

Challenges of the Legal Protection of Peace, Passage and Profit on Space Colonies

Since life has emerged on Earth it has aspired to extend its reach to ever new territories. There was only one frontier that Earth-based biology could not brave in all the hundreds of millions of years, the space between planets. A paradigm shift was required in the adaptation of lifeforms, one not based on biological evolution but on the emergence of culture and technology. While humankind has used its technology to inhabit, or at least utilise almost all corners of the Earth, space remained a domain of myth, legend and religion for millennia. Only in the early 20th century did humans manage to invent planes to traverse the skies rapidly and rocket engines to escape Earth's gravity. Over the past decades, we have made the initial steps of conquering this new domain, stepped on the Moon and inhabited Earth's orbit, if not with life, at least with technology. The next step in the evolution of human civilisation and thereby the spread of life, the establishment of space colonies on the Moon, Mars and possibly beyond, has become a realistic mid-term goal for the leading space nations and their partners.

However, physically reaching these locations and building infrastructure is not enough in itself. As humanity's spread is not enabled by biology but mainly by culture and technology, as with all previous conquests, rules, customs and in the end, law must be set. Effective social life consists not only of physical presence but of lawful order to guide our activities and avoid descending into chaos through armed conflict. Once these new space enterprises are launched and operated, they will consume a significant amount of national and private resources, meanwhile, they are also posed to generate profit and

¹ Doctoral student, Ludovika University of Public Service, Doctoral School of Military Sciences; ORCID: <https://orcid.org/0000-0003-3543-8961>; e-mail: zsolt.jpca@gmail.com

thereby multiply the invested capital. This additional consideration means that further legal protection is needed to guarantee the strengthening of civilian and profit-oriented aspects of the new space activities alongside the pressing security considerations.

This chapter discusses the applicability of the existing international legal framework on future space colonies focusing on three main issues: what is permitted to defend a space facility on or around an astronomical body other than Earth; the business environment and economic activity considerations and the right of safe transport. The chapter concludes by highlighting the need to mitigate existing legal gaps before the establishment of space colonies.

OVERVIEW OF THE APPLICABLE LEGAL FRAMEWORK

As with all new territories reached by humans, issues of war and peace were the primary factors in shaping the legal environment of space activities. It is beyond symbolic, that the first human made object reaching outer space was the V₂ rocket, the “vengeance weapon” built by Nazi Germany to bring devastation to Allied cities. The political context of the initial emergence of space law was the Cold War. While the superpowers were deeply antagonistic towards each other, the Cold War was more focused on deterrence, building and maintaining alliance networks and spheres of influence, instead of active warfare between the U.S. and the USSR. Beyond the complex political environment, the particular security consideration regarding space activities was first and foremost its role in nuclear warfare and deterrence. The tools for reaching space were the same tools which enabled mutual destruction by intercontinental missiles armed with nuclear warheads. Satellites, vital for modern communications, navigation and analysing natural and human processes on Earth were also responsible for detecting a nuclear first strike from the enemy. Therefore, space has this dual nature from a human perspective, of being capable of enabling warfare and conflict while also providing great benefit through peaceful activities and international cooperation.

The urgent need to develop the legal framework of space activities emerged once the USSR successfully put the Sputnik satellite in orbit in 1957, with the U.S. in close pursuit. The new achievements in space could have upset previous meticulous calculations regarding nuclear warfare, therefore the rules had to be settled, to keep the Cold War from heating up. In terms of international politics, the establishment of the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) as a permanent body in 1959 has been a rapid development. The next two decades have seen a dynamic development of the elements of space law; however, it is important to note that there was no and there cannot be any *ex lex* state in space, as the UN Charter applies to all human issues even without any specific legal framework for a particular issue (SULYOK 2022: 79). In 1962, the United Nations General Assembly Resolution 1802 (XVII) has requested that the UN COPUOS establish a comprehensive legal framework for the “peaceful use” of space. It was however not defined what “peaceful use” meant, and this points to a further important point, the lack of exact definitions in space law. As all nations have different capabilities and interests, consequently they have differing visions for the utilisation of space, or if they cannot reap certain benefits, they are motivated to block their adversaries or competitors from gaining advantages from space activities. This means that the development of space law has been hindered by the lack of an all-encompassing vision for space, and the method to resolve the disputes was employing often loose terms when legislating new space law treaties. While the nations have many different interests, they all want to avoid a nuclear Armageddon, therefore it was logical to adopt two non-binding General Assembly resolutions to swiftly limit the potential for the Cold War to “heat up” in outer space. The General Assembly Resolution 1962 (XVIII) entitled Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space has set the main framework for the subsequent Outer Space Treaty and thereby set the guidelines for the use of outer space for peaceful purposes. Furthermore, in 1963 the Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water and the United Nations General Assembly Resolution 1884 (XVIII) banned

the deployment of nuclear weapons in outer space which was a highly alarming prospect during the Cold War and even to this day. These were urgent needs to avoid a rapid escalation in terms of the (potentially nuclear) weaponisation of space, while the more nuanced negotiations were ongoing regarding the adoption of a comprehensive and hard legal framework for space law.

