rules, upon which the development of Space Law could be founded. Even though, the 1903 was the year that the likelihood of establishing rules in outer space emerged,[5] the main body of Space Law was promulgated later on, following the appearance of new technologies, as well as the expansion of their space-related technologies in terrestrial applications.

The core substance of International Space Law is based on the five (5) United Nations (UN) treaties. The primary treaty governing the Law of Space is the Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies or more commonly known as the "Outer Space Treaty" of 1967.[6] The following treaties are equally important: the 1968 "Rescue Agreement",[7] the 1972 "Liability Convention",[8] the 1975 "Registration

[3] Listner , M. J., 2003. The Ownership and Exploitation of Outer Space: A Look at Foundational Law and Future Legal Challenges to Current Claims. *1 Regent J. Int'l Law,* 75(76).

[4] Article 38(1) defines the sources of Public International Law by listing the sources that the ICJ uses to resolve disputes as follows:

"1. The Court, whose function is to decide in accordance with international law such disputes as are submitted to it, shall apply:

a) international conventions, whether general or particular, establishing rules expressly recognized by the contesting states;

b) international custom, as evidence of a general practice accepted as law;

c) the general principles of law recognized by civilized nations;

d) subject to the provisions of Article 59, judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law."

[5] Tronchetti, F., 2013. *Fundamentals of Space Law and Policy.* 1st ed. New York and London: Springer Briefs in Space Development, pp. 3-5.

[6] UN, 1967. *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies,* London, Moscow and Washington, D.C.: General Assembly Resolution 2222 (XXI), annex.

[7] UN, 1968. *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space,* London, Moscow and Washington, D.C.: General Assembly Resolution 2345 (XXII).

[8] UN, 1972. *Convention on International Liability for Damage Caused by Space Objects,* London, Moscow and Washington D.C.: General Assembly Resolution 2777 (XXVI).

Convention"[9] and the 1979 "Moon Agreement."[10] These treaties form the core of the International Space Law that was formulated during the 1950s until the 1980s and will be shortly presented in the next part of the present Article.

Since then, a plethora of resolutions and guidelines has followed on a non-binding basis, but not a cohesive Convention like, for instance, the UN Convention on the Law of the Sea[11] that deals with all issues as a package deal providing a holistic approach on oceans, has been adopted for space thus far. Thus, the absence of an updated binding treaty along with the maturity and the progressive development of technology increases the need of Space Law to be further developed, as well as the need to interpret it in the light of the arisen issues.

II. Overview of the Five UN Space Treaties

Sputnik 1 acted as an initiator in the establishment of the outer space legal regime in 1957, since it was the first Earth's artificial satellite that was ever launched. This development occurred during the International Geophysical Year («IGY»),[12] which strengthened the international community's involvement with the outer space. The international community, in order to cope with the increased danger of military activities in outer space, adopted the Resolution 1721 of 20 December 1961[13] to promote and safeguard the peaceful use of the outer space, while the United Nations became the main forum for discussions on these issues,[14] since its structure alleviates the competition and distrust among the countries and cultivates consensus that has the potential to lead to a subsequent agreement. The constitution of the UN has been beneficial to the establishment of the Ad Hoc Committee in 1958,[15] since it allows a broad spectrum of activities. The Ad Hoc Committee acted as an essential step for the development of the international space law and its contribution was acknowledged

[9] UN, 1972. *Convention on Registration of Objects Launced into Outer Space,* London, Moscow and Washington, D.C.: General Assembly Resolution 3235 (XXIX).

[10] UN, 1979. *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies,* New York: General Assembly Resolution 34/68.

[11] UN, 1982. *United Nations Convention on the Law of the Sea,* Montego Bay: UN.

[12] For more information on the International Geophysical Year, visit the official website of the Nas at: http://www.nas.edu/history/igy/ (last visited on January 11, 2018.)

[13]UN, 1961. *International co-operation in the peaceful uses of outer space,* New York: UN Doc. Resolution 1721 (XVI).

[14] Kopal, V., 2011. Origins of Space Law and the Role of the United Nations. In: C. Brunner & A. Soucek, eds. *Outer Space in Society, Politics and Law.* Wien and New York: Springer: Studies in Space Policy Volume 8, pp. 224-225.

[15] UN, 1958. *Question of the Peaceful Use of Outer Space,* New York: UN Doc. 1348 (XIII).

only a year after its function with the establishment of the UN Committee for the Peaceful Uses of Outer Space (UNCOPUS)[16] as a permanent body within the UN.[17]

i) Customary Law and the Outer Space Treaty

The Soviet Union's and the USA's space-related activities initiated the creation and development of Space Law, including Customary Law and the Resolutions that were adopted by the General Assembly, such as the 110 (II)/1947 Res,[18] the 1884/1963[19] and the 1962/1963 Res.[20] These Resolutions constitute the pre-contractual stage of Space Law and reflect customary rules, as well as they define the principles, in embryotic state, governing the exploration and exploitation of outer space. These fundamental customary principles that most were devised by the Legal Sub-Committee of the UNCOPUS are reflected and incorporated in the "Outer Space Treaty" (OST). These principles include:

- the principle of the freedom of exploration and use of outer space and the principle of the benefit and interests of all mankind (art. I);
- the principle of non-appropriation (art. II);
- the principle of using the moon and other celestial bodies exclusively for peaceful purposes (art. IV);
- the principle of international co-operation and assistance (art. V);
- the principle of responsibility for national activities in outer space (art. VI);
- the principle of liability for damage caused by state's space objects (art. VII) and
- the principle of registration space objects (art. VIII.)

Not less important than these principles is the Article IV which other than the peaceful use of outer space explicitly "forbids the Parties to place any objects carrying nuclear weapon or any other kinds of mass destruction in orbit around the Earth, install such

[16]For more information on UNCOPUS, visit the official website of the UN at: http://www.unoosa.org/oosa/en/ourwork/copuos/index.html (last visited on March 27, 2017.)

[17] Jessup, P. & Taubenfeld, H., 1959. The United Nations Ad Hoc Committee on the Peaceful uses of Outer Space. *The American Journal of International Law,* 53(4), pp. 877-881.

[18]UN, 1947. *Resolution adopted by the General Assembly 110 (II). Measures to be taken against propaganda and the inciters of a new war,* New York: UN Documents A/RES/2/110.

[19] UN, 1963. *Resolution adopted by the General Assembly 1884 (XVIII). Question of general and complete disarmament,* New York: UN Document A/RES/18/1884.

[20] UN, 1962. *Resolution adopted by the General Assembly 1962 (XVIII). Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space,* New York: UN Documents, A/RES/18/1962.

weapons on celestial bodies or station such weapons in any other manner".[21] Special attention should be drawn to Article IX, which, even though it incorporated the forward and backward environmental protection,[22] it also reflected the limits of the Treaty, when the consultations about a potentially harmful activity weren't made obligatory.

