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I. Introduction

The vast expanse of outer space has always been a source of fascination for humanity, beckoning us to explore and understand its mysteries. While the concept of outer space being owned by anyone may seem inconceivable, the potential for extracting valuable resources from it has sparked the interest of scientists, entrepreneurs, and governments alike. However, as we venture further into the depths of space, questions arise: who has the right to access and benefit from these resources? Should they be reserved for the benefit of a select few, or should they be shared equitably among the global community?

As we enter the new era of space exploration, the space economy is rapidly growing, reaching a value of 469 billion USD in 2022, and is expected to reach approximately 737 billion USD within the next decade.[1] This growth is pushed by a combination of robust private and public investment, with the United States leading the pack, being the top investor with 63% of global public investment in space exploration, which currently stands at $25.5 billion worldwide in 2022, a 59% increase over the past ten years.[2]

The evidence shows that using the resources provided to us by outer space combined with investments in space applications yield numerous valuable benefits on Earth in a number of fields of science and technology.[3]

For example, the unique outer space environment has enabled the conduct of ground-breaking experiments and the development of novel technologies within the medical field. Due to the specific location of astronauts (typically 400.000 km above the Earth's surface on board the International Space Station), leaps of progress have been made in telemedicine, i.e. remote diagnosis and treatment of patients.[4] Similarly, experiments on astronauts have resulted in

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[1] Space Foundation Releases The Space Report 2022 Q2 Showing Growth of Global Space Economy. In: *The Space Foundation* [online]. 2022. Available: https://www.spacefoundation.org/2022/07/27/the-space-report-2022-q2/

[2] MOHANTA, N. Global Government investment in Space Exploration to cross $30 billion by 2031. In: *Geospatialworld.net* [online]. 2022. Available: https://www.geospatialworld.net/prime/governmental-space-exploration-31b-globally/

[3] *Benefits Stemming from Space Exploration* [online], 2013, Available: https://www.nasa.gov/sites/default/files/files/Benefits-Stemming-from-Space-Exploration-2013-TAGGED.pdf

[4] DIETRICH, Damien, Ralitza DEKOVA, Stephan DAVY, Guillaume FAHRNI and Antoine GEISSBÜHLER. Applications of Space Technologies to Global Health: Scoping Review. *Journal of Medical Internet Research* [online]. 2018, **20**(6) [cit. 2023-04-20]. ISSN 1438-8871. Available: doi:10.2196/jmir.9458

findings that improve our understanding of cardiovascular disorders, type 2 diabetes, osteoporosis, and cancers.[5]

Furthermore, space activities play a key role in modernizing and maximizing the efficiency of agriculture. Remote sensing is a technique of remotely observing and measuring the Earth's surface and atmosphere using sensors mounted on satellites orbiting the Earth. The satellites capture electromagnetic radiation emitted or reflected by the Earth's surface and atmosphere, and the data is transmitted to ground stations for analysis. Remote satellite sensing is a valuable tool for a wide range of applications, from scientific research to resource management and national security. Perhaps most importantly however, remote sensing can play a key role in agriculture as it can be used to provide data about soil fertility, moisture, snow cover, and crop development. Similarly, other important agricultural factors can also be monitored, such as rainfall assessment, drought assessment, and weather predictions. Equipped with this data, farmers are able to maximize the effect of their soil and crops, reducing food shortages.[6]
Other applications of space activities include advancements in robotics[7], life support systems[8], telecommunications, and natural disaster prevention.[9]

While the current uses of outer space already yield significant returns, the future looks even brighter. Extraterrestrial mining and resource extraction from celestial bodies are often cited as the next step in our roadmap to becoming an interplanetary civilization. The Moon and other celestial bodies, such as asteroids in the Kuiper Belt, contain an attractive amount of significant natural resources. Potentially interesting for humanity are water crystals on the

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[5] Improving Healthcare. In: asc-csa.gc.ca [online]. 2020. Available: https://www.asc-csa.gc.ca/eng/about/everyday-benefits-of-space-exploration/improving-health-care.asp
[6] Benefits of Space: Agriculture. In: *unoosa.org* [online]. Available: https://www.unoosa.org/oosa/en/benefits-of-space/agriculture.html
[7] GUZMAN, A. Space Station Spurs Advances in Robotics for Space, Industry. In: *nasa.gov* [online]. 2022. Available: https://www.nasa.gov/mission_pages/station/research/benefits/iss-spurs-advances-robotics-for-space-industry
[8] JACKSON, S. Life Support Systems. In: *nasa.gov* [online]. 2017. Available: https://www.nasa.gov/content/life-support-systems
[9] Space technologies for disaster risk reduction and response. In: *joint-research-centre.ec.europa.eu* [online]. Available: https://joint-research-centre.ec.europa.eu/scientific-activities-z/space-technologies-disaster-risk-reduction-and-response_en

Moon's poles, Helium-3 particles in the Moon's regolith[10] and platinum or other minerals on asteroids.[11]

While there is no denying that our achievements in space have been impressive, and underlying problem remains unaddressed. The space activities described above are predominantly being conducted by the developed nations which have the financial and technological capacity to do so. Most notably the United States, China, Japan, and the EU. Unfortunately, developing nations with lacking capabilities are left behind, as seen from public investments into space programs per nation, which shows that the contributions of developing countries pale in comparison to the big players.[12][13] This is significant because the least developed countries would benefit the most from effective space applications. Often, these nations lack the trained personnel and equipment to fully employ such technologies and are therefore left reaping few of the benefits of humanity's actions in outer space. Such countries include most of the African countries with the exception of Nigeria and Rwanda, Latin American countries, and Middle Eastern countries.[14] [15] The listed regions would benefit greatly from the agricultural, medicinal, and other applications deriving from space activities, potentially helping them move from a developing country status to a developed member of the international community.