More than five years after the “urgent” need emerged to create a legal instrument guiding peaceful space activities, in 1967 the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty, or OST) has been adopted. The OST affirms that the UN Charter is the basis for guaranteeing international peace and security, thereby it also confirms that international humanitarian law applies to space warfare (RAMEY 2000: 127). This repeated reassurance of the role of the UN Charter is vital to enshrine core legal rules in space law. Even though there is no strict hierarchy between international treaties, the UN Charter takes precedence in case any other treaties counteract it (SULYOK 2022: 80). A major remaining issue regarding peace and conflict in space is the issue of what exactly does the “peaceful use” mean, which all the legal framework intends to assure (VLASIC 1991: 37). The two possible interpretations lead to significantly different outcomes and future for space activities. One maximalist understanding called non-military use favoured by the Soviet bloc would interpret this as a ban on any kind of utilisation, direct or indirect, of space for military purposes, therefore banning the *militarisation of space*. The other, in hindsight more realistic ambition calling for non-aggressive use is preventing to the farthest extent possible the *weaponisation of space*, meaning the deployment and stationing of weapons in space (HARRISON et al. 2021: 3). International practice firmly supports the latter understanding originally promoted by the U.S. and its allies that peaceful use of space means a varying degree of bans on the weaponisation of outer space. Space is militarised, meaning that it can indirectly support countries in achieving their military goals, including communication, intelligence, navigation and potentially serve as the route where intercontinental ballistic missiles would travel if they would be used in an armed conflict.

Apart from the direct relevance for potential conflict in space, the most important element of the OST and the basis of later space law is that under Article II, outer space, including the Moon and other celestial bodies can be explored freely, but cannot be subjected to national appropriation. This notion has created the basic framework of space activities, one that is ever more constraining as the technological possibilities soon extend our reach to other celestial bodies. The ban on exercising sovereignty in outer space, including on celestial bodies, including exclusive usage, or restricting access of other parties. The permitted activities are the freedom of exploration, use and scientific investigation (OST, Article I). As I will demonstrate later, these rules stand in opposition to the vision of the major space powers, most importantly the U.S. which is the farthest ahead to launch space activities involving a degree of exercising sovereignty beyond the norms established in the OST permitting sovereign rights over registered space objects, including objects landed or (most relevant for this chapter) constructed on a celestial body, anyone on board and the country's nationals in space (OST, Article VIII).

The OST was followed up by four other treaties, setting the finer details of space activities. The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (1968) expands on the responsibilities of other nations vis-à-vis the astronauts who, considering the extreme danger of their activities in a most hostile natural environment, require the maximum extent of protection and aid in case of an emergency. The Convention on the International Liability for Damage Caused by Space Objects (1972) has settled the responsibility for causing damage through space activities and enshrined the state bearing the cost of any damage by a space object or astronaut operating under their flag. Thirdly, the Convention on Registration of Objects Launched into Outer Space (1975) has established the practice of registering objects launched into space at the relevant UN bodies, a practice which needs an urgent update to make space activities transparent instead of creating insecurity through vague descriptions.

The last international treaty of this generation of space law is the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies

(Moon Agreement) adopted in 1979 which has qualified the resources of the Moon and other celestial bodies of our Solar System as a “common heritage of mankind” thereby severely limiting the potential for outer space resource extraction (Moon Agreement, Article 11). It has proposed an international regime to coordinate any future space mining is implausible due to the persistent conflicts and clashes of interests among the nations. The Moon Agreement also reinforced the earlier ban on deploying weapons of mass destruction (WMD) in outer space set in the OST, a key pillar of the legal limits on the weaponisation of space [Moon Agreement, Article 3(2)]. Unlike the OST and the three follow-up treaties, which have widespread international acceptance and more than 100 countries ratifying them, the Moon Treaty has been largely a failed legal enterprise as only 17 countries ratifying it, with only France and India among the leading space nations even signing, but not ratifying the treaty.