Overall, the OST is one of the unique outstanding law-making treaties of Public International Law, where all major space countries are Signatory Parties to it. It also resemblances the legal regime governing Antarctica. It significantly contributed to the development of Article 13 of the UN Charter[23] and served as a springboard in the subsequent treaties, which elaborated upon and amplified its contents. Since then, Space Law has been evolving accordingly to the space-related activities, in order to ensure that they are carried out in a peaceful manner.

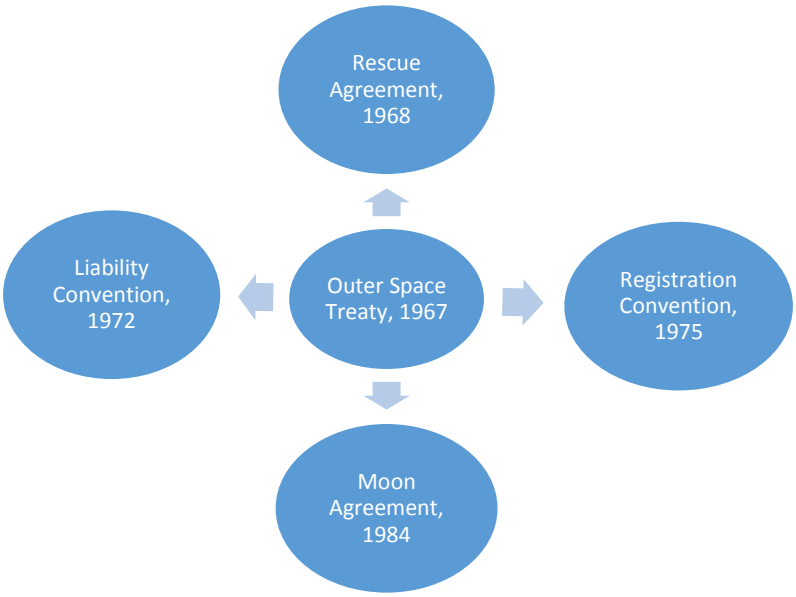
In order to provide a holistic understanding of the outer space legal regime, a brief overview of the four subsequent treaties will follow, that is essential for acknowledging the issues covered by the existing framework and answering the question whether there is a need or not to reform it.

[21] Soucek, A., 2011. International Law: The Outer Space Treaty. In: A. Soucek & C. Brünner, eds. *Outer Space in Society, Politics and Law.* Wien and New York: Springer: Studies in Space Policy Volume 8, pp. 299-332.

[22] The environmental protection, as understood in Space Law, receives a dual form: the forward and the backward one. The forward environmental protection refers to the protection of outer space from any object coming from the Earth that may contaminate the outer space, while the backward environmental protection concentrates on Earth's protection from contamination by a space object. For more information see (Conley & Rettberg, 2011)Conley, C. & Rettberg, P., 2011. COSPAR Planetary Protection Policy - Present Status. In: M. Hofman, P. Rettberg & M. Williamson, eds. *Protecting the Environment of Celestial Bodies.* Paris: International Academy of Astronautics Cosmic Study (PECB), pp. 16-24.

[23] "Article 13: 1. The General Assembly shall initiate studies and make recommendations for the purpose of: promoting international co-operation in the political field and encouraging the progressive development of international law and its codification; promoting international co-operation in the economic, social, cultural, educational, and health fields, and assisting in the realization of human rights and fundamental freedoms for all without distinction as to race, sex, language, or religion.
2. The further responsibilities, functions and powers of the General Assembly with respect to matters mentioned in paragraph 1 (b) above are set forth in Chapters IX and X."

Shape No.1. The Outer Space Legal Landscape



ii) Rescue Agreement, 1968

The 1968 Rescue Agreement specifies the Article V of the OST and deals almost exclusively with "the return of astronauts and space objects",[24] the "assistance to astronauts"[25] and the "obligation to inform other states and the UN Secretary-General of any phenomena liable to constitute a danger to the life or health of astronauts".[26] In space, astronauts have the obligation to help other astronauts, but for the countries it is not compulsory to render them assistance. Thus, the provisions of the Agreement explicitly integrate the issue of "assistance to astronauts in the territories under"[27] and "beyond the jurisdiction of space parties",[28] but they do not address the issue of assistance in space[29] nor the expenditure concerning the rescue and return of astronauts. Overall the Agreement enshrines the immunity of astronauts and establishes rescue procedures in the event of an accident.

iii) Liability Convention, 1972

The Liability Convention is essentially an elaboration of Article VII of the OST and addresses the key issues that were previously left unanswered. The Convention provides definitions of key terms, in order to determine the extent of the issue. It establishes two versions of liability: on the one hand, the strict or absolute liability

[24]Article 4 and 5 of the Rescue Agreement.
[25] Article 2 and 3 of the Rescue Agreement.
[26] Article 1, 2 and 5 of the Rescue Agreement.
[27] Article 1 of the Rescue Agreement.
[28]Article 5 (3) of the Rescue Agreement.
[29] Ibid.

applies in case of "damage on the surface of the Earth or to aircraft in flight" by a space object,[30] while on the other hand, the fault-based liability applies in the event of "damage being caused elsewhere than on the surface of the Earth".[31] Under the strict liability provisions, "States are always liable for damage caused by their space objects", without the need to prove that damage is the consequence of the fault of the launching state. In contrast, under the fault-based liability regime it is necessary to search for the fault, that is, whether it has been caused by "an act or omission done with intent to cause damage on the part of a claimant State, or negligent or from an accidental and unforeseeable event".[32] Finally, liability lies even in the case of legitimate activities, while the term "space object" includes "the components of a space object, as well as the launch vehicle and its parts".[33]

iv) Registration Convention, 1975

Similarly, the Registration Convention has close ties with the 1967 OST and specifically in Article VIII with regard to the "obligation of the launching state to register the space object, when it is launched into Earth orbit or beyond and inform the Secretary-General of the UN of such a registration".[34] Thus, the Convention establishes two different ways that a space object must be registered with specific information[35] either in a "national registry"[36] or in a central "Register to be maintained by the UN Secretary-General".[37] The registration serves a two-fold purpose to contribute to the minimization of weapons being placed into orbit and the peaceful handle of outer space given the difficulty to identify a spacecraft otherwise. It is worth noting that according to Lyall and Larsen "*registration establishes a link between a space object (and any personnel aboard) and a particular state for the purposes of jurisdiction, control and the return of astronauts set out in Arts V and VIII of the OST."*[38] However, the implementation of the Convention is highly influenced by the reluctance of the states to disclose their real mission, especially in the case of military purposes, and this leads to widespread mistrust and insecurity. This ambiance is enhanced by the term "as soon as practicable" that refers to the responsibility of states to send