This dissonance leads to the central research questions of this paper: Is there a framework for sharing of space benefits and resources between the developed world and developing

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[10] Lunar regolith is the layer of loose, fragmented material that covers the surface of the Moon. It is composed of a mixture of materials including dust, soil, rock fragments, and other debris that have been accumulating on the lunar surface for billions of years. Lunar regolith is created by the impact of meteoroids on the Moon's surface, which pulverize the solid rock and create a layer of debris.

[11] VON DER DUNK, Frans. *Handbook of Space Law* [online]. Edward Elgar Publishing, 2015 [cit. 2023-04-20]. ISBN 9781781000366. Available: doi:10.4337/9781781000366. p. 772

[12] BRUKARDT, R. Space around the globe. In: *mckinsey.com* [online]. 2022. Available: https://www.mckinsey.com/industries/aerospace-and-defense/our-insights/space-around-the-globe

[13] BOAMAH, Frederick, Kwabena Kyei POAKWA and Kusi ADU-AMANKWAH. The Legal Regime of the Global Commons: An Examination of the High Seas and Outer Space in Africa. *Air and Space Law* [online]. 2023, 48(1), 49 [cit. 2023-04-20]. ISSN 0927-3379. Available: doi:10.54648/AILA2023013

[14] ONIOSUN, Temidayo Isaiah and Julie Michelle KLINGER. A Review of Country Classification Frameworks in the Space Sector: Priorities, Limitations, and Global Considerations. *Space Policy* [online]. 2022, **61** [cit. 2023-04-20]. ISSN 02659646. Available: doi:10.1016/j.spacepol.2022.101491

[15] POLANSKY, John and Mengu CHO. Classification of Countries Worldwide according to Satellite Activity Level. *Trans. JSASS Aerospace Tech. Japan Vol. 14*. 2016. Available: https://www.jstage.jst.go.jp/article/tastj/14/ists30/14_Pv_7/_pdf

countries? If so, is the current framework sufficient? What would a future framework look like?

This paper will describe the legal framework for the benefit-sharing principle and the current reflections of such framework in practice, as well as analyse possible paths moving forward.

In the first chapter, outer space as the province of mankind will be described, followed by chapter two outlining space resources and the legal framework for their use. The third chapter will describe the benefit-sharing principle as defined by international space law and analyze its current applications. Chapter four will outline some of the popular proposed frameworks moving forward.

II. The Legal Regime of Outer Space

To have a meaningful discussion about the benefit-sharing principle of outer space resources, the legal status of outer space in general, needs to be established. The leading document of international space law, the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies ("The Outer Space Treaty" or "OST") provides the key overarching principles of international space law. Firstly, the Outer Space Treaty defines outer space as a *"province of mankind"* in the treaty's very first article.[16] This pivotal principle of international space law, born out of a rare mutual understanding between the United States and the Soviet Union in the 1960s,[17] puts outer space in the category of *res communis omnium* or *global commons* – things belonging to all. This means that outer space may be explored and scientifically investigated by all states freely,[18] but may under no circumstance be appropriated by any nation. To facilitate this ubiquitous principle, the Outer Space Treaty further establishes the second

[16] RESOLUTION ADOPTED BY THE GENERAL ASSEMBLY 2222 (XXI). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. 1967. Article I
[17] VON DER DUNK, Frans. *Handbook of Space Law* [online]. Edward Elgar Publishing, 2015 [cit. 2023-04-20]. ISBN 9781781000366. Available: doi:10.4337/9781781000366. p. 37
[18] RESOLUTION ADOPTED BY THE GENERAL ASSEMBLY 2222 (XXI). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. 1967. Article I

crucial principle – the non-appropriative nature of outer space,[19] exempting outer space from national appropriation in Article 2. No state may therefore claim any part of outer space, including celestial bodies such as the Moon, asteroids, or any other, and exercise national sovereignty over the given body. This principle was adopted to avoid a scenario where outer space would become a theatre of international conflict for resources and sovereign control over celestial bodies.[20] It is important to note here, that the non-appropriation principle applies to private actors too. While the Outer Space Treaty does not explicitly prohibit appropriation by private actors, a systematic interpretation of the OST leads to the conclusion, that private appropriation is prohibited. According to Article VI of the OST, the activities of private entities in outer space require authorization and continuous supervision by the appropriate launching state, which also becomes liable for the actions of the entity under Article VII. Built upon further in the 1972 Convention on International Liability for Damage Caused by Space Objects ("Liability Convention"), the principle of liability of the state over the actions of private entities in outer space is an integral part of international space law. Therefore, if any private entity were to appropriate a part of outer space, such appropriation would implicitly become national and therefore prohibited.[21]
Finally, according to the Outer Space Treaty, outer space is to be used exclusively for peaceful purposes.[22]

The adoption of the Outer Space Treaty in 1967 marks the beginning of the golden age of international space law. Soon after 1967, the adoption of the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space ("Rescue Agreement") in 1968 and the aforementioned Liability Convention in 1972 followed, building on the principles set out in the Outer Space Treaty.

