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SUSTAINABLE USES OF OUTER SPACE, CELESTIAL BODIES AND RESOURCES AS THE END GAME FOR THE PRIVATE ACTORS - CONGRUENCE OR DIVERGENCE?

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ABSTRACT

From the official lift-off of the space age in 1957, up until today, during the growing space commercialization, and the emergence of astropolitics, astro-preneurs, astro-activists, space-environmentalists, space pirates and cowboys, it appears that mankind is once again before the moral dilemma between the three pillars of sustainable development - social, economic and environmental. While anthropocentrism took us to space, environmentalism, which is still much needed on Earth, only recently emerged as a paradigm to be seriously considered in outer space. Such circumstances highlight some relevant questions relating to the recent boom of commercial space activities:

What trends and threats does the sustainable development of commercialised outer space face?

What parts of outer space are most vulnerable?

How is Outer Space, the Moon, Celestial Bodies and Mars protected from various threats related to human influence, and what existing regulation is applicable?

Can the commercial space actors be subsumed under the existing regulation, and should their activities be formally compliant with current Space Law framework?

Can the economic, environmental and social factors be reconciled?

If humans colonise other celestial bodies, are we taking the right path and following proper directions? What should be taken into space, and what left behind?

If Outer Space is seen as a new platform of sui generis international relations, and Mars as a plan B, should conclusions be drawn based on the mistakes made on Planet Earth?

This article explores these questions and related concepts separately to provide an understanding of the why, what, who, and how of Space Law. The objective is to draw a conclusion on the state of development of the outer space legal framework, by providing a nexus through highlighting current issues, trends, actors, objects of protection and existing and developing regulation, that can provide a reconciliation of the social, environmental and economic factors of sustainable development.

The analysis should highlight that the recent developments require the Space law framework to become more flexible, adaptable, inclusive and predictive rather than solely descriptive in nature,

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in order to evolve along with the trends characterising the New Space era, with newly engaged commercial subjects in a new spectrum - in Space.

Keywords: Space Law, Sustainability, Principles, Prevention, Celestial Bodies, Moon, Mars, Outer Space, Space Activities, Commercial, Private Actors, Environmental Damage, Space Debris, OST.

1. INTRODUCTION

The need to revisit and understand basic concepts related to outer space sustainability is influenced by the recent rise of commercial space activities of private space actors, along with the continued State sponsored activities, making space a multi-stakeholder spectrum. Since multiple companies all endeavour to participate in such activities, in order to understand whether the existing rules of the game provide for fair and equal play and sustainable competition in the long run, in balance with outer space conservation, we would first need to determine:

- The relevant indicators, factors, participants and stakeholders in space activities;
- The issues arising from the current development of outer space commercialization;
- The scope and clarification of the main concepts, related terminology and definitions;
- The subjects and objects of the activities inside and outside of scope for regulation;
- The relevant framework for sustainable uses of outer space;

Therefore, in light of the fast development of commercial space activities, in order to assess whether the current framework of Space law is sufficient and adequate to provide appropriate protection to the parts of the space ecosystem, a holistic, multidisciplinary approach should be undertaken, since, in appreciation of the current scientific and technological development, when describing and regulating natural phenomena, all the relevant factors should be carefully examined and considered.

2. COMMERCIALIZATION OF OUTER SPACE AND ITS EFFECTS AS LESSONS

2.1 The current state and development of commercial space activities

In an address to the United Nations General Assembly, after mentioning the pandemic and the climate crisis, the Secretary-General António Guterres singled out "*billionaires joyriding to space*", lumping space tourism alongside corruption and loss of freedoms as part of a "malady of mistrust" facing the world, and another sign of the backlash to private human spaceflight.[2]

[2] Tamara Blagojević, 'ALIGNING THE STARS: SUSTAINABLE DEVELOPMENT AND SPACE JUSTICE' (AContrarioicl.com, 2021), <https://acontrarioicl.com/2021/10/11/aligning-the-stars-sustainable-development-and-space-justice/> accessed 10 November 2021.

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In mid-November 2021, in a response to similar comments by David Beasley, director of the United Nations's World Food Programme ("**WFP"**), Elon Musk challenged the UN official's claim that just a small percentage of his wealth could help solve world hunger, by stating that if the WFP, using transparent and open accounting, "*can describe… exactly how $6 billion will solve world hunger*", he would "*sell Tesla stock right now and do it*".[3] The WFP responded with a plan in which it was enumerated: "*$3.5 billion for food and its delivery, $2 billion for cash and food vouchers, $700 million for country-specific costs to design, scale up and manage, and $400 million for global and regional operations management, administration and accountability*."[4] Possibly as a response to this public criticism, in November 2021, Elon Musk, donated a total of 5,044,000 Tesla shares worth $5.74 billion, to an undisclosed charity, as per the data of the US Securities and Exchange Commission (SEC), which donation ranked Musk as America's second-biggest donor after Bill Gates and Melinda French Gates.[5] Musk is supposedly making sizable donations to other projects, as for example, the Musk Foundation,[6] which he established to finance efforts related to renewable energy expansion, human space exploration and safe usage of artificial intelligence.[7] Musk also signed "The Giving Pledge,"[8] a promise to donate at least half of his wealth to charitable efforts during his lifetime, which is something Jeff Bezos has not done.[9] In 2021, Bezos did however spend $5.5 billion only to hover near low Earth orbit (**"LEO"**) for the entire four minutes.[10] This has been criticised by those arguing these funds could have been used to help assist with issues such as the COVID-19 pandemic, global hunger or mitigation of the environmental crisis.[11] Shortly following his "joyride to space", Jeffrey Bezos gave the following statement to MSNBC:

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[3] 'Tesla Boss Musk Challenges UN Official' (*Aljazeera.com*, 2021) <https://www.aljazeera.com/economy/2021/11/1/tesla-boss-musk-challenges-un-official> accessed 12 December 2021.

[4] 'WFP's Plan To Support 42 Million People On The Brink Of Famine | World Food Programme' (*Wfp.org*, 2021) <https://www.wfp.org/stories/wfps-plan-support-42-million-people-brink-famine> accessed 10 November 2021.

[5] Elon Musk donated $5.74bn in Tesla shares to charity last year (The Guardian, February 2021). < https://www.theguardian.com/technology/2022/feb/15/elon-musk-tesla-shares-donation-sec>, accessed 25 August 2022.

[6] The Musk Foundation, <http://www.muskfoundation.org/ >

[7] Jackie Wattles, 'UN To Elon Musk: Here's That $6 Billion Plan To Fight World Hunger' (CNN, 2021) <https://edition.cnn.com/2021/11/18/tech/elon-musk-world-hunger-wfp-donation/index.html> accessed 10 November 2021.

[8] The Giving Pledge, A Commitment to Philanthropy (TheGivingPledge.org),<https://givingpledge.org/>

[9] Ibid.

[10] Jeff Bezos Just Spent $5.5B to Be in Space for 4 Minutes. Here Are 7 Things That Money Could Help Solve. (Global Citizen, July 20 2021) <https://www.globalcitizen.org/en/content/jeff-bezos-space-flight-money-better-uses/>

[11] Blagojević, (n.1)

"*We need to take all heavy industry, all polluting industry, and move it into space, and keep Earth as this beautiful gem of a planet that it is*."[12]

Additionally, SpaceX Falcon 9 launched 60 Starlink satellites into orbit on May 26th, 2021, bringing the total number of Starlink satellites the company has launched to 1,735, excluding the two prototype Starlink satellites launched February 22, 2018.[13] Aside from adding to outer space traffic congestion, at least one more consequence of these activities could be light pollution from the satellites threatening the discoveries of hazardous near-earth asteroids.[14]

In relation to outer space sustainability, not that long ago, Musk announced plans to terraform Mars. Terraforming is a process to create a more habitable environment, through releasing greenhouse gases into the atmosphere by dropping nuclear bombs on the planet.[15] Some scholars state that terraforming can even be considered a grave offence, bearing in mind that testing nuclear weapons is prohibited on Earth.[16] To add to these concerns, in October 2020, Elon Musk's SpaceX published its Terms of Service for the beta test of its Starlink broadband mega-constellation,[17] supposed to provide internet connection to the entire globe.[18] The Terms stated:

"For Services provided on Mars, or in transit to Mars via Starship or other colonisation spacecraft, the parties recognize Mars as a free planet and that no Earth-based government has authority or sovereignty over Martian activities. Accordingly, Disputes will be settled through self-governing principles, established in good faith, at the time of Martian settlement."[19]

However, such lack of recognition of any Earth-based authority or sovereignty wouldn't stand, as Musk, as a U.S. citizen is also bound by Space Law (at least indirectly, by being bound by U.S. laws), and as U.S. is a signatory of the Space Treaties, it is obliged by the principles such as non appropriation, and has an obligation to retain jurisdiction and control over its spacecraft and its nationals and responsibility to conduct space activities with due regard.[20]

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12 'Jeff Bezos Says Now He's Gonna Pollute Space, Too', (*Futurism*, 2021) <https://futurism.com/jeff-bezos-pollute-space-too> accessed 10 November 2021.

13 Ibid.

14 Samantha Lawler, 'Spacex's Starlink Satellites Are About To Ruin Stargazing For Everyone' (*Stuff*, 2021) <https://www.stuff.co.nz/world/123435267/spacexs-starlink-satellites-are-about-to-ruin-stargazing-for-everyone> accessed 20 October 2021.

15 Tamara Blagojević, 'Lessons From Earth To Outer Space: Space Law, Elon Musk, And The Future Of Mars' (*NWSidebar*, 2021) <https://nwsidebar.wsba.org/2020/11/30/lessons-from-earth-to-outer-space-space-law-elon-musk-and-the-future-of-mars/> accessed 2 December 2021.

16 See: Cristian van Eijk, 'Sorry, Elon: Mars Is Not A Legal Vacuum – And It'S Not Yours, Either' (*Voelkerrechtsblog.org*, 2021)

17 Cristian van Eijk, 'Sorry, Elon: Mars Is Not A Legal Vacuum – And It'S Not Yours, Either' (*Voelkerrechtsblog.org*, 2021), accessed 18 November 2021.

18 Ibid

19 Ibid.

20 See: Tamara Blagojević, 'Lessons From Earth To Outer Space: Space Law, Elon Musk, And The Future Of Mars' (*NWSidebar*, 2021) <https://nwsidebar.wsba.org/2020/11/30/lessons-from-earth-to-outer-space-space-law-elon-musk-and-the-future-of-mars/>

As clearly visible from above, environmental concerns are not the only ones existing, and on the contrary, are often followed by safety concerns, or are interconnected. Just as in another brief example, in July 2021, billionaire Richard Branson's Virgin Galactic mission, VSS Unity, went ahead with his flight despite some technical issues that could have caused safety concerns.[21]

Finally, there are concerns around sustainability and legality of mining of celestial bodies. Some proposals for mining, and actors engaged include:

- Planetary Resources, a company recently formed and funded by Google executives Larry Page and Eric Schmidt with the intent of mining asteroids.[22]
- Moon Express, founded by Microsoft billionaire Naveen Jain, which plans to use robots to start mining the Moon.[23]
- Shackleton Energy Company, which is raising funds to mine ice in Shackleton Crater at the lunar south pole to provide propellant for planetary missions.[24]
- Deep Space Industries (founded in 2013), which plans to focus on asteroid science and exploration and manufacturing in outer space.[25]
- Russian Federal Space Agency (ROSCOSMOS, Russia)[26] and
- Astro-Forge, a California-based startup, founded in January 2022;[27]

All of such indicated trends shed light on the emerging oligopoly of billionaires in space exploration and tourism (initially and formally meant to benefit the entire humanity), the inappropriate distribution of resources and unsustainable use and allocation of funds which could,

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[21] Hanneke Weitering, 'Pilots Saw 'Red Light' Warning During Virgin Galactic's Historic Spaceflight With Richard Branson: Report' (*Space.com*, 2021) <https://www.space.com/virgin-galactic-branson-flight-red-light-warning> accessed 10 November 2021.

[22]Rand Simberg, 'Property Rights In Space' (*The New Atlantis*, 2021), pp. 20-31, <https://www.thenewatlantis.com/publications/property-rights-in-space> accessed 15 November 2021.

[23] Steve Jurvetson, 'The 'Self-Made' Billionaire Who Wants To Mine The Moon' (*Theweek.com*, 2021) <http://theweek.com/article/index/220556/the-self-made-billionaire-who-wants-to-mine-the-moonnbsp> accessed 2 December 2021.

[24]Simberg, (n 15), pp. 20-31

[25]Scot W Anderson, Korey Christensen and Julia LaManna, 'The Development Of Natural Resources In Outer Space' (2018) 37 Journal of Energy & Natural Resources Law , p.10, <https://www.hoganlovells.com/~/media/hogan-lovells/pdf/2018/the_development_of_natural_resouces_in_outer_space_august_2018.pdf> accessed 17 November 2021.