After the failure of the Moon Agreement and the slowing pace of the space race as other considerations emerged during the end of the Cold War, legislation of hard space law under UN auspices has gone off track, notwithstanding the achievements in terms of non-binding General Assembly resolutions adopted in the 1980s and 1990s, which belong to soft law instruments. There was no need, nor interest in resuming the legislative process during the 1990s. In the first decade of the post-Cold War order, international cooperation seemed to reign with unchallengeable U.S. leadership, Russia lost its means to act as a peer competitor and China was not yet a major space power. In this context, an overarching legislation gave way to different soft law instruments, including memoranda of understanding and agreements governing particular projects. Soft law offered a flexible way of guiding the cooperation of willing countries based on mutual interests in joint space activities. While soft law has its advantages, it cannot substitute international treaties regulating the most crucial aspects of space law, especially peace and security and resource extraction (FROEHLICH–PECUJLIC 2016: 37). As the OST and the following three basic treaties were legislated until 1975, the technological environment for which these legal tools were developed are currently almost fifty years old. By the 2020s humanity is within reach of deploying infrastructure

and conducting economic activity on the Moon, Mars and possibly several asteroids, which creates a potential for security threats stemming from the increasing competition (Defense Intelligence Agency 2022: 35). In the centre of these concerns are the required ownership over land, resources and access in outer space, interests will clash which can result in armed conflict. Therefore, comprehensive adaptation of space law to current and future challenges has never been more urgent.

LEGAL LIMITS ON WAGING ARMED CONFLICT ON SPACE COLONIES

Existing space legislation primarily aims at preventing a nuclear war on two levels. Firstly, it aims to prevent any attack against the adversaries' satellites in case an armed conflict erupts, as such an attack could be most likely interpreted as a prelude to a nuclear strike by the attacker (EDL 2023: 52). Secondly, it consists of strong bans on deploying weapons of mass destruction in Earth orbit and outer space (YOO 2020: 96). Current efforts at adapting the legal tools to ban weaponisation and at least limit the further militarisation of space still mostly focus on the danger presented by anti-satellite weapon (ASAT) weapons, their testing and the resulting environmental damage (BORGEN 2020). These considerations are rational, due to the limited possibilities of other celestial bodies to become part of an armed conflict in comparison to Earth orbit which has been a possible warfighting domain for decades, even if countries and alliances only adopted this formally in recent years. While the OST bans the stationing of weapons of mass destruction in Earth orbit, it does permit other types of weapons (SCHMITT 2006: 104). The legal framework guiding peace and security in Earth orbit intends to limit the use of these weapons, by banning the use of force, unless it is a case of self-defence or under a prior and express authorisation by the UN Security Council (UN Charter, Chapter VII). However, due to the outdated nature of the OST, most of the

possible space weapons were not imaginable during the legislating process half a century ago, therefore they are not regulated (EAGLESON 2023).

Nonetheless, even during the Cold War space law intended to counter any possibilities of weaponising other celestial bodies. This previous, mostly hypothetical plausibility is gaining additional relevance as the projects aiming at returning to the Moon and reaching Mars are advancing. The OST, which is the main source of what is legally permissible when preparing for an armed conflict in space (and refers to the UN Charter), in its Article IV, bans deploying any kind of weapons on celestial bodies, may they be conventional weapons or weapons of mass destruction. Even though it is still unlawful to initiate an armed conflict, even the preventive deployment of weapons on or in orbit of the celestial bodies is banned. This creates a significant problem when thinking about the issues of protection of space colonies and other assets spacefaring nations would build on other celestial bodies. The first question is defence, how can someone justify deploying, for example, missile defence systems on their space colonies, as the rockets or energy beams utilised for destroying incoming missiles, could be used for offensive aims as well, which has already been proven in Earth orbit (HARRISON 2020: 7).

It is hard to imagine any nation investing hundreds of billions of dollars' worth of capital in space colonies, only to have them destroyed by a few missiles from an adversary and become very expensive sitting targets. It can be imagined that the most vital parts of any space colony, factory or other facility would burrow underground for protection (this would also make sense to protect the space colonists from harmful radiation); however, this would only mean that the transportation and communication systems of the colony would be vulnerable to an attack. An intermediate step in advancing the relevant legal framework has emerged in the Artemis Accords, signed by 36 nations, which, under U.S. leadership sets out to create a common ground for the return to the Moon and eventually to Mars. In the Accords the signatories agree to establish "safety zones" guarding their facilities and activities in outer space against harmful interference (NASA 2020: 5–6). However, the exact nature of these zones is not defined, only that the

detailed regulations of the particular safety zone will be communicated to the other parties. What is permissible in a safety zone and what will be the negative consequences to any party committing a transgression in these zones? Without kinetic or cyberweapons installed to protect these zones, the new concept lacks a significant element of hard power to support the security aspect of the zone. Therefore, currently it should be understood as an initial concept to be updated with practical details when the space programmes of the Artemis Accords' signatories are in a more advanced state.