The next step in the evolution was supposed to be the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies ("Moon Agreement"), a document reflecting

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[19] RESOLUTION ADOPTED BY THE GENERAL ASSEMBLY 2222 (XXI). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. 1967. Article II
[20] VON DER DUNK, Frans. *Handbook of Space Law* [online]. Edward Elgar Publishing, 2015 [cit. 2023-04-20]. ISBN 9781781000366. Available: doi:10.4337/9781781000366. p. 778
[21] ONDŘEJ, Jan. *Právní režimy mořských oblastí: srovnání s kosmem a Antarktidou*. Plzeň: Vydavatelství a nakladatelství Aleš Čeněk, 2017. Vydavatelství a nakladatelství Aleš Čeněk. ISBN 978-80-7380-630-9. p. 63
[22] RESOLUTION ADOPTED BY THE GENERAL ASSEMBLY 2222 (XXI). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. 1967. Article III

upon the Moon landing of Apollo 11 in 1969 and the numerous following landings in the 1970s.[23] Aiming to redefine the legal status of celestial bodies as *"common heritage of mankind"*, the Moon Agreement was too ambitious in nature, with only 13 states ratifying. However, the Moon Agreement still plays a vital role in the legal discourse about space resources. Why? Let's reframe our focus to the legal regime of space resources.

III. The Legal Regime of Space Resources

1. Definition of Space Resources

Having established the overarching legal framework pertaining to outer space, let us now direct our attention towards the specific legal regime governing the extraction and utilization of space resources. Since there is no accepted definition of space resources provided by international space law, we have to look into national legislation for answers. Two opposing philosophies of space resources definitions can be found:

According to one philosophy, space resources are defined as any tangible and intangible resources found in outer space. This includes tangibles such as minerals and elements, but also intangibles such as orbits and energy. This definition was used for example in Title 51 of the US Code of 2010.[24]

The opposing philosophy considers space resources to only be tangible resources of outer space, typically minerals and other physical objects. The United States Commercial Space Launch Competitiveness Act of 2015 is an example of this interpretation, along with The Hague International Space Resources Governance Working Group, which defines space resources in the Building Blocks for the Development of an International Framework on Space Resource Activities as *"an extractable and/or recoverable abiotic resource in situ in outer space"*.[25]

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[23] ONDŘEJ, Jan. *Právní režimy mořských oblastí: srovnání s kosmem a Antarktidou*. Plzeň: Vydavatelství a nakladatelství Aleš Čeněk, 2017. Vydavatelství a nakladatelství Aleš Čeněk. ISBN 978-80-7380-630-9. p. 134

[24] 51 U.S.C. United States Code, 2010 Edition Title 51 - NATIONAL AND COMMERCIAL SPACE PROGRAMS, § 40302(9)

[25] Building Blocks For The Development Of An International Framework On Space Resource Activities. 2019. Article 2

The author would like to note here, that the international discourse seems to be moving towards the latter approach, and understandably so. To understand why, it is important to remind ourselves, that space mining is very much imminent. For example, the NASA Artemis program[26] aims to establish a human presence on the Moon within the next decade. If such presence were to become sustainable, some level of resource exploitation on the Moon is inevitable. It is therefore vital, that a new regime allowing for legally consistent space mining is developed as soon as possible. If the discussion surrounding this topic is only limited to tangible natural resources, the international community is more likely to take part in the discussions and come to a compromise. On the other hand, if the intangible resource approach would be taken, the discussion would have to involve for example already in use Earth's orbits. This raises the stakes of the discourse significantly. Therefore, while the intangible resource approach seems to be legally more consistent, the tangible resource approach is likely going to yield more much-needed results in terms of the evolution of international space law.

2. The Current Legal Framework for Space Resource Utilization

We now understand that outer space is a *res communis omnium* with a standing non-appropriation principle in place. We also established that celestial bodies include valuable space resources. How do the general principles of outer space apply to space resources? This is an ongoing complicated debate among legal scholars with two common opposing views cited:

The pro-exploitation view

According to this interpretation of the non-appropriation principle, space resources may be extracted and exploited within the language of Article I of the Outer Space Treaty.[27] The supporters of this framework argue, that extraction and exploitation of resources in itself does not facilitate appropriation. As a supporting argument, the utility of this framework is brought up, as it allows for the continuation of the human journey into outer space. For example, the

[26] The Artemis program is a space exploration initiative led by NASA with the goal of landing the first woman and the next man on the Moon by 2024 and establishing a sustainable human presence on the lunar surface by the end of the decade.