[30]Article II of the Liability Convention.
[31]Article III of the Liability Convention.
[32] Article VI of the Liability Convention.
[33]Article I (d) of the Liability Convention.
[34]Article II of the Registration Convention.
[35]Article IV of the Registration Convention.
[36] Article II (1) of the Registration Convention.
[37]Article III of the Registration Convention.
[38] Lyall, F. & Larsen, P. B., 2016. *Space Law: A Treatise.* 1st edition ed. New York: Routledge, pp. 89.

particular information as to a space object which they have registered, which leaves a small "window" to send the information after the launch.[39]

v) Moon Agreement, 1979

The Moon Agreement is the latest international space treaty that was adopted under the perception that the use of the Moon was imminent after the US Moon landing in 1969.[40] Unlike the other treaties, this Agreement came into force on 11 July 1984, but is not ratified by the decisive countries,[41] since they do not want to renounce their rights or to compel themselves to share technologies for exploitation activities, as the Moon Agreements provides. The Agreement is a result of a compromise between the developing countries and the space faring countries by accepting the principle of "common heritage of mankind"[42] along with the confirmation of "the freedom of scientific investigation, exploration and use of the Moon as a right of all states".[43] The larger part of the Agreement is not controversial, since it reiterates the general rules and principles of the OST, such as the use of celestial bodies for exclusively peaceful purposes, the obligation to assist astronauts and international liability. The controversial part of the Convention is solely limited to "the establishment of an international regime to govern the exploitation of the natural resources"[44] reflected by the concept of the "common heritage of mankind."[45] This concept refers to the common management of areas outside national jurisdiction with "an equitable sharing in the benefits derived from those resources, despite the level

[39] Jasentuliyana, N., 1984. *Maintaining Outer Space for Peaceful Uses,* Hague: Proceedings of a Symposium held at The Hague, pp. 117-120 and pp.111-116.

[40] Bini, A., 2010. The Moon Agreement in the 21st century. *Acta Astronautica,* 67(3-4), pp. 496-501.

[41] Reynolds, G. H., 1995. The Moon Treaty: prospcets for the future. *Space Policy,* 11(2), pp. 115-120.

[42]Article 4, par.1 of the Moon Agreement. The meaning of the term "common heritage of mankind" has been further elaborated during the United Nations Convention on the Law of the Sea, where according to the 137 article: "(1). No State shall claim or exercise sovereignty or sovereign rights over any part of the Area or its resources, nor shall any State or natural or juridical person appropriate any part thereof. No such claim or exercise of sovereignty or sovereign rights nor such appropriation shall be recognized. (2). All rights in the resources of the Area are vested in mankind as a whole, on whose behalf the Authority shall act. These resources are not subject to alienation. The minerals recovered from the Area, however, may only be alienated in accordance with this Part and the rules, regulations and procedures of the Authority. (3). No State or natural or juridical person shall claim, acquire or exercise rights with respect to the minerals recovered from the Area except in accordance with this Part. Otherwise, no such claim, acquisition or exercise of such rights shall be recognized."

[43] Article 6 of the Moon Agreement.

[44]Article 11 (5) of the Moon Agreement.

[45] Article 4(1): The exploration and use of the Moon shall be the province of all mankind; Article 11(1): The Moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement, in particular in paragraph 5 of this article.; Article 11(5): States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the Moon as such exploitation is about to become feasible.

of participation in the exploitation activities." [46] It is worth noting that the Agreement outlines the basic principles and purposes of the international regime,[47] but without establishing it, which leaves upon the states to structure these rules after the "exploitation becomes feasible".[48] All in all, given the paltry level of ratifications, the Agreement only binds its members, despite the fact that its content is reasonable.

The Moon Agreement heralded the end of an era of space law-making globally accepted,[49] so during the 1980s and 1990s the United Nations returned to the adoption of Resolutions by the General Assembly. In this way, the most prominent Resolutions are the "1986 Remote Sensing Principles",[50] the "1992 Nuclear Power Sources Principles"[51] and the "1996 Space Benefits Declaration".[52] The Resolutions, combined with the less active engagement of the UNCOPUOS regarding the development of new space law rules, reflect the "soft law" [53] approach. This approach promotes the adoption of legal documents, such as Declarations, that are not legally binding, but they have succeeded in formulating a common ground and understanding on controversial or difficult to handle issues among the international community. In addition, it facilitates the development of Space Law in line with the technological developments that have contributed to the expansion of the uses and application of space related technologies along with the increased capabilities of new states-actors becomes a necessity. Thus, the "soft law" approach is crucial to the development of Space Law, as well as other branches of law, since it may later constitute the first steps towards the creation of legally binding treaties.

Following the presentation of the outer space legal regime throughout the "preparatory stage", the "law-making era" and the "soft law era,"[54] there is a clear need for an assessment of the existing legal regime in the light of the emerging issues and the consequent need, if any, for legal reform.

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[46] Moon Agreement Article 7(d): An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the Moon, shall be given special consideration.

[47] Article 11 (7) of the Moon Agreement.

[48] Article 11 (5) of the Moon Agreement.

[49] Dunk, v. d. F., 2015. International Space Law. In: F. Tronchetti & v. d. F. Dunk, eds. *Handbook of Space Law.* UK and USA: Edward Elgar Publishing: Research Handbooks in International Law, p. 103.

[50] UN, 1986. *Principles relating to remote sensing of the Earth from space,* Resolution adopted by the General Assembly: A/RES/41/65, 95th plenary meeting.

[51] UN, 1992. *Principles Relevant to the Use of Nuclear Power Sources in Outer Space,* Resolution adopted by the General Assembly: A/RES/47/68, 85th plenary meeting.

[52] UN, 1996. *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,* s.l.: Resolution adopted by the General Assembly: A/RES/51/122, 83rd plenary meeting.

[53] Boyle, A., 2014. Soft law in international law-making. In: M. Evans, ed. *International Law.* Oxford: Oxford University Press, pp. 118-123.

[54] Tronchetti, F., supra, pp. 5-7.

III. The Challenges Ahead

The OST, along with the Agreements and Conventions that shed light on particular aspects of the treaty, has been successful in establishing a legal regime that maintained peace and order in outer space. However, the adoption of the OST already counts several decades, which sets the emerging issues beyond the effective management of the current Space Law. The need for new Space Law rules, according to Tronchetti: "is driven by four main factors: (a) the technological developments, (b) the increased capabilities of specifically launching satellites into orbit, (c) the rise of new commercial space activities and (d) the emergence of new legal and technical issues that were not foreseen or considered relevant at the time of the drafting of the UN space treaties." [55]

A few of the current issues regarding Space Law, for instance, currently include: the increasing role of private sector in outer space, which calls for a review of current policies and legislation; the use of domestic laws, and the consequent need for their own legal reform, in order to encourage broader engagement with commercial space innovation; the adequacy of existing international liability regime to protect space tourists in the event of a space vehicle accidents; the increasing use of space for military activities; the challenges of scavenging space debris, with a focus on active remedial methods; the protection of space assets;[56] and the legal regime pertaining to Anti-satellite weapon (ASAT). Also, it invites *opinio juris* from law scholars for ensuring the applicability of the Outer Space Treaty on all states without ratification and universal abidance with Space Law without demur. These indicative issues highlight the multi-level dimension of space-based legal issues.