[26] Many more companies and agencies are planning similar engagements: ispace (Japan); Asteroid Mining Corporation (UK); Kleos Space (Luxembourg); TransAstra (US); OffWorld (US); SpaceFab.US (US); National Aeronautics and Space Administration (NASA, US); European Space Agency (ESA, France); Japan Aerospace Exploration Agency (JAXA, Japan); China National Space Administration (CNSA, China). To read more, see: Space Mining Market by Phase (Spacecraft Design, Launch, and Operation), Type of Asteroid (C-Type, M-Type, S-Type), Application (Construction, Fuel, and Others), Asteroid Distance, Commodity Resources, and Geography - Global Forecast to 2025, Space Mining Markets Report, <https://www.marketsandmarkets.com/Market-Reports/space-mining-market-129545886.html#:~:text=Major%20players%20and%20space%20agencies,SpaceFab.US%20(US)%3B%20National>

[27] 'Mike Wall, Asteroid-mining startup AstroForge raises $13 million, books launch for test mission', (Space.com, May 26, 2022), < https://www.space.com/asteroid-mining-startup-astroforge-2023-launch>

during the Climate Change, as well as COVID-19 crisis, be directed towards more sustainable options. Additionally, the interconnection between various concerns, such as the fact that bad investments, lack of proper impact assessments and imprecise calculations can lead to safety hazards, which can lead to environmental hazards, further confirms their interdependence and the need to balance and consider all three pillars of sustainable development.

This recent boom in well-funded but under-regulated commercial space activities undertaken by private space actors requires urgent and serious consideration, which is why understanding the nature, characteristics and implications of such space activities is necessary in order to determine the scope of applicable regulation, and the appropriate legal regime.

2.2 Space Activities

The term "Space activities" appears to be a generic term that encompasses all space related activity: launch, activities conducted in outer space, reentry, and recovery.[28] Although not explicitly defined or enumerated in the five main space treaties (together the "**Space Treaties**")[29], space activities also include physically distinct operations such as: being in orbit; and activities on the Moon and other celestial bodies (landing, being on the surface of, and launching); as well as operationally distinct activities in the exploration and use of outer space (including activities in the field of international direct television broadcasting by satellite and remote sensing activities).[30]

The Rescue Agreement of 1967 extends its scope not only to *"rescue activities wherever they may occur"*,[31] but also to a certain type of space-related activity,[32] as for example *"recovery of objects"*[33] launched into outer space from Earth.

The Article I of the Registration Convention of 1975 states that when a "s*pace object is launched into Earth orbit or beyond the launching State shall register the space object in an appropriate registry and inform the Secretary General of the United Nations of such registry"*.[34]

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[28] Koninklijke Brill Nv, 'The Functional Approach: What Are Space Activities?', *How High the Sky? The Definition and Delimitation of Outer Space and Territorial Airspace in International Law,* Studies in Space Law Series, Volume: 13, Chapter 13,, (Leiden, 2018_, p.246 <https://brill.com/view/book/9789004366022/BP000023.xml> accessed 13 November 2021.

[29] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205, Art 1, [hereinafter OST], Convention on Registration of Objects Launched into Outer Space', June 6 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention] <https://www.unoosa.org/pdf/gares/ARES_29_3235E.pdf> , Agreement on the Rescue of Astronauts and the Return of Objects Launched in Outer Space, Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119 [hereinafter Rescue Agreement] <https://www.unoosa.org/pdf/gares/ARES_22_2345E.pdf>, Convention on International Liability for Damage Caused by Space Objects', Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention]; and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 18, 1979, 1363 U.N.T.S. 3 [hereinafter Moon Agreement].

[30] Koninklijke (n). 27.

[31] Ibid

[32] Ibid

[33] Convention on Registration of Objects Launched into Outer Space', June 6 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15, Article 5. Paragraph 2, <https://www.unoosa.org/pdf/gares/ARES_22_2345E.pdf>

[34]Koninklijke (n) 27.

Although this convention is more administrative in nature the wording of this provision practically implies, among other things, that if an activity or an object related to the activity is subject to the matter of one of the five Space Treaties, by being tied to the state of its registry, then the activity should be regarded as a space activity. But, isolated from listing a number of types of space activities (such as launching, registering, recovering and returning) none of the Space Treaties provide any other definitions and mention nothing on the nature of space activities or the form they can take.

However, the Artemis Accords,[35] as the principles for cooperation in the civil exploration and use of the Moon, Mars, comets, and asteroids for peaceful purposes, might be the most suitable to provide a modern definition of space activities, since they *"apply to civil activities in outer space, and all activities that may take place on the Moon, Mars, comets, and asteroids, including their surfaces and subsurfaces, as well as in orbit of the Moon or Mars, in the Lagrangian points for the Earth-Moon system, and in transit between these celestial bodies and locations."*

The recently published McGill University Manual on International Law Applicable to Military Uses of Outer Space (MILAMOS), intended only to restate lex lata, highlights space activities in its rule 101:

> "*Space activities are activities in the exploration and use of outer space, including the Moon and other celestial bodies. Space activities may have or be intended to have direct effects:*
>
> *a. in outer space, including the Moon and other celestial bodies;*
> *b. on the operation of space infrastructure; and/or*
> *c. from outer space to another domain*."[36]

The fact that space activities take place not only in outer space, but also in the attempt to reach outer space or another domain, implies that space activities also include activities that are somehow functionally related to space and/or are undertaken for purposes related to space. In other words, space activities presume not only activities that are literally undertaken in LEO, outer space, Moon, Mars or on other celestial bodies or asteroids, but also activities undertaken in order to get there, and therefore are not only geographically and physically defined, but also functionally and operationally, having in mind a particular context and purpose of such activities.

For example, the Hague International Space Resources Governance Working Group,[37] defines the "*space resource activity*" as:

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[35] 'The Artemis Accords', NASA, (Oct. 2020, Nasa.gov), https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf

[36] Ram S. Jakhu & Steven Freeland, eds, McGill Manual on International Law Applicable to Military Uses of Outer Space: Volume I - Rules (Montreal: Centre for Research in Air and Space Law, 2022), pp.9, <https://www.mcgill.ca/iasl/files/iasl/mcgill_manual_volume_i_-_rules.pdf > Accessed Sept. 2022.

[37] The Hague International Space Resources Governance Working Group was set up following a round table on the Governance of Space Resources, convened by The Hague Institute for Global Justice on 1 December 2014. The round table was attended by industrial leaders, scientists, diplomats as well as political and legal experts from across the globe and served as a forum to discuss and propose solutions for the current lack of a legal framework for the use of space resources found on asteroids and other celestial bodies. See: <https://www.unoosa.org/res/oosadoc/data/documents/2018/aac_105c_22018crp/aac_105c_22018crp_18_0_html/AC105_C2_2018_CRP18E.pdf> accessed August 2022.

"*An activity conducted in outer space for the purpose of searching for space resources, the recovery of those resources and the extraction of raw mineral or volatile materials therefrom, including the construction and operation of associated extraction, recovery, processing and transportation systems*."[38]

As for the "*utilisation of space resources*", the Working Group defines such activity as: *"Recovery of space resources and the extraction of raw mineral or volatile materials therefrom*."[39]

In that regard, space mining is an example of a space resource extraction activity recently addressed in the scientific community (due to the growing interest of certain private companies and investors to endeavour in such activities), or to be explicit, mining of celestial bodies. Similar to leveraging resources on Earth, there are four basic steps to exploiting asteroid resources: (1) prospect; (2) extract or harvest; (3) process; and (4) utilise.[40]

Since mining on Earth can take place in higher risk jurisdictions (with low transparency and a weak commitment to the rule of law), mining companies operating in those jurisdictions often rely on bilateral investment treaties or similar international norms and constructs to mitigate the risk of expropriation and nationalisation.[41] However, a space mining venture is more likely to move forward if the mining company has some assurance that its rights will be recognised and enforced, and if the company has access to a dispute resolution mechanism that will provide for the adjudication of those rights.[42] But, the language of Article II of the Outer Space Treaty **("OST")** of 1967 restricts national appropriation of celestial bodies which creates uncertainty as to whether a space mining company can achieve the security of tenure necessary to move forward with an investment in space mining.[43] However, the likeliness of a strict automatic transplantation of mining practices and standards from Earth to outer space, seriously decreases, if we consider the challenges such practices already face on Earth (international cross-border dimension, lack of accurate historic land records and registries, corruption and current tensions between recognition of indigenous peoples' land claims in former colonies) in the light of non appropriation and the fact that the outer space has been claimed for all mankind.

Having in mind the need for allocating appropriate rights to adequate holders, along with the fact that the Space Treaties render certain freedoms to the entire mankind, it is hard to imagine that extracting, harvesting, processing and utilising would be allowed for private actors at this stage of the development of Space law, to undertake by returning samples to conduct research and utilise them back on Earth, especially since these acts usually belong to owners in the property

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[38] 'Building Blocks For The Development Of An International Framework On Space Resource Activities' The Hague International Space resources Governance Working Group, Leiden, (*Universiteitleiden.nl*, 2019), [hereinafter Building Blocks], p.. 2 , <https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimterecht/space-resources/bb-thissrwg--cover.pdf> accessed 18 November 2021.

[39] Ibid, p..2.

[40] See: Anderson, (n 18), p. 22-31

[41] Ibid.

[42] Ibid.

[43] Ibid.

rights regime.[44] However, usually, in light of the lack of any explicit provisions prohibiting space mining *stricto sensu*, such an activity can be considered generally permitted.[45]

But, in order to properly assess the current development of the space law framework, and find the necessary minimum standardised rules and principles that would be adequate for ensuring the sustainable development of outer space activities, we need to understand the consequences of commercial space activities.

2.3 Consequences

The risk of exploitation, as the extraction and consumption of extraterrestrial resources for non-scientific purposes, without adequate and proper research of long-term impacts, is exponentially rising as the prospect of harnessing resources in outer space becomes commercially feasible.[46] This exploitation, if not limited, could generate environmental damage, since such damage can occur as a consequence of the qualitative or quantitative negative change of natural goods and resources,[47] which means that it can take the shape of degradation of resources or contamination by congestion of the space ecosystems.

Since many commercial activities in space are planned to be undertaken on celestial bodies or asteroids, the conservation of already congested Earth's orbits, is no longer the only concern, as the atmospheres of our neighbouring planets and celestial bodies might be far more fragile than Earth's.[48] When imagining the scale of a lunar mining operation, some say it would be easy to predict the potential of introducing enough biological or chemical contaminants that could produce carbon emissions or induce a process similar to climate change on Earth.[49]

Aside from the potential issues created by the emerging competition of private space actors, there have also been other consequences of the space race.

For example, in 2019, Tardigrades or "Water bears",[50] known as the first animal to survive in space back in 2007, were travelling on an Israeli spacecraft that crash-landed on the Moon.[51] Arch Mission Foundation co-founder of the organisation Nova Spivack thought they are almost definitely still alive, although they had been dehydrated to place them in suspended animation and

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[44] See: Eytan Tepper, 'The Big Bang Of Space Governance: Towards Decentralised Regulation Of Space Activities' (PhD, McGill University Libraries 2020)

[45] Tanja Masson-Zwaan, *Governance of space mining activities and The Hague Working Group,* (The Hague International Space Resources Working Group, University of Tokyo, Japan, March 2018), pp.10, <https://stig.pp.u-tokyo.ac.jp/stig/wp-content/uploads/2018/02/Tanja.pdf>

[46] William B. Altabef, 'The Legal Man in the Moon: Exploring Environmental Personhood for Celestial Bodies', *Chicago Journal of International Law,* Vol. 21 Nu. 2 , January 2021, p. 480, <https://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=1792&context=cjil>

[47] Blagojević, (n 10)

[48] Altabef, (n 30), p.480

[49] Ibid.

[50] Creatures under a millimetre long that can survive being heated to 150C and frozen to almost absolute zero.

[51] Kameron Virk, 'Tardigrades: 'Water Bears' Stuck On The Moon After Crash' (*BBC News*, 2019) <https://www.bbc.com/news/newsbeat-49265125> accessed 12 November 2021..

then encased in artificial amber.[52] Since the operators of this spacecraft never informed other State parties or UN authorities of their activities, this can be considered as a breach of the obligation to inform as well as harmful interference with the Moon's natural environment. Having this scenario in mind, in the light of the current trend towards legitimization of space mining and resource extraction and use related activities, one can only imagine what could happen in a reverse scenario - if various private companies were to endeavour in space mining, with the lack of transparency that such a long distance implies, and further were to return extracted resources, tested only with space based equipment, without the exposure to Earth's conditions, to Earth, creating back contamination and irreversible damage.

But, environmental damage can also occur by pollution through waste generation from dysfunctional space objects. Space waste is commonly known as space or orbital debris.[53]

NASA's Space Debris Quarterly news report dated from June 2021, states that the 18th Space Control Squadron of the U.S. Space Force detected the first two on-orbit breakup events of 2021 in March.[54] The first breakup was associated with NOAA 17 on March 10th, which generated 102 fragments that have been identified and tracked.[55] The second breakup was associated with YunHai 1-02 (International Designator 2019-063A, Catalogue number 44547) on March 18th, and generated 43 fragments from the breakup.[56]

According to the Union of Concerned Scientists ("**UCS**"), which keeps a record of the operational satellites, there are 6,542 satellites, out of which 3,372 satellites are active and 3,170 satellites are inactive, as recorded by January 1st, 2021.[57]

At the end of April 2021, according to the Index of Objects Launched into Outer Space, maintained by the United Nations Office for Outer Space Affairs, there were 7,389 individual satellites in Space, which is an increase of 27.97% compared to 2020.[58] The database also shows that since inception 11,139 satellites have been launched, out of which only 7,389 are still in Space, while the rest have either been burnt up in the atmosphere or have returned to Earth in the form of debris, much like the recent Chinese Long March 5C rocket, which dived into the Indian Ocean.[59]

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[52] Ibid.