[27] VON DER DUNK, Frans. *Handbook of Space Law* [online]. Edward Elgar Publishing, 2015 [cit. 2023-04-20]. ISBN 9781781000366. Available: doi:10.4337/9781781000366. p. 789

establishment of water mining facilities on the Moon could facilitate further exploration of our solar system.[28] It is also argued that private investment and private activity in outer space becomes unprofitable and therefore unlikely to continue without a framework allowing for the exploitation of space resources.[29]

The prime representative of the pro-exploitation view are the Artemis Accords. This series of non-binding bilateral agreements concluded between the United States and parties interested in participating in the Artemis program stipulates explicitly, that *"…the extraction of space resources does not inherently constitute national appropriation under Article II of the Outer Space Treaty…"*[30] While remaining a non-binding agreement outlining principles of space exploration, Artemis Accords are an incredibly divisive document. The most echoed criticisms mention their American-centric nature as well as the fact that the Artemis Accords obstruct the United Nations, which has been the main stage for international space law legislation up to this point. Some scholars argue that the goal of the Artemis Accords is to establish new international customary law under which the exploitation of space resources is permitted,[31] effectively bypassing a discussion with the rest of the international community in the United Nations.

The non-appropriation loyalist view

This view stands with the most stringent interpretation of the rules set out in the Outer Space Treaty, arguing that any exploitation or extraction of space resources is equal to appropriation. The leading argument for this view is the correlation between sovereignty and ownership. In order to extract or exploit a space resource, the party doing so must effectively declare ownership of the resource. However, private ownership must always be derived from the

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[28] Exploring the Presence of Water on the Moon. In: *science.nasa.gov* [online]. Available: https://science.nasa.gov/science-news/news-articles/exploring-the-presence-of-water-on-the-moon

[29] BOHACEK, Petr, Simon P. WORDEN and Kyran GRATTAN. Benefit-Sharing as Investment Protection for Space Resource Utilization. *New Space* [online]. 2022, **10**(2), 127-135 [cit. 2023-04-20]. ISSN 2168-0256. Available: doi:10.1089/space.2021.0050. p. 2

[30] THE ARTEMIS ACCORDS, Principles For Cooperation In The Civil Exploration And Use Of The Moon, Mars, Comets, And Asteroids For Peaceful Purposes. 2020. Section 10.

[31] DEPLANO, Rossana. THE ARTEMIS ACCORDS: EVOLUTION OR REVOLUTION IN INTERNATIONAL SPACE LAW?. *International and Comparative Law Quarterly* [online]. 2021, **70**(3), 799-819 [cit. 2023-04-20]. ISSN 0020-5893. Available: doi:10.1017/S0020589321000142

exercise of sovereignty by a state. Therefore, declaring ownership over a resource means that the sovereignty of a state over the same resource is implicitly established.[32]

The non-appropriation loyalist view is being represented by for example Russia.[33] Arguably, the reason for doing so is the lack of technological capacities to capitalize on the pro-exploitation view at this point in time.

The dispute between the two presented views is in some ways similar to the space resources definitions dispute, described in the previous section. Legally, the non-appropriation loyalist view seems to have stronger foundations but does not serve a useful purpose moving forward. As it seems unlikely, that a universal framework on the floor of the United Nations is going to be adopted anytime soon, it is in the interest of the space-faring countries to follow the pro-exploitation view.

IV. The Space Resource Sharing Principle

As has been touched upon in the introduction to this paper, space resources are being utilized with great effect, benefiting nations able to invest in their utilization. However, since outer space is a *province of mankind* and is, therefore, a global common, is it acceptable that only select nations stand to benefit?
The answer to this question has been contentious in international space law for decades.

1. The Outer Space Treaty and Equitable Sharing of Space Resources

In 1967, The Outer Space Treaty provided the first answer within the definition of *province of mankind* in Article I, stating: *"The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the*

[32] LEFEBER, René. Relaunching the Moon Agreement. *Air and Space Law* [online]. 2016, **43** [cit. 2023-04-20]. ISSN 0927-3379. Available: doi:10.54648/AILA2016004

[33] Russia Compares Trump's Space Mining Order to Colonialism. In: *themoscowtimes.com* [online]. 2020. Available: https://www.themoscowtimes.com/2020/04/07/make-quarantine-art-a69902

province of all mankind."[34] This vague version of the benefit-sharing principle is what is left of one of the pivotal conflicts that took place during the inception of the Outer Space Treaty. The global North, i.e. the developed world, prioritized the freedom of access to outer space, seeing a frontier of new opportunities to expand and explore. The global South on the other hand, prioritized equitable access to outer space and the equitable utilization of the benefits offered by it.[35] Since the Outer Space Treaty was prepared and negotiated almost exclusively between the United States and the USSR in 1966,[36] the result was a vague commitment to explore and use outer space for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development[37] with no further elaboration in the text of the final Outer Space Treaty a year later.

2. The Bogota Declaration

An attempt of the global South to improve its position in relation to access to outer space, the Bogotá Declaration, was adopted in December 1976 by the equatorial countries, claiming the geostationary orbit (an incredibly valuable space resource, for more see Chapter IV) above their territories.[38] The declaration was considered to be in breach of the Outer Space Treaty and was not generally accepted as relevant.[39]

3. The Moon Agreement and the Common Heritage of Mankind Principle

Unimpressed with the achievements of the Outer Space Treaty in how the issue of equitable sharing of space resources was managed, the global South saw an opportunity in the negotiations for a new treaty concerning the Moon. During the course of the 1970's the *common heritage of mankind* principle was gaining global support, with nations such as the

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[34] RESOLUTION ADOPTED BY THE GENERAL ASSEMBLY 2222 (XXI). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. 1967. Article I