The remainder of this article will discuss two key issues of the current space law namely: (1) the privatization and commercialization of outer space along with space tourism; and (2) the regulation of orbital space debris and environmental aspects, such as climate change.

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[55] Tronchetti, F., supra, p. 19.

[56] Space asset: "any individual part of a space system as follows. (1) Equipment that is or can beplaced in space (e.g., a satellite or a launch vehicle). (2) Terrestrially based equipment that directly supports space activity (e.g., a satellite ground station). Definition at the Dictionary of Military and Associated Terms. US Department of Defense 2005, available at: https://www.thefreedictionary.com/space+asset (last visited on December 31, 2017.)

i) Commercial Human Spaceflight – New Space

While exploitation of space is still in embryonic level, there are some new developments that gradually take place. Thus, we face a new era of Space Law during which the outer space operations that were traditionally conducted by government agencies are open to the public and the private sector. The rise of private spaceflight industry is directly related to the emerging term of "NewSpace"[57] or alternatively "commercial" or "entrepreneurial space" or even "astropreneurship."[58] The Space Frontier Foundation defines "NewSpace" as "*people, businesses and organizations working to open the space frontier to human settlement through economic development."*[59] Likewise, the most appropriate definition of "private manned spaceflight", according to Frans von der Dunk is the "*flights of humans intended to enter outer space (a) at their own expense or that of another private person or private entity, (b) conducted by private entities, or (c) both."*[60] Similarly, a commercial space activity, according to Tronchetti, can be defined "*as one in which a private entity puts its own capital at risk and provides goods or services mostly to other private subjects or consumers rather than to the government."*[61] Despite the lack of a clear legally binding definition of NewSpace and "private manned spaceflight", according to a NASA presentation: "*We are at a turning point in the history of space exploration and development - new industries are being born that use space in many different ways.*[62]"

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[57] See a very expressive description of the contemporary understanding between the terms "old space" and "newspace": Achenbach, Joel, "Which way to space? Flights of fancy may launch the industry's future", 23 November 2013, The Washington Post, available at: www.*washingtonpost.com*: "To hear the dreamers tell it, this is the next Silicon Valley. The Mojave Air and Space Port is the spiritual heart of the industry that people call 'New Space.' [...] Old Space (and this is still the dreamers talking) is slow, bureaucratic, government-directed, completely top-down. Old Space is NASA, cautious and halting, supervising every project down to the last thousand-dollar widget. Old Space is Boeing, Lockheed, Northrop Grumman. Old Space coasts on the glory of the Apollo era and isn't entirely sure what to do next. [...] New Space is the opposite of all that. It's wild. It's commercial, bootstrapping, imaginative, right up to the point of being (and this is no longer the dreamers talking) delusional. [...] Many of the New Space enterprises are still in the PowerPoint stage, with business models built around spaceships that haven't yet gone to space. A bold attitude and good marketing aren't enough to put a vehicle into orbit. The skeptics among the Old Space people will say to the upstarts: Where's your rocket? How many times have you launched? Can you deliver reliably? Repeatedly? Safely? We put a man on the moon — what have you done? [...] Old Space and New Space turn out to be symbiotic. New Space companies need NASA contracts, and NASA needs New Space companies to pick up the agency's slack."

[58] See, MIT Conference to Focus on Space Travel for the Public, www.*boston.cbslocal.com. 11 March 2017, available at:* http://boston.cbslocal.com/2017/03/11/mit-space-travel-conference-public-astropreneurship/ *(last visited on April 2017.)*

[59] Definition at the Space Frontier Foundation available at: https://spacefrontier.org/what-is-newspace/ (last visited on January 12, 2017).

[60] Von der Dunk, F., 2015. Legal aspects of private manned spaceflight. In: F. von der Dunk & F. Tronchetti , eds. *Handbook of Space Law.* Cheltenham and Northampton: Edward Elgar Publishing: Research Handbooks in International Law, p. 667.

[61]Tronchetti, F., supra, p. 72.

[62] Gary, M., 2016. *NewSpace: The 'Emerging" Commercial Space Industry", NASA.* [Online] Available at: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20140011156.pdf [Accessed 29 08 2017].

More and more states are undertaking space activities themselves or are authorizing a private enterprise to do so, which increases the danger to take decisions that ignore or even contradict the international space agreements. This leads to a new approach to Space Law and highlights the need to reform the laws, in order to catch up to the new reality. Especially, if we take into account that soon all countries will be able to carry out exploitation missions, due to lower launch costs.

The rise of private sector's involvement is space began in the 1990s due to technological maturity, significant benefits and decreasing costs along with the governmental need to reduce space expenditures. The benefits from the commercial use of technologies related to outer space are significant and they range from the field of telecommunications and remote sensing to space tourism and space navigation. The commercial private human access to outer space is one of the most imminent and hard to handle topics, which it is defined as "any commercial activity offering customers direct or indirect experience with space travel."[63] Space tourism[64] started as a concept after the launch of Dennis Tito to the Russian part of the International Space Station (ISS) in 2001,[65] while the launch of Scaled Composites' SpaceShipOne in 2004[66] marked the begging of re-usable spaceships. Since then, the commercial use of space has evolved and has subsequently risen major legal questions. This new reality requires regulation by both private and public sectors of legislation, in order to address central issues, such as launch permits and restrictions which a state may impose for reasons of national security. Countries are begging to adopt national legislation for outer space activities[67] with the pioneers being the US[68] and Australia. Until today, most space activities are conducted by governmental space agencies like the US National Auronautics and Space Association (NASA),[69] the Russian State Space

[63] Hobe, S. & Cloppenburg, J., 2004. Towards a new aerospace convention? Selected legal issues of space tourism. *International Institute of Space Law,* 4(1).

[64] For more information on Space Tourism see Parker, M., 2009. Capitalists in Space. In: D. Bell & M. Parker, eds. *Space Travel and Culture: From Apollo to Space Tourism.* Oxford: Wiley-Blackwell, pp. 83-97.

[65] von der Dunk, F., 2007. Passing the Buck to Rogers: International Liability Issues in Private Spaceflight. *Nebraska Law Review,* 86(2), pp. 404-405.

[66] Sharp, T., 2014. SpaceShipOne: The First Private Spacecraft. *Space.com*, 2 October.

[67] Linden, D., 2016. The Impact of National Space Legislation on Private Space Undertakings: Regulatory Competition vs. Harmonization. *Journal of Science Policy & Governance,* 8(1), pp. 1-17.