[53] See more: T. Blagojevic, 'To Infinity and Beyond, finding an adequate approach to protect from environmental damages in outer space - prevention or remediation', Chapter 9, *Green Crimes and International Criminal Law*, Ed. (Regina Paulose, Vernon Press, 2020)

[54] 'National Aeronautics And Space Administration Orbital Debris Quarterly News,' (*Orbitaldebris.jsc.nasa.gov*, 2021) <https://orbitaldebris.jsc.nasa.gov/quarterly-news/pdfs/odqnv25i2.pdf> accessed 10 December 2021.

[55] Ibid.

[56] Ibid

[57] Nibedita Mohanta, 'How Many Satellites Are Orbiting The Earth In 2021?' (*Geospatial World*, 2021) <https://www.geospatialworld.net/blogs/how-many-satellites-are-orbiting-the-earth-in-2021/> accessed 14 November 2021.

[58] Ibid.

[59] Ibid.

In mid-November 2021, newly released NASA recordings captured the dramatic moment the crew of the International Space Station was ordered to seek shelter as debris from an exploded Russian satellite closed in on the orbiting craft.[60]

On average over the last two decades, 12 accidental 'fragmentations' have occurred in space every year – and this trend is unfortunately increasing.[61] The continued creation of space debris will lead to the Kessler syndrome, when the density of objects in low Earth orbit is high enough that collisions between objects and debris create a cascade effect, each crash generating debris that then increases the likelihood of further collisions, at which point, certain orbits around Earth will become entirely inhospitable.[62]

The European Space Agency (ESA) has highlighted in its 2022 Report,[63] that the amount of space debris in orbit continues to rise, and that more than 30000 pieces of space debris have been recorded and are regularly tracked by space surveillance networks, but that due to the time elapsed between the creation of debris and the observation, it is difficult to trace their origins to a specific "fragmentation event".[64] Based on ESA models, the true number of objects larger than 1 cm in size is likely over one million.[65]

A robotics professor at the University of Utah, Jake Abbott, told The Salt Lake Tribune that "*Earth is on course to have its own rings, they'll just be made of junk*."[66] Abbott was part of a team of researchers that published a report in October 2021,[67] which detailed how nonmagnetic space junk can conduct electricity, by which he believed to have found a way by using controlled force and torque to slow spinning objects, move them around and eventually collect them.[68]

The current state of the LEO, the growing interest in commercial space activities and the following space traffic congestion should stress the urgent need to find the necessary minimum of regulation within the framework provided by Space Law, which would provide a path towards the

[60] Jorge Fitz-Gibbon, 'Russia Shoots Down Satellite In 'Debris-Generating Event': US Space Command' (*Nypost.com*, 2021) <https://nypost.com/2021/11/16/russia-shoots-down-satellite-in-debris-generating-event-us-space-command/> accessed 19 November 2021.
[61] 'The Current State Of Space Debris' (*https://www.esa.int*, 2020) <https://www.esa.int/Safety_Security/Space_Debris/The_current_state_of_space_debris> accessed 6 November 2021.
[62] *Ibid.*
[63] See: ESA Space Debris Office, 'ESA'S ANNUAL SPACE ENVIRONMENT REPORT', (April 2022) <https://www.sdo.esoc.esa.int/environment_report/Space_Environment_Report_latest.pdf> Accessed August 2022.
[64] ESA's Space Environment Report 2022 (ESA.int, March 2022), <https://www.esa.int/Space_Safety/Space_Debris/ESA_s_Space_Environment_Report_2022#:~:text=We%27ve%20spotted%20more%20than%2030%20000%20pieces%20of%20space%20debris&text=The%20amount%20of%20space%20debris,of%20unidentified%20objects%20(UI).> Accessed August 2022.
[65] Ibid.
[66] Shirin Ali, 'Scientist Predicts Earth Will Develop Rings Like Saturn' (*TheHill, Changing America*, 2021) <https://thehill.com/changing-america/resilience/smart-cities/582777-scientist-predicts-earth-will-develop-rings-like> accessed 15 November 2021.
[67] Pham, L.N., Tabor, G.F., Pourkand, A. *et al.* 'Dexterous magnetic manipulation of conductive non-magnetic objects', *Nature* 598, 439–443 (2021). <https://doi.org/10.1038/s41586-021-03966-6>
[68] Ali, (n 46)

long-term sustainability of undertaking space activities, while providing protection and conservation of outer space and celestial bodies environments.

3. OUTER SPACE AND CELESTIAL BODIES AS THE OBJECTS OF PROTECTION

3.1 Outer Space as Common Good and its regime

Having in mind that outer space is not legally defined but is regarded in the Space Treaties as the "Province of All Mankind",[69] and Moon and its natural resources as the "Common Heritage of Mankind"[70] and considering the fact that "Commons" are resources potentially used by multiple actors,[71] there is a need to differentiate the particular parts of outer space in order to determine what space consists of and understand the particular legal regime applicable to those parts. This distinction is of particular importance due to the congestion already present in the Earth's Orbits, and the potential inadequacy or insufficiency of the protection provided by the existing framework.

Certain important provisions of the Space Treaties extend their scope to celestial bodies, while some do not. For example,while the OST Article I and II[72] do not differentiate between outer space and celestial bodies, Article IV paragraph 2 provides rules on military uses which apply only to celestial bodies, but not to other parts of space.[73] On the other hand, the Moon Agreement contains an implied differentiation, since it applies only to the Moon and celestial bodies within the solar system, including orbits or other trajectories to or around it." [74]

As outer space is commonly referred to as "global commons", the particular parts or domains are also traditionally considered to be "global commons", although they have different characteristics and different property rights regimes considering the specific benefits that they can generate.[75]

By the term "parts of space", some scholars differentiate areas, resources, and objects, natural or artificial, e.g., planets, asteroids, void space, Earth orbits, and even man-made spacecraft.[76] The term parts of space as "Economic Commons", should refer to the four types of goods/resources: private goods; public goods; common pool resources ("**CPR**"); and toll goods - which should then facilitate determining whether parts of space - planets, minerals to be harvested,

[69] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205, Art 1, [hereinafter OST]. <https://www.unoosa.org/pdf/gares/ARES_21_2222E.pdf>

[70] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 18, 1979, 1363 U.N.T.S. 3 [hereinafter Moon Agreement]. Article 11. <https://www.unoosa.org/pdf/gares/ARES_34_68E.pdf>

[71] Eytan Tepper, 'The Big Bang Of Space Governance: Towards Decentralised Regulation Of Space Activities' (PhD, McGill University Libraries 2020),p 202

[72] OST, Article 1, (n. 49)

[73] Tepper (n 40), p 202

[74] Moon Agreement, Article 1, par 1 and 2, (n 50)

[75] Tepper, (n 40), p 201

[76] Ibid, 201

void space, and orbits - are economic commons or another type of a resource.[77] These economic qualifications should be in effect to further facilitate appropriate legal regulation, especially in the era when space resource extraction and space mining are becoming a common discussion in scientific and legal circles.

For example, a CPR is one of four types of goods/resources which has two features: subtractability from others and non-excludability.[78] Both CPRs and public goods share the feature of non-excludability, and it is the subtractability or rivalry that distinguishes between them.[79] The OST implies rivalry and difficulty of exclusion of potential users[80] by providing "*free exploration and use by all States of Outer space, the Moon and other celestial bodies.*"[81] Otherwise, it could have been that the original state parties and negotiators have foreseen the probability of future rivalry and therefore intended to prevent such issues by declaring space for all mankind and limit future actors seeking exclusive use**.**

Celestial bodies, orbits, and void space are resources potentially used by multiple actors and therefore are economic commons, but void space or deserted orbits are not CPRs, since they probably feature lower subtractability, compared to the Moon, Mars, asteroids, resources and minerals.[82] Likewise, those artificial objects in space that have multiple users, such as the ISS, are also economic commons, regardless of their ownership, but since they feature subtractability, and exclusion, they are not CPRs.[83] On the other hand, those artificial objects with a single user, e.g., a satellite belonging to and serving a single State, are not economic commons.[84]

There are five rights most relevant for the use of CPR's: access; withdrawal; management; exclusion, and alienation.[85]

Generally, any kind of property can have various types of "holders" - owner, proprietor, claimant, authorised user or authorised entrant - and their identity can vary, meaning that a holder can be an individual, corporation, government, or communal group,[86] which justifies subsuming activities of private space actors under the scope of space law, having in mind that they are mainly corporations planning to claim certain rights in the future mining ventures, or at least, the fact that as entrants, they have to be authorised by states.

This can also be used to analyse the meaning of the OST Article I which grants all States the freedom to access, and thereby renders such States at least as authorised entrants or users, as there is also freedom of exploration, and scientific investigation.[87] According to Tepper it may be argued that the ability to make a "withdrawal" also falls under a form of use of space that is free

[77] Ibid. 204-208
[78] Ibid. 120
[79] Ibid. 208
[80] Ibid.
[81] OST, Article I, par. 2.
[82] Tepper, (n 51),. p. 208, 209
[83] Ibid, p.209
[84] Ibid, p.209
[85] Ibid, p.222
[86] Ibid. p.225
[87] There is also freedom of exploration, and scientific investigation. Ibid, p.223,

to all States.[88] The rights of management, exclusion, and alienation are given neither to any single State nor to an intergovernmental organisation, and therefore they belong (by default) either to all States collectively or to humankind.[89] All these factors imply the inadequacy of the existence of the current regime under the Space Treaties, with a single governing regime that would be appropriate for all parts of space and all types of activities and subject matters, as it emerged in the Cold War era, and implied the limitation of space activities to scientific and educational purposes whereas now there is a clear need for acknowledging the commercial use. The additional complexity is that these rights and freedoms are vested in "mankind" as a collective, and mankind is not a distinguishable legal entity, nor is it explicitly or formally recognized as such by International Law.[90] According to the OST, certain freedoms, such as the freedom to access, are given to all States, separately, which further means that the identity of the beneficiary of the freedom is not a group, and it is not common property.[91] Other rights, such as the rights of management and exclusion, are not held by any single State and are in the collective hands of all States, and can be enjoyed as common rights by all States,[92] as collective decision makers. In other words, it appears that private ownership, for certain parts of space, at least for the time being, possibly coexists side by side with common property.[93] But if all states enjoy the same mutual freedoms on an equitable basis, private ownership which involves competing interests, would be possible stricto sensu, only upon making a legal and written differentiation between various parts of space, its resources, and rendering states, or even commercial actors different freedoms or rights based on the characteristics of such parts of space or objects.

This highlights the need for space governance operating in multiple nested layers with various governance centres and subsidiary centres, which requires the allocation of certain powers or delegation of such powers to each level of governance.[94] The result is that each resource or type of resource has a governance system suited to its characteristics, within the larger governance system for space natural resources, all of which are part of space governance and operate in conformity with the Space Treaties and in coordination with other governance centres and the main forums – UN-COPUOS (United Nations Committee for Peaceful Uses of Outer Space) and UNOOSA (United Nations Office for Outer Space Affairs).[95]

Such distinctions and differentiations highlight the need to recognize all space actors and parts of space as participants in the industry, and allocating appropriate levels of interests, benefits,

[88] Ibid, p.223
[89] Ibid, p.223
[90] Ibid. p.229
[91] Ibid. p.229
[92] Ibid. p.229
[93] Ibid. p.229
[94] Ibid.p 233
[95] Ibid.p. 233

freedoms, rights and duties, all in order to provide proper protection to all parts of space according to their nature and characteristics.

3.2 Parts of Space - Celestial bodies, their orbits and space resources

When it comes to the legal definition of the term "celestial bodies", there is uncertainty among the scientific community on which method to use. First, it has been argued that the celestial body concept should comprise only certain astronomical categories, such as stars, planets and their satellites.[96] That definition reaffirms the fact that Mars, as the fourth planet from the Sun and the seventh largest,[97] and especially as a celestial body, is protected by, at the very least, the OST and the Moon Agreement, having in mind that these treaties use the wording, and extend the scope of their provisions to "Outer space, Moon and other Celestial bodies"[98].

On the other hand, because there is no officially accepted governing definition of celestial bodies, it is unclear whether "celestial bodies" include asteroids.[99] Most legal scholars agree that asteroids should be encompassed within the treaty terms, reflected by the International Astronomical Union ("**IAU**") definition of "celestial bodies" which also includes asteroids.[100] Within the solar system, the IAU recognizes the following celestial bodies: the Sun; the planets; the Moon of Earth and the moons of other planets; Near-Earth Objects; dwarf planets; trans-Neptunian objects; asteroids; comets; and Kuiper belt objects.[101] But it has been suggested that the meaning of "celestial body" should not necessarily correspond to that of its scientific equivalent.[102] In fact, most commentators dispense with the astronomical classification and focus on the physical properties of the material phenomenon at stake, relying solely on qualities such as the body's size or mass to determine its legal status.[103]

Working Group III of the International Institute of Space Law on the legal status of celestial bodies, defined Celestial bodies as all

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[96] Phillip De Man, 'The Commercial Exploitation Of Outer Space And Celestial Bodies – A Functional Solution To The Natural Resource Challenge', *Proceedings of the 53rd IISL Colloquium on The Law of Outer Space, Young Scholars Session,* (The International Institute of Space Law Paris, France,2011), p 46, <https://www.iislweb.org/docs/NewPerspectivesonSpaceLaw.pdf>

[97] See: 'Astropages | Planets' (*Wwu.edu*, 2021) <https://www.wwu.edu/astro101/a101_planets.shtml> accessed 10 November 2021.

[98] Most of the provisions in the Outer Space Treaty extend their scope to " Outer Space, Moon and other celestial bodies", which is visible even in its title. See for example: Annex 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, pp.13 <https://www.unoosa.org/pdf/gares/ARES_21_2222E.pdf>. Accessed August 2022.