[35] VAN EIJK, Cristian. Unstealing the Sky: Third World Equity in the Orbital Commons. *Air and Space Law* [online]. 2022, **29.** [cit. 2023-04-20]. ISSN 0927-3379. Available: doi:10.54648/AILA2022002

[36] VAN EIJK, Cristian. Unstealing the Sky: Third World Equity in the Orbital Commons. *Air and Space Law* [online]. 2022, **32.** [cit. 2023-04-20]. ISSN 0927-3379. Available: doi:10.54648/AILA2022002

[37] RESOLUTION ADOPTED BY THE GENERAL ASSEMBLY 2222 (XXI). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. 1967. Article I

[38] The Declaration of the First Meeting of Equatorial Countries. 1976. Section 2.

[39] HOBE, Stephan. Geostationary Orbit. *Max Planck Encyclopedias of International Law [MPIL]* [online]. 2019. Available: https://opil-ouplaw-com.ezproxy.is.cuni.cz/display/10.1093/law:epil/9780199231690/law-9780199231690-e1171?rskey=6VWvq3&result=1&prd=MPIL

United States, the UK, and Canada, expressing support to the principle, along with the global South.[40]

The *common heritage of mankind* principle as defined in the Moon Agreement was an evolution to the prevalent *province of mankind* principle of the Outer Space Treaty, redefining the legal status of celestial bodies and their natural resources. The central attribute of the common heritage of mankind principle is the establishment of a framework for equitable sharing of the benefits acquired from resources on celestial bodies, with special considerations given to the interests and needs of the developing countries.[41] The principle, therefore, speaks into existence a notion, that was only vaguely expressed in the Outer Space Treaty: Space resource utilization on celestial bodies must benefit all countries, especially developing countries, and a framework to facilitate this obligation must be created.

With these goals, the Moon Agreement was drafted during the 1970s, but when it came to signing the document in 1979, most Western nations and the Eastern bloc, came to the conclusion that a legal regime for the Moons resources should be postponed until space mining becomes feasible and the types available of resources become known.[42] Until today, only 13 states have ratified the Moon Agreement.

4. The Space Benefits Declaration

The final entry into the history of the global South's struggle to establish equitable access to outer space and equitable sharing of benefits has however been successful. In 1996, UN resolution No. 51/122, titled "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" ("The Space Benefits Declaration") has been adopted. This resolution highlighted the importance of the involvement of developing countries in the growing space economy. Notably, the Space Benefits Declaration advocated for international cooperation between the developed world and developing countries in space

[40] ONDŘEJ, Jan. *Právní režimy mořských oblastí: srovnání s kosmem a Antarktidou*. Plzeň: Vydavatelství a nakladatelství Aleš Čeněk, 2017. Vydavatelství a nakladatelství Aleš Čeněk. ISBN 978-80-7380-630-9. p. 136
[41] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies. 1979. Article 11
[42] ONDŘEJ, Jan. *Právní režimy mořských oblastí: srovnání s kosmem a Antarktidou*. Plzeň: Vydavatelství a nakladatelství Aleš Čeněk, 2017. Vydavatelství a nakladatelství Aleš Čeněk. ISBN 978-80-7380-630-9. p. 137

activities, with particular attention given to the needs of such developing countries.[43] The described international collaboration should foster space capabilities in developing countries and effective technology transfer.[44] Note however, that no concrete framework has been established.

V. Equitable sharing of space resources and benefits today

With the legal framework for equitable sharing of space resources and other space benefits established, the next step is to apply the framework in practice. Upon investigating the practice and its potency, the outcomes are a mixed bag. This paper will examine some of the instances of equitable sharing of resources in international law, tied more or less to outer space.

1. The Geostationary Orbital Slot Allocation System and the ITU

The Earth's geostationary orbit (GEO) is an orbit located at an altitude of approximately 35.000 km above the Earth's surface and is considered to be one of the most desirable real estates. Why? Any object placed in GEO has an orbital period[45] equal to the rotational period of the Earth. In practice, this means that any object placed in GEO would appear stationary from our planet, and any satellite placed in GEO, therefore, has the capacity to continuously monitor the same selected area on Earth.[46] With only 3 satellites, it is possible to cover and sensor the entirety of the Earth's surface. As mentioned, this makes the GEO a unique strategic place in outer space, which is however limited to only approximately 2000 satellite slots.[47]

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[43] RESOLUTION ADOPTED BY THE GENERAL ASSEMBLY 51/122. Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries. 1996. Article 3

[44] RESOLUTION ADOPTED BY THE GENERAL ASSEMBLY 51/122. Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries. 1996. Article 5

[45] The time needed for the orbiting object to complete a full orbit. For example, the orbital period of the Earth around the Sun is approximately 365.25 days, which is the length of one year.