[68] Gabrynowicz, J. I., 2010. One Half Century and Counting: The Evolution of U.S. National Space Law and Three Long-Term Emerging Issues. *Harvard Law and Policy Review,* 4(1), pp. 405-426. See further e.g. I. Marboe & F. Hafner, 2010. Brief Overview over National Authorization Mechanisms in Implementation of the UN International Space Treaties. In: F. von der Dunk, eds. *National Space Legislation in Europe,* pp. 40–42.

[69] Visit the official site of NASA, available at: https://www.nasa.gov/ (last visited on December 31, 2016.)

Corporation: Roscosmos,[70] the European Space Agency (ESA)[71] or the Japan Aerospace Exploration Agency (JAXA),[72] in collaboration with private companies.[73]

The outer space legal regime was drafted at a time that space activities where purely scientific and the only actors in the exploration and exploitation where the governments, hence all space treaties address only states. Nevertheless, entrepreneurs operating in space are subject to international, regional (e.g. European Union Space Law) and national legal regulations.[74] Thus, commercial operations are concerned with the principles of the OST along with the Liability Convention. According to the provisions of the OST: "Outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation or by any other means".[75] The most important regulation about private actors is Art. VI of the OST, which states that "*States Parties to the Treaty shall bear international responsibility for national activities in outer space, whether such activities are carried on by governmental agencies or by non-governmental entities*". It also clarifies that the "appropriate state bears the responsibility for authorization and supervision of all activities of non-governmental entities".[76] This Article establishes a dual system, where private activities are permissible, but at the same time the responsibility lies with the states as a result of finding consensus between the conflicting claims of the Soviet Union and the United States. Correlatively by Art. VII a "launching state is internationally liable for damages its object may cause to another state party" of the OST, as well as "it retains jurisdiction and control over a space object and its personnel" based on Art. VIII. From these Articles it is clear that the current legal regime outlines the main core for the commercial activities, but it is up to interpretation and national legislation of each State to clarify the details.[77] The most prevailing view is that states remain legally responsible in the case of activities by their national private commercial entrepreneurs. The access to space is controlled by states and therefore they should take the appropriate measures for licensing and supervision of the private users acting within their own territory either per case or on a more general basis.

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[70] Visit the official site of Roscosmos, available at: http://en.roscosmos.ru/ (last visited on December 31, 2016.)

[71] Visit the official site of ESA, available at: http://www.esa.int/ESA (last visited on December 31, 2016.)

[72] Visit the official site of JAXA, available at: http://global.jaxa.jp/ (last visited on December 31, 2016.)

[73] Walter, E., 2011. The privatisation and commercialisation of outer space. In: C. Brunner & A. Soucek, eds. *Outer Space in Society, Politics and Law.* Wien and New York: Springer: Studies in Space Policy Volume 8, p. 493.

[74] Sundahl, M., 2017. Legal status of spacecraft. In: R. Jakhu & P. Dempsey, eds. *Routledge Handbook of Space Law.* London and New York: Routledge, pp. 47-48.

[75] Article II of the Outer Space Treaty.

[76] Article VI of the Outer Space Treaty.

[77] Walter, E., supra, pp. 504-505.

The approach to the legal aspect of liability in the light of private entrepreneurs is a demanding one. As discussed above, the Liability Convention distinguishes between strict and fault-based liability, but it does not address the issue of who is the "owner" of and who is "responsible for" the space object causing the incident. According to the Convention, the "launching state is held liable for any damage caused by its space object", but in the light of private involvement, the issue is not so simple. There are many uncertainties regarding the terms that define the "launching state," such as who is undertaking the launch and what is the liability if it is a private launch operator. The "territory"[78] that is used for the launch is an exclusively reserved right for the states, [79] but what if the launch takes place outside the territory of any states, such as at the high seas? Nevertheless, since the treaties address only states, states are the only ones that carry the full burden of international liability according to the state the space object is registered. Such an assumption leaves the countries exposed to the risk of high compensations, unless national space legislation provides specific regulations, such as the obligation for a liability insurance in an effort to guard themselves against liability.

In a more specific context, the issue of space tourism also raises challenging questions about liability issues, since the space treaties refer only at issues including astronauts. According to Article V of the OST astronauts are "envoys of mankind", which allots them special rights.[80] The Rescue Agreement also focuses on the return of the personnel and the assistance to astronauts, who conduct "activities for the benefit and in the interest of all countries". In this context it is unclear if space tourists[81] fall under the right of rescue. Even though there is no explicit provision, it is considered that it covers whoever is in the outer space. The Article 31 of the Vienna Convention regarding the interpretation of treaties leads to this conclusion.[82] According to this article: "*a treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose,"*[83] which essentially prohibits the unreasonable results

[78] Article VII of the Outer Space Treaty.

[79]Generally, on territorial rights see: Stilz, A., 2009. Why do states have territorial rights?. *International Theory,* 1(2), pp. 185-213.; Miller, D., 2011. Territorial Rights: Concept and Justification. *Political Studies*, 60(2), pp. 252-268.

[80] Cenan AL-EKABI, Revisiting 'Envoys of Mankind' in the Era of Commercial Human Spaceflight, European Space Policy Institute, available at: https://www.files.ethz.ch/isn/153730/ESPI_Perspectives_62.pdf (last visited on January 2, 2017.)

[81]Generally, on the legal status of space tourists see: Al - Ekabi, C., 2012. *Revisiting "Envoys of Mankind" in the Era of Commercial Human Spaceflight,* Paris: ESPI Perspectives No. 62.; von der Dunk, 2006. *Space for Tourism? Legal aspects of private spaceflight for tourist purposes*, Proceedings of the Forty-Ninth Colloquium on the Law of Outer Space, pp. 18-28.

[82] Sundahl, M. J., 2009. The Duty to Rescue Space Tourists and Return Private Spacecraft. *Journal of Space Law,* 35(1), pp. 163-200.

[83] UN, 1969. *Vienna Convention on the Law of Treaties,* Vienna: United Nations-Treaty Series Vol. 115,1-18232.

and highlights the elementary considerations of humanity. But on the other hand, the ISS Partner States[84] and the US legislation[85] make an explicit distinction between professional astronauts and spaceflight participants, which reinforces the view that the Rescue Agreement should not apply to spaceflight participants.[86] Even though there is a remarkable difference of opinion, the prevailing theory is that humanitarian considerations entail the applicability of the Agreement and the existing general humanitarian obligations to assist humans in distress are sufficient without the qualifications as "envoys of mankind".[87] However, it will be extremely useful for the international community to elucidate the status of "space-flight participants" and their relationships with the Rescue Agreement, which will lead to the clarification of the provisions and the elimination of conflicting laws and practices.