The second issue apart from protection against kinetic attacks is that a country does not only want to protect its assets after an attack was launched but present a credible threat to any potential adversary so that even the attempt of an armed aggression by a hostile party could invite a response against their space facilities. Mutual deterrence has been a cornerstone of the balance of threat systems on Earth, of which the mutually assured destruction by nuclear weapons between the U.S. and the USSR during the Cold War is the most famous example. An offensive action must bear a certain risk for the attacker, otherwise predating on other nations would be a cost-free strategy and peaceful international relations would be unimaginable. This prospect is similarly threatening the future of space colonisation and international relations in outer space. One practical solution might be deploying defensive systems and deterring weaponry (non-WMD) on spacecraft patrolling in space between celestial objects, but not on orbital trajectories. These military assets, however, would need to use energy sources to manoeuvre in space, and this is not a sustainable solution at our current technological level.

A similar problem emerges when considering the legality of establishing military bases on the Moon and other celestial bodies which are strictly banned under Article IV of the OST. Is it plausible that nations will not establish military bases after a certain developmental stage of their space assets? It is, again, hard to imagine that in the tense international environment, the expansion of human presence in space can advance without an accompanying hard power security umbrella, or simply put, without deploying military assets in space. One could imagine nations circumventing the current, binding international

regulations and secretly and illegally arming their space colonies, aiming to deploy dual-use equipment, for example, defensive lasers covered as mining lasers or a similar scheme. Also, defensive weaponry is not only important against human aggression but also as planetary defence, would these get a pass under the ban on weaponisation of celestial objects? Until now I have only discussed kinetic weapons, which were the focus of existing space law, however, electronic and cyberweapons can also hinder space colonisation efforts. Under the non-binding Tallinn Manual 2.0 on the International Law Applicable to Cyber Warfare, Rule 68 states:

“Any cyber operation that originates in, transits, or terminates in outer space and rises to the level of an unlawful threat or use of force is barred” (SCHMITT 2017).

However, the Tallinn Manual is not a binding legal document, and these cyberattacks are even more easily deniable than kinetic attacks.

The final issue, when it comes to the defence and security of the space colonisation effort, is the difficulty of monitoring the exact situation on other celestial bodies and their orbits. Even on Earth, during contemporary conflicts, it is challenging to have real-time intelligence on the whole of the battlefield, and to give advanced warning. Also, there are ample opportunities for deniability. The difficulty is exponentially greater as the distance grows between the object of monitoring and the monitoring agent. Firstly, developing surveillance equipment which gives accurate information on what is happening on the surface of the Moon or Mars or beyond is a technological feat and expensive. This also applies to equipment installed on space facilities and their maintenance. Secondly, there are the physical constraints for example the speed of light, which limits the availability of real-time intelligence and therefore coordination between the home base and the colony or facility in space. These all provide windows of opportunity for any potential aggressor to commit an attack in outer space, create facts on the ground (or orbit) and even later deny any responsibility. While investing in more advanced equipment can ease some of the difficulties, physical constraints result in the need to make space

colonies autonomous in their defence to a degree, a requirement which is not permitted under current international space law.

BUSINESS CONSIDERATIONS

Space colonisation has definite scientific and research value, not to speak about the sense of advancement and high morale it would result in if humans stepped on Mars and could successfully establish permanent colonies. However, discovery and pride only last as long as security and business considerations come into the picture. After discussing security constraints, I will turn to the similarly debilitating limits on any potential economic ventures in space. The value of the space economy is projected to reach one trillion dollars a year in a decade (BRUKARDT et al. 2022: 12.) with virtually unlimited growth potential in the future. This means that any nation which gets a head start on capturing market share will also alter the balance of power on Earth; therefore, this is not only a business consideration but also a national security concern. Currently, in 2024, the major obstacle to rapidly expanding economic activities in space is still technological and financial and not predominantly legal in nature. However, the legal constraint will emerge once the first space colony is established, and economic activity starts which would involve some kind of ownership in outer space.