[46] HOBE, Stephan. Geostationary Orbit. *Max Planck Encyclopedias of International Law [MPIL]* [online]. 2019. Available: https://opil-ouplaw-com.ezproxy.is.cuni.cz/display/10.1093/law:epil/9780199231690/law-9780199231690-e1171?rskey=6VWvq3&result=1&prd=MPIL

[47] THOMPSON, Jannat C. Space for Rent: The International Telecommunications Union, Space Law, and Orbit/Spectrum Leasing. *62 J. Air L. & Com.* [online]. 1996. p. 284. Available: https://scholar.smu.edu/jalc/vol62/iss1/10

Free access without any limitations to the GEO could have devastating implications. Without a coordination system, the risk of collision among satellites and interference between their signal frequencies is high. Therefore, the International Telecommunications Union (ITU)[48] has been tasked with developing a geostationary orbital slot allocation system, which ensures that each satellite, which is to be placed in GEO, has an allocated place in the orbit and a unique frequency.

When faced with this task, the ITU had to balance two primary principles: efficient use of the GEO (as it is a limited natural resource) and equitable access to it.[49] Unfortunately, these principles go against each other in a fundamental manner. If we ought to maximize the efficient use of the GEO, the establishment of a *first come first served* basis of the orbital slot allocation system presents itself as the perfect answer. Developed nations in possession of the launch capabilities should occupy the entirety of the GEO, as their advanced satellites will yield the most benefits in the shortest amount of time. On the other hand, if we ought to protect the interests of developing nations, which are still working on their launch capabilities, some number of orbital slots need to stay protected and reserved for such nations, which inevitably means that the potential of the GEO is not maximized.

The story of the clash of these two principles is rich and includes for example Tonga becoming a satellite powerhouse (at least on paper and at least for a certain time), but the outcome is the ever-updating ITU Radio Regulations document, which defines the orbital slot and frequency allocation system attempting to satisfy both principles. In the early years, the *first come, first served* approach prevailed, whereby the first user to notify the ITU of their intended use of a particular frequency or position enjoyed legal protection from interference. Expectedly, this conclusion was criticized by developing nations. To address this, the concept of *a priori planning* was introduced, establishing a planning regime for the allocation of orbital slots and radio frequencies for all states, with protected and reserved orbital slots.[50]

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[48] The International Telecommunication Union is a specialized agency of the United Nations responsible for issues related to information and communication technologies. The ITU was founded in 1865 and is headquartered in Geneva, Switzerland. It has 193 member states and over 800 private-sector entities and academic institutions as members. The ITU is responsible for regulating the allocation and use of radio-frequency spectrum and satellite orbits, and for coordinating efforts to ensure that telecommunications networks and services are accessible to people everywhere, including in developing countries. It also sets technical standards for telecommunications equipment and networks.

[49] Constitution and Convention of the International Telecommunication Union. 1992. Article 44

[50] HOBE, Stephan. Geostationary Orbit. *Max Planck Encyclopedias of International Law [MPIL]* [online]. 2019. Available: https://opil-ouplaw-com.ezproxy.is.cuni.cz/display/10.1093/law:epil/9780199231690/law-9780199231690-e1171?rskey=6VWvq3&result=1&prd=MPIL

Furthermore, the launch of the registered satellite must now take place within 7 years from the slot allocation, to shorten the time that any given slot is reserved.[51]

While still criticized by some, the GEO orbital slot allocation system developed by the ITU stands as a rare instance of a successful marriage of two opposing views, that govern human activity in outer space: effectivity and equity.

2. Copernicus, EGNOS and Open Data

Another method of sharing the benefits and resources of outer space is inspired by the scientific community and the Open Science movement. Open science refers to the practices and principles of making scientific research and data accessible freely to the public, including researchers from other fields, scientists from other countries, policymakers, and the general public. Since research is usually funded from public sources, it is a logical extension that scientific results should be publicly available. The general goals of Open Science are transparency, fostering of scientific collaboration, reproducibility in scientific research, and transfer of knowledge to developing countries[52] - goals in many ways similar to the space resources and benefits sharing goals of The Outer Space Treaty and The Space Benefits Declaration.

The philosophy of Open Science has already been implemented successfully in some areas of the space economy. The Copernicus program[53] provides open data to the public. The program's objective is to provide accurate, timely, and easily accessible data and information to support environmental and security policy-making and operational applications worldwide. Such data include satellite imagery, weather data, ocean and land monitoring, and atmospheric composition information.[54] The data is made available through the Copernicus

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[51] GALERIU, Iulia-Diana UPDATE: "Paper Satellites" and the Free Use of Outer Space. *Hauser Global Law School Program, New York University School of Law* [online]. 2018. Available: https://www.nyulawglobal.org/globalex/Paper_satellites_free_use_outer_space1.html#_ednref56

[52] Open Science. Making science more accessible, inclusive and equitable for the benefit of all. In: *unesco.org* [online]. Available: https://www.unesco.org/en/open-science

[53] The Copernicus program, also known as the European Earth Observation Programme, is a European Union initiative aimed at providing accurate and reliable information on environmental and security issues through the use of Earth observation satellites and in-situ sensors. The program is managed by the European Commission in partnership with the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), and other European organizations.

[54] Access to data. In: *Copernicus.eu* [online]. Available: https://www.copernicus.eu/en/access-data

Open Access Hub,[55] which is the main portal for accessing Copernicus data, as well as through other data access points and platforms.

Future space activities should take notes from the Copernicus, as making Open Science industry standard could greatly benefit all actors of the space economy.

3. UNCLOS and ISA

An interesting source of inspiration for the next evolution of international space law may be the current framework in the field of maritime law.