At the regional level the main regulations for space activities lay within the EU legal framework, notably provisions regarding data protection and general economic rules. Its main concern is to "*prevent outer space from becoming an area of conflict*" and in this process the EU issued a "Draft Code of Conduct for Outer Space Activities"[88] in 2008. On a national level the adoption of a national space legislation is directly linked to the demand of private space commerce and it is mainly concerned with issues of liability and supervision of private actors. The US, UK, Australia and the USSR have developed national space legislation, while China, India, Indonesia and Thailand are in the process. For instance, the US have adopted the Commercial Space Launch Act,[89] which establishes the licensing regime and addresses the authorization, supervision and liability of commercial operations. The "Spurring Private Aerospace Competitiveness and Entrepreneurship (SPACE) Act" of 2015 constitutes an update of commercial space legislation, which allows US citizens to "*engage in the commercial exploration and exploitation of space resources",*[90] even though there is a debate whether the recognition of ownership of space resources is an act of sovereignty that violates the OST or not.

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[84] ISS Multilateral Crew Operations Panel (MCOP), November 2001. *Principles Regarding Processes and Criteria for Selection, Assignment, Training and Certification of ISS (Expedition and Visiting) Crewmembers.* [Online] Available at: http://www.spaceref.com/news/viewsr.html?pid=4578 (last visited on March, 2 2017].

[85] US Congress, 2004. *Commercial Space Launch Amendments Act of 2004,* Washington : Public Law 10-492, 108th Congress.

[86] von der Dunk, F., supra, pp. 710-712.

[87] Christol, C. Q., 1982. *The modern international law of outer space.* 1st. ed. New York:Pergamon Press: Pergamon Policy Studies on International Politics, pp. 153-159.

[88] EU, 2014. Draft Code of Conduct of Outer Space Activities.

[89] Ibid

[90]US Congress, 2015. *U.S. Commercial Space Launch Competitiveness Act: Spurring Private Aerospace Competitiveness and Enterpreneurship,* Washington, D.C.: Public Law 114-90, 114th Congress.

Due to the legal vacuum left by the treaties about commercial space activities there is still an ongoing debate on whether these activities operate within a lawless or not business environment.[91] The fact that space has been acknowledged as part of the "common heritage of man" raises the question whether space should continue to be defined as that or whether its definition should be changed to allow private property in space. The "principle of non-appropriation" is said to pose a barrier in the way of a thriving space economy, since the absence of explicitly guaranteed proprietary rights deters investors, especially in the case of celestial bodies where mining is possible.[92] The need to devise rules to regulate intellectual property[93] in the light of the increasing commercialization of outer space and the emerging need to determine whether existing copyright law should be applicable to satellite activities are additional issues. Oosterlinck held the view that there was need for a legal framework about intellectual property relating to the outer space activities, but with "minimum conflict and maximum progress."[94] On the other hand, Balsano and Smith highlight that the "*present framework for use of IPR (Intellectual Property Rights) in space activities suffers from several inadequacies, inequalities, and ultimately from potential conflicts with the founding principles both of national IPR law and of international law."*[95] Either way, the OST provision that "a state shall retain jurisdiction and control over an object on its registry"[96] fine-tunes the issue and allows for a creative interpretation through the extension of the national intellectual property rights to encompass space activities and inventions, especially in the fields of pattern and copyrights.[97] However, the different point of views and interpretations in national laws hamper the applicability of intellectual property rights. The main issues continue to be the lack of legally binding definitions of the "appropriate state" and "space object" in the light of commercialization of outer space along with the concerns about the applicability of

[91] Salin, P. A., 2001. Privatization and militarization in the space business environment. *Space Policy,* 17(1), pp. 19-26.

[92] Foust, J., 2016. Mining Issues in space law. *The Space Review*, 9 May.

[93] Doldirina, C., 2015. Intellectual property rights in the context of space activities. In: F. von der Dunk & F. Tronchetti, eds. *Handbook of Space Law.* Cheltenham and Northampton: Edward Elgar Publishing: Research Handbooks in International Law, pp. 949-994.

[94] Oosterlinck, R., 1983. *Intellectual Property and Space Activities,* Budapest: Proceedings 26th Colloquium, pp. 161-164.

[95] Balsano, A. & Smith, B., 1997. Intellectual Property and Space Activities: A New Role for UNCOPUOS?. In: G. Laferranderie & D. Crowther, eds. *Outlook on Space Law over the next 30 years.* Hague, London and Boston: Martinus Nijhoff Publishers: Kluwer Law International, pp. 363-371.

[96] Article VIII of the Outer Space Agreement.

[97] Generally, on the application of intellectual property rights to outer space activities and inventions see: Abeyratne, R., 2011. The Application of Intellectual Property Rights to Outer Space Activities. In: R. Abeyratne, ed. *Space Security Law.* London and New York: Springer, pp. 83-96.; Walter, E., 2011. The privatisation and commercialisation of outer space. In: C. Brunner & A. Soucek, eds. *Outer Space in Society, Politics and Law.* Wien and New York: Springer: Studies in Space Policy Volume 8, pp. 509-511; Bhat, B.S., 2010. Inventions in Outer Space: Need for Reconsideration of the Patent Regime. *Journal of Space Law*, 36(1), pp.1-19.

Space Law, Air Law or both, especially within the liability context. A positive step could be the adoption of a multilateral agreement to cover the transfer of supervisory duties and authority between states in the event of a change of ownership of a space object in space.[98] Also, an improvement would be the adoption of a space traffic management system under the Registration Convention regime along with need for a formal relationship between space traffic and air traffic control. According to Lyall and Larsen,[99] the establishment of a boundary between air-space and outer space[100] alongside with the need to harmonization between the use of air-space and transit to and from outer space would also be remarkable.

In the years to come, the international community, the space companies and the legislatures will have to play a crucial role in handling the complicated legal issues that will raise from the increased commercial human spaceflight and the subsequent questions of liability in the event of accidents.[101] The private entrepreneurs are anticipated to increase their share in space operations in cooperation with the government agencies, but it cannot be expected to take over space in the medium term. There are several factors that play an essential role in this assumption, such as more the costs of such trips and less the inadequacy of the legal framework, since it is still unclear where space legislation applies. Nevertheless, the space business will continue to evolve, especially if we take into account Walter's comment that "*the past has shown that cut-throat competition and legal uncertainty have seldom discouraged entrepreneurs from trying something new."*[102] In the light of these developments it is an absolute necessity for International Law to establish the balance between respect for the main principles of Space Law and the need to support private imitative.[103]

ii) Environmental Aspects of Space Law - Space Debris

Space presents a variety of environmental issues to which law must respond, of which the most severe are those that might take place after the launch. Faced with the environmental risk, the states, according to Article IX of the OST, have the obligation to "avoid harmful contamination of outer space (forward contamination),

[98]Lyall, F. & Larsen, P.B., supra, p. 497.

[99] Lyall, F. & Larsen, P. B., supra, p. 562.

[100] Qizhi, H., 1982. The Problem of Defination and Delimitation of Outer Space. *Journal of Space Law,* 10(2), pp. 157-164.