The four main types of sovereignty claims can be grouped into land or position; bases or facilities; resources; and the generated profits. Under the current space law framework, a nation can establish stations and colonies on celestial bodies or in their orbits, given that they serve solely peaceful purposes, and the owner provides access to other nations to them (Outer Space Treaty, Article VIII). Notwithstanding, we must note that once the first space colony or other permanent facility is built, it will mean that other nations cannot build their colony at that same location. Therefore, the process of space colonisation will in practice create a new challenge for the legal environment, namely how to move forward once space exploration becomes an (at least partly) zero-sum

game, with nations exclusively settling particular areas on celestial objects. Secondly, providing access to other nations for monitoring reasons, such as assuring that no weapons of mass destruction are stored inside space colonies or orbiting stations is reasonable. However, this “access” could be abused and in effect obstruct the work and indeed the life of the space colonists. What would happen, for example, if one hundred astronauts of another nation would appear at a space colony only suitable for sustaining one hundred colonists already at the facility? While there are certain safeguards against the potential abuse of this method in the legal body [Outer Space Treaty, Article XII; Moon Agreement Article 15(1)] mainly by requiring “reasonable advance notice” of the visit to provide an opportunity for “appropriate consultation”, there are no rules regarding what “reasonable” or “appropriate” means in practice. I would argue that when there are such doubts about the outcomes, security considerations will naturally prevail in the calculations of each nation. However, to uphold security, one needs sovereign decision-making powers and the ability to enforce security measures. Without sovereign rights in space, rules of human interaction break down, for which neither our legal, social, or international norms are ready.

Considering the issue of resources, space facilities cannot be sustainable in the long term without utilising materials present on the celestial bodies. Apart from sunlight, which is basically unlimited, all other resources come in restricted quantity and with limited access. One could argue that, for example, harvesting water out of the icecaps of Mars for sustaining a research colony is only done in support of keeping the astronauts alive and thereby it falls under legally permitted activity to sustain scientific space operation [Moon Agreement, Article 6(2)]. However, once a country or company starts resource extraction in outer space, this will create a constant debate about to what degree and exact usage is permissible, and the strict rule of the current international legal environment is challenged, which, I argue, opens the way to eventual mining of resources for business ventures. An interesting case of dual-use applications can be also envisioned in outer space by blurring the lines not only between military and peaceful use but between scientific and commercial-industrial usage of the extracted resources. Before turning to the main issue, space mining,

we should consider the few economic activities which are imaginable under the current space law. Naturally, the first are research activities, all nations and their companies are free to establish research colonies to conduct tests and to develop new technologies and materials. The second is space manufacturing if it only uses materials from Earth and utilises the micro-gravity and clean environment in space to create instruments of unprecedented quality. It is plausible that even when supplied from Earth with materials, such space factories can be profitable if placed in Earth's orbit, but it would not be reasonable to place such a factory on another celestial body if it cannot use the resources present there. Thirdly, non-material services provided by other celestial bodies are legal. Tourism, entertainment and communication services can be imagined in this category, but what company would want to take oxygen from Earth to their hotel on the Moon if it can be extracted from the available resources there?

The main issue is, however, resource extraction from celestial bodies for commercial goals, which includes the mining of the materials or even utilising them to sustain the colonisation effort. These practices are strictly forbidden under the current space law. They would be in breach of legal norms in three ways, firstly, occupy certain parts of celestial bodies, secondly, gain exclusive ownership over the extracted materials, and thirdly, gain most probably an extra value from the enterprise. Even though most nations did not ratify or even sign the Moon Treaty, which further constrained commercial resource extraction possibilities, as the OST also bans bringing any locations or resources in outer space under national sovereignty, all the above activities are illegal. To demonstrate the surreal nature of the current legal situation, it is worthwhile to imagine a few hypothetical scenarios of how space mining would occur under a current legal framework. Even if one nation would establish a space mine, they would not own the site and would need to provide open access to other nations, who could in theory enter freely into the facility. Also, the mined materials would be not owned by the mining nations and other nations could, again, in theory, freely take the materials for scientific exploration. Finally, any profit generated by the space venture would have to be shared internationally and not owned by the owner nation or company.