The United Nations Convention on the Law of the Sea ("UNCLOS") is an international agreement that sets out the legal framework for the use and conservation of the world's oceans and seas. The convention was adopted in 1982 and entered into force in 1994. One of the most important principles enshrined in UNCLOS is, similarly to the Moon Agreement, the *common heritage of mankind* principle.

UNCLOS applies the common heritage of mankind principle to the resources found in the international seabed area beyond the limits of national jurisdiction. The convention recognizes that the resources in this area are the common heritage of mankind and should be managed in the interest of all states.[56] UNCLOS establishes the International Seabed Authority ("ISA") to regulate the exploration and exploitation of these resources and to ensure that the benefits derived from their use are shared equitably.

The ISA was established in 1994 and has since developed a comprehensive regulatory framework to govern the exploration and exploitation of the resources in the international seabed area. The framework includes provisions for environmental protection, technology transfer, and the sharing of benefits. The ISA's revenue-sharing system is designed to ensure that the benefits derived from the use of the resources in the international seabed area are shared equitably among all states. The system is based on the establishment of a fund, to

[55] The Copernicus Open Access Data Hub is available here: https://scihub.copernicus.eu/
[56] United Nations Convention on the Law of the Sea. 1982. Article 136

which mining operators voluntarily contribute. The contributions are then distributed among land-based mining countries directly affected by seabed mining activities.[57]

VI. The Path Forward

As we continue to explore the vast reaches of outer space, the question of how to manage and allocate space resources in an equitable manner becomes increasingly pressing. While existing international legal frameworks provide a foundation for regulating space activities and have been successfully implemented to a degree, as discussed in the previous chapter, they do not offer clear guidance on how to fairly distribute the benefits derived from the use of space resources in the future and on a larger scale. To address this challenge, a number of proposals have been put forth by scholars, policymakers, and industry experts, which offer potential solutions to promote the equitable sharing of space resources and benefits. In this chapter, we will examine and evaluate these proposed frameworks in order to assess their feasibility and effectiveness in advancing the shared goals of sustainability, innovation, and fairness in the exploration and exploitation of space resources.

1. Building Blocks for the Development of an International Framework on Space Resource Activities (Building Blocks)

Formulated by the Hague International Space Resources Governance Working Group in 2019, the Building Blocks are a set of guidelines and principles that have been developed to promote responsible and sustainable exploration and use of space resources. The Building Blocks enjoy international recognition, as their genesis included the voices of experts from various fields including law, policy, science, and industry.[58]

The Hague Building Blocks serve as a blueprint for the development of a comprehensive and harmonized international legal regime for space resources. Space exploration and use should be carried out for the benefit and interests of all countries and humanity. To achieve this, the international framework should ensure that States and international organizations responsible

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[57] Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982. Section 7

[58] The Hague International Space Resources Governance Working Group. In: *universiteitleiden.nl* [online]. Available: https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-of-air-space-law/the-hague-space-resources-governance-working-group

for space resource activities promote participation by all countries, particularly developing countries, and provide for benefit-sharing. These benefits may include the development of space science and technology capabilities in developing states, support of education and training, joint ventures, exchange of expertise and technology among states,[59] and finally, the establishment of an international fund, which would act as the catalyst for financial benefit sharing.[60] However, the Building Blocks stress that compulsory monetary benefit-sharing should not be required under the international framework. Instead, operators should be encouraged to provide for benefit-sharing voluntarily.

However, some authors have criticized the approach taken by the Building Blocks. The main criticisms cite the symbolic nature of the proposed steps (technology transfer, support of education etc.) while weakening the only firm proposal - the international fund establishment - by making contributions voluntary.[61] Furthermore, critics argue, that the framework does not actually benefit the least developed nations, as shared information, technology transfers, joint ventures, and education are hardly beneficial to a nation that does not have the capacity to use them.[62] In other words, the Building Blocks only benefit nations which directly participate, or are actively trying to participate in space activities - which is not the promise given by the Outer Space Treaty and the Benefits Declaration.

2. Social License to Operate

A social license to operate (SLO) is a concept that has emerged in the mining industry as a critical component of sustainable development. The SLO is not a legal requirement but rather a social contract between the mining company and the community in which it operates. [63]The equation is simple: If a mining project is to take place in an area that would affect the well-

[59] Building Blocks For The Development Of An International Framework On Space Resource Activities. 2019. Article 13.1
[60] Building Blocks For The Development Of An International Framework On Space Resource Activities. 2019. Article 13.2

[61] BOHACEK, Petr, Simon P. WORDEN and Kyran GRATTAN. Benefit-Sharing as Investment Protection for Space Resource Utilization. *New Space* [online]. 2022, **10**(2), 127-135 [cit. 2023-04-20]. ISSN 2168-0256. Available: doi:10.1089/space.2021.0050.
[62] BOHACEK, Petr, Simon P. WORDEN and Kyran GRATTAN. Benefit-Sharing as Investment Protection for Space Resource Utilization. *New Space* [online]. 2022, **10**(2), 127-135 [cit. 2023-04-20]. ISSN 2168-0256. Available: doi:10.1089/space.2021.0050.
[63] HEIKKINEN, Hannu I., Élise LÉPY, Simo SARKKI and Teresa KOMU. Challenges in acquiring a social licence to mine in the globalising Arctic. *Polar Record* [online]. 2016. ISSN 0032-2474. Available: doi:10.1017/S0032247413000843

being of a local community, the mining company takes unnecessary risks - it may face challenges such as opposition from the community, regulatory barriers, and reputational damage, which can impact its ability to operate and achieve its objectives. It is therefore incentivized to raise the level of acceptance and support that the mining company has from the local community and other stakeholders as much as possible. How can such a level of support and acceptance be raised? Typical tools used to obtain an SLO are investments in local infrastructure, opening employment opportunities, investments into local education, development of partnerships with local services, and minimizing the negative impacts of the mining project.[64] Thus, obtaining an SLO helps to ensure its long-term viability and sustainability.