[99] Leslie I Tennen, 'Towards a New Regime for Exploitation of Outer Space Mineral Resources' (2010) 88 Neb L Rev, p. 794, 796.

[100] Ibid. p. 796-797

[101] Leslie I. Tennen, 'Enterprise Rights and the Legal Regime for Exploitation of Outer Space Resources', 47 U. Pac. L. Rev. 281 (2017). P. 284, Available at: <https://scholarlycommons.pacific.edu/uoplawreview/vol47/iss2/14> .

[102] E. Vassilevskaia, 'Les problèmes juridiques de la mise en valeur de la Lune et des planètes', in A. PIRADOV (ed.), *Le droit international de l'espace*, Moscow, Editions du Progrès, 1976, 148.

[103] Ph. De Man, (n76), p.47.

"*natural objects in outer space, including their eventual gaseous corona, which cannot be artificially moved from their natural orbits*".[104]

However, the inclusion of "g*aseous coronas*"[105] in the definition has been denounced for running counter to common sense.[106]

The majority opinion is that the functional approach is more flexible for adaptation to new concepts and phenomena, and is more in line with the central goal of the Space Treaties (which is to encourage the exploration and use of outer space, including the Moon and other celestial bodies), meaning that there is little to no reason to apply a uniform definition of celestial bodies to a wide range of human activities that by their aim are geared toward different phenomena in space.[107]

In regards to Orbits, the orbits around the Moon are included in the scope of protection provided by the Moon Agreement, "*…including orbits around or other trajectories to or around it*".[108] An orbit is the curved path that an object in space (such as a star, planet, moon, asteroid or spacecraft) takes around another object due to gravity.[109]

However, although the Moon orbits are protected, some orbits, such as the Earth orbits, are not explicitly included in the scope of the Space Treaties. There are essentially three types of Earth orbits: high Earth orbit, medium Earth orbit, and LEO.[110] Many weather satellites and some communications satellites tend to have a high Earth orbit, while navigation and specialty satellites, designed to monitor a particular region, orbit in the medium Earth orbit.[111] However, most scientific satellites are located in LEO.[112] Some orbits, such as Geostationary, are congested and the use thereof by one actor subtracts from the use of other actors, which means that they can be considered CPRs, whereas other orbits might be rather deserted, with low density and therefore low subtractability.[113] This implies that different legal definitions, rights and regimes should be applied to different orbits based on their functionality and use, as much as their characteristics.

Aside from orbits and celestial bodies, space also contains valuable resources that provide compelling reasons for entrepreneurs, investors, and governments to pursue space exploration and settlement.[114] Asteroids are known to be rich in valuable elements like Neodymium, Scandium,

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[104] See the comments of HALEY and SZTUCKI in the discussions of the Working Group III in the 1965- 1966 IISL Proceedings; R. FROHN, Internationalisierung von Himmelskörpern, Berlin, Verlag, 1969, 69; M.G. MARCOFF, Traité de droit international public de l'espace, Fribourg, Editions Universitaires de Fribourg Suisse, 1973, 242.

[105] The Gaseous Galactic halo or corona provides a place for disc space to vent its energy. See: The Gaseous Galactic Corona, Savage, B. D, The Physics of the Interstellar Medium and Intergalactic Medium. <https://adsabs.harvard.edu/full/1995ASPC...80..233S>

[106] Ibid.

[107] Ph. De, (n 46) p.48,

[108] Moon Agreement, (n. 51)

[109] ibid

[110] Holli Riebeek, 'Catalog Of Earth Satellite Orbits' (*Earthobservatory.nasa.gov*, 2021) <https://earthobservatory.nasa.gov/features/OrbitsCatalog> accessed 9 November 2021.

[111] Ibid

[112] Ibid

[113] Eytan Tepper, The Big Bang of Space Governance: Towards Decentralised Regulation of Space Activities, December 2019,p 202-203

[114] See*:* Simberg, (n 15) pp. 20-31

Yttrium, Iridium, Platinum, and Palladium, most of which are rare on Earth, and because of the high price that these minerals command, harvesting them from space could possibly justify even very costly mining expeditions.[115] The Moon is thought to be an abundant source of Helium-3, a few hundred tons of which could meet Earth's energy needs for an entire year.[116]

Some amount of extraterrestrial resource usage should be permissible to satisfy human needs for research and scientific gains, but there should also be a contamination threshold beyond which there is some sort of legal ramification.[117] The contamination threshold[118] could be determined by considering the value[119] of the contaminated body and the severity of the contamination, which can be governed by the categories of planetary protection priority already established by the The Committee on Space Research (COSPAR)[120] based upon the probability that those bodies have life on them.[121]

It it also necessary to differentiate between resource systems[122] and resource units[123], because they do not necessarily have the same governing regime, rather it is more adequate to create several different governing regimes where each set of rights will have distinct and different grantees, rights, and limitations.[124] Rules must be in place to determine and limit the access to the relevant resource system, while perhaps a different set of rules must be in place to determine and

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[115] Ibid.

[116]Altabef, (n. 30), p. 480.

[117] Ibid, p.483.

[118] A contamination threshold is based on a threshold response characterised by a toxic effect occurring above an exposure concentration. Most environmental contaminants are threshold contaminants. See: <http://www.popstoolkit.com/riskassessment/module/exposure+and+toxicity+analysis/toxicity/threshold+contaminants.aspx#:~:text=A%20threshold%20response%20is%20characterized,environmental%20contaminants%20are%20threshold%20contaminants.>

[119] The economic value is associated with monetary value, but a complete understanding of the resource value should include other values, such as: *market value* (price associated to the resources), *environmental value*, even if it is not recognised by the market, and *strategic value*, which can be linked to economic, social, geopolitical, cultural or even symbolic considerations. See: Delgado-Serrano, M. del M., & Ramos, P. (2015). Making Ostrom's framework applicable to characterise social ecological systems at the local level. *International Journal of the Commons*, *9*(2), 808–830. DOI: http://doi.org/10.18352/ijc.567 <https://www.thecommonsjournal.org/article/10.18352/ijc.567/#:~:text=3.2.-,Resource%20system%20(RS),resources%20are%20located%20or%20produced.> Accessed august 2022.

[120] Note: This will be examined more thoroughly in the appropriate part of this article, related to Soft Law

[121] Ibid.

[122] Resource system (RS) This subsystem describes the environmental conditions where the resources are located or produced. See: Delgado-Serrano, M. del M., & Ramos, P. (2015). Making Ostrom's framework applicable to characterise social ecological systems at the local level. *International Journal of the Commons*, *9*(2), 808–830. DOI: http://doi.org/10.18352/ijc.567 <https://www.thecommonsjournal.org/article/10.18352/ijc.567/#:~:text=3.2.-,Resource%20system%20(RS),resources%20are%20located%20or%20produced.> Accessed august 2022.

[123] Resource Unit is a subsystem which describes the natural resource units generated by the resource system. They can be countable/manageable (e.g. fish, water, wood) or need approximations to be measured (e.g. biodiversity). See: Delgado-Serrano, M. del M., & Ramos, P. (2015). Making Ostrom's framework applicable to characterise social ecological systems at the local level. *International Journal of the Commons*, *9*(2), 808–830. DOI: http://doi.org/10.18352/ijc.567 <https://www.thecommonsjournal.org/article/10.18352/ijc.567/#:~:text=3.2.-,Resource%20system%20(RS),resources%20are%20located%20or%20produced.> Accessed august 2022.

[124]Tepper,(n 51),p. 234

limit the right to harvest the resource units to ensure sustainable use of the resource system and its flow of benefits.[125]

According to the understanding of The Hague International Space Resources Governance Working Group, "*space resources are an extractable and/or recoverable abiotic resource in situ in outer space*,"[126] which includes mineral and volatile materials, including water, but excludes (a) satellite orbits; (b) radio spectrum; and (c) energy from the sun except when collected from unique and scarce locations.[127]

Now that each fundamental part of space and its relevant characteristics have been identified and explained (above), and that a sense of the importance of their future sustainable use and conservation has been highlighted, as objects of protection covered by the space law framework, in order to have a comprehensive view of the current state of the commercial space development, we need to understand who are the subjects, vesting their interest in those parts of outer space, and how are they covered by the current framework.

4. COMMERCIAL SPACE ACTORS AS SUBJECTS OF SPACE LAW

Although private space actors are neither formally and explicitly enumerated nor clearly defined as subjects of the Space Law, that does not automatically mean that their activities are not generally or at least implicitly covered or that they cannot be subsumed under the existing space law regime. Rather, the Space Treaties should be interpreted in good faith with due regard to the possible intent of the drafters. Since the Space Treaties originated in the 1960s, when States were the main and dominant actors in space activities, it is not reasonable to conclude that excluding private actors was intentional. Moreover, most relevant provisions that can pertain to space activities of private actors are already provided by the OST, and given the level of dependency of State authorities on commercial space activities, a trend towards their formal inclusion, is to be expected.

The Declaration on International Cooperation[128] (the "**Declaration**") provides that "...International cooperation in the exploration and use of outer space for peaceful purposes shall be conducted ….through means found most effective and appropriate by the States concerned, including inter alia, *governmental and non-governmental; commercial and non-commercial*; global, multilateral, regional or bilateral; and international cooperation among countries in all levels of development."[129] Therefore, having in mind that such cooperation can be achieved through both commercial and non-governmental means of organising, it is inherently implied that private entities are covered by the scope of Space Law, and being organised under the laws of a

[125] Ibid, p 204
[126] Building Blocks, (n 37), p. 1.
[127] Ibid, fn. 2,
[128] 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, 1997, A/RES/51/122, UN. General Assembly (51st sess. : 1996-1997), <https://www.unoosa.org/pdf/gares/ARES_51_122E.pdf>
[129] Ibid. par. 4, p 3

particular State as a direct subject of this principle, such a state is the one to ensure compliance with Space law. Additionally, the fact that the non-governmental organisations[130] are not explicitly defined or enumerated in any of the Space Treaties, broader interpretation allows subsuming any other form of a private entity as well.

The fact that States should cooperate in space activities, and are able to choose commercial forms or means of nongovernmental organising to do so, creates practical inherent limitations to the rights claimed by private actors. Even the concepts of the "Province of all mankind", and the "Common Heritage of mankind", imply free access and benefit sharing, but are inherently limited by the mere fact that they are provided to mankind as a whole, which is effectively a limitation of one's own rights if they cannot be exercised without interfering or breaching rights of others. However, since none of the principles or rules of Space Law directly refer to private actors and private actors are not directly or explicitly defined as recipients of duties, such duties are still tied to the states directly.

In that regard, the OST addresses the responsibility of States by stating that:

"*States Parties bear international responsibility for national activities in space including the Moon and other celestial bodies whether such activities are carried out by government agencies or non-governmental organisations, and for guaranteeing that national activities will be carried out in accordance with the treaty provisions*."[131]

Interpreting this article in good faith would presume that if States are to guarantee that national activities will be compliant with treaty provisions, *argumentum a fortiori* guides us to conclude that a form of indirect duty to comply can exist even for the private entities, since their activities are undertaken under the jurisdiction of a particular state, and therefore fall under its national activities. This provision is further strengthened by the fact that such "*activities of non-governmental entities in space require the authorization and continuing supervision of the appropriate State Parties*."[132] Similarly, the Declaration states that such acts "*require authorization and continuing supervision by the State concerned*", while the Moon Agreement states that "*....states shall ensure that non-governmental entities under their jurisdiction shall engage in activities on the Moon only under the authority and continuing supervision of the appropriate State Party."*[133] The concerned state must be the state of territory or nationality of such activities or actors, which should coincide with the appropriate state party. Authorization and continuous supervision imply the principle of effective control, or in other words, the fact that the State has to exercise due diligence over acts of its agents, such as astronauts, private actors, or even space tourists, or else liability provisions can be enforced. The test of effective control over

[130] Although they are usually non profit, since there is no universally agreed-upon definition of an NGO, and since they are typically a voluntary group or institution with a social mission, which operates independently from the government, such a broad approach allows flexible interpretation. See: "What is an NGO?" (NGOsource), <https://www.ngosource.org/what-is-an-ngo>

[131] Ibid, Article VI

[132] Ibid, Article VI

[133] 'Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space 1963, Preamble', point 5, <https://www.unoosa.org/pdf/gares/ARES_18_1962E.pdf>

States "agents" envisages that the State will be directly responsible for the acts of individuals or groups that *de facto* or *de jure* act as its agents, if it had real, immediate and effective control over them, which is possible if the State was aware of the activities, which the State funded, which were undertaken by actors the State has financed. Even if the State was not the one financing such activities, the State is the one with the obligation to authorise and supervise them.

The following articles of the OST clarify the basis of international liability of States for "*damage from a space object or its components on Earth, in airspace or outer space, including the Moon and other celestial bodies*, *to another State Party or its natural or legal persons,*" by tying it to the action of launching, procuring the launch, the territory or the facility used for launching.[134] This provision confirms the nexus between private space actors and the State, based on usage of the State's territory or object, or the fact that the State was participating in some manner, or had financial interest related to the launch. In other words, the liability is tied to the State based on the nationality principle[135] or the territorial principle, if the act was done on its territory or by usage of its facility. Therefore, even if the private space actors cannot be held responsible or liable directly, the State can, and could further hold such actors liable in national courts by enforcing its national laws.