There are important first steps to alter the legal framework regulating the space economy, do away with the constraints inherent in the OST and ignore the Moon Treaty. There are two avenues of these efforts, the first one is different kinds of national space legislation permitting a limited, economy-focused sovereignty over space assets. The second is international agreements between like-minded nations. Considering the first, national space legislation of the United States, Japan, the United Arab Emirates and Luxemburg all create an environment for companies and the nations they belong to be able to benefit from the space economy and permit resource extraction for business purposes (ÜNÜVAR 2022). These more permitting national legislations are currently in conflict with the prevailing international space regulations, which creates the potential for legal conflict in the future if these outstanding differences are not settled. Secondly, agreements like the Artemis Accords attempt not only to spearhead the space colonisation effort but also to create legal facts on the ground. As with the reinterpreting of what is permissible to guarantee security in space, the Artemis Accords is even more bold in rewriting the rules of utilising space resources. Under Section 10 of the Accords, it is stated that “the extraction of space resources does not inherently constitute national appropriation under Article II of the Outer Space Treaty”. While this section concerns primarily sustaining the operation of the particular space mission it still means that the signatories with the leadership of the U.S. will start resource extraction on celestial bodies once the program arrives at the stage where this becomes relevant. After the initial, operation-focused resource extraction practices are well underway it is difficult to foresee a future in which eventually the lucrative prospects in the space economy would not be utilised. The question is whether we will have a follow-up treaty to the OST setting guidelines to business connected sovereignty or have a fractured and deeply conflicted legal framework of an outdated OST existing in parallel with more advanced and practical national and soft law instruments.

TRANSPORTATION AND THE RIGHT OF PASSAGE

As mentioned, the OST enshrines free access to all points in space (Outer Space Treaty, Article I), and therefore it is illegal for any country to block access to another nation's space objects, including vehicles, stations and other facilities. Several additional rules, however, must be applied to enjoy this freedom of access and movement.

Firstly, as nations are liable for the damage their space objects or their astronauts cause, the free movement must not result in damage to another object, which would be basically space-ramming (Outer Space Treaty, Article VII).

Secondly, the protection of transportation not only stems from the right to free access but also the overarching principle of protecting the life of the astronauts as envoys of humankind (Outer Space Treaty, Article V). Endangering them is strictly forbidden and every effort must be made to aid them by other nations in an emergency which develops in space.

Thirdly, nations must register their space objects with the UN Secretary General (where the Register is in practice managed by the United Nations Office for Outer Space Affairs) and inform and regularly update the UN regarding their ongoing mission on celestial bodies. This has the purpose of guaranteeing that these missions are serving only peaceful purposes and do not, for example, carry weapons to other celestial bodies. There is no established verification method however, no inspectors to make sure these registrations are exact. There are usually also quite vague descriptions hiding the true purpose of the space objects launched.

Fourthly, the employed transportation methods must be safe for the environment. This means, for example, that nuclear fission engines, while not completely ruled out (UN COPUOS – IAEA 2009), are much debated, as there is no established method of what to do with the radiating materials. Also, one could argue that a nuclear-powered spacecraft can be of dual nature and used not only as a science probe but as a crude weapon of mass destruction as well.

It is also worthwhile to note that safe transportation in space is impossible without advancements in space observation and navigation technologies. Space

traffic management encompasses the means and the rules to access, conduct activities in, and return from outer space safely, sustainably and securely (European Commission [s. a.]). Even understanding real-time the position, speed and trajectory of all space objects orbiting Earth is still in its infancy and the task becomes exponentially greater as the distance grows from Earth (Defense Intelligence Agency 2022: 36). As I have discussed in the subchapter about security, the lack of verification creates opportunities for damage and potentially armed conflict in space, both by providing opportunity and motivation due to a miscalculation and misunderstanding of the facts. Safe transportation is an element of this conundrum, which not only has technological elements but also legal and regulatory requirements. Significant investment will be needed in space traffic management with all its aspects. A particular issue is the building of spaceports around Earth orbit and orbiting other celestial bodies. Would these be also free to access to other nations? A wholly new system of regulation will need to emerge once some nations start building these facilities as the resources to sustain port calls by spacecraft are much more demanding than on the oceans of Earth, and even there, port calls have their own political, security and diplomatic system in international relations.

A particular issue emerges with space blockades, which are forbidden under existing international law, however, we must be ready for the instance one nation starts applying them. In realistic terms, a blockade is an attempt by a country to obstruct another nation's effort at accessing a particular location on a celestial body or in space or accessing outer space from Earth itself. A blockade may be physical or conducted through electronic interference. This notion is already present in Chinese strategic thinking about interstate competition in space; therefore, it is plausible that it will become a feature of space colonisation efforts (EDL 2022: 265). A space blockade is naturally illegal under international law, as it precludes free access, however, a blockading nation could refer to its stated rights to an aforementioned "safety zone" around its space facilities or objects. A space environment where nations erect blockades without the fear of other countries breaking the blockade by employing weapons is not sustainable. A similar problem emerges regarding the safety of space transportation lanes, when they

are developed, meaning some of the most economical routes to access certain locations on celestial bodies or in space. These lanes will need to be protected against natural and human threats, which is difficult to imagine without defensive weaponry. These can be installed at the endpoints, space milestones or spaceports and on hypothetical patrolling spacecraft. However, currently, this would be illegal (apart from armed spaceships not in orbit), and as with mutual deterrence and defensive reasons, a new legal equilibrium must follow as the practice of space colonisation will move ahead in the coming decades.