The SLO may be employed in the area of space resource utilization similarly. In this scenario, the affected community becomes the international community as a whole. Instead of investments into local infrastructure etc., the mining company (in this case, the operator) would be required to address how the planned space mining project will contribute to the efforts to combat various global challenges both in space, such as space debris, planetary defense; and on the Earth, such as climate change, crisis management, and disaster relief, telecommunications etc.[65]

The implementation of this framework seems realistic as well – some national authorities which register each launch and mission from public and private actors in their respective countries already require information on similar aspects of the project such as environmental impact. This is required by national legislation in for example Belgium,[66] Finland,[67] and Portugal. Adding a mandatory SLO analysis seems like a realistic measure.

3. Relaunching of the Moon Agreement or similar

[64] BOHACEK, Petr, Simon P. WORDEN and Kyran GRATTAN. Benefit-Sharing as Investment Protection for Space Resource Utilization. *New Space* [online]. 2022, **10**(2), 127-135 [cit. 2023-04-20]. ISSN 2168-0256. Available: doi:10.1089/space.2021.0050.
[65] BOHACEK, Petr, Simon P. WORDEN and Kyran GRATTAN. Benefit-Sharing as Investment Protection for Space Resource Utilization. *New Space* [online]. 2022, **10**(2), 127-135 [cit. 2023-04-20]. ISSN 2168-0256. Available: doi:10.1089/space.2021.0050.
[66] Law of 17 September 2005 on the Activities of Launching, Flight Operation or Guidance of Space Objects. Article 7
[67] Act on Space Activities (63/2018). Section 10

As we have previously established, the Moon Agreement is based on the principle of the *common heritage of mankind*, which holds that the resources of the Moon and other celestial bodies are the shared heritage of all nations and should be used for the benefit of all humanity.

While the Moon Agreement has been ratified by a number of countries, including Austria, Belgium, Chile, Mexico, and Pakistan, it has not been ratified by any of the major spacefaring nations, such as the United States, Russia, China, or India. As a result, the Moon Agreement has been largely ignored in practice, and there is little consensus on how the principles it embodies should be applied in practice.[68]

However, given the current state of affairs in the space resource discourse, the re-adoption of the Moon Agreement or a similar regime does not seem unattractive.

Mostly, because unlike most other avenues being explored, the Moon Agreement contains clear rules for the exploitation of space resources which has been developed on the floor of the United Nations. Such a regime would provide a framework for the development of space activities and resource utilization that takes into account the interests of all nations and promotes equitable sharing of the benefits of space exploration.

The adoption of the common heritage of mankind principle would have the following attributes:[69]

a. Celestial bodies containing resources may not be appropriated.
b. The exploitation of such resources would be controlled by a central authority.
c. The benefits of such exploitation would be shared equitably.
d. Resource exploitation must be conducted in a sustainable manner.

By adopting a common framework for the exploitation of space resources, we can avoid the potential for conflict and ensure that the benefits of space exploration are shared fairly among

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[68] HOFMANN, Mahulena. Moon and Celestial Bodies. *Max Planck Encyclopedias of International Law [MPIL]* [online]. 2010. Available: https://opil-ouplaw-com.ezproxy.is.cuni.cz/display/10.1093/law:epil/9780199231690/law-9780199231690-e1198?rskey=aTSS5j&result=1&prd=MPIL

[69] LEFEBER, René. Relaunching the Moon Agreement. *Air and Space Law* [online]. 2016, **44** [cit. 2023-04-20]. ISSN 0927-3379. Available: doi:10.54648/AILA2016004

all nations. While the Moon Agreement provides a mere blueprint for such a framework, it is an intriguing starting point.

VII. Conclusion

As humanity enters a new age of space exploration, issues and uncertainties that we failed to address in the past arise once again. One of these issues is the status of developing countries in our chase toward the stars. Should the less financially capable states benefit from the developed world's utilization of space?

This paper examined the current legal framework and found it mostly insufficient, as the practice shows, that developing countries are lacking in terms of benefiting from space activities. However, some current practices are a good sign pro futuro and should be seen as building blocks towards a more equitable future in space. Examples include the ITU orbital slot allocation system and the sharing of Copernicus data.

The next step for humanity needs to be an establishment of an international regime for space resource utilization to stimulate public and private investment. While legal uncertainties remain, there can be no expectations of prolonged progress into our solar system. Finally, this paper went on to define some of the proposed frameworks and highlighted their qualities and potential weaknesses.

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51 U.S.C. United States Code, 2010 Edition Title 51 - NATIONAL AND COMMERCIAL SPACE PROGRAMS

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