[101] Hampson, J., 2017. *The Future of Space Commercialization,* s.l.: Niskanen Center Research Paper. Available at: https://science.house.gov/sites/republicans.science.house.gov/files/documents/TheFutureofSpaceCommercializationFinal.pdf (last visited on January 13, 2017).

[102] Walter, E., supra, p.513.

[103]Achilleas, P., 2016. *New Space Legal Issues, IDEST.* [Online] Available at: http://www.unoosa.org/documents/pdf/copuos/lsc/2016/sem2-301.pdf (last visited on September 2, 2017.)

as well as adverse changes in the Earth resulting from the introduction of extraterrestrial matter"[104] (backward contamination). This Article is the basis on which states have the obligation to "adopt appropriate measures" and therefore act to prevent changes in the space environment. Article IX along with Articles I (1), III, IV and VIII outlines the core environmental protection. The importance of maintaining the space environment is, among other things, directly linked to its contributions in solving environmental issues of the Earth. Thus, for the scope of the current analysis the crucial role of the space observations for the protection of the environment along with the most imminent environmental space issue, the space debris, will be discussed. Of course, space debris are by no means the only environmental issues related to space exploration, since, other issues, such as nuclear contamination and forward and backward contamination are of equal importance.

It is commonly known that numerous space-related activities can serve as an effective tool for the protection of the environment, such as satellites that monitor the earth environment providing data about the complicated global changes of the Earth system and early warning systems for natural disasters. These systems are able to mitigate the consequences of natural disasters through coordination and technological space capacities.[105] Thus, satellite observations play a crucial role filling the gap in the data sparse regions and assist in understanding the functions of our natural environment. The collection of global data through atmospheric, climate, hydrological and ecological applications[106] is undeniably a significant contribution to developing and implementing means to solve environmental or human problems. Apart from the data, space technologies play a crucial role in sustaining the Earth's resources. For example space observations help in securing freshwater resources,[107] as well as in forest management, climate change and disaster and risk management.[108] For instance, one of the most important initiatives for earth monitoring is the Global Monitoring for Environment and Security (GMES), [109] which collect data and provides information that enhances the areas of climate change (adaptation and mitigation

[104]Article IX of the Outer Space Treaty.

[105] See Charter On Cooperation To Achieve The Coordinated Use Of Space Facilities In The Event Of Natural or Technological Disasters Rev.3 (25/4/2000).2. Bally, P. et al., 2010. In Action around the world: The International Charter for Space and Major Disasters. *ESA Bulletin,* 143(1), pp. 2-12.

[106] Qu, J. J., Powell, Jr., A. M. & Sivakumar, M., 2013. *Satellite-based Applications on Climate Change.* 1st ed. Leiden: Springer Atmospheric Sciences.

[107] For example: The European Space Agency (ESA) launched the TIGER initiative to promote the use of Earth Observation (EO) for improved Integrated Water Resources Management (IWRM) in Africa.

[108] Mantl, L., 2011. The European Union: The Global Monitoring for Environment and Security. In: C. Brunner & A. Soucek, eds. *Outer Space in Society, Politics and Law.* Wien and New York: Springer: Studies in Space Policy Volume 8, p. 426.

[109] Potin, P. & Aschbacher, J., 2009. The contribution of earth observation to environmental monitoring and Global Monitoring for Environment and Security (GMES). In: K. Schrogl & C. Mathieu, eds. *Threats, Risks and Sustainability- Answers by Space.* Wien and New York: Springer: Studies in Space Law Volume 2, pp. 76-91.

policies), emergency response services, land and marine monitoring services and atmosphere services.[110] These space applications are only indicative of the importance of space technology for improving life on Earth.

The increase of space activity has created a "veritable junkyard of orbital space debris" consisting of defunct satellites, as well as components and tools lost during extravehicular activities.[111] Space debris can create a navigation hazard to operational space craft satellites, especially in the Geostationary Satellite Orbit, where they can wander increasing the possibility to collide with functioning satellites or interfere with their transmissions. The peculiarity of this issue according to Viikari's observation is that "most threats posed by environmental hazards in outer space do not affect the particular operation which causes them, but endanger other space (and even terrestrial) activities". The increased number of objects that are in orbit has made the case of space debris a real problem. Thus, Earth orbit is crowded with 600.000 objects in orbit increasing the risk for radioactive contamination and other harmful substances. The issue of space debris is an imminent one as it was evidenced by the collision of two satellites in orbit for the first time in 2009.[112] As Kleiman points out: "*If enough debris accumulates, it will become virtually impossible to operate spacecraft in Earth orbit."*[113]

Neither the UN space treaties nor the most recent Space Law provisions adequately address the space debris problem with the efficacy it is required. This inadequacy is related to the uncertainty in case of liability for damage caused by space debris and the lack a legally binding treaty. Under the 1972 Liability Convention the "launching state is liable for damage caused to a space object or to persons or property on board of another state" if the damage is due to negligence. This assumption raises two important issues: on the one hand, the difficultly to prove the negligence, since "space traffic rules" do not systematic exist[114] and on the other hand, the insurmountable problem to determine in most cases who is responsible taking into account the uncertainty of origin of most space debris. The absence of a legally binding definition of space debris is another issue that arises, even though it is widely accepted

[110] EU, 2010. *Regulation (EU) No 911/2010 of the European Parliament and of the Council on the European Earth monitoring programme (GMES) and its initial operations (2011 to 2013),* Strasbourg: Official Journal of the European Union L 276/1.

[111] Listner, M., 2011. International Space Law: An Overview of Law and Issues. *New Hampshire Bar Journal,* 52(1), pp. 62-71.

[112] Williams, M., 2011. Space Debris as a 'Single Item for Discussion'. *Proceedings of the International Institute of Space Law,* 4(1), p. 333.

[113] Kleiman, M. J., 2010. *Space Law 101: An Introduction to Space Law,* Washington, DC: American Bar Association: Young Lawyers Division 101 Practice Series.

[114] Viikari, L., 2015. Environmental aspects of space activities. In: F. von der Dunk & F. Tronchetti , eds. *Handbook of space law.* Cheltenham and Northampton: Edward Elgar Publishing: Research Handbooks in International Law, pp. 717-769.

that the term comprises everything from small parts to "dead" satellites.[115] The Registration Convention also has relevance, since the availability of information can be essential in the case of a collision between space objects providing identification. However, this Convention entails problems of terminology that leave enough space for interpretation considering the term "space object". Nevertheless, important steps have been taken to alleviate environmental degradation of outer space both at national[116], international[117] and regional level.[118] In 2009, at international level, the adoption of the "Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space",[119] that were originally drafted in 2002 after an assessment of the space debris environment and threat, was a positive development.[120] The text distinguishes two main sources of space debris: (a) the accidental and intentional break-ups and (b) the debris released during the operation launch of the vehicle. The guidelines encompass seven provisions and are based on the distinction between near- and long-term measures. These guidelines concern: "the limitation of debris released during normal operations; the minimization of the potential break-ups during operational phases; the limitation of the probability of accidental collision in orbit; the avoidance of intentional destruction and other harmful activities; the minimization of potential post-mission break-ups resulting from stored energy; the limitation of the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit (LEO) region after the end of their mission; and the limitation of the long-term interference of spacecraft and launch vehicle orbital stages with the geosynchronous Earth orbit region after the end of a mission".[121] The implementation of these guidelines is voluntary in nature, but they have an important impact, since they have been adopted by all major organizations and actors in outer space. The implementation of the guidelines along with space traffic management are a necessity taking into account the limited maneuvering capability and their high speed.