Moreover, Article VIII of the OST states that

> "*A State Party on whose registry an object launched into space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to Earth…*".[136]

The formal incorporation of the principle of *retaining ownership over space objects and their staff*[137] reduces the possibility of isolating the state from liability by claiming that it lacks effective control over its national activities.[138] Moreover, as this article includes "*...and any personnel thereof*", without explicitly defining personnel, this should include private actors as well, at least if their space object is registered in the State from whose territory it was launched. Additionally, the fact that objects "*landed or constructed on a celestial body"* are included only reaffirms the fact that one cannot completely evade Space law regulation, by landing or constructing an object first, especially having in mind the principles of free access, peaceful uses and non-appropriation, for which it can be argued that have value and effect *erga omnes*.[139] If

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[134] Moon Agreement, Article 14, par 1.

[135] L. Kovudhikulrungsri, D. Nakseeharach, Liability Regime of International Space Law: Some Lessons from International Nuclear Law, 4 Journal Of East Asia And International Law And Int'l L. 291, 298, (2011), <https://heinonline.org/HOL/LandingP.?handle=hein.journals/jeasil4&div=30&id=&p.=&t=1556925702>

[136] OST, Article VII

[137] Ibid, Article VIII

[138] Blagojevic, Infinity (n 37) p 319

[139] Having in mind that more than 50 years have passed from the date when the OST was brought, in the 1963, up until today, in 2022, in what time scope no state has yet officially protested to the emergence of customs, in the light

nothing else, these provisions provide that the launching State, as the appropriate State concerned, or the State of registry, is still responsible and liable for the actions of any organisation, individual or legal entity, regardless of whether they are explicitly listed in the Space Treaties.[140]

These rules and principles from OST are supported by the provisions of Liability Convention[141] and Registration Convention.[142] The Liability Convention does that through clarifying relevant terms, where "*launch*" includes an "*attempted launch*", and "*launching State*" includes "*the State initiating or procuring the launch of a space object, and the State from whose territory or facility the space object is launched*."[143]

The definition of the liable State of the Liability Convention was further elaborated within the Registration Convention which reaffirmed the condition of registration of the space object with the launching State for establishing liability, by coinciding the launching state and the state of registry, through defining the "State of registry" as the "*launching State on whose registry a space object is carried.*"[144] This confirms that the liability of the launching state derives from the territorial principle, or affiliation of the space object, or nationality of personnel it has jurisdiction and control over, which, having in mind the principle of retaining ownership over the space object, also facilitates proving the causality by attributing the action that causes damage to the State of registry, regardless whether such an action comes from private actors not explicitly listed in these conventions.[145]

Having in mind all of the above, we cannot oversee the fact that remains - there is no explicit or clear definition or reference to private space actors in regard to their direct rights or duties in the current Space Law regime. But, taking into account the already tested functional approach, based on the type of activities undertaken, the private actors could be subsumed under other analogous concepts referring to subjects in outer space, such as astronauts, personnel, staff or operators, and only functionally and contextually, the corresponding provisions could be applicable to private actors as well.

For example, in relation to the definition of "astronauts", there are various definitions:
1. Although not otherwise explicitly defined in the Space Treaties, they are generally described alternatively as "*persons who travel beyond Earth's atmosphere, or trainees for spaceflight*."[146] 2. According to the Cambridge Dictionary, an astronaut is "*a person who has been trained for*

of the theory that Space Law emerged almost instantly, through a kind of unprotested "Instant custom", interpretation can allow an erga omnes value.

[140] N 137, p 319

[141] 'Convention on International Liability for Damage Caused by Space Objects', Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention].

[142] 'Convention on Registration of Objects Launched into Outer Space', June 6 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

[143] Liability Convention, (n 116) Art. I, a)-d)

[144] Ibid, Article I, c)

[145] Blagojevic, Infinity, (n 37), p. 320

[146] Louis de Gouyon Matignon, 'The Legal Status Of Astronauts*', (*January 26, 2019), <https://www.spacelegalissues.com/space-law-the-legal-status-of-astronauts/>

travelling in space".[147] Since due to safety reasons and high risk of space activities, everyone going to space has to be trained to some extent, we would have to conclude that any private actor should be covered by the provisions that are referring to astronauts, at least temporarily, while travelling beyond Earth's atmosphere. Additionally, this idea is accepted by private actors to some extent as well, since some private companies have proposed the term *touronaut*[148] to define a space tourist, and if proven acceptable in future commercial space practice, should include private actors who procure or operate such flights.

3. From an international law perspective, astronauts are "*people who carry out professional activities connected with the exploration and use of outer space itself and on celestial bodies, in accordance with the rules and principles of international law*."[149] These conditions are set out in cumulation,[150] meaning that astronauts have to simultaneously be individuals, undertaking space activities, which are compliant with international law. Such definition does not exclude private actors, and sets out the compliance of space activities with space law as a *conditio sine qua non.* In reference to their legal status, it could be that the person must be in an object located in space, conducting their activities for the benefit and in the interests of all countries, regarded as an envoy of mankind in outer space.[151] Since such conditions are cumulative, it implies that, for the private actors to be considered astronauts, they must conduct their activities for the benefit and in the interest of mankind.

4. Article X of the Moon Agreement opens up the definition of "astronaut" by simply stating that "*any person on the Moon should be regarded as an astronaut*", meaning that any company installed on the Moon could claim an astronaut status and the rights attached to it, and that by analogy, any person in outer space, inside or outside any spacecraft or space object, could be considered as an astronaut.[152]

5. The legal status of astronauts is also regulated both in the OST and the Rescue Agreement.[153] In that regard, Article V of the OST states:

> "S*tates Parties to the Treaty shall regard astronauts as envoys of mankind in outer space and shall render to them all possible assistance in the event of accident, distress, or emergency landing on the territory of another State Party or on the high seas*".[154]

The OST further establishes that "*when astronauts make such a landing, they shall be safely and promptly returned to the State of registry of their space vehicle*,"[155] which reaffirms the nationality principle and registration as the basis to establish State liability (even in the case where private actors were to be considered astronauts and claim ownership over the object).

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[147] Ibid.
[148] Ibid.
[149] Ibid.
[150] Ibid.
[151] Ibid
[152] Ibid
[153] Agreement on the Rescue of Astronauts and the Return of Objects Launched in Outer Space, Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119 [hereinafter Rescue Agreement].
[154] OST, Article V, par 1
[155] Ibid, Article V, par 1

But, aside from rights, the OST establishes some responsibilities for astronauts as well, by providing that

> "*in carrying out activities in outer space and on celestial bodies, the astronauts of one State Party shall render all possible assistance to the astronauts of other States Parties*",[156]
> which provision is not repeated in the Rescue Agreement.

However, the OST, by providing that

> "*States Parties shall immediately inform other States Parties or the Secretary-General of the United Nations of any phenomena they discover in outer space, including the Moon and other celestial bodies, which could constitute a danger to the life or health of astronauts*",[157]

allows for an interpretation that in order for the State Party to disseminate such information, the same must be detected and gathered by astronauts, which showcases that they also have some amount of duty or responsibility.

Regarding the rescue operations and rendering assistance, the Rescue Agreement goes further than the OST, since Article III provides for the *rescue of the personnel of a spacecraft who have alighted on the high seas or in any other place not under the jurisdiction of any state*.[158] Thus, in addition to calling for the rescue of astronauts who have landed on the high seas, as provided for in Article V of the OST, the Rescue Agreement would require that rescue operations be undertaken where a landing has been made on the Moon or other celestial bodies, or on any land area of the Earth's surface not under the jurisdiction of any State, such as Antarctica.[159] Article IV further imposes an unconditional obligation to return the personnel of a spacecraft whose landing on the territory of a Contracting Party or outside the jurisdiction of any state is unintended or due to accident, distress, or emergency, to the launching state.[160] As we can see here, astronauts are also tied by the nationality principle, and their cooperation in rescue missions as a kind of agent or executor, through a certain delegation of the state's duties to rescue, implies the need for compliance with the provisions of OST and Rescue Agreement. Based on this interpretation, similar can be said for the expectations of due diligence delegated to non-governmental entities, private actors, as well as operators or personnel of the spacecraft.

With all of this in mind, a rational person could say that only extraterrestrial beings, Aliens, Martians or other indigenous beings originating from other celestial bodies, are not obliged to act in compliance with Space law, and only the potential future choice of Mars colonists to exercise the right for self-determination or renouncing citizenship and becoming stateless, would potentially theoretically justify "*alienation*" from the existing well-established principles. However, if not taken as subsumed under non-governmental entities, or not perceived as astronauts, operators, personnel or nationals, private actors, if they do not adhere to, but rather

[156] Ibid, Article V, par 2
[157] Ibid, Article V, par 3
[158] Rescue Agreement, Article III
[159] Ibid, Article III
[160] Ibid, Article IV

breach the existing principles related to the sustainable undertaking of space activities, may otherwise be perceived as cowboys or space pirates.

5. THE EXISTING NECESSARY MINIMUM OF SUSTAINABILITY

In order to even imagine the level of regulation required for future mining, construction and colonisation in Outer Space, Moon, Mars or other celestial bodies, the most important provisions related to sustainable undertaking of outer space activities must be outlined.

5.1 Outer Space Treaty and the Moon Agreement

The OST is the first legally binding treaty governing Space which, by incorporating the principles of space law, creates certain legal units per objects of protection or main regulatory matter, out of which, each such unit is more thoroughly elaborated in subsequently adopted contracts.[161] The OST preamble extension of international law and the UN Charter to outer space,[162] gives rise to the possibility of application of environmentally oriented provisions, and especially the framework provision of Sustainable development (including the precautionary principle and the principle of prevention, impact assessment, polluter and user pays principle, environmental information, transparency, public participation and similar).[163]

The OST more explicitly incorporates environmental principles of prevention and precaution by providing that space exploration should be undertaken so as to "*avoid harmful pollution and adverse changes resulting from the introduction of extraterrestrial matter into Earth's environment and adopt measures when necessary.*"[164] This provision should naturally and logically extend to all space actors (including private actors), when conducting space activities, since it has no explicit limitation in that matter, at least as an ethical instruction, or indirectly, through the State's responsibilities. Furthermore, a similar purpose can be achieved with the "*prevention of harmful interference with peaceful exploration and uses of outer space undertaken by other state parties*", through connection with the principle of information and transparency and providing that if a State is to notice such activities "*it should undertake consultations prior to proceeding with them*".[165] Both of these provisions were breached by the Israeli rocket which spilled Tardigrades in 2019, without any repercussions.

Most comparable provisions to the OST are contained in the lastly adopted Moon Agreement, which, although not accepted by all the space faring nations (and therefore, having an

[161]Blagojevic , Infinity, (n 37), p.313
[162]*Ibid*., p 313
[163] *See*: T. Blagojevic, 'To Infinity and Beyond, finding an adequate approach to protect from environmental damages in outer space - prevention or remediation', Chapter 9, *Green Crimes and International Criminal Law*, Ed. Regina Paulose, (Vernon Press, 2020)
[164]*Ibid*. p. 315
[165]*Ibid*.p. 316

effect as if it never entered into force)[166] consists of more progressive environmentally-oriented provisions.[167] Given such congruence of their regulation, many of the provisions from the Moon Agreement can be seen as explanatory to comparable provisions and serve to clarify other space treaties.[168] Moreover, the soft law sources have later on repeated many of the principles from the OST and Moon Agreement, confirming their legal force and value, as probable future standards in space.

For example, the Moon Agreement explicitly incorporates the principle of sustainability by foreseeing that

> "*attention should be paid to the interests of present and future generations, as well as to the need for promoting higher life standards and conditions of economic and social progress in accordance with the UN Charter.*"[169]

In addition to providing undertaking of measures to prevent disturbances to the existing balance of the Moon's and Earth's natural environment by introducing adverse changes through harmful contamination by extraterrestrial matter or otherwise,[170] the Moon Agreement requires the UN Secretary-General to be informed of the adopted measures and of all the placement of radioactive materials on the Moon and the reasons for it.[171] This provision could also serve to be adapted for the future Mars regulations, as similar standards are already in place in the regulation provided by some sources of soft law.