FUTURE CHALLENGES AND CONCLUSIONS

The conclusion from the above overview of some of the legal aspects of security, business considerations and transportation connected to outer space activities and space colonisation is that there are multiple debilitating contradictions and legal obstacles. The legal framework under UN auspices was developed for the main issues of the first two decades of the space race starting in 1957 and since the relative failure of the Moon Treaty, this process has been frozen. The existing hard space law has many positive aspects, but it lagged behind in the 1980s and became obsolete as the new space race emerged with complex business considerations, new technologies and a transition to a tense and increasingly multipolar world order. Current legal efforts are understandably focused on banning or at least regulating ASAT weapons; however, it does address the issue that rapidly unfolding space colonisation efforts will need protection, which can be only provided by hard power, meaning deploying military assets into space. Unmitigated weaponisation of space is not in the interest of any party, but neither is a situation in which the first country introducing weapons could endanger the investment of all other powers. This would be akin to building colonies on another continent, without sending any soldiers to protect them, it is unimaginable. Therefore, as the first colonies and facilities are built and the “safety zones” are established, a constructive discussion must emerge regarding the defensive systems permissible on and around space facilities.

This international legal effort is vital, as national law and soft law are not substitutes for the further development of space law under UN auspices and the family of treaties following the OST. The main issue will be how each space power will adjust to the practices of the other major powers, codified in international treaties, and not how countries self-regulate or settle joint conduct with their partners and like-minded nations. Peaceful and profitable exploration and colonisation of space will depend on the mutual understanding between the U.S., the European states and Japan, and the three other major space powers, Russia, China and India. Anything less than an international treaty on security, ownership and transportation will bear a significant risk to continued peaceful activity in outer space. National law and soft law are worthwhile for self-regulation, presenting stability and a regulatory framework to the business community and signalling intent underpinning the major legal negotiations in the future. This will be required for the transitional period we are embarking upon when each space block is aiming at charting its next major space programmes and coalesce around a common vision. Naturally, the most advanced of these initiatives is the Artemis Accords, which means that as presented above, this has the most comprehensive evolutionary vision for the adaptation of the legal framework, upsetting the status quo, while also keeping the cornerstones of the security-focused achievements and the overarching value of the peaceful nature of space exploration of the OST treaty family.

In the end, no country, not even the U.S. can go alone in space and not let serious risks mount from other major space powers. Asymmetric threats are just as prevalent in space warfare in the future as on Earth, but the dangers are amplified by the remote and inhospitable nature of the environment. This means that not only a supporting network of partners and allies will be needed but also a degree of understanding reached with competitors and even adversaries. As all nations perfectly understand that an ASAT warfare would be a race to the bottom, warfare erupting in outer space would just negate the possibility for all nations to benefit from the resources of other celestial bodies. International practice accompanied by national law and soft law will chart the way in setting the first milestones of

space colonisation. However, international treaties will be needed to make these trailblazer practices sustainable for the coming decades. With the end of U.S. hegemony in space, the growing number of countries interested in stable space colonisation and resource extraction will create tensions, while on the other hand raising the number of interested parties in setting a stable legal environment for all of them to benefit from space. Space can be safe and profitable even in a multipolar world order, but to achieve that, certain outdated concepts pointed out in the chapter will need to be rewritten or reinterpreted. Therefore, we should expect a conflicted decade ahead of us, as nations break with the status quo.