The UNCOPUOS Space Debris Mitigation Guidelines do not provide a holistic solution to the issue, even though they constitute a remarkable step towards

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[115] The term in use at deliberations in UNCOPUOS refers to all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional. For more information, see Tortora, J.J (2011). *Studies in Space Policy*. London and New York: Springer.

[116] See also Johnson, N., 18-20 April 2005. *Orbital debris research in the US.* Darmstadt, Germany, Proceedings of the Fourth European Conference on Space Debris, ESA/ESOC.

[117] UN, 2012. *Active Debris Removal — An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space. A Report of the International Interdisciplinary Congress on Space Debris Remediation and On-Orbit Satellite Servicing ,* Vienna: Doc. A/AC.105/C.1/2012/CRP.16.

[118] For example, EU, 2014. *Draft Code of Conduct of Outer Space Activities*.

[119] UN, 2010. *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space,* Vienna: UN Office for Outer Space Affairs.

[120] Williams, M., 2008. Safeguarding Outer Space: On the Road to Debris Mitigation. In: UN, ed. *Security in Space: The Next Generation- Conference Report 31 March-1 April.* New York and Geneva: United Nations Institute for Disarmament Research, UNIDIR/2008/14, pp. 81-101.

[121] Ibid.

minimizing risks related to space debris. They could, however, "create a basis for legally binding rules to be negotiated at some time in the future."[122] The process to establish binding rules for this issue is a slow one, due to two major factors according to Schrogl: first, "space powers did not want to develop rules jointly with states not involved in space activities" and secondly "they are reluctant to bind themselves to technical modifications that are necessary in order to harmonize with the guidelines".[123] Another important aspect of this issue is the growth in the commercial uses of outer space and the need to set norms also applicable to them. Nevertheless, there is room for improvement.

One of the possible solutions to the space debris issue is the establishment of a piece of legislation similar to the law of salvage under maritime law, which will eliminate any possibility of removing another country's debris without permission to be considered illegal, since the UN space treaties recognize no termination of the jurisdiction and control over a space object.[124] A major improvement could be the review of the Registration Convention so that notifications concerning explosions and break-ups of registered space objects would become compulsory. Part of the solution of this issue could also be the on-orbit satellite servicing (OOS). The most vital solution for the space debris issue is the clear universal distinction between functional spacecraft and non-functional space debris and the adoption of legally binding definitions for all ambiguous terms. Also, it is possible as well as necessary to consider remediation measures,[125] especially since the technological developments makes the distraction or thermal decomposition of space debris a pragmatic solution.[126] The main issue with the remediation measures, apart from the high cost, is the differences between the suggestions made. One of the prevailing theories is that the simplest and most economic method for dealing with space debris is to take preventive measures through the design of the spacecraft[127] instead of remediation measures. A different approach is presented by Jasentuliyana according to whom: "the most effective procedure for removing satellites and other space vehicles is to bring them down

[122] See Review of the Legal Aspects of the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, with a View to Transforming the Guidelines into a Set of Principles to be adopted by the General Assembly, Working Paper Submitted by the Czech Republic, 50th session of the LSC, 2011, UN Doc. A/AC.105/C.2/L.283, para. 18.

[123] Schrogl, K.-U., 2011. Space and its sustainable uses. In: C. Brunner & A. Soucek, eds. *Outer Space in Society, Politics and Law.* Wien and New York: Springer in Space Policy Volume 8, pp. 604-618.

[124] Schwetje, K., 1990. Liability and Space Debris. In: K. Böckstiegel, ed. *Environmental Aspects of Activities in Outer Space: State of the Law and Measures of Protection.* Cologne: C. Heymanns Velag, pp. 36-40.

[125] Schrogl, K.-U., supra, p. 606.

[126] McGill-Cologne Declaration on Space Debris 2010: 'Recognizing that the principle of common but differentiated responsibility, as enabling all States to fulfil their obligations associated with current international efforts in preserving the terrestrial environment, is an important precedent to guide current and future space debris mitigation and remediation efforts."

[127] Leinberg, G., 1989. Orbital Space Debris. *The Journal of Law and Technology,* 4(1), pp. 93-116.

through controlled reentry after they have fulfilled their function." Overall, the preferred solution to resolve all legal questions and to provide a holistic approach to this issue could be through the adoption of an international treaty[128] that will include binding legal and technical measures regulating the prevention and management of space debris at all stages of a space operation.

IV. Conclusion

As humans increase their presence in outer space, the law that govern human activities in that environment is becoming increasingly relevant and important to both States and the commercial sector. In this context, this analysis focused to provide a clear understanding of the international space regime that has emerged from within the United Nations. The OST has a critical role in this regime, which sets out the most fundamental principles and policies adopted by the international community to govern human activities in outer space and is the basis upon which all other instruments have been developed. However, the technological development has enabled space activities and private operators, which have not been integrated into the existing legal framework. This development raises the need for some international regulatory and policy changes with a view to maintaining orderly and peaceful space exploration and exploitation. Among the most significant challenges that the international community will face in the coming years are commercialization of outer space along with the space debris. Other issues, such as property rights to outer space resources, will grow in importance as the space technology and its applications matures.

Throughout the analysis it is clear that the core substance for the continuation of the peaceful space exploration and exploitation is the international co-operation, but the Space Law is bifurcating, a development which emerged mainly from the commercial uses of space. In order to tackle this issue, the enactment and harmonization of domestic space legislations are essential to the creation of a secure environment for space activities regarding the legislative framework applicable to them.[129] Domestic legislation should, however, be harmonized, following the developments of International Space Law. Ensuring the applicability of the Outer Space Treaty could also be a step in the right direction, since it will provide a common legal foundation for all states and enhancement of compliance. Furthermore, it is of essence to preserve the long-term sustainability of space activities even through the adoption of non-binding norms, since the fulfillment of the numerous issues, such as

[128] Kopal, V., 2008. *An Introduction to Space Law.* 3rd revised edition ed. Netherlands: Kluwer Law International, p. 103.

[129] Tronchetti, F., supra, pp. 82-83.

environmental concerns, is a challenging task. At last, it is worth noting that there is a strong need to strike a balance between the need to revise and reform the treaties and the preservation of matters that are at present apparently secure. Alternately, the possibility of the absence of a general agreement might lead the existing framework to fall apart.