Additionally, the environmental orientation is visible in the

"*...obligation to inform the UN Secretary-General, the public and the international scientific community of any indications of organic life and any phenomena discovered by States Parties in space and on the Moon that could endanger human life or health*."[172]

Similar to the OST provision, this too was disregarded by the Israeli authorities and operators of the 2019 Israeli spacecraft that crash-landed on the Moon resulting in the spill out of Tardigrades. Some scholars consider such actions violate existing planetary protection guidelines, practices set out by the international COSPAR and national space agencies to prevent cross contamination between planetary bodies.[173]

But, the Moon Agreement also takes into account the economic development, sharing of resources and cooperation by anticipating the

"*equal and just enjoyment of the freedom of scientific research, right to collect, remove and dispose of samples of mineral and other substances of the Moon for scientific purposes*".[174]

In that regard, the Moon Agreement also provides the need to

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[166] *Ibid*. p. 314-315
[167] *Ibid*. p. 313/314
[168] *Ibid.* p. 313
[169] *Ibid.*p. 316
[170] *Ibid,* p. 316
[171] *Ibid,* p. 316
[172] *Ibid. p. 316*
[173] (N 87), p. 482
[174] *Ibid*. 316

"*inform the UN Secretary-General, the public, and the international scientific community of the potential discovery of natural resources on the Moon by a State Party*".[175]

Reporting by State parties to the UN Secretary-General on "*areas of special scientific interest on the Moon, in order to declare such areas international scientific reserves and to agree on special protection arrangements in consultation with the competent UN bodies*" is also a good solution.[176]

Development of the space industry is acknowledged by anticipating the need to establish an "*international regime and procedures for managing the exploitation of natural resources on the Moon*", which regime and procedures "*shall be subject to periodic revision following the scientific and technological development"*.[177] The goals of establishing an international regime are "orderly, safe, and rational development and management of Moon's natural resources, as well as their fair distribution among all States Parties, taking into account, especially, the interests and needs of developing countries and the efforts of the countries that have contributed to the exploration of the Moon".[178]

But, since the Moon Agreement is not internationally accepted, similar provisions have to be looked for in the OST, to justify their value and application. When it comes to specific commercial space activities, such as space mining and extraction of space resources which raise many questions and debates in legal theory, while the OST Article I reaffirms the principle of peaceful exploration and use of space, without discrimination, the Article II embodies the principle of non-appropriation by stating 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*."[179]

But, this provision only prohibits "national" appropriation, not all forms of resource extraction or claiming ownership over them, which leaves some inconsistencies between peaceful use and exploration, and non appropriation, still open for clarification. In that regard, the International Institute of Space Law, reiterated in its Position Paper dating from 2015, that:

> *"...it is uncontested under international law that any appropriation of "territory" even in outer space (e.g. orbital slots) or on celestial bodies is prohibited, it is less clear whether this Article also prohibits the taking of resources. Article I para. 2 of the Outer Space Treaty specifies the right of the free exploration and use of outer space and celestial bodies, without discrimination of any kind, on the basis of equality and in accordance within international law. Yet, there is no international agreement, whether the right of "free use" includes the right to take and consume non-renewable natural resources, including minerals and water on celestial bodies. According to the Moon Agreement of 1979, natural resources cannot become "property of any State, international intergovernmental or*

[175] *Ibid*. 316
[176] *Ibid*. 316
[177] Ibid. 317
[178] Ibid. 317
[179] OST, Article II

nongovernmental organisation, national organisation or non-governmental entity or of any natural person" (Article 11 para. 3). State Parties to the Moon Agreement agreed to establish an international regime to "govern the exploitation" of mineral resources "as such exploitation is about to become feasible". Article 11 has not gained the status of a rule of customary international law. Therefore, in view of the absence of a clear prohibition of the taking of resources in the Outer Space Treaty one can conclude that the use of space resources is permitted."[180]

As we can see, even the Moon Agreement recognises that exploitation of mineral resources is only about to become feasible, and the necessity of the recognition of their economic value and possible benefit sharing. But, the possible future regime supposed to be established, should preferably recognise both the economic value and possible priority rights, but also the characteristics of each type of the resource, renewable, or nonrenewable, and condition such extraction with scientific purposes that could contribute to future development.

All of such environmentally oriented provisions could only bind private space actors, if the State parties to the Space Treaties introduce domestic legislation requiring compliance and in relation to States, are only effective to the extent States and private actors each act in accordance with them.

5.2 Principles for the use of nuclear energy sources in space

The uncontrolled entry of the Soviet spacecraft 954 into Canada in January 1978[181] prompted the adoption of principles for the use of nuclear energy sources in space in 1992 by UN General Assembly Resolution 47/68 (the "**Nuclear Energy Principles**").[182] The Nuclear Energy Principles are important because space activities are still powered by nuclear power, due to the long distance and the lack of more sustainable and suitable alternatives.

The Nuclear Energy Principles must be read in the spirit of the Space Treaties, 1986. Atomic Energy Agency Convention on Early Notification of Nuclear Incidents[183] and the Convention on Assistance in Nuclear Incidents or Radiological Emergencies.[184] Even though the above are more permissive than prohibitive, they confirm the existing rules, and focus on the sustainable and safe undertaking of space activities.

The Nuclear Energy Principles apply to nuclear energy sources in the function of producing electricity in space objects for non-propulsion purposes, and reflect the efforts of the launching

[180] International Institute for Space Law, "POSITION PAPER ON SPACE RESOURCE MINING", (December 2015), <http://iislwebo.wwwnlss1.a2hosted.com/wp-content/uploads/2015/12/SpaceResourceMining.pdf>
[181] Ibid, 918
[182]'Principles Relevant to the Use of Nuclear Power Sources In Outer Space - With Introductory Note', UNGA Resolution 47/68, 14 December 1992, Introductory remark, p. 918,
<https://aerospace.org/sites/default/files/policy_archives/Principles%20on%20Nuclear%20Power%20Sources%20in%20Space.pdf>
[183] Ibid, 919
[184] Ibid, 919

States aimed at protecting individuals, populations and the biosphere against radiological disasters.[185] A summary of the Nuclear Energy Principles is set out below.

- The preamble of the Nuclear Energy Principles includes reference to the environmental principle of impact assessment, with special emphasis on reducing the risk of accidental public exposure to harmful radiation and radioactive materials.[186]
- The provided guidelines and criteria for safe use envisaged the use of nuclear energy sources only as the last resort, in order to reduce the amount of radioactive materials in space and the accompanying risks.[187] Such use is provided by nuclear reactors and radioisotope generators in interplanetary missions, in sufficiently high orbits, as well as for other missions leaving the Earth's gravitational field, and possibly in LEO, only if the operational part of the mission is deployed in sufficiently high orbits.[188]
- In addition, the design of nuclear reactors must not allow entering critical stages before reaching planned high orbits or interplanetary trajectory.[189] Taking into account generally accepted international guidelines for radiological protection, and in order to protect individuals, populations and the biosphere from radiological hazards, radiation and provide nuclear safety, the design and use of nuclear energy sources should ensure:
  (a) high reliability that radioactive material does not cause significant space pollution;
  (b) that there is no significant exposure to radiation during normal functioning of operations; and
  (c) the possibilities of accidents with serious consequences should be reduced.[190]
- Principle 4 is a duty of the launching State to conduct a thorough and comprehensive pre-launch safety assessment, through cooperation arrangements, covering all relevant mission phases, and publishing results prior to each launch, with notification to the UN Secretary-General.[191]
- Principle 5 requires timely notification on the re-entry into Earth orbit of dysfunctional space objects containing nuclear energy sources, so as to avoid the risk of radioactive contamination.[192]
- Principle 6 requires States to respond to requests for information and consultations, as far as possible.[193]
- Principle 7 requires all States with space monitoring and tracking facilities to promptly notify the UN Secretary-General and the State concerned and provide relevant information, on

[185] Ibid, 919
[186] 'Principles Relevant to the Use of Nuclear Power Sources In Outer Space', UNGA, A/RES/47/68, 14. December 1992, Preambule, <https://www.un.org/documents/ga/res/47/a47r068.htm>
[187] Ibid, Principle 3, par. 1, point 1
[188] Ibid. par. 2. Point a): i), ii), iii); par. 3 point. a) and d)
[189] Ibid. point. e)
[190] Ibid. par. 1 point,. a), b) and c)
[191] Ibid, Principle 4, par 1
[192] Ibid. Principle 5, par. 1 and 3.
[193] Ibid.

expected re-entries into the Earth's atmosphere of a space object containing a nuclear power source.[194]

The above overview demonstrates how the Nuclear Energy Principles elaborate on existing obligations of States parties to the Space Treaties, confirming their application explicitly to space objects with nuclear energy sources, and showcase the adaptation of environmental principles of prevention, precaution and impact assessment. It is noteworthy that principles 3 to 8 (inclusive) of the Nuclear Energy Principles are obligations that the USSR failed to undertake in the famous case of Cosmos 954,[195] as the first test of the Liability convention's applicability on nuclear damages created by space objects on Earth. The avoidance of similar future scenarios, is why this example showcases why these principles should be considered even in the development of commercial space activities.

5.3 Safety framework for the application of nuclear energy sources in space

The 2009 Safety Framework for Nuclear Power Source Applications in Outer Space ("**Safety Framework**") is a joint draft of the Scientific and Technical Subcommittee of UNCOPUOS and the International Atomic Energy Agency (IAEA) and provides guidance to governments and International Intergovernmental organisations to adopt and monitor the implementation of technical standards and guidelines for the design, proper use and operation of nuclear energy sources during all phases of the mission.[196] Although these guidelines and instructions are not strictly legal documents, and are to be adopted on a voluntary basis,[197] they could serve just as well to private companies and spacecraft manufacturers planning to endeavour in the commercial space industry.

The obligations of Governments and International Intergovernmental Organisations are set out in Section 3 and are limited to:

(i) establishing and ensuring compliance with security policies, requirements and processes;
(ii) assessing and providing an acceptable justification for the use of space nuclear energy sources in relation to alternatives;
(iii) establishing a formal process for mission launch approval; and
(iv) the preparation of an emergency response.[198]

It is also provided that the management in such organisations involved in the application of nuclear energy sources in space should adhere to governmental and relevant intergovernmental

[194]Ibid. Principle 7, par 1
[195] See: Blagojević, Infinity.
[196] 'Safety Framework for Nuclear Power Source Applications in Outer Space', Jointly published by the United Nations Committee on the Peaceful Uses of Outer Space Scientific and Technical Subcommittee and the International Atomic Energy Agency, IAEA, UN COPUOS, (Vienna, Austria, 2009.)Preamble, <:https://fas.org/nuke/space/iaea-space.pdf>
[197] Ibid, Preamble
[198] Ibid, p. 3

security policies, requirements and processes, in order to achieve the basic goal of security.[199] This provision could be of value for management of commercial organisations just as much, or at least serve to justify the necessity for compliance with space related security policies, requirements and processes implemented by their governments.

The technical guidelines concern emergency preparedness and consequence control of potential incidents, radiation risk assessment, nuclear safety assurance and other measures applied in the design, flow and phases of missions of space nuclear energy sources.[200]

Similar to the Nuclear Energy Principles, the Safety Framework provides for the appropriateness of certain environmental principles applicable in outer space, and could serve as the basis for safe and sustainable undertaking of commercial space activities by private actors as well. But, since the Safety Framework focuses on protecting people and the environment in the Earth's biosphere from possible accidents related to the launch, operation, completion of servicing of applied nuclear energy sources,[201] this framework does not cover protecting people in space during missions and the environment of other celestial bodies.

For such reasons, related to insufficiency in regards to protection of other parts of space, and the non-binding nature of these soft law instruments, as well as in order to understand the trend that the evolution of space law framework is to take, we would need to consider some similar, but slightly newer, or at least more progressive, sources of soft space law.

5.4. COSPAR Planetary protection policy and requirements

> The legal basis for planetary protection was established in Article IX of the OST by stating: "*...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 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…*"[202]

These COSPAR Planetary Protection Policy and Requirements are instructions to ensure that scientific investigations related to the origin and distribution of life are not compromised, and protect the Earth from the potential hazard posed by extraterrestrial matter carried by a spacecraft returning from an interplanetary mission.[203] COSPAR further maintains and promulgates a planetary protection policy for the reference of spacefaring nations, to set an international standard

[199] Ibid.
[200] Ibid, p. 4
[201] Ibid, p. 2
[202] Cospar Planetary Protection Policy (20 October 2002; As Amended To 24 March 2011) Approved By The Bureau And Council, World Space Council, Houston, Texas, USA (Prepared By The Cospar/Iau Workshop On Planetary Protection, 4/02, With Updates 10/02; 1/08, 4/09, 12/09, 3/11), Preamble p.. 1.
[203] G. Kminek , C. A. Conley, Planetary Protection Policy and Requirements, June 2015, p.3, <https://science.nasa.gov/science-red/s3fs-public/atoms/files/2Kminek-Conley.pdf#:~:text=COSPAR%20maintains%20and%20promulgates%20a%20planetary%20protection%20policy,forms%2C%20precursors%2C%20and%20remnants%20must%20not%20be%20jeopardized.>

on procedures to avoid organic constituent and biological contamination in space exploration, and to provide accepted guidelines and requirements in this area to guide compliance with the wording of the OST.[204]

The guidelines state:

"*The conduct of scientific investigations of possible extraterrestrial life forms, precursors, and remnants must not be jeopardised. In addition, the Earth must be protected from the potential hazard posed by extraterrestrial matter carried by a spacecraft returning from an interplanetary mission. Therefore, for certain space mission/target planet combinations, controls on contamination shall be imposed in accordance with issuances implementing this policy*."[205]

The COSPAR planetary protection policy also provides for five categories for target body/mission type combinations and their respective suggested ranges of requirements, assignment of which is to be determined by the best multidisciplinary scientific advice.[206] From category I to V, the requirements gradually enhance, and are summarised below.