REFERENCES

- Agreement Governing the Activities of States on the Moon and Other Celestial Bodies adopted by the General Assembly in its resolution 34/68, opened for signature on 18 December 1979, entered into force on 11 July 1984.
- BORGEN, C. J. (2020): *Space Power, Space Force, and Space Law*. Lieber Institute. Online: <https://lieber.westpoint.edu/space-power-space-force-space-law/>
- BRUKARDT, R. – KLEMPNER, J. – PACTHOD, D. – STOKES, B. (2022): The Role of Space in Driving Sustainability, Security, and Development on Earth. *McKinsey & Company*, 19 May 2022. Online: www.mckinsey.com/industries/aerospace-and-defense/our-insights/the-role-of-space-in-driving-sustainability-security-and-development-on-earth
- Defense Intelligence Agency (2022): *Challenges to Security in Space. Space Reliance in an Era of Competition and Expansion*. Online: www.dia.mil/Portals/110/Documents/News/Military_Power_Publications/Challenges_Security_Space_2022.pdf
- EAGLESON, D. (2023): Protecting Our Critical Satellite Infrastructure: The Importance of Space-Based Infrastructure to Humanity and Its Status within NATO. *NATO Review*, 24 October 2023. Online: www.nato.int/docu/review/articles/2023/10/24/protecting-our-critical-satellite-infrastructure-the-importance-of-space-based-infrastructure-to-humanity-and-its-status-within-nato/index.html

- EDL, A. (2022): Deterrence in Space. *Hadtudomány*, 32(1), 256–267. Online: <https://doi.org/10.17047/Hadtud.2022.32.E.256>
- EDL, A. (2023): A világűr-tevékenység és a biztonság. *Századvég*, 3(1), 47–67. Online: https://szazadvegfolyoirat.hu/wp-content/uploads/2023/09/SZAZADVEG_2023_01_teljes.pdf
- European Commission [s. a.]: *Space Traffic Management*. Online: https://defence-industry-space.ec.europa.eu/eu-space-policy/space-traffic-management_en
- FROELICH, A. – PECUJLIC, A. N. (2016): *Mechanisms for the Development of International Norms Regarding Space Activities*. European Space Policy Institute. Online: www.espi.or.at/wp-content/uploads/espidocs/Public%20ESPI%20Reports/Rep57_ABA_160522-1906.pdf
- HARRISON, T. (2020): *International Perspectives on Space Weapons*. Center for Strategic and International Studies. Online: www.csis.org/analysis/international-perspectives-space-weapons
- HARRISON, T. – JOHNSON, K. – YOUNG, M. (2021): *Defense Against the Dark Arts in Space: Protecting Space Systems from Counterspace Weapons*. Center for International and Strategic Studies. Online: www.csis.org/analysis/defense-against-dark-arts-space-protecting-space-systems-counterspace-weapons
- NASA (2020): *The Artemis Accords. Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes*. Online: www.nasa.gov/wp-content/uploads/2022/11/Artemis-Accords-signed-13Oct2020.pdf
- ÜNÜVAR, G. (2022): Can National Laws on Space Resources Serve as Evidence of Customary International Law? *Opinio Juris*, 8 Nov 2022. Online: <https://opiniojuris.org/2022/11/08/can-national-laws-on-space-resources-serve-as-evidence-of-customary-international-law>
- RAMEY, R. A. (2000): Armed Conflict on the Final Frontier: The Law of War in Space. *The Air Force Law Review*, 48, 1–158.
- SCHMITT, M. N. (2006): International Law and Military Operations in Space. *Max Planck Yearbook of United Nations Law*, 10, 89–125. Online: www.mpil.de/files/pdf3/04_schmitt-iii.pdf
- SCHMITT, M. N. (2017): *Tallinn Manual 2.0 on the International Law Applicable to Cyber Warfare*. Cambridge: Cambridge University Press. Online: <https://doi.org/10.1017/9781316822524.016>
- SULYOK, G. (2022): Nemzetközi jogi szabályozás. In BARTÓKI-GÖNCZY, B. – SULYOK, G. (eds.): *Világűrjog*. Budapest: Ludovika Egyetemi Kiadó. 79–115.

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies adopted by the General Assembly in its resolution 2222 (XXI), opened for signature on 27 January 1967, entered into force on 10 October 1967.

UNCOPUOS – IAEA (2009): *Safety Framework for Nuclear Power Source Applications in Outer Space*. United Nations Committee on the Peaceful Uses of Outer Space – International Atomic Energy Agency. Online: www.unoosa.org/pdf/publications/iaea-nps-sfrmwrkE.pdf

VLASIC, I. A. (1991): The Legal Aspects of Peaceful and Non-Peaceful Uses of Outer Space. In JASANI, B. (ed.): *Peaceful and Non-Peaceful Uses of Space. Problems of Definition for the Prevention of an Arms Race*. London: Routledge.

YOO, J. (2020): Rules for the Heavens: The Coming Revolution in Space and the Laws of War. *University of Illinois Law Review*, (1), 123–194.