- Category I includes "*any mission to a target body which is not of direct interest for understanding the process of chemical evolution or the origin of life*", which is why no protection of such bodies is warranted and no planetary protection requirements are imposed".[207]
- Category II requires only basic reporting and documentation.
- Categories IV and V contain more strict requirements. Mars, Europa, Enceladus are subsumed under Category IV (if just lander missions are included) and Category V (if including Earth return).[208] Venus and Moon can be subsumed under Category II (if including only flyby, orbiter or lander missions), but also fall under the Unrestricted Earth Return when subsumed under Category V, whereas Mars and Europa fall under the "Restricted Earth Return".[209]

The current COSPAR planetary protection principles for human Mars missions[210] provide among else that:

"*The intent of planetary protection is the same whether a mission to Mars is conducted robotically or with human explorers; Safeguarding the Earth from potential back contamination is the highest planetary protection priority in Mars exploration; The greater capability of human explorers can contribute to the exploration of Mars only if human-associated contamination is controlled and understood; One of the critical issues: for Apollo the preservation of human life took precedence over the quarantine*."[211]

[204]Cospar (n.189), Preamble, p.. 1
[205]DeVincenzi et al. 1983; COSPAR PP Workshop 2008; ESA PPWG 2008
[206]Cospar (n.189), Policy, p..1
[207]Ibid
[208]Ibid. 8, Appendix: Implementation Guidelines And Category Specifications For Individual Target Bodies (Version March 24, 2005), p. A-2
[209]Ibid. p. A-2
[210]Ibid, (n 189), p..9.
[211]Ibid, p. A-5

In regards to Mars, "*Special Regions*" are defined as regions within which terrestrial organisms are likely to replicate, but any region which is interpreted to have a high potential for the existence of extant Martian life forms is also subsumed under this definition.[212] Additionally, and given the current understanding of terrestrial organisms, Special Regions are defined as:

> "*areas or volumes within which sufficient water activity and sufficiently warm temperatures to permit replication of Earth organisms may exist*" , while "*Spacecraft-induced special regions are to be evaluated, consistent with these limits and features, on a case-by-case basis*".[213]

However, it is indicated that no Special Regions have been (currently) identified on the basis of possible Martian life forms, and if and when information becomes available on this subject, Special Regions will be further defined on that basis.[214]

The difference between COSPAR planetary protection principles and the above sources of soft law is that the COSPAR principles (by implementing a multidisciplinary approach to definitions and regulations and by the usage of scientific and technical criteria), take into account the specific nature and characteristics of celestial bodies and parts of space individually. The conciliation between human safety, mission security, the scientific and economic gain and sustainability and environmental conservation is clearly visible and demonstrates that a future model based on a functional approach would be most appropriate in outer space regulation. But, these principles, just like other sources of soft law, will have value and effect only to the extent they are firstly implemented by the states, and only then, to the extent that commercial space actors are willing to abide by them, and to the extent of the transparency of their activities and states ability to retain effective control and supervise them.

6. PAVING THE WAY TOWARDS CONGRUENCE AND RECONCILIATION OF ECONOMIC AND ENVIRONMENTAL PILLARS

Aside from the mentioned principles, guidelines and soft law in general, new regulation is emerging which reflects the main regulation that relate specifically to outer space, celestial body and resource protection. The recent increase in space activities and actors, and subsequent congestion of outer space traffic in the orbits, has developed a trend in sustainability inspired provisions that relate to orbit and planetary protection, which extends to non-governmental entities and to some extent, even to commercial actors. Such regulation, takes into account both economic and environmental pillars of sustainable development, and instructs on the need for their reconciliation in the near future.

6.1 Space Debris Mitigation Guidelines

[212] Ibid, p. A-5
[213] Ibid
[214] Ibid

The Space Debris Mitigation Guidelines ("**Debris Mitigation Guidelines**") are a legal policy document adopted by UNCOPUOS, endorsed by UN General Assembly Resolution 62/217 in 2007, and published by UNOOSA in 2010.[215] The Debris Mitigation Guidelines were developed relying on similar, but more detailed Guidelines of the Inter-Agency Space Debris Coordination Committee Space Debris Mitigation Guidelines.[216] In addition to legal and political recommendations, these Inter-Agency Guidelines contain scientific and technical terms and explanations reflecting common principles for space waste reduction. However, the Space Debris Mitigation Guidelines only recommend States and organisations to make every effort to implement, enforce and adhere to them.[217]

This soft law instrument refers to mission planning, design, production and operation of all phases of spacecraft, as well as the orbital phases of the launch facility.[218] Although the Debris Mitigation Guidelines are primarily intended for application in the planning of new, future missions and operation and functioning of newly designed spacecraft and orbital stations, compliance is recommended for current operations and existing aircraft, stations and missions.[219]

There are seven guidelines, which relate to, among other things:

(i) Limiting space debris during normal operations;

(ii) Reduction of potential fractures during the operational phase and due to energy accumulation in the post-mission stage;

(iii) Limiting the possibility of accidental collisions within the orbit;

(iv) Avoidance of intentional destruction and other harmful activities; and,

(v) Limiting the long-term presence of the orbital phases of spacecraft and launch objects in the LEO region after the completion of their mission.[220]

The Space Debris Mitigation Guidelines are primarily dealing with reducing the risk of space debris, but do not address the consequences and remediation of the environment after an environmental incident, nor the protection of specific celestial bodies. However, they can serve in the gradual development of a minimum of standards for states and private space actors, which would presume sustainable and safe undertaking of space activities on a long-term basis.

6.2 Guidelines For The Long-Term Sustainability Of Outer Space Activities

[215] *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space*, UN COPUOS, UNOOSA, Vienna, 2010, Preamble, p.. iii, iv, http://www.unoosa.org/pdf/publications/st_space_49E.pdf

[216] Inter-Agency Space Debris Coordination Committee Space Debris Mitigation Guidelines, IADC-02-01 Revision 1, Inter-Agency Space Debris Coordination Committee,September 2007.http://www.unoosa.org/documents/pdf/spacelaw/sd/IADC-2002-01-IADC-Space_Debris-Guidelines-Revision1.pdf

[217] *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space*, UN COPUOS, UNOOSA, Vienna, 2010., Prelude,pint. 3, p..2, http://www.unoosa.org/pdf/publications/st_space_49E.pdf

[218] *Ibid*. point. 4. p.. 2

[219] *Ibid*. point. 3 par. 2 i 3, p.. 2

[220] See: *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space*, UN COPUOS, UNOOSA, Vienna, 2010, http://www.unoosa.org/pdf/publications/st_space_49E.pdf

These voluntary Long-term Sustainability Guidelines were introduced to set out a holistic approach to the long-term sustainability of outer space activities, as an essential tool to meet the UN Sustainable Development Goals.[221] They comprise a compendium of internationally recognized measures and commitments to ensure the long-term sustainability of outer space activities and enhance the safety of space operations.[222]

The Long-term Sustainability Guidelines are premised on the understanding that outer space should remain an operationally stable and safe environment, maintained for peaceful purposes and open for exploration, use, and international cooperation by current and future generations, in the interest of all countries, irrespective of their degree of economic or scientific development, without discrimination of any kind and with due regard for the principle of equity.[223] Within these Guidelines, long-term sustainability of outer space activities is defined as:

> "*...Ability to maintain the conduct of space activities indefinitely into the future in a manner that realises the objectives of equitable access to the benefits of the exploration and use of outer space for peaceful purposes, in order to meet the needs of the present generations while preserving the outer space environment for future generations*".[224]

The Long-term Sustainability Guidelines further note their consistency with, and support the objectives of the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space and the OST, as such objectives are integrally associated with a commitment to conducting space activities in a manner that addresses the basic need to ensure that the outer space environment remains suitable for exploration and use by current and future generations.[225] It is clear that by repetition and reference to the main principles of space law and making a conditional nexus through interdependence between undertaking space activities and sustainability, these Sustainability Guidelines will help standardise and strengthen the adherence to environmentally-friendly aspects of space regulation.

Furthermore, the scope of the Long-term Sustainability Guidelines extends to both governmental and non-governmental entities, as well as to *all space activities*, whether planned or ongoing, as practicable, and to all phases of a space mission.[226] Since they reiterate that "*nothing in the guidelines should constitute a revision, qualification or reinterpretation of the principles and norms*"[227] of the main sources of Space law, it can be concluded that they provide a confirmation of the fact that the private actors are already covered by the space law framework.

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[221] 'Guidelines for the Long-term Sustainability of Outer Space Activities', A/AC.105/2018/CRP.20, *Conference room paper by the Chair of the Working Group on the Long-term Sustainability of Outer Space Activities*, (Committee on the Peaceful Uses of Outer Space, 27 June 2018). p. 1, <https://www.unoosa.org/res/oosadoc/data/documents/2018/aac_1052018crp/aac_1052018crp_20_0_html/AC105_2018_CRP20E.pdf>

[222] Ibid. p. 1

[223] Ibid, p. 1

[224] Ibid, p. 2

[225] Ibid, p. 2.

[226] Ibid. p. 3.

[227] Ibid. p. 3.

The instructions for better implementation, promotion and enforcement of already existing regulation are provided, in regards to:

(i) Policy and regulatory framework for space activities;
(ii) Safety of space operations;
(iii) International cooperation, capacity-building and awareness; and
(iv) Scientific and technical research and development.

The section relating to the policy and regulatory framework consists of instructions such as to *adopt, revise, amend, address, consider, promote, plan, supervise, ensure, and enhance,* which all refer to the sustainable and safe undertaking activities in compliance with the main sources of space law, as well as to Sustainable Development Goals, the Space Debris Mitigation Guidelines, the voluntary guidelines of the Inter-Agency Space Debris Coordination Committee and the Committee on Space Research, the Safety Framework for Nuclear Power Source Applications in Outer Space and the Principles Relevant to the Use of Nuclear Power Sources in Outer Space,[228] all in order to provide long term sustainability.

The Long-term Sustainability Guidelines elaborate instructions on methods to properly supervise national space activities by ensuring that entities undertake planning of procedures compliant with long term sustainability, and provide a supervising body in that order.[229] They also address the need to ensure the equitable, rational and efficient use of the radio frequency spectrum and the various orbital regions used by satellites,[230] which should prevent space traffic congestion and potential environmental incidents. They further established that the practice of registering space objects should be enhanced, in accordance with the obligations under Article VIII of the OST, the Registration Convention and taking into consideration the recommendations contained in General Assembly resolutions 1721 B (XVI) and 62/101.[231]

In the part referring to the "*Safety of space operations"*,[232] it is foreseen that the sharing of updated information on space objects and orbital events should be provided, as well as to enable timely coordination to reduce the probability of and/or to facilitate effective responses to orbital collisions, break-ups and other events that might increase the probability of accidental collisions or may pose a risk to human lives, property and/or the environment, in the case of uncontrolled re-entries of space objects.[233] Furthermore, it is provided that the accuracy of orbital data on space objects should be improved, that the practice and utility of sharing of such information should be enhanced, that the promotion of collection, sharing and dissemination of space debris monitoring information should be provided, that the conjunction assessment during all orbital phases of controlled flight should be performed; and that the practical approaches for pre-launch conjunction assessment should be developed.[234] Additionally, the sharing of operational space weather data

[228]Ibid, Guideline A-1 point 4, and A-2, point b) - f), p.5-6
[229]Ibid, p. 6-7
[230]Ibid. p. 7-8
[231]Ibid. p. 8
[232]Ibid. p. 10.
[233]Ibid. p. 10.
[234]Ibid. p. 11-12

and forecasts should be provided, and space weather models and tools and collecting established practices on the mitigation of space weather effects should be developed.[235] Measures should also be taken to address risks associated with the uncontrolled reentry of space objects, and the measures of precaution undertaken when observing and using sources of laser beams passing through outer space.[236]

In part referring to the *International cooperation, capacity-building and awareness*, the Sustainability Guidelines instruct on the promotion, facilitation, supporting and sharing experience related to the long-term sustainability of outer space activities and developing new procedures for information exchange.[237] In similar regard, the guidelines promote and instruct on the need to raise awareness on the importance and benefit coming from space activities.[238]

In the part on the *Scientific and technical research and development,* the Long-term Sustainability Guidelines provide for the need for promotion of research into, and the development of ways to support sustainable exploration and use of outer space with reference to the outcome document of the United Nations Conference on Sustainable Development,[239] the social, economic and environmental dimensions of sustainable development on Earth.[240] In that regard it is provided that the:

> "*States and international intergovernmental organisations should promote the development of technologies that minimise the environmental impact of manufacturing and launching space assets and that maximise the use of renewable resources and the reusability or repurposing of space assets to enhance the long-term sustainability of those activities*."[241]
>
> The Long-term Sustainability Guidelines also highlight the need to:
>
> "*investigate and consider new measures to manage the space debris population in the long term*."[242]
>
> Furthermore, such investigation could:
>
> "*include methods for the extension of operational lifetime, novel techniques to prevent collision with and among debris and objects with no means of changing their trajectory, advanced measures for spacecraft passivation and post-mission disposal and designs to enhance the disintegration of space systems during uncontrolled atmospheric re-entry*."[243]

By holistically referring to the Space Treaties, and instructing on how to properly implement and enforce them, the Long-term Sustainability Guidelines strengthen the force of the existing regulation and reaffirm the basic principles of the Space Treaties. Since the goal is the

[235] Ibid. p. 13-14
[236] Ibid. p. 15
[237] Ibid. p. 17-19
[238] Ibid. D. Scientific and technical research and development, Guideline D.1, p. 18-19
[239] General Assembly resolution 66/288, Annex, <https://documents-dds-ny.un.org/doc/UNDOC/GEN/N11/476/13/PDF/N1147613.pdf?OpenElement>
[240] Guideline D.1 (n 220), p.19
[241] Ibid.
[242] Ibid.
[243] Ibid, p. 19-20

long-term sustainability and safety in undertaking space activities, the Long-term Sustainability Guidelines reconcile the three main factors of sustainable development, by referring to simultaneous adherence to the existing Space Law framework, explicit application on non-governmental entities, and subtle extension of some provisions to private space actors.

6.3 Building Blocks For The Development Of An International Framework On Space Resource Activities

The Hague International Space Resources Governance Working Group, guided by the principle of adaptive governance, created Building Blocks for developing an International Framework on Space Resource Activities (the "**Building Blocks**").[244] The Building Blocks are a summary of references to already existing main principles, elaborated or clarified in some areas, acting as a guidance for future international framework for space resource activities, to reconcile the principles of economic investment, entrepreneurship and development with sustainability and security of undertaking space activities. The purpose of the future international framework is to:

> "*…create an enabling environment for space resource activities that takes into account all interests and benefits all countries and humankind*."[245]

Its scope is broad and covers the *space resource activities within the solar system, undertaken by states, international organisations, and non-governmental entities*.[246]

The main principles of the Building Blocks refer to the consistency of the framework with international law, through:

> "*adaptive governance and regulating space resource activities at the appropriate time, with due regard to promoting compatibility and predictability of national frameworks, contribution to sustainable development, prevention of disputes arising out of space resource activities, promotion and security of the orderly, safe, sustainable, rational, efficient and economic utilisation of space resources, providing legal certainty and predictability for operators and with taking into particular account the needs of developing countries, science, as well as contributions of pioneer operators*".[247]
>
> Furthermore, the international framework should provide that:
>
> "*space resources shall be used exclusively for peaceful purposes, and that space resource activities shall be carried out for the benefit and in the interests of all countries and humankind irrespective of their degree of economic and scientific development, as well as that appropriate international consultations shall be undertaken in accordance with Article IX OST if there is a reason to believe that any potentially harmful interference may be caused and that the international cooperation in space resource activities shall be conducted in accordance with International law*".[248]

[244] Building Blocks (n 37), Introduction, p.1.
[245] Ibid, Objective, p.1
[246] Ibid, Scope, p.2
[247] Ibid, Par 4.1 and 4.2, Principles, points a)-k) p.2.
[248] Ibid, Par 4.3, p. 2

Aside from referring to the main principles of Space law, it is clear that the Building Blocks implicitly extend the space regulation to private actors, when referring to pioneer operators. Noting that operators are defined so as to include both governmental, international as well as non-governmental entities conducting space resource activities,[249] the future framework, and all of its provisions extending to operators, are likely intended to extend to private space actors to the extent to which they are undertaking space resource activities. In this way, the Building Blocks confirm that private actors' space activities are at least covered within the scope, if not directly obliged by the existing framework and that their contributions should be formally and explicitly noted and regulated in the future.

In reference to priority rights, the Building Blocks state that the:

"international framework should enable their attribution to an operator to search for and/or recover space resources for a maximum period of time and a maximum area upon registration in an international registry, and provide for the international recognition of such priority rights".[250]

Furthermore, such:

"attribution, duration, and the area of the priority right should be determined on the basis of the specific circumstances of a proposed space resource activity."[251]

This is a clear, general statement requiring economic development to be pursued in parallel with sustainability, and requiring all operators to have equal opportunity, and their benefits to be recognised, since all are considered subjects of the future framework. Although it is visible that a path towards a development of different but parallel property rights regimes, depending on the actor and the part of space in question, has been created, another objective may have been to limit the duration and area of such activities, to comply with the non-appropriation principles in the OST. Similar limitations are placed on resource rights for raw minerals and volatile materials:

"*The international framework should ensure that resource rights over raw mineral and volatile materials extracted from space resources, as well as products derived therefrom, can lawfully be acquired through domestic legislation, bilateral agreements and/or multilateral agreements."*[252]

Therefore, the limitation of resource rights is firstly achieved by limiting by time and geographical area, then by the type of resources extracted, all of which must be compliant with domestic regulation and with Space law. But, the Building Blocks also add that the international framework should enable the mutual recognition between States of such resource rights.[253]

Finally, the international framework should ensure that the utilisation of space resources is carried out in accordance with the principle of non-appropriation under Article II OST, and the

[249] Ibid, Par. 2. Definition of key terms, p.1 and 2.
[250] Ibid, Par 7, Priority rights, p.3
[251] Ibid.
[252] Ibid, Par 8.1, Resource Rights, p.3.
[253] Ibid, Par 8.2, Resource Rights, p.3.

equal enjoyment of such rights is provided by elaborating the principle of due regard for corresponding interests of all countries and humankind.[254]

This is confirmed by requiring States and international organisations responsible for space resource activities to provide benefit-sharing by promoting space resource activities in all countries, particularly developing countries.[255] In practice this is achieved by mandating registration and information sharing by both States and international organisations of priority rights of operators to search and/or recover space resources in accordance with the international framework.[256] Such registration, sharing information and notification should be in compliance with the Registration Convention, United Nations General Assembly Resolution 1721 B (XVI), Article XI OST, taking into account United Nations General Assembly Resolution 62/101, the Radio Regulations of the International Telecommunication Union, and the legitimate interests of operators, information and best practices on the prior authorization and continuing supervision of space resource activities for which they are responsible through an international database.[257] The notification is supported by a statement on the condition of the area where the space resource activity was carried out including the presence of any space objects or space-made products, or parts thereof.[258]

Similar intentions are visible in the part on institutional arrangements, where the Building Blocks state that the international framework should provide for an establishment and maintenance of a publicly available international registry for registering priority rights of an operator to search and/or recover space resources, as well as a publicly available international database, and finally the designation or establishment of international bodies responsible for monitoring and governance.[259]

Regarding the international responsibility for space resource activities, reference is made to the Space Treaties and the Building Blocks reiterate that non-governmental space resource activities shall require prior authorization and continuing supervision by the appropriate State.[260] Regarding space-made products used in space resource activities for which States are responsible, it is stated that the "*international framework should provide that States have jurisdiction and control over such products"*,[261] which further strengthens State's authority, and limits the potentially illegitimate activities of private actors, that without supervision and authorization, could otherwise lead to an exhaustion of space resources.

In addition to ensuring the enablement of economic engagement in space activities, these building blocks also address sustainability by elaborating on the measures that should be adopted

[254] Ibid, Par 8.3, Resource Rights, p.3.
[255]Ibid. Par. 13, .Sharing of benefits arising out of the utilisation of space resources, p.5
[256]Ibid. Par. 14.Registration and sharing of information, p.5.
[257]Ibid. p.5
[258]Ibid.
[259] Ibid, Par. 18. Institutional arrangements, p.6.
[260]Ibid, Par. 5. International responsibility for space resource activities, p.3.
[261] Ibid, Par 6. Jurisdiction and control over space-made products used in space resource activities, p.3.

for avoidance and mitigation of potentially harmful impacts resulting from space resource activities.[262] Such risks include:

- The safety of persons, the environment or property;
- Damage to persons, the environment or property;
- Adverse changes in the environment of the Earth,
- Harmful contamination of outer space, and of celestial bodies, taking into account internationally agreed planetary protection policies;
- Harmful effects of the creation of space debris;
- Harmful interference with other ongoing space activities, including other space resource activities;
- Changes to designated and internationally endorsed outer space natural or cultural heritage sites;
- Adverse changes to designated and internationally endorsed outer space sites of scientific interest.[263]

Aside from that, the Building Blocks also provide for technical standards for, prior review of, and safety zones around space resource activities.[264] Monitoring and redressing harmful impacts resulting from space resource activities[265] is also foreseen as a necessary part of the future framework. When addressing the assistance in case of distress, the Building Blocks refer to Article V OST and the Rescue Agreement.[266]

Regarding the liability in case of damage resulting from space resource activities, the Building Blocks state that the international framework should provide for the applicability of Articles VI and VII OST and the Liability Convention to damage resulting from space resource activities.[267] This part goes beyond the existing Space Law framework by adding that the international framework should *encourage initiatives of operators to provide, individually or collectively, compensation for damage resulting from their space resource activities.*[268]

Regarding the visits relating to space resource activities, the building blocks provide that the international framework should support the applicability of Article XII OST.[269]

Regarding the settlement of disputes, the Building Blocks state that the international framework should encourage recourse by States, international organisations and operators to the resolution of disputes through adjudicatory, non-adjudicatory or hybrid mechanisms, for example by developing procedures for consultation or promoting the use of the 2011 Permanent Court of Arbitration Optional Rules for Arbitration of Disputes Relating to Outer Space Activities.[270]

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[262] Ibid, Par. 10.Avoidance and mitigation of potentially harmful impacts resulting from space resource activities, p.3 and 4
[263] Ibid.
[264] Ibid, Par. 11.Technical standards for, prior review of, and safety zones around space resource activities, p.4
[265] Ibid. Par. 12.Monitoring and redressing harmful impacts resulting from space resource activities, p.4 and 5.
[266] Ibid, Par. 15.Provision of assistance in case of distress, p.6.
[267] Ibid. Par. 16.Liability in case of damage resulting from space resource activities, p.6.
[268] Ibid. p.6.
[269] Ibid, Par. 17.Visits relating to space resource activities , p. 6.
[270] Ibid. Par. 19.Settlement of disputes, p. 7.

Finally, the Building Blocks also state that mechanisms should be developed for monitoring implementation of the international framework, for example on the basis of reports.[271]

It is noticeable that these building blocks provide an elaboration of the existing principles, rights and duties, with a very subtle evolutive and broader interpretation and adding a few new terms and concepts, which allow for the space activities of private actors to be subsumed under the future framework. But, the main difference between the Building Blocks and the Long-term Sustainability Guidelines is that the guidelines provided a foundation by highlighting the already existing principles and sources of space law, which the Building Blocks then further elaborated and expanded, as a suggestion of future regulation of activities undertaken in outer space.

6.4. The Artemis Accords

As part of the USA's Artemis program, NASA has released the Artemis Accords that aim to establish a common set of principles which govern the civil exploration and use of outer space in general, or in other words, to "*to create a safe and transparent environment which facilitates exploration, science, and commercial activities for all of humanity to enjoy*".[272] Having in mind that not all space powers accepted and implemented the Moon Agreement, the Accords are a clear step forward towards the preservation of sustainable development in outer space. Although the Accords claim to be grounded in the OST's basic principles, within their current scope of ten principles, they also introduce 'new' elements, such as "*safety zones"* on the Moon or interoperability, that take into account the evolution of space technology and of the space sector in general since the 1960s.[273]

The Accords call upon respecting the provisions of the OST and the Rescue Agreement, but also urge the states signatories, that have not yet signed the Registration Convention, to sign it. They also require publication of policies and plans of partner nations in a transparent manner and the release of scientific data, in order to ensure that the entire world can benefit.[274]

Publicity, transparency and informing are also requested in regards to safety zones, by stating:

"…partner nations will provide public information regarding the location and general nature of operations to inform the scale and scope of 'Safety Zones', and there shall be notification and coordination regarding these safety zones."[275]

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[271] Ibid. Par. 20.Monitoring and review, p.7

[272] David Alexandre, Dr. Gerry Bean, Jason Choi, Sarah Moens, Gregory Tulquois, 'Artemis Accords: New law for the moon and outer space?', (DLA Piper, July 2020), p.3, <https://www.dlapiper.com/en/us/insights/publications/2020/07/artemis-accords-new-law-for-the-moon-and-outer-space/>, accessed 1/9/2022

[273] Ibid.

[274] Ibid.

[275] 'The Artemis Accords - Principles For Cooperation In The Civil Exploration And Use Of The Moon, Mars, Comets And Asteroids For Peaceful Purposes', (NASA, Oct 2020), <https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf>

When it comes to sustainability and the protection and conservation of outer space, the Accords request commitment of partner nations *to the protection of sites and artefacts with historic value.*[276] In regards to the space resources, the Accords request that their

"extraction and utilisation can and will be conducted under the auspices of the Outer Space Treaty, with specific emphasis on Articles II, VI, and XI." [277]

When it comes to Orbital debris and spacecraft disposal the Accords request from NASA and the partner nations to

"*agree to act in a manner that is consistent with the principles reflected in the Space Debris Mitigation Guidelines, including agreeing to plan for the mitigation of orbital debris."*[278]

As we can see, similar to other soft law instruments, the Artemis Accords also have value to the extent to which they refer to already established principles, and any other clarifications or elaborations, can only contribute good faith and evolutive interpretations, geared towards the type of Space Law framework, such as the one suggested by the Building Blocks.

7. Conclusion

Noting the accelerated development of the commercial engagement in space activities, with the private space actors as the new legitimised subjects in the game, it is reasonable to conclude that it is necessary consider and reconcile the well-established principles related to free peaceful uses and sustainability, with the need to benefit share and recognise the efforts and investments in science and exploration.

Insufficient legally binding coverage of commercial space activities, the lack of formal inclusion and explicit recognition of private actors as official subjects of space law lead to numerous inconsistencies which further create legal insecurity and create a potential for a legitimization of unsustainable commercial space practices.

Such current developments, in the light of the recent rise of interest in commercial space activities and especially space mining, highlight the need to further implement the efforts such as the ones established by the Long-term sustainability guidelines and the Building Blocks, as international guidelines intended for the development of a harmonised set of rules on transparent, safe, equal and sustainable space resource exploitation and their use for explicit scientific and peaceful purposes, under the authorisation and supervision of the launching state, or the state of registry, in order to prevent illegitimate or unsustainable activities becoming customary and setting the course for creating standards for space mining.

To reconcile the economic, social and environmental pillars, and with the goal to provide long-term sustainability, and safeguard our new spectrum and potential Plan B, the law must become more flexible, inclusive and prescriptive. The evolution of Space law should take into account the existing legal gaps and ambiguities, lessons from similar mistakes which lead to

[276] Ibid.
[277] Ibid
[278] Ibid.

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unbalanced sustainability and Climate Change on Earth, to the extent of their adequacy for the new insufficiently explored terrains, taking into consideration their nature and characteristics of the parts of space, as well as scientific and technological developments, with due diligence and a multidisciplinary approach, based on inclusion, equality and transparency, in order to prevent the mistakes that were made on Planet Earth and in the LEO.

Notwithstanding the above, Space law is in part *in statu nascendi*, with basic, primary provisions (for rights and duties), basic concepts, terms and subjects or objects of protection still not individually and separately clarified or mutually harmonised. The current provisions will for the time being have to suffice, as general deterrent and prevention to private actors and devil's advocates in the pursuit for legal black holes in bad faith and with plainly anthropocentric